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An insight into R&D in emerging countries and prominent concepts within the literature

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ABSTRACT

Multinational companies (MNCs) show an apparent tendency toward research and development (R&D) for the last three decades. Many kinds of research have recently focused on R&D in emerging countries (ECs) to reveal the differences from R&D in developed countries. This paper presents a literature review consisting of 23 articles from 2004-2019 on R&D in emerging markets. By conducting content analysis, it has been analyzed their prominent concepts and results. According to the research focus, the articles examined have been classified into five main groups – internationalization of R&D, R&D activities, R&D investments, technology-based R&D, R&D offshoring – along with articles that cannot be grouped. The main purpose of this study is to determine the current tendency of R&D in emerging markets. Thus, it provides to understand in which position R&D has in emerging markets, and under which circumstances it is successful. Furthermore, practitioners can benefit from the results of the presented study. The systematic evaluation of the findings contributes to the formation of a general view for future research.

Introduction

The importance of research and development (R&D) activities has been accepted by many multinational companies (MNCs) in every sector. As MNCs make technological investments in emerging countries (ECs) to gain competitive advantage, the need for investing in R&D of the technology also arises in these countries. The transfer of technology from the home country to the host country by MNCs accelerating their R&D activities has benefited the ECs. Foreign R&D investments also have contributed to the local R&D activities in the countries (Krammer, 2010). Thus, the current situation of R&D in ECs within the framework of literature has been a matter of curiosity. Although R&D literature has been reviewed several times, R&D in ECs in the field of International Business hasn't take part in the literature systematically. In this paper, it is aimed to examine the current trends of R&D in ECs by focusing on the findings of selected articles.

Many MNCs give particular importance to R&D activities and attempt to spread them all around the world (Ambos & Schlegelmilch, 2004; Zedtwitz & Gassmann, 2002; Hakanson & Nobel, 1993). Therefore, the internationalization of R&D has become a popular concept with the spillover of MNCs' R&D activities (Hsu et al., 2014). The internationalization of R&D has maintained in developed countries until the 1970s (Lie and Xie, 2011). However, MNCs have shifted their pattern of R&D from developed countries to ECs (Lewin et al., 2009; Huggins et al., 2007) because of the seeking profitability (Demirbag & Glaister, 2010). Competitive advantage, which was once in developed countries, now exists in lower-cost regions including China, India, Korea, and other ECs (Demirbag & Glaister, 2010; Atkinson, 2007; Huggins et al., 2007, Luo, 2006). MNCs have started to assess the opportunities of entering these new markets with R&D investments. In addition, emerging markets are attractive for them in terms of various characteristics such as the intensity of competition, current market size, and technological skills required. So, MNCs tend to conduct their R&D activities in regions including these characteristics with the potential to produce high-tech output (Yang & Jiyang, 2007).

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In this literature review, total 23 articles representing theoretical and empirical literature were selected from various academic databases. The sample covers the articles between the year 2014-2019. The contents of articles are usually in contact with each other as the topic is mainly studied in the field of International Business. Therefore, a chronological order of publications has been followed to comprehend the subject. The main purpose of this paper is to determine the common features of selected studies as well as their contributions. Besides, the perspectives, and ways of dealing with the subject are examined. The relevant literature has been reviewed in the following section. Then, R&D studies in emerging countries have been treated in five categories: internationalization of R&D, R&D investments, R&D activities, technology-based R&D, and R&D offshoring successively. Moreover, a comprehensive table of relevant academic papers was created in order to give a general picture of the literature review in the second part of the study. This study has been concluded with several suggestions for future studies.

Literature Review

Theoretical Background

Emerging economies refer 'low-income, rapid-growth countries using economic liberalization as their primary engine of growth' (Hoskisson et al., 2000, p. 249). One of the major theoretical perspectives have been used to analyze management in emerging economies is institutional theory (Hoskisson et al., 2000; Wright et al., 2005; Young et al., 2008). The institutional theory asserts that the institutional environment formalizes organizational arrangements, activities, and firm structures (Baum & Oliver, 1991; Yaprak & Karademir, 2010). Institutions help overseas expansion of companies from ECs (Yamakawa et al., 2008), and they guide to firms on their strategic decision-making process. Thus, companies are able to gain effective outcomes. The institutional theory which attends to increase companies' surviving capacities in a competitive environment includes a supportive perspective about the presence of R&D. In other words, R&D has a critical role in developing the environmental performance of the industry.

R&D refer to the activities usually companies and governments conduct in order to present innovative products, services, and procedures. The initial phase in the development process of new products and services is R&D (Kenton, 2019). So, it has a fundamental and complementary role in creating innovation. For instance, many MNCs can keep their production up-to-date thanks to R&D investments. The ultimate goal of R&D is to provide new products and services to the market and thus contribute to the company's profitability. Therefore, R&D enables the long-term productivity of MNCs and enhance the social welfare of ECs.

MNCs conduct R&D activities overseas for one of two reasons. First, for the purpose of adopting some products or services and meeting special requirements to attract foreign markets. Second, attaining technological know-how to advance locally (Jha, 2018). However, if the host country of MNC is an emerging country, the company can face some disadvantages such as volatile market demand, insufficient technological infrastructure or lacking intellectual property can be a problem while engaging R&D investments (Govindarajan & Ramamurti 2011).

In recent years, some leading ECs which are called BRIC - Brazil, Russia, India, and China - have adopted global innovation by three means. First, they have attracted R&D investments from MNCs of developed countries with well-educated, low-cost labor. Secondly, the new opportunities offered by the BRIC countries contribute to the growth of developing MNCs which spread the innovation to developed countries via mergers and acquisitions or greenfield R&D investments (Jin et al., 2014). Thirdly, during the last two decades, the constant institutional advancement and policy changes within the local innovation systems of these countries have been realized (Zhang et al., 2007; Jin et al., 2014).

Empirical Studies

The latest studies in literature show that R&D investment is connected with increasing firm performance and enhanced reputation in markets. Some studies illustrated the potential nexus between firm performance and R&D investment (Kotabe et al., 2002; Hu et al., 2005; Xu and Sim, 2018). Similarly, R&D intensity which represents the numbers of R&D investment is found related to firm performance in the context of emerging countries (Nunes et al., 2012; Xu & Sim, 2018). Besides, R&D has an important role in providing long-term economic growth processes in the industry as well as the dynamic evolution of an industry. As technology improves with the investments of companies, growth proceeds at the firm and industry level. Some research approves the positive relationship between R&D and sustainability (Alam et al., 2019; Yazgan & Yalçınkaya, 2018). R&D is a kind of trigger for innovations pertaining to different areas. For instance, the improvement of artificial intelligence-driven algorithms has led the new types of applications in marketing strategies, financing systems or human resource functions. Future potential groundbreaking innovations are also initiated by today's R&D activities.

Organizing Framework

This review determines the current trends of R&D in ECs by reviewing relevant literature. The articles that include the main two issues "R&D" and "Emerging Markets/ Countries/ Economies" in their publication name were selected. It has also been accepted the articles including the name of the specific emerging country in the title. However, pre-2004 publications and articles with irrelevant topics (titles not relevant to the field of International Business) have been excluded. The selected articles have been limited between 2004-2019. A total of 23 relevant articles has been collected from Wiley Online Library, ScienceDirect, Emerald, Taylor & Francis,

JSTOR, and Springer Link, during April and May 2019. These academic databases and online sources were chosen because they consist of a large majority of the articles published in the field of International Business.

The relevant articles have been examined by conducting content analysis. The unit of analysis is the abstracts of articles. Thus, all abstracts have been analyzed in-depth and been classified according to prominent concepts within the abstracts. To visualize text analysis results, it has been benefitted from the word cloud analysis. Furthermore, the findings of articles have been summarized in a general framework with a comprehensive table. Table 2. is providing a summary of all selected articles in terms of authors, sample, types of study, method, and findings. Implications and limitations of the findings are discussed in the conclusion part of the study. Accordingly, the findings of the study consist of three parts:

i) *Descriptive statistics for R&D in emerging countries literature*

ii) *Annual scientific production*

iii) *Main categories based on research focus with word cloud*

Table 1. Descriptive Information

Total Publications	23	Publication Range	2004-2019
Total Theoretical Publications	2	Total Empirical Publications	21
Publications Using Case Study	6	Publications Using Statistical Technics	17
Total Authors	55	Authors per Document	2

Source: Authors' search

The literature about R&D in emerging markets was limited between 2014-2019. Total 23 research articles were collected from several academic databases and online sources. 21 of these 23 articles are experimental and 2 are theoretical. Among empirical studies, six of them use the case study as a research method. The remainder have chosen statistical technics such as panel data, multiple regression or lineer regression. The total number of authors 55 and the number of authors per publication is 2.

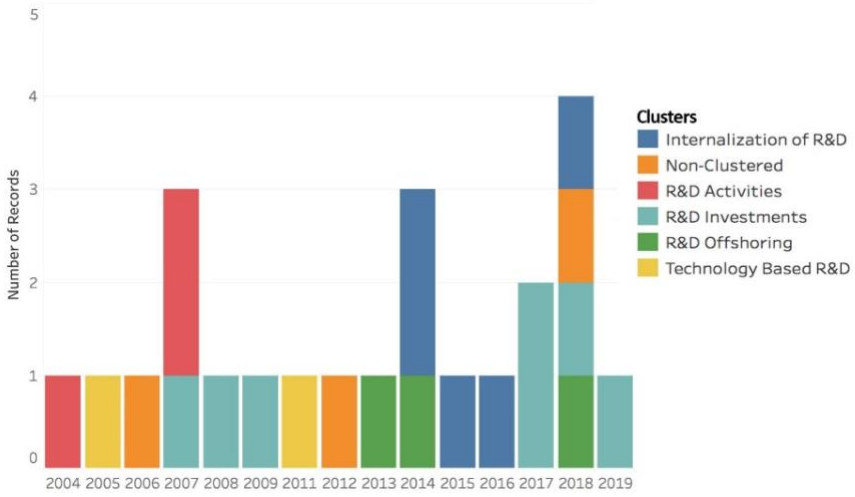

Fig. 1: Annual scientific production

This figure shows the number of annual scientific productions of the studies included in this research. The majority of articles has been published in 2018. In order to have an overview of the literature in the last twenty years, at least one article has been attempted to assign for review each year.

R&D Studies in Emerging Markets

To provide obvious insight, all 23 articles are grouped as internationalization of R&D, R&D investments, R&D activities, technology-based R&D, and evolution of R&D. The articles that cannot be included in any group was also named non-clustered.

Internationalization of R&D

The internationalization of R&D means an arrangement of production activities by MNCs that aim to spread them across countries. As a result of R&D internationalization, R&D-based resources such as know-how and new technologies can be used in different countries (Cantwell, 1995). Dunning defines internationalization as a transfer of outputs and production process across the countries (Dunning & Lundan, 2009). It paves the way for obtaining know-how, thereby MNCs are able to produce innovative production with technocentric manufacturing systems (Luo & Tung, 2007). According to the literature available, internationalization of R&D is a relatively new topic in the field of International Business during the 1970s and the early 1980s (Papanastassiou et al., 2019). R&D has been realized in the home countries of MNCs instead of foreign countries when it is commenced. Foreign affiliates rarely could transfer or adapt their technologies to the local markets. The internationalization of R&D accelerated remarkably over the following years (Dachs, 2017). In the 1990s, studies have concentrated on asset- exploiting, asset-seeking, and asset-augmenting strategies within the scope of internationalization of R&D (Papanastassiou et al. 2019). Selected articles in this study, have demonstrated the current situation of this topic as follows.

Athreye et al. (2014) have focused on R&D internationalization of Fiat automobile company that has globalization strategy. The company directs R&D operations into Turkey, Brazil and India among its all emerging market subsidiaries. So, the authors have investigated competence-creating subsidiaries in these ECs to determine the difficulties related to management and technology development. As a result of the study, it is concluded that R&D activities of MNEs in ECs are more related to succeeding decent market performance including overall product market strategies and mode of entry, than having solely technological competence. In addition, Brazil is the only company that creates competence among Fiat's other subsidiaries. In the research, case study including interview and secondary data has been used. Interviews with 15 managers has been evaluated with secondary data composing of specific business reports as well as academic studies on Fiat company.

According to Jin et al. (2014), ECs with their activities broaden the globalization of innovation activities. The ECs either host R&D activities of developed countries in their location or conduct their own R&D activities in developed countries. In the paper, the authors have aimed to understand the R&D international pattern of innovation at firm-level and national-level on the case of China. For this reason, they have presented a framework including emerging and developed countries' internationalization patterns, and selected a model that enable ECs to reach the global innovation level. As a result of the study, both Chinese emerging multinational firms and developed multinational firms in China integrate an overseas pattern with an overseas-headquarter pattern to apply R&D internationalization. Namely, they don't prefer to use the host country's innovation system. At the national level, although research has shown that R&D investors play a dominant role in China, with more global innovations in China and abroad, global innovation has equally increased its role in the competitive environment.

Haakonsson and Ujjual (2015) have alleged that the internationalization of R&D activities is a subject for global networks while developing innovation. In the article, they have studied new R&D strategies and tendencies by means of case study of a global biotechnology MNC. The findings show us it is possible to integrate the augmenting strategies with exploiting strategies in emerging markets. That is, MNCs can adopt totally dual approaches. On one hand while seeking novel resources, on the other hand they can strive to use current facilities in ECs as much as effectively. Their case study based on foreign subsidiaries India, China, Brazil, and headquarter in Denmark that is biotech company. The data have been collected between the years of 2009 and 2015 by doing interviews and focus-group discussions. It has been also benefitted from secondary data for supporting the findings.

Purkayastha et al. (2016) have suggested that there is a positive relationship between R&D expenditures and degree of internationalization of firms that is affiliated to business groups. In traditional view assert that affiliated firms's internationalization is not enough successful since they start to work later and don't have firm-specific knowledge. The traditional view has been criticized by showing the opposite results. According to findings, as firms internationalize, the R&D expenditures increase. This positive relationship between R&D expenditures and degree of internationalization in emerging markets is higher for affiliated firms than unaffiliated ones. Because, the headquarter's network enable affiliated firms to have linkages for technology transfer, clients, suppliers and other partners. So, it is obvious that internationalization of R&D was quite favorite as it facilitates to learn the means of continuing earnings globally. The research has been carried out on the affiliated and non-affiliated 2455 firms in Indian by obtaining the data for the period 2006–2012 from an Indian official center. It has been used panel data regressions to test their hypotheses.

Tang et al. (2018) has pointed out if R&D internationalization for emerging markets enables an improvement in international performance measured by foreign sales. So, it measured the effect of R&D internationalization breadth on international performance by using product diversification as a moderator. The results have showed that product diversification has a significant moderating effect on the relationship between R&D internationalization breadth and international performance. Therefore, executives should control the R&D internationalization breadth while supporting product diversification as international performance may be decline or increase. In this study has been used panel data regression as statistical method to test hypotheses. The gathered data (350 observation) compose of initial sample of selected firms from China and secondary data, ranging from 2010 to 2014.

Fig. 2: Word cloud visualization consisting of the abstracts of first category articles

R&D Investments

R&D investment, which has a leverage effect on the production quality of firms, is often defined as the technological intensity of a company or a particular sector (Ruffoni et al., 2018). As long as R&D investments maintain in a sector or company, their R&D intensity increases. Innovations can be seen as a tangible output of activities depending on the R&D investments or intensity. So, innovations provide that the companies gain competitive advantage. In other words, R&D investment is a way to create value for firms through innovation. The new investments lead to economic growth in a long term (Alam et al., 2019). However, since investment patterns differ from one country to another (Ozturk, 2018), analyzing emerging market barriers helps the MNCs at the executive level. Most ECs have quite economic susceptibility arising environmental conditions than developed market economies (Yang, 2007; Boisot & Child, 1988;). For example, Peng and Heath (1996) assert that emerging economies have some problems with the legal system to protect intellectual property, labor, and financial markets. The selected literature deals with R&D investments from the following perspectives.

Zhang et al. (2007) has asserted that there is a need for studying the relationship between R&D intensity so-called R&D investment and the performance of MNCs overseas subsidiaries. Therefore, initially the R&D investments of international joint ventures (IJV) in developing countries were examined and the risks faced by IJVs in R&D activities related to home and host countries were discussed. It is concluded that the IJVs' market focus and ownership structure has an impact on the level of these risks, and moderates the relationship between R&D intensity and IJV performance. Besides, multiple regression analysis has been chosen to conduct the research.

Ozcelik and Taymaz (2008) has researched which factors determine the private R&D investments at firm level. The results have proved that private investments on R&D has been affected by public support programs positively. Especially start-ups and small and medium-sized enterprises which work on R&D benefit more from these programs.

Tsai et al. (2009) supports that emerging economies should advance their research capabilities in order to come close to the opportunities of developed countries. So, this article has addressed for the purpose of disclosing the optimal investment decisions of manufacturers under uncertainty by presenting a basic model. Briefly, in this paper, the effects of adjustment cost on optimal investments, the advantages of the investment period in production, and the results of the development of capital-information stocks have demonstrated.

Rapp and Udoieva (2017) have investigated whether there is an effect of both ownership structures and shareholder rights protection on R&D investment of companies. Results showed that ownership concentration has a negative effect on the degree of R&D intensity in developing markets. Namely, the rise in the ownership concentration, which is a kind of internal management mechanism, will result in a decrease in R&D investments due to R&D intensity is accepted as important determinants of the R&D investment. This result is most probably because, the managerial decisions become questionable by shareholders with increment of ownership concentration. The sample of the study has been gathered from different information channels involving observations of 24 different countries, used Panel data.

Alam et al. (2017) mainly have pointed out that MNCs in ECs prefer to finance their R&D investments by using internal funds. Also, R&D financing behaves differentiate in terms of alliance and non-alliance firms. While alliance firms invest on R&D by using internal and external funds, the non-alliance firms only appropriate external funds for such expenditures. The preferences of firms' financial systems being market-based and bank-based change the fund usage. Specifically, the firms that are in countries having a structure based on banks are incline to appropriate external funds, while the firms from countries adopting market-based financial system prefer to use internal funds.

Xu and Sim (2018) have explained the features of Chinese and South Korean manufacturing firms' expenses during the period 2012-2016 by comparing the determinants of R&D investment of manufacturing companies in two emerging markets. Also, it has been questioned the effect of R&D investment on firm performance. In conclusion, the relationship between R&D investments and firm performance has been revealed. To analyze the related hypotheses, Tobin's Q ratio, correlation and regression are used. Then, it has been found that debt maturity and cash reserves are the determinants of R&D investments for Chinese and South Korean firms. Besides, R&D intensity effect on the performance of manufacturing companies positively in both countries, while R&D investment has a positive impact only on the performance of Chinese manufacturing companies.

Alam et al. (2019) have searched the idea that institutional environment changes the innovation decisions, and verified that there is an impact of the of ECs' external environment on companies' investments regarding R&D. The data have composed of selected 664 firms among 20 emerging markets, from 2006 to 2013. According to the results, while several environmental factors - government effectiveness, rule of law, and regularity quality - positively effect on emerging markets' R&D investments, some factors have - corruption and political instability - negative affect. These finding are beneficial to learn how sustainable development can be provided to realize worthwhile investments.

Fig. 3: Word cloud visualization consisting of the abstracts of second category articles

R&D Activities

MNCs have brought novelties with their activities such as production, R&D or management to the host countries. Today, specific R&D activities carried out in subsidiaries have also enabled the welfare of host countries and increase productivity growth. (Zanatta, 2008). Besides, as MNCs in developed economies diffuse almost all over the world, they have had to direct their R&D activities into emerging markets. Countries such as China and India, where traditionally only are preferred for low-cost advantages, have become part of R&D investments (Li & Kozhikode, 2009). So, it generally has been seen that R&D activities play a critical role in emerging economies as well as advanced economies. According to literature, R&D activities have been addressed in the following way.

Gassmann and Zan (2004) has declared that MNCs has enhanced R&D activities conjunction with the increasing international investments. Throughout the world, China is one of the most lucrative investment destinations for MNCs. To be successful for the R&D investment on ECs like China, the advantages of disadvantages of markets should be disclosed. So, in the study, it is researched the basic reasons of establishing R&D activities in China. Besides, the handicaps R&D managers facing while doing R&D activities. The study is based on qualitative interviews with R&D managers having experience in China, case studies, official research results and previous studies findings. Thus, the primary data has been collected from expert interviews, and secondary data have been obtained from firms' press releases or internet. As a result of study, the human asset is stated. That is, even the Chinese workforce is cheap and qualified, they do not know foreign language at sufficient level, cannot keep pace with cultural differences. Thus, a huge potential goes to waste. The gap in salaries between foreign Western employees and Chinese staff cause another undesirable conflict. It is suggested that universities and official institutes can support the R&D activities of global firms with many different ways in order to overcome these problems. Firstly, both in Chinese universities and good institutes have qualified, native talents as potential employees of R&D departments. Secondly, their facilities can be utilized through partnering thereby the expenses of investments decrease. Thirdly, many universities and research institutes are in contact with official institutions. Keeping in touch with them can reduce bureaucratic difficulties.

Yang and Jiang (2007) concentrated on the R&D activities which subsidiaries conduct, and location advantages which affect R&D activities of subsidiaries. It is mentioned four perspectives of location advantages: competitive conditions, technological infrastructure, supplier conditions, and government support. The main purpose of the study is to examine subsidiaries' employee mobility in order to hinder managerial problem related to losing intellectual property. This article provides us to understand the current situation of subsidiaries' R&D activities by explaining different views about location advantages on subsidiaries' R&D activities. Also, it is viewed that location is not an advantage for subsidiaries in R&D activities.

Zanatta, et. al. (2008) have aimed to find out the effective policy-making enabling increasing MNCs' investments in Brazil by using comparative analysis. For this purpose, it has revealed the main policies increasing technological activities in several other countries to illustrate successful examples, and examine. In conclusion, it has shown that there are some advantages and disadvantages to each country in terms of attracting FDI. The general advice for the countries expecting an exact way to attain actively R&D activities intensively is to improve the factors of attraction with enduring and comprehensive policies, attached to their industrial strategy.

Fig. 4: Word cloud visualization consisting of the abstracts of third category articles

Technology-based R&D

Hu et al. (2005) has mentioned the growth of emerging economies through technological advance and sorted three ways of development: domestic R&D, technology transfer, and foreign direct investment. Each way has a different level of contribution to countries. According to the results of data collected from Chinese large and medium-sized enterprises, technology transfer helps R&D activities' success inside of the organization. The results also showed that foreign direct investment activities do not accomplish technology transfer via market. As a method, panel data analysis has been used by using 400 data from Chinese companies. Li and Xie (2011) has claimed that MNCs which invest R&D activities attempt both protect their technological competence and attain new technology. However, they need to decide proper entry mode for example the MNCs prefer wholly-owned entry mode in the countries where they can protect technological competence. On the other hand, the MNCs choosing cooperative entry mode do not have technology protection due to possibility of expropriation by local partners. In analysis, Ordinary Least Squares regression has been used.

Fig. 5: Word cloud visualization consisting of the abstracts of fourth category articles

R&D Offshoring

Qu et al. (2013) studied that the ease of learning in host countries affect the choices of R&D offshoring into ECs. Besides, R&D offshoring by MNCs increase ECs' R&D activities. As the MNCs become widespread their R&D offshoring the R&D activities of ECs increase. However, the far a geographical distance between foreign affiliates and host country firms causes the lack easy of learning, and if the distance is much, the positive effect on R&D efforts of host country diminish. The study has been conducted as an empirical analysis of 12,309 manufacturing firms in China.

Gerybadze & Merk (2014) has emphasized that there are company-specific investment models and presented the new research on R&D offshore location decisions. The study has also paid attention three types of innovation-based R&D activities for developing technology competences in ECs: developing quality and number of R&D labs, producing new products at particular markets in ECs, accelerate application for patent activities by inventors in host countries. For the analysis part of the study, data attained from 55 MNCs via database.

Ozturk (2018) has aimed that to find out the relationship between R&D sourcing strategies and the types of R&D, as companies follow the types of basic and developmental R&D. According to the results, R&D offshoring affects basic R&D. In contrast, local R&D usage affects developmental R&D. In other words, while R&D offshoring with an outsourcing has impact on the type of basic R&D, local R&D with an insourcing affects the type of developmental R&D. This empiric study has been conducted by collecting data from 2367 Turkish companies.

Fig. 6: Word cloud visualization consisting of the abstracts of fifth category articles

Table 2: Overview of selected articles

Research Focus	Authors	Sample	Types of Study	Method	Findings
Internationalization of R&D	Athreye et al. (2014)	Primary data: 15 interviewers from 3 different countries' subsidiaries of Fiat. Secondary data: Academic studies on Fiat.	Empirical	Case study: Fiat	• The R&D internationalization choice of Fiat in ECs are more related to succeeding good market performance, than having technological competence. • Brazil is only subsidiary to have enough qualification on competence-creating among other subsidiaries of Fiat. • Some of the factors to develop competence-creating subsidiaries in R&D has sorted: Managerial mindset of parent company, embeddedness and mode of entry, product market performance and subsidiary capability.
	Jin et al. (2014)	Secondary data: All assigned grant patents associated with China USPTO patent dataset.	Empirical	Case study: China	• It is clarified the international R&D patterns at firm-level and national-level on the case of China. • At firm level, emerging MNCs mostly do overseas investment while developed MNCs have both overseas and integration patterns. • Both types of companies are reluctant to improve their host innovation systems. • At the national level, global innovation has increased its role in the competitive environment.
	Haakonsson and Ujjual (2015)	Primary data: Interviews with 16 individuals from India, China, Brazil and Denmark, and 48 hours of focus-group discussions.	Empirical	Case study: Novozymes	• International R&D strategies in India, China and Brazil was compared. • As a result, MNCs can integrate the augmenting strategies with exploiting strategies in emerging markets. • While MNCs can seek new resources, on the other hand they can remain to use current facilities in ECs.
	Purkayastha et al. (2016)	Secondary data: Affiliated and non-affiliated 2455 Indian firms' data during the period 2006-2012.	Empirical	Panel data regressions	• There is a positive relationship between R&D intensity and degree of internationalization of firms that is affiliated to business groups. • The relationship can be strengthened by ownership structure of firms and professionalization of executives. • As firms having affiliation internationalize, the R&D expenditures increase.
	Tang et al. (2018)	Primary data: 70 companies in China. Secondary data: 350 observations.	Empirical	Panel data regressions	• Product diversification has a significant moderating effect on the relationship between R&D internationalization breadth and international performance. • Thus, MNCs in EM can reach high international performance via breadth (geographic distribution) and depth (overseas investments) of R&D internationalization in ECs.

R&D Investments	Zhang et al. (2007)	Primary data: 243 observations from international joint ventures' questionnaires.	Empirical	Multiple Regression	• For the international joint ventures (IJVs) dealing with export markets, performance increases as R&D investments increase. That is a positive correlation is found between R&D investment and performance. • However, this relationship is uncorrelated with international joint ventures focusing on local markets. • If IJVs' ownership structure is majority ownership, it does not mean necessarily solve local-partner- related problems.
	Ozcelik and Taymaz (2008)	Secondary data: Three panel databases	Empirical	Regression and Matching analysis	• R&D support has impacts on private R&D expenditures. • Especially, small investors make advantage of public R&D support more. • Technology transfer from foreign countries integrate with local R&D applications.
	Tsai et al (2009)	Related articles	Theoretical		• The usage to scale of the stock of knowledge is found quite important to determine the investment–uncertainty relationship. • It is disclosed the optimal investment decisions of manufacturers. • The effects of adjustment cost on investments, the advantages of the investment period in production, and results of the development of capital information stock are discussed. • The paper draws out implications for emerging economies with regard to policies striving to develop strategic industries.
	Rapp and Udoieva (2017)	Primary data: 29,612 firm observations from 24 countries between 1998-2012.	Empirical	Panel data regressions	• Ownership concentration has a significant negative effect on the degree of R&D intensity in developing markets. • The increase in the ownership concentration, which is a kind of internal management mechanism, will result in a decrease in investments in R&D.
	Alam et al. (2017)	Primary data: 302 firms from 20 countries from the year 2003 to 2015.	Empirical	Panel data regressions	• They pointed out that MNCs in ECs prefer to finance their R&D investments by using internal funds. • R&D financing behaves differentiate in terms of alliance and non-alliance firms. • While alliance firms invest on R&D by using internal and external funds, the non-alliance firms only appropriate external funds for such expenditures. • The preferences of firms' financial systems being market-based and bank-based change the fund usage. • The firms that are in countries having a structure based on banks are incline to appropriate external funds. • The firms from countries adopting market-based financial system prefer to use internal funds.
	Xu and Sim (2018)	Secondary data: 4800 observations from 960 Chinese firms, and 1055 observations from 211 Korean firms.	Empirical	Panel data regression	• The findings have demonstrated that debt maturity and cash reserves are determinants of R&D investments for Chinese and South Korean firms. • The positive effect of investment on performance has been determined.
	Alam et al. (2019)	Primary data: 664 firms among 20 emerging markets, from 2006 to 2013.	Empirical	Panel data regressions	• While several environmental factors - government effectiveness, rule of law, and regularity quality - positively effect on emerging markets' R&D investments, some factors have - corruption and political instability - negative affect. • These finding are beneficial to learn how sustainable development can be provided to realize worthwhile investments.

R&D Activities	Gassmann and Zan (2004)	Primary data: 18 interviews with R&D managers between 2002 and 2003. Secondary data: Company press releases and Internet research, previous, study's findings.	Empirical	Case studies: ABB, Siemens, SIG, Schindler, Microsoft, GM, VW, Siemens VDO Automotive	• Some problems were determined about human asset: Chinese employee cannot use required terminology in foreign language. There is a cultural difference among employees. Also, the gap in salaries between foreign and Chinese staff cause conflict. • To solve these problems several suggestions have been offered: • Universities and official institutes can support the R&D activities of global firms. Since both Chinese universities and good institutes have local talented individuals for R&D departments, they might be assessed in future work. Facilities of these institutions can be utilized through partnering. • Many universities and research institutes are in contact with official institutions. Keeping in touch with them can reduce bureaucratic difficulties.
	Yang and Jiang (2007)	Related articles	Theoretical		• This article provided an understanding the current situation of subsidiaries' R&D activities. • However, location advantages, which are supposed to be stimulating for subsidiaries to undertake R&D activities, confront great challenges in emerging economies. • First, subsidiaries find that R&D costs are not as low as they had estimated and that the return on R&D investment erodes over time. • Second, governments find that subsidiaries' R&D activities are not so satisfactory. • The authors suggest that in emerging markets, because of talented employees' high mobility, subsidiaries struggle the risk of transferring knowledge such as expertise, organizational memory and social relations to competitors.
	Zanatta, et. al. (2008)	Secondary data: 11 Country reports	Empirical	Comparative analysis: based on Brazil case	• The analysis of selected ECs has enabled uncover the crucial factors in attracting MNC R&D activities. • It is recommended to improve the determinants of attraction with enduring and comprehensive policies, attached to industrial strategy for ECs. • The analysis of other countries' experiences shows that Brazil has some handicaps in the global competition for technology FDI: • When it is compared with selective countries, Brazil has less number of R&D projects. • In Brazil, it is a mistake not to have an investment promotion agency among its priorities. • So, it needs to have selective FDI policies in terms of R&D activities. It also needs to take governmental actions and institutions should be held responsible for FDI attraction.

Technology-based R&D	Hu et al. (2005)	Secondary data: Chinese LMEs including 29 manufacturing industries and over 400 industries data	Empirical	Panel data	• It is evaluated benefits of technological advance which can provide by three means Domestic R&D, Technology Transfer or FDI. • R&D inside company achieve technology transfer both domestic and foreign basis. • Foreign direct investment activities do not accomplish technology transfer via market.
	Li and Xie (2011)	Secondary data: 348 R&D investments in China from 1997 to 2002.	Empirical	Ordinary Least Squares regression	• MNCs attempt to develop new technological competences by protecting existing competence. • All entry modes have different level of technology protection. • The MNCs choosing wholly-owned entry mode have more protection while the cooperative entry mode is weak to preserve technology. • If MNCs want to access indigenous R&D sources they chose cooperative entry mode. But, this time their technological sources might be exposed to expropriation by local partners.
R&D Offshoring	Qu et al. (2013)	Secondary data: 12.309 manufacturing firm from ICT sector in China.	Empirical	Linear regression method and Tobit analysis	• The study found that the ease of learning in host countries affect the choices of R&D offshoring into ECs. • R&D offshoring by MNCs increase ECs' R&D activities. • The far a geographical distance between foreign affiliates and host country firms means they lack easy of learning. So, if the distance is much, the positive effect on R&D efforts of host country diminish.
	Gerybadze & Merk (2014)	Secondary data: 55 MNCs' company-specific R&D and patenting data from the Interis database	Empirical		• The study has introduced company-specific investment trends. • According to the article, researchers have directed towards development of activities.
	Ozturk (2018)	Primary data: 2367 Turkish firms' questionnaires results.	Empirical	Tobit maximum likelihood estimation	• This study hypothesized according to types of R&D such as basic or developmental R&D and their performing choices of firms such as offshore or domestic R&D. • The R&D offshoring with outsourcing has an impact on the type of basic R&D. • The Domestic R&D with insourcing affects the type of developmental R&D.

Non-clustered	Luo (2006)	Primary data: 188 survey from 56 wholly-owned subsidiaries;132 Chinese and foreign countries' alliances. Secondary data: Archival data	Empirical	Multiple regression analysis	• The study analyzed the autonomy of foreign R&D departments in ECs, and their conditions. • When development in local markets advances, the autonomy of foreign R&D units' increase. • Foreign market entry mode for R&D investment does not related with the autonomy of this unit. • The entry mode just balances external risks and the level of autonomy.
	Agostino and Santangelo (2012)	Secondary data: 221 OECD countries that invest in top six developing countries.	Empirical	Ordinary Least Squares regression	• Technology-intensive laboratories of OECD countries conducting R&D and adaptation activities examined. • It is found that the laboratories that are interested with adaptation is beneficial for the host countries' R&D regarding knowledge creation. • The laboratories including non-intensive technology operations is helpful for local R&D improvement in terms of development.
	Jha et al. (2018)	Primary data: 20 executives interviewed. Secondary data: Press releases etc.	Empirical	Case study	• It is proved that R&D units are in a partnership inside the MNEs. • It is offered an general framework about R&D units by combining with model of emerging markets R&D.

Source: Authors' search

Conclusion

Previous studies have frequently emphasized that how remarkably important R&D for the MNCs' future. Possessing technological sources is not sufficient by itself to win in global competition. As technologies go out of date, preferability of prior products and services released by companies mostly decrease. Therefore, MNCs should engage in R&D activities as much as it is possible in the respective sector. Additionally, the issue of which country is more suitable for MNCs that intend to invest in R&D has been another matter of debate. Drawing by addressing the opportunities and challenges of R&D investment abroad, MNCs can achieve correct R&D activities in the right regions. The research has indicated that ECs have significant advantages in accelerating the spillover of MNCs' R&D activities. Therefore, high potential of ECs should not be overlooked while making strategic investment decisions. Briefly, the economic development of ECs or the success of MNCs depends on two sides.

Although past research on R&D in emerging markets is useful in terms of many aspects, this review infers from that there is a need for complementary findings. Such kind of research will be guiding light for R&D practitioners that are interested in ECs. This research provides a broad perspective on R&D issues in the scope of ECs as well as determining the current trends within the literature. According to the research focus of selected articles, R&D research have been classified into five major groups - internationalization, investments, activities, technology, and offshoring - except for cannot be clustered articles. The main categories represent the current topics that have become prominent in literature the last two decades. Practitioners can conclude from these articles the necessity of developing R&D inside of the company rather than outsourcing. Also, MNCs making R&D offshoring investment should prefer close regions to enable learning required technology easily. In the articles, empirical findings support that R&D activities of MNCs in ECs are related with the decent market performance; and this relationship leads more R&D internationalization. Similarly, the R&D intensity of the market is positively related to market expansion. For certain economies, such as China, Korea, and India, it can achieve market expansion easier than others due to the specific capabilities such as intensity of competition, current market size, and technological skills required.

This study has limitations to take into consideration for future research. While deciding the suitable articles for this study, it has been focused on only the publication name of the study. Also, the discussion has been limited to the MNCs' applications in ECs and the academic discipline of international business. The article number of the study is limited by title as well as a certain time. It can be expanded to reach comparative results in this area. As a conclusion, it is recommended to focus on other types of companies such as small or medium-sized enterprises, while conducting similar formative studies.

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