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# Measuring and Promoting (R&D) Expenditure in Manufacturing Companies of High-Tech Healthcare Products in the Dominican Republic

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Rochester Institute of Technology

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## *Abstract*

Globally, R&D is recognized as an important driver of economic and social progress. In 2013, the Dominican Republic invested only 0.3% of GDP (Gross Domestic Product) in R&D expenditure, which is a level of investment equivalent to half the Latin American average. The globalization process has allowed many corporations to internationalize their value chain including R&D activities, which represents an extraordinary opportunity for a developing country as the Dominican Republic to attract FDI (Foreign Direct Investment) as a way to increase innovation process related to R&D activities. This research project investigates whether R&D expenses have an effect on the profit, revenue, and productivity for companies of high-tech healthcare products in the Dominican Republic, and why some of these companies do not invest more in R&D inside the country. The research adopted a mixed methods approach by using quantitative research (survey and content analysis) and qualitative research (interviews). The results suggest that companies surveyed concentrate their main R&D programs outside the country due to lack in quality and the capacity through government or academic institutes to engage in complex R&D activities required by these firms. As a result, the companies surveyed only perform process innovation and product testing in their manufacturing facilities. Also, cooperation among (company-university-government) in the innovation system has become ineffective. In this sense, it is necessary a strong effort from all stakeholders involved in innovation policy to lift the quality and magnitude of R&D spending in the Dominican Republic, as a way to increase nation's competitiveness and innovation.

***Keywords:*** R&D, innovation, competitiveness, productivity, globalization

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# Chapter 1: Introduction

## 1.1. Background

Economic globalization and advances in technology have significantly increased market competitiveness. Consequently, innovation, R&D, and education are three extraordinary opportunities for the Dominican Republic that need to be interconnected as a necessity to develop the human capital required for building the society of the future.

Nowadays, the Dominican Republic invests only 0.3% of GDP (Gross Domestic Product) in Research and Development expenditure, which is a level of investment equivalent to half the Latin American average and is far below that of most developed countries (Legatum Institute, 2013). In this context, investing more in R&D is a way to improve innovation, in order to increase the competitiveness of the Dominican Republic in the global market. Innovation has to be actively encouraged and supported by the government, universities and stakeholders.

Today, the Dominican Republic is a hub for top medical technology companies which have chosen the country for developing and manufacturing a wide range of sophisticated medical products, creating one of the largest clusters in healthcare manufacturing in the region. In this context, the medical device industry in the Dominican Republic has played a key role in promoting and sustaining economic growth of the country, due to a significant and sophisticated network of experienced people and companies, whom are incorporating new and advanced technologies.

This study will (1) improve our understanding of R&D effects on manufacturing companies of high-tech healthcare products in the Dominican Republic; (2) provide a better

understanding of innovation process and economic growth to improve the overall competitiveness of the Dominican Republic in the global market; (3) create the strategies to develop the effective methods to promote more intensively R&D investment in different industries of the Dominican Republic.

## *1.2. Problem Statement*

Nowadays, the Dominican Republic invests only 0.3% of GDP (Gross Domestic Product) in Research and Development expenditure, which is a level of investment equivalent to half the Latin American average and is far below that of most developed countries (Legatum Institute, 2013). In this context, investing more in R&D is a way to improve innovation and economic growth, in order to increase the competitiveness of the Dominican Republic in the global market. Investing in R&D has great potential for benefiting broader society. This research project investigates whether R&D expenses have an effect on the profit, revenue, and productivity for companies of high-tech healthcare products in the Dominican Republic, and why some of these companies do not invest more in R&D.

## *1.3 The Central Research Questions*

1. *What % of budget is invested in R&D by manufacturing companies of high-tech healthcare products in the Dominican Republic?*

2. *What are the barriers to investing resources in R&D in the high tech manufacturers in the Dominican Republic?*

## *1.4 Significance Statement*

R&D is recognized as an important driver of economic and social progress worldwide. It can be a powerful source to improve productivity, innovation, and competitiveness; to help to reduce poverty, and to stimulate long-term economic growth. The OECD (Organization for Economic Cooperation and Development) emphasizes the hazards of cutting spending on R&D and other investments that support innovation and economic growth, declaring, cutting back public investment in support of innovation may provide short-term fiscal relief, but will damage the foundations of long terms growth (OECD, 2010). In 2005, industryweek.com did a study about the effects of innovation based on R&D expenses and they found that, "overall revenue growth (78%), increased productivity (71%), and profits margins (68%)" were a result of the impact of R&D efforts. This research project will guide us to develop a more accurate understanding of the real impact that R&D expenses can make on manufacturing companies in the Dominican Republic. By providing a systematic, detailed understanding of the innovation process, this study will (1) improve our understanding of R&D effects on manufacturing companies of high-tech healthcare products in the Dominican Republic; (2) provide a better understanding of innovation process and economic growth to improve the overall competitiveness of the Dominican Republic in the global market; (3) create the strategies to develop the effective methods to promote more intensively R&D investment in different industries of the Dominican Republic.

## *1.5 Hypotheses*

- *Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D, are more profitable than those who invest less.*

- *Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D increases their revenue than those who invest less.*

- *Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D increases their productivity levels than those who invest less.*

# *Chapter 2: Literature Review*

## *2.1 Literature Review*

Today, as new technologies are arriving to the market faster than ever before and the world is becoming more connected. There is a necessity to develop the right tools and solutions to deliver the best value to the customers. In any sector of the economy, this necessity is driven by innovation in process, products and services with the objective to enhance the experience and value to the customer. Also, economic globalization and advances in technology have significantly increased market competitiveness. Consequently, innovation, R&D, and education are three extraordinary opportunities for the Dominican Republic that need to be interconnected as a necessity to develop the human capital required for building the society of the future.

In this context, several studies indicate that investment in R&D will foster the capacity to create, spread, adopt, and adapt knowledge in ensuring long-term economic growth and sustainable development. A higher productivity level based on innovation promotes economic growth, creates employment with better levels of remuneration, reduces poverty on a sustainable basis and raises general living standards. The creation and spread of knowledge is carried out by government, businesses, universities, research institutes, and nonprofit organizations.

R&D is recognized as an important driver of economic and social progress worldwide. It can be a powerful source to improve productivity, innovation, and competitiveness; to help to reduce poverty, and to stimulate long-term economic growth. The OECD (Organization for Economic Cooperation and Development) emphasizes the hazards of cutting spending on R&D and other investments that support innovation and economic growth, declaring, cutting back public investment in support of innovation may provide short-term fiscal relief, but will damage

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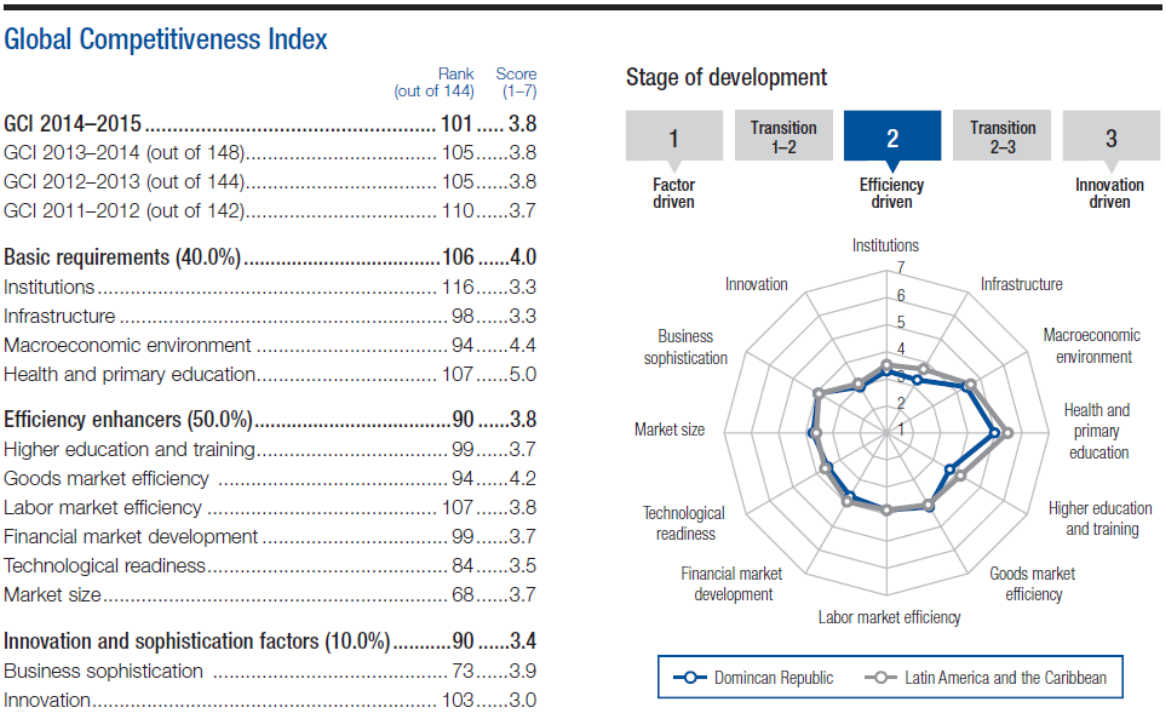
Developing countries, such as Kenya, Senegal, Tanzania, and Uganda are currently investing between 0.5% and 1% of their gross domestic product in Research and Development (World Bank, 2013).

Innovative value-added products and services have direct effects on competitive advantages. For example, in Latin America some countries that export more complex products enjoy more prosperity that those only export commodities or those that are based on comparative advantages alone. These are the cases of Chile, Brazil, Costa Rica, and Mexico, in which they export high-end products and services. For example, large global companies based in Brazil include oil and gas producer Petrobras, mining company Vale, aircraft manufacturer Embraer who designed and manufactured aircrafts completely in the country; Mexican multinationals include Bimbo, the world's largest bread manufacturer; building materials manufacturer CEMEX; and telecom giant America Movil.

The global markets generate pressure for companies to innovate and improve, in order to create new and better products, processes or services. For that reason, the innovation dynamics are relevant to create the business environment to pursue better competitive advantage for the country. At present, R&D expenditure is considered as an asset for the government and all stakeholders. Also, the government and companies will be able to utilize some of the results of its R&D to be transferred through various channels, such as: licensing and cooperation between companies. Knowledge generated as a result of R&D is not a public good that can be utilized by just anyone (Callon, 1994). In this case, a certain form of education and the right networks are required to be able to understand and utilize new knowledge from R&D. In this context, the social return on the R&D performed by companies is greater than the private return. For example, the private return is on average 20% to 35%, while the social return may be two to three times higher. According to the (Global Competitiveness Index, 2015) provided by the World Economic Forum, the Dominican Republic ranks on places 73$^{th}$ and 105$^{th}$ in business sophistication and innovation respectively from 144 countries evaluated (see Figure 2.1). Innovation and R&D are important for the economy. They can be mutually reinforcing and together can be a powerful source of improved productivity and competitiveness, helping to reduce poverty and stimulate long-term economic growth (World Bank, 2013). Investments in R&D that provide new knowledge are seen as an important factor that explains growth and increased productivity (Romer, 1990).

**Figure 2.1** The Global Competitiveness Index 2015 - Illustrates the Overall Performances of the Dominican Republic in the Global Market.



Global Competitiveness Index

| | Rank (out of 144) | Score (1–7) |
|---|---|---|
| **GCI 2014–2015** | **101** | **3.8** |
| GCI 2013–2014 (out of 148) | 105 | 3.8 |
| GCI 2012–2013 (out of 144) | 105 | 3.8 |
| GCI 2011–2012 (out of 142) | 110 | 3.7 |
| **Basic requirements (40.0%)** | **106** | **4.0** |
| Institutions | 116 | 3.3 |
| Infrastructure | 98 | 3.3 |
| Macroeconomic environment | 94 | 4.4 |
| Health and primary education | 107 | 5.0 |
| **Efficiency enhancers (50.0%)** | **90** | **3.8** |
| Higher education and training | 99 | 3.7 |
| Goods market efficiency | 94 | 4.2 |
| Labor market efficiency | 107 | 3.8 |
| Financial market development | 99 | 3.7 |
| Technological readiness | 84 | 3.5 |
| Market size | 68 | 3.7 |
| **Innovation and sophistication factors (10.0%)** | **90** | **3.4** |
| Business sophistication | 73 | 3.9 |
| Innovation | 103 | 3.0 |

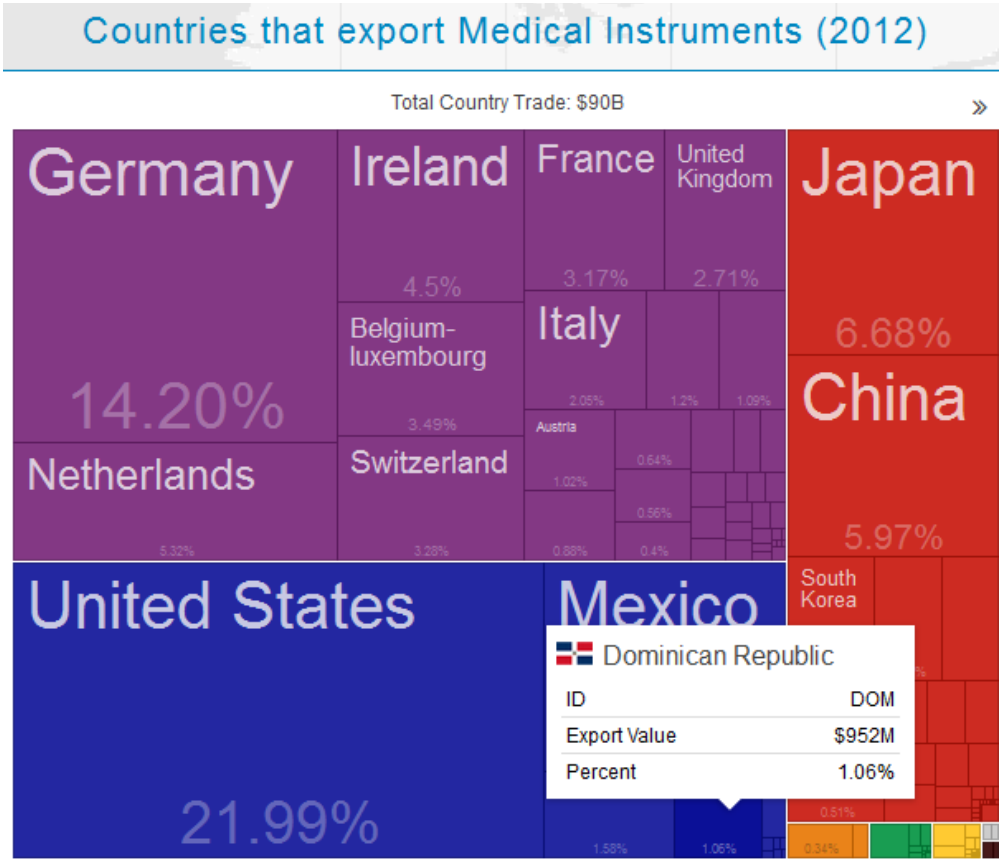


*Note.* From World Economic Forum. (2014). *The Global Competitiveness Report 2014-2015.* Retrieved from World Economic Forum: www.weforum.org/issues/global-competitiveness

According to the last data of the Observatory of Economic Complexity developed by the Massachusetts Institute of Technology (MIT), exports in 2012 for the Medical Instruments in the Dominican Republic was a 15.37% of the free zone exports or US$952 Million (see Figure 2.2) and 1.06% of the global commerce of Medical Instrument. This represents a consolidated position of medical devices in the export sector. Investment in R&D is a determining factor for the successful acquisition of foreign technology. However, in the Dominican Republic, a lack of R&D investment limits the capacity to develop the strategies and the tools required at promoting innovation. International organizations, such as: the IMF, World Bank, OECD, and the World Economic Forum suggest that developing countries should invest very heavily in R&D.

The estimates of the return to R&D expenditure for advanced countries have been so high to justify intensive levels of investment (Jones and Williams, 1998). Also, investigators argue that R&D in developing countries is essential to support the absorptive process of technological advance developed in other countries.

**Figure 2.2** Countries that Export Medical Instruments (2012) - Illustrates the Overall Performances of the Dominican Republic in Medical Instruments exports**.**

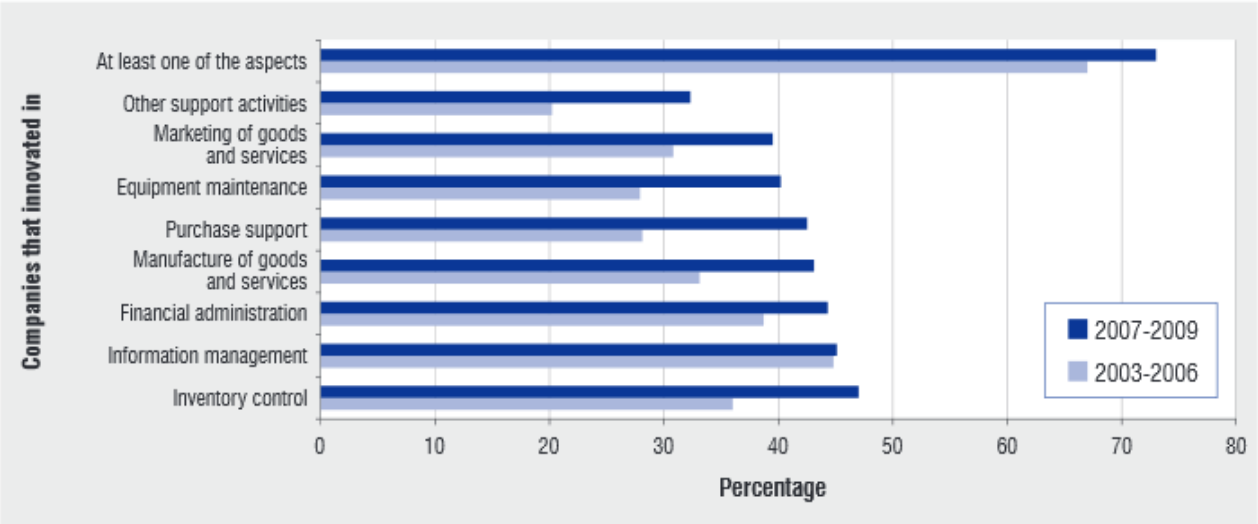



*Note*. From MIT-Observatory of Economic Complexity. (2012). *Countries that export Medical Instruments (2012)*. Retrieved 2014, from MIT: http://atlas.media.mit.edu/en/explore/tree_map/hs/export/show/all/9018/2012/

According to the UNCTAD-United Nations Conference on Trade and Development-(2010) in the investigation "Science, Technology & Innovation Policy Review: Dominican Republic" developed two survey to measure innovation activities in two sectors: the business sector and the academic and scientific sector, such as institutions of higher education and research centers. The results of that survey show that there are a significant number of companies that innovate in products (55%) and processes (73%), and that those innovations are usually of an imitative nature, incremental and not radical. Also, more than 80% of the companies that innovate in processes or products declared that the innovations introduced were new for that company but not for its geographical market.

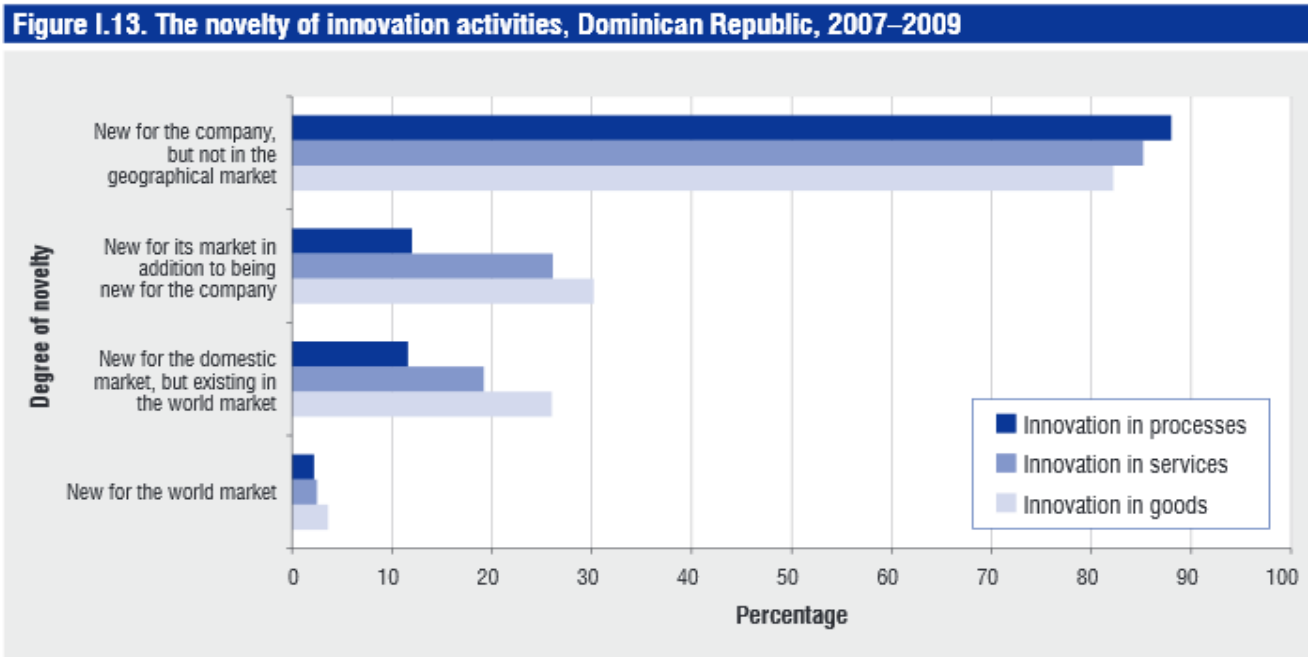
The survey also shows that companies rarely cooperate with other institutions or companies in innovating (see Figures 2.3, 2.4, 2.5). There is a notable absence of cooperation with universities. In this context, an identifiable characteristic of innovative companies in the Dominican Republic is the significant influence that the level of managers' training has on the intensity of the innovative activity. In general, the results based on the responses indicate a low level of private R&D investment in all economic sectors. Other characteristic is that financing for innovation usually comes from the business itself (more than 88% of the companies used their own resources). In perspective, the role of venture capital companies and the direct support of government entities to finance innovation are very limited in the Dominican Republic.

**Figure 2.3** Innovations in Processes in the Dominican Republic, 2003-2009.



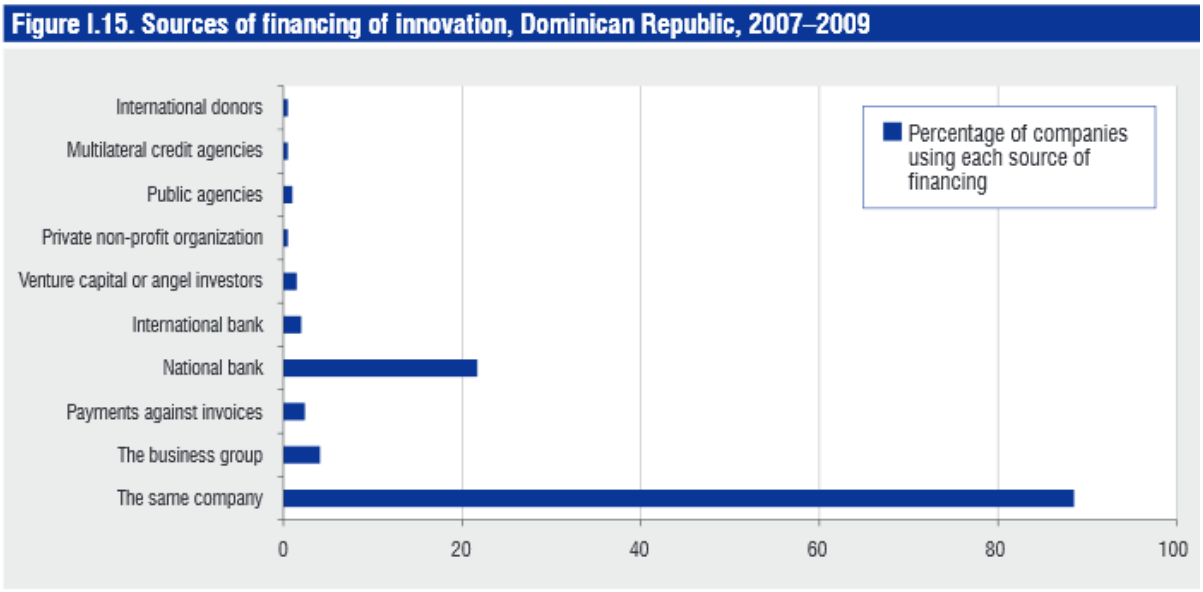

*Note*. UNCTAD. (2012). *Science, technology & innovation policy review: Dominican Republic.* Retrieved from http://unctad.org/en/publicationslibrary/dtlstict2012d1_en.pdf

**Figure 2.4** The Novelty of Innovation Activities, Dominican Republic, 2003-2009.




*Note*. UNCTAD. (2012). *Science, technology & innovation policy review: Dominican Republic.* Retrieved from http://unctad.org/en/publicationslibrary/dtlstict2012d1_en.pdf

**Figure 2.5** Sources of Financing for the Innovation, Dominican Republic, 2003-2009.




*Note.* UNCTAD. (2012). *Science, technology & innovation policy review: Dominican Republic.* Retrieved from http://unctad.org/en/publicationslibrary/dtlstict2012d1_en.pdf

Today, the Dominican Republic is a hub for top medical technology companies which have chosen the country for developing and manufacturing a wide range of sophisticated medical products, creating one of the largest clusters in healthcare manufacturing in the region. In this context, the medical device industry in the Dominican Republic has played a key role in promoting and sustaining economic growth of the country, due to a significant and sophisticated network of experienced people and companies, whom are incorporating new and advanced technologies.

However, overall investment in R&D activities in health sector was estimated to be 0.06% of the GDP according to a survey made by Bravo (Bravo et al, 2004). In this study, it was estimated that in the Dominican Republic there were with 359 researchers (72.7% with a Master's degree and 29.5% with a Ph.D.) in 2004, but only 57.6 % of those work full time on

research. According to the same source, it was estimated that 24% of the researchers work in the field of health, which means 86 researchers. In fact, this is a very small number given the country's size and the challenges it faces in the field of health. At present, 150 companies operate in the health sector, of which 39 are Dominican. According to CEI-RD (Center for Export and Investment of the Dominican Republic), the pharmaceutical industry supports approximately 10,000 jobs, which represents 3% of total industrial employment and 0.3% of the economically active population.

There is no solid evidence that health industry carries out significant research activities in the country. In this context, the report of Mullin Consulting (2003) makes reference that the Dominican innovation system is built around the diffusion and absorption of external knowledge, where equipment suppliers play a key role. As a result, the few companies that are capable of creating and managing technical innovation will continue to be more the exception than the rule. Also, the innovation survey developed by Grupo Consultoría Pareto (2007) confirms the perception that the industry vision is disconnected from the universities and centers of research, as illustrated in Figure 2.6. According to the chart 2.6, 90.5% of source of innovation is provided by the company itself, and the work with universities is only 0.7%.

**Figure 2.6** Sources of Innovations Made by Innovative Dominican Companies.

**Table IV.2. Source of innovations made by innovative Dominican companies**

| | Percentage | Accumulated percentage |
|---|---|---|
| The company itself | 90.5 | 90.5 |
| The company together with other companies | 6.1 | 96.6 |
| The corporation or subsidiary abroad | 1.4 | 97.9 |
| The company with a university | 0.7 | 98.6 |
| Another company of the business group abroad | 0.7 | 99.3 |
| Another company not directly related | 0.3 | 99.6 |
| Another company in the business group in the country | 0.2 | 99.8 |
| Miscellaneous | 0.2 | 100.0 |
| **Total** | **100** | ... |

*Source: Grupo de Consultoría Pareto (2007).*

*Note*. UNCTAD. (2012). *Science, technology & innovation policy review: Dominican Republic.* Retrieved from http://unctad.org/en/publicationslibrary/dtlstict2012d1_en.pdf

This chart (Figure 2.6) reveals that cooperation between the elements of the innovation system is ineffective. For that reason, economic incentives in R&D must be established for projects that link the industry and academic institutions. However, the key to support an effective R&D program between companies and universities should consider aspects, such as: intellectual property, diagnostic of companies' technological needs, financial instruments, and standard operating procedures.

In this context, Wieser (2005) suggests that R&D has a positive and statistically significant effect on growth in terms of sales and productivity. In his study, the private return for investing in R&D is between 7% and 69%. The median is 27% and the mean value is 28%. Also, the return to other companies is considered twice as high as the private return, which means that the social return (private return + spillovers) is on average 90% to 100%. Consequently, the social return on R&D is very important in an economic-political perspective, this one of the reason that motivates the government to fund R&D. Some empirical studies suggest that public-funding in the form of direct funding or tax incentives stimulates rather than replaces private R&D. However, in the case of the transfer of technology from the universities to industry, it is necessary to develop the best strategies and policies that allow the universities and all researchers involved in the R&D process, to pursue a future commercialization of their inventions or innovations.

As we have seen, the literature review suggests that for developing countries is necessary a strong effort to lift the quality and magnitude of R&D spending, as a way to increase economic growth, innovation, and entrepreneurship. The extraordinary growth in R&D performed by the BRIC (Brazil, Russia, India and China) countries in the last decade, may be justified by the fact of compromise between the government and all stakeholders that support R&D process, for improving the quality of human capital, strengthening research institutions, implementing a national innovation system, and raising the sophistication of the private sector to compete globally. In perspective, R&D is recognized as an important driver of economic and social progress worldwide. It can be a powerful source to improve productivity, innovation, and competitiveness; to help to reduce poverty, and to stimulate long-term economic growth.

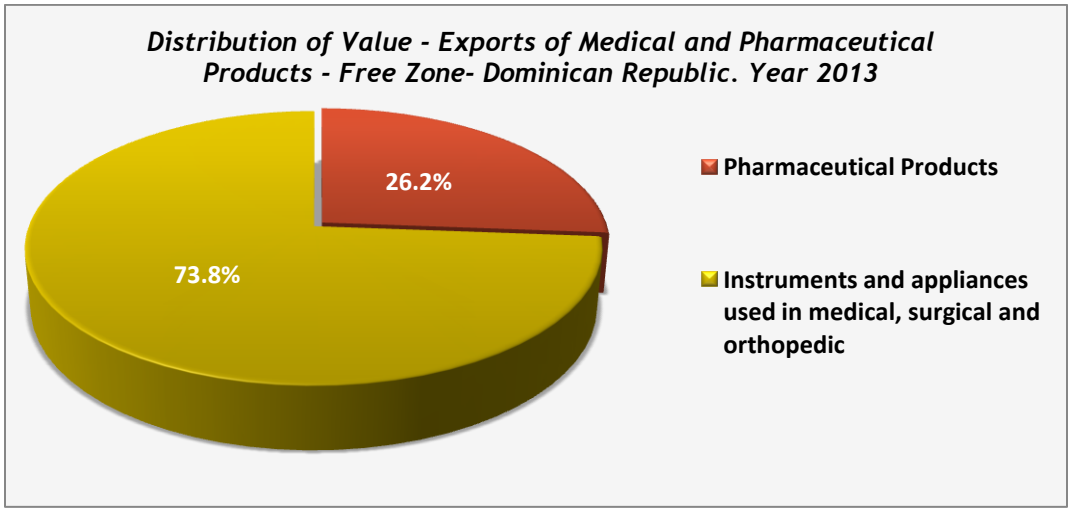
## *2.2 Statistical Overview of the Population of this Study*

The free zone regime (Act 8-90) in the Dominican Republic has become the central platform for growth and development of manufacturing Medical and Pharmaceutical products. According to data recorded by the National Council of Free Zones (CNZF), in 2013, a total of twenty six companies in the medical and pharmaceutical industry were operating under the free zone regime, generating about 17,000 direct jobs and more US$1,230 million in foreign exchange.

The development of the sector of medical and pharmaceutical products, also known as "The Life Sciences Industry" in the free zones of the Dominican Republic was originated in the late eighties. However, the installation of the medical industry companies would not have been possible without the existence of an appropriate industrial infrastructure in the Dominican Republic, which could be successfully provided by the Parks Zone located on the outskirts of the city of Santo Domingo, specifically the Free Trade Zones Itabo, San Isidro and Las Americas, which also enjoy quick access to major seaports and airports.

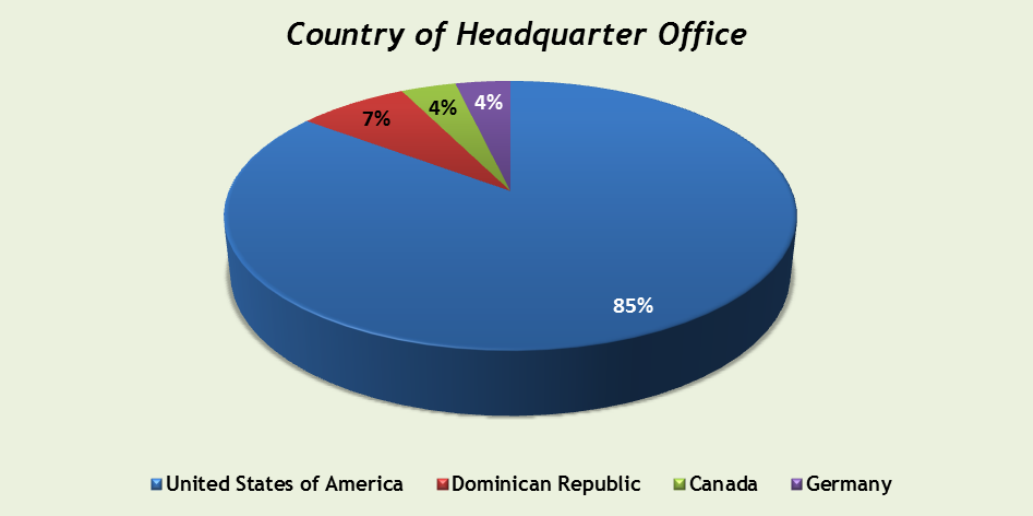
Medical and pharmaceutical products manufactured by companies in free zones located in Dominican Republic can be classified into two broad categories: 1) pharmaceuticals and personal care products, drug compounds, laboratory preparations, disposable products for the treatment of injury and products hygiene oral and 2) Instruments and appliances used in medical, surgical and orthopedic, which include a variety of products ranging from devices for transfusion and treatment of blood components for pacemakers and biopsy needles until prostheses and other items for orthopedic use.

**Figure 2.7** Distribution of Medical and Pharmaceutical Products Exported by the Dominican Republic 2013.




*Note*. Based on MIT. (2013). *Observatory of Economic Complexity-Medical Instruments* . Retrieved December 2014, from MIT: http://atlas.media.mit.edu/profile/hs/9018/

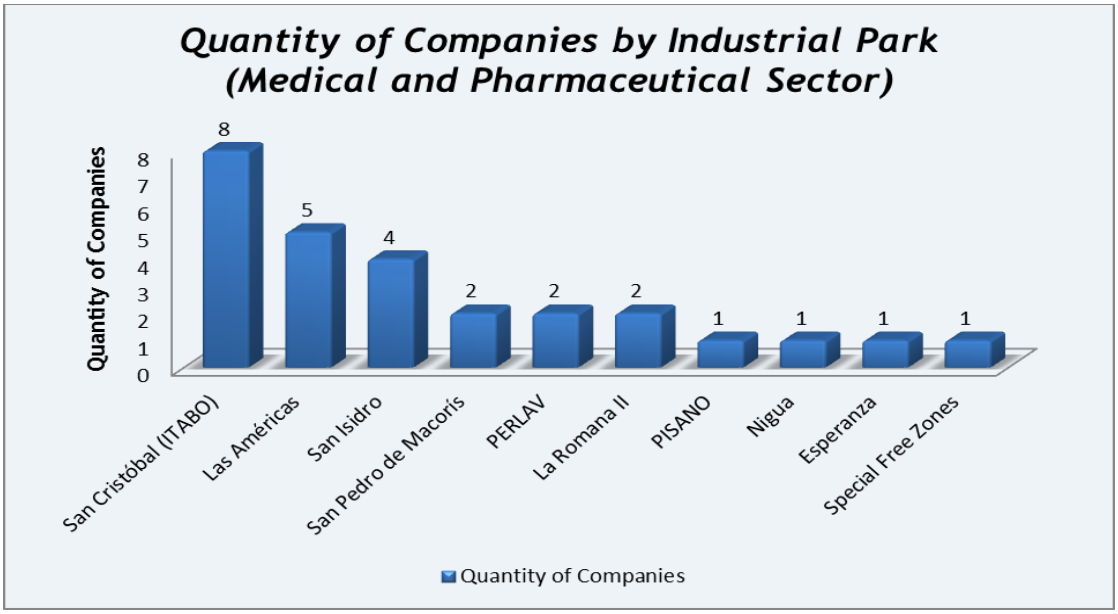
**Figure 2.8** Country of Origin of the Medical Manufacturers in the Dominican Republic.




*Note*. Based on the National Council of Free Zone of the Dominican Republic (CNZF). (2013). *Sector Report of Medical Products and Pharmaceuticals. Dominican Republic. 2013*. Retrieved from CNZF: http://www.cnzfe.gob.do/images/transparencia/Estadisticas/Informes_Tecnicos/Informe-Productos-M%C3%A9dicos-y-Farmac%C3%A9uticos-2013.pdf

In Figure 2.8, the country of headquarter office of the 26 companies that operates in the country is distributed by a 85% or 23 companies from United States of America, 7% or 2 companies from the Dominican Republic, 4% or 1 company from Canada, and 4% or 1 company from Germany.

**Figure 2.9** Quantity of Companies by Industrial Park (Medical and Pharmaceutical Sector) in the Dominican Republic 2013

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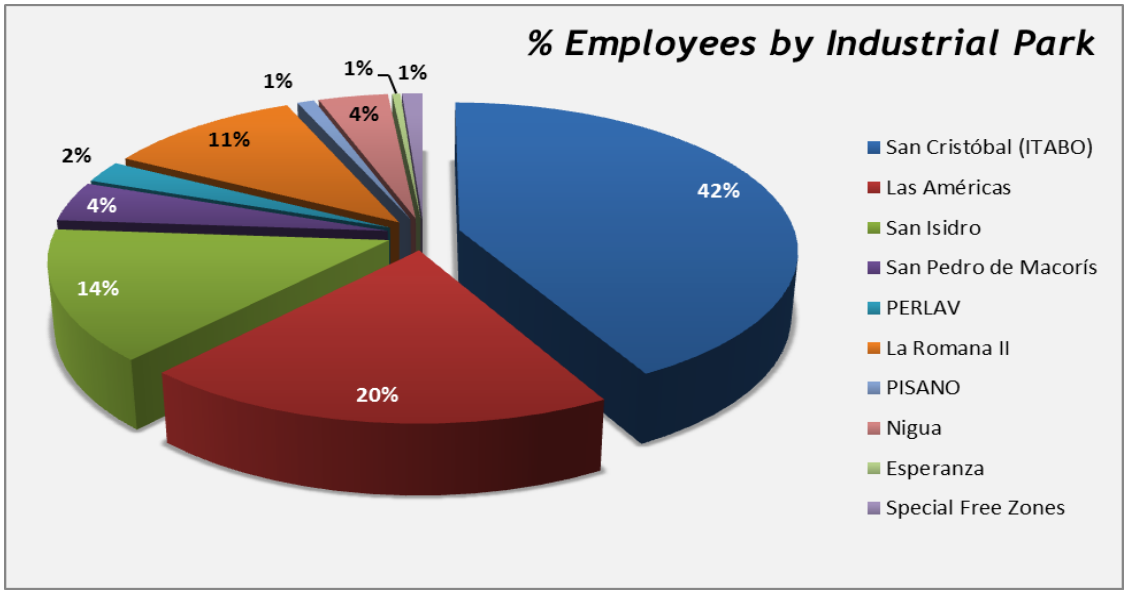
In Figure 2.9, in the Dominican Republic are established 10 industrial parks, where are located the 26 companies of Medical and Pharmaceutical products.

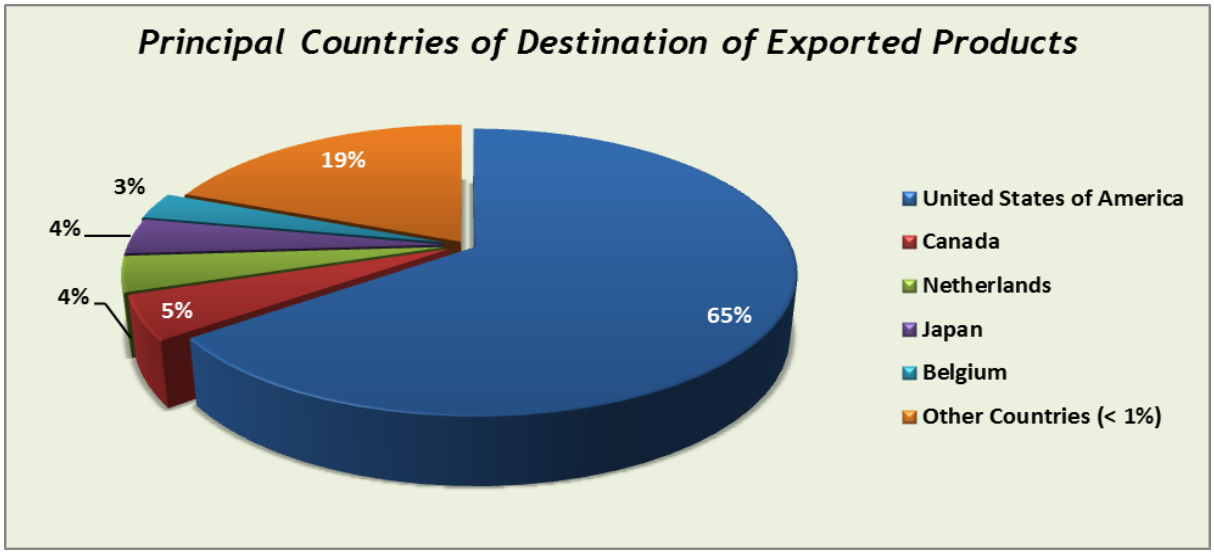
**Figure 2.10** Percent of Employees Working with Medical Manufacturers by Industrial Park in the Dominican Republic 2013.




*Note*. Based on the National Council of Free Zone of the Dominican Republic (CNZF). (2013). *Sector Report of Medical Products and Pharmaceuticals. Dominican Republic. 2013*. Retrieved from CNZF: http://www.cnzfe.gob.do/images/transparencia/Estadisticas/Informes_Tecnicos/Informe-Productos-M%C3%A9dicos-y-Farmac%C3%A9uticos-2013.pdf

In Figure 2.10, we can see the distribution of employees by industrial parks, where ITABO, Las Americas, and San Isidro represent the major generators of jobs. Due to the level of technological sophistication of the manufacturing process of these products, these companies require technical personnel and highly qualified engineering, which receives substantially higher salaries to those granted in other export activities in the country.

**Figure 2.11** Main Countries of Destination for the Medical Products Manufactured in the Dominican Republic 2013.

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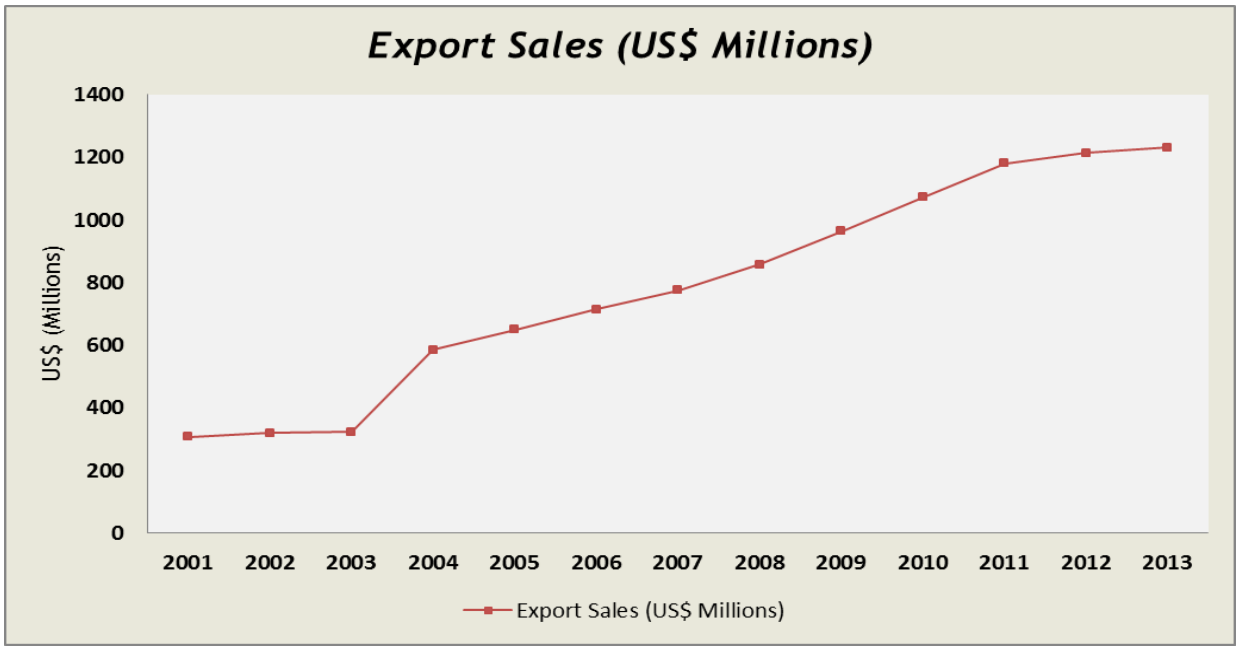
In Figure 2.11, we can appreciate the principal countries of destination of exported products by Sector Medical and Pharmaceutical in the Dominican Republic, where United States of America receive around 65% of the total production. According to the Trade Competitiveness Map by UNCTAD, the medical products exported to United States are equivalent to US$675 million, for Canada is US$51 million, Netherlands US$44 million, Japan US$41 million, and Belgium US$34 million. The country exports around 74 different products to these destinations. However, behind this relative concentration of exports in the American market, there is a simple arithmetic logic that could not be ignored in international business; in fact our country has a unique comparative advantage, located at a relatively short distance from the world's largest

consumers market. Also, the Dominican Republic has a versatile infrastructure to deliver operations of supply chain more efficiently in the region with the incorporation of seaports as Multimodal Caucedo and the application of DR-CAFTA an international free-trade agreement with the government of United States and other countries from Central America. The DR-CAFTA constitutes the first free trade agreement between the US and a small group of developing countries. It was created with the purpose of creating new and better economic opportunities by opening markets, eliminating tariffs, and reducing barriers to services. For this reason, it is necessary to further exploit our geographical potential, promoting the development of competitiveness of free zones. Recently, the launch of the logistic center of the Zona Franca Multimodal Caucedo, whose executives have announced a plan to invest US$150 million for the period 2012-2015, could position our country as an efficient regional center for the transshipment, consolidation and distribution of goods.

**Figure 2.12** Export (US$ Millions) in the Medical and Pharmaceutical Sector. Dominican Republic 2013.



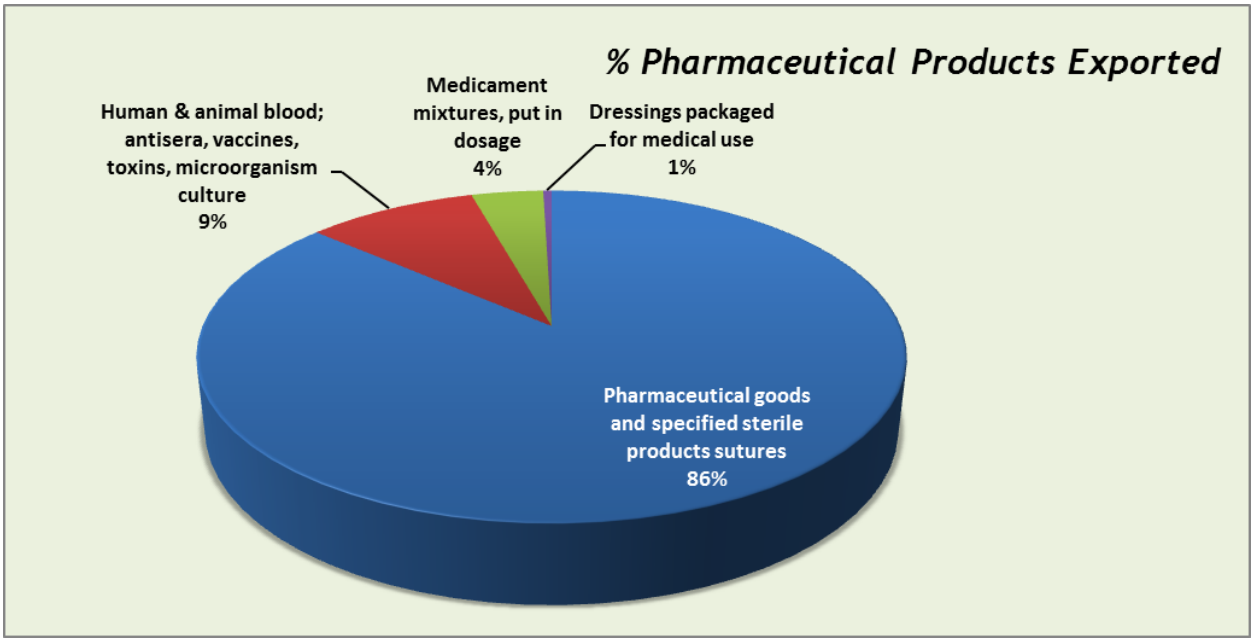
*Note (Figure2.12)*. Based on the National Council of Free Zone of the Dominican Republic (CNZF). (2013). *Sector Report of Medical Products and Pharmaceuticals. Dominican Republic. 2013*. Retrieved from CNZF: http://www.cnzfe.gob.do/images/transparencia/Estadisticas/Informes_Tecnicos/Informe-Productos-M%C3%A9dicos-y-Farmac%C3%A9uticos-2013.pdf

In Figure 2.12, the export sales of the sector have grown systematically from 2004 between 10%-12% annually. In 2013, the sector of medical and pharmaceutical products had exports worth a total of US$ 1,230 million, of which a total of US$322.16 million from pharmaceutical products, and exports of US$907.84 million of instruments for medical, surgical and orthopedics, occupying 73.8% of total exports of the sector. Indeed, the sector of surgical instruments was the most dynamic in the industry, experiencing growth of 14% over 2013, while exports of pharmaceutical products grew by 8.7% in the same period.

The future success of the scheme of free zones in our country depend to some extent on the continued diversification into high value-added sectors and incorporating innovative taxes regime, paying special attention to the promotion of new activities to the synergies with other national productive sectors. One of the most important aspects of the restructuring of the sector's exports has been diversifying into higher-technology sectors, which has undoubtedly led to an increase in value added of the exports. According to a research published by the University of Oxford, entitled Development Trajectories and New Comparative Advantages: Costa Rica and the Dominican Republic under Globalization. Free zones in the Dominican Republic have been even more successful than those located in Costa Rica, in terms of value added exports. This finding is particularly interesting, since technological escalation of the free zones of Costa Rica, mainly after installing an Intel manufacturing facility in that country, is frequently cited as a prominent success story in the region. A good example of the evolution of the value added of exports from free zones of our country is the relationship between exports and jobs. In 1995,

exports per employee had a value of US$17.6, while in 2011 its value was US$38.8, experiencing growth of 121%, significantly higher than the 64% growth of total exports in the period 1995-2011.

**Figure 2.13** Percent of Pharmaceutical Products Exported. Dominican Republic 2013

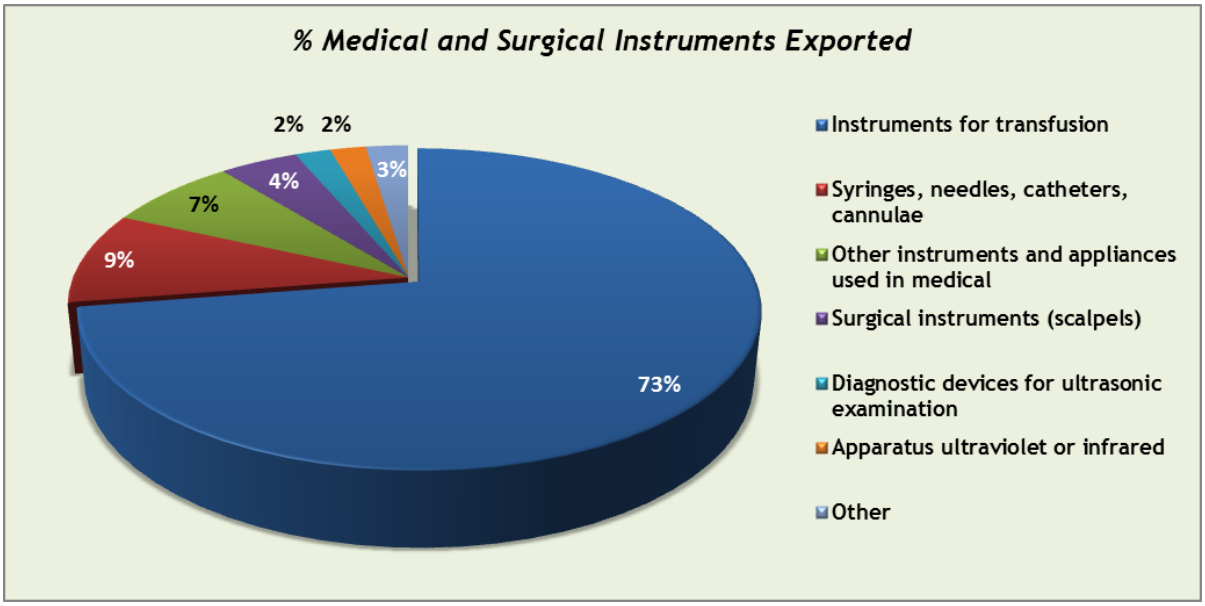



*Note*. Based on the National Council of Free Zone of the Dominican Republic (CNZF). (2013). *Sector Report of Medical Products and Pharmaceuticals. Dominican Republic. 2013*. Retrieved from CNZF: http://www.cnzfe.gob.do/images/transparencia/Estadisticas/Informes_Tecnicos/Informe-Productos-M%C3%A9dicos-y-Farmac%C3%A9uticos-2013.pdf

In Figure 2.13, within the category of pharmaceuticals and personal care, one of the biggest exports was dental floss with a total value up to US$ 34.28 million, where the multinational company Johnson & Johnson, with over 25 years of operation in the country, took a leading role. Also, the "dressings packaged for medical use" has decreased in the last three years from US$72.6 million on 2010 to US$1.47 million or 1% in 2013, this decreased is due to changes on the supply chain globally of these goods, where China is taking a more significant role.

However, after Covidien in 2012 installed a modern manufacturing facility to sterilize products, this segment "specified sterile products" has experienced an extraordinary shift from US$0.00 in 2011 to US$141.4 million in 2013.

**Figure 2.14** Percent of Medical and Surgical Instruments Exported. Dominican Republic 2013




*Note*. Based on the National Council of Free Zone of the Dominican Republic (CNZF). (2013). *Sector Report of Medical Products and Pharmaceuticals. Dominican Republic. 2013*. Retrieved from CNZF: http://www.cnzfe.gob.do/images/transparencia/Estadisticas/Informes_Tecnicos/Informe-Productos-M%C3%A9dicos-y-Farmac%C3%A9uticos-2013.pdf

In the figure 2.14, within the category of surgical instruments, the most exported product was the apparatus for blood transfusion and intravenous, with a total value of US$671 million in 2013, occupying 73% of total exports of medical instruments. Within the group of manufacturers and exporters of these products highlights US-based multinational Fenwal Blood Technologies, Hospira, and the German company B. Braun. The Dominican Republic made exports of surgical instruments with a total value of US$907.84 million in 2013, ranking the 37$^{th}$ position worldwide

according to International Trade Centre, and standing over countries such as Costa Rica, Turkey, Portugal, and New Zealand.

# *Chapter 3: Methodology*

## *3.1 Methodology*

This research project investigated whether R&D expenses have an effect on the profit, revenue, and productivity for companies of high-tech healthcare products in the Dominican Republic. This part of the research is constituted by the three main hypotheses that declare:

- *Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D, are more profitable than those who invest less.*
- *Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D increases their revenue than those who invest less.*
- *Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D increases their productivity levels than those who invest less.*

Also, the main research questions are related to: *What % of budget is invested in R&D by manufacturing companies of high-tech healthcare products in the Dominican Republic?; and What are the barriers to investing resources in R&D in the high tech manufacturers in the Dominican Republic?* In section 3.2 is explained Research Strategy and Data Collection Method.

## *3.2 Research Strategy and Data Collection Method*

- ***Method***

This research adopted a mixed methods approach as both quantitative and qualitative research methods were used. A quantitative approach was used to measure the level of Research & Development Expenditure for companies of high-tech healthcare products in the Dominican Republic. In quantitative research, the goal is to determine the relationship between one thing (an independent variable) and another (a dependent or outcome variable) in a population (USC Libraries, 2014). In this sense, the quantitative approach allowed us to determine correlation between the variables stated in the hypotheses of this research, where the dependent variables are (profits; revenue; and productivity) and the independent variable is (R&D expenditure) for this study. Also, the quantitative research helped us to analyze empirical result from the survey for a reliable conclusion of the level of Research & Development for companies of high-tech healthcare products in the Dominican Republic.

With the quantitative data provided by the survey developed for this research (see Appendix A for the survey questions), we were able to determine these metrics: Expenditure on in-house R&D; the source of funds for in-house R&D expenditure; the numbers of employees working in R&D; the type of employees working in R&D (researchers, technicians, staffs); whether R&D is performed in-house or outsourced; and the number of patents registered. The information gathered from these metrics allowed us to answer the first research questions: What % of budget is invested in R&D by manufacturing companies of high-tech healthcare products in the Dominican Republic? The result was calculated with the help of Microsoft Excel.

In this context, it was necessary also to perform some content analysis together with the quantitative research to answer the three hypotheses of this research. The content analysis was used to complete information related to: global R&D expenditure performed by the companies surveyed, US$ sales globally performed by the companies surveyed, and US$ profits globally performed by the companies surveyed. These metrics were gathered from the annual reports provided by the companies surveyed via e-mail or through their web page. Content analysis was used because many of these companies consider their international manufacturing facilities as a dependent unit from their headquarters. For that reason, to develop a more reliable study it was necessary to use the data gathered from the annual reports of the surveyed companies. The three hypotheses were answered by the information provided from the quantitative research of the survey and the data gathered from the annual reports of the companies surveyed.

The hypotheses were answered using statistical functions of Microsoft Excel as correlations, average, and ratio. The correlation test was used to measure the strength of a linear association between two variables, where the value r = 1 means a perfect positive correlation and the value r = -1 means a perfect negative correlation with the objective to prove the relationship between R&D expenditures with profits and R&D expenditures with revenue. For the first hypothesis, "*Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D, are more profitable than those who invest less",* after we gathered the data history of the last 4 years from the annual reports such as Global R&D Expenditure, Global Revenue, and Global Profit; we calculated the coefficient correlation of the variables (R&D Global Expenditure with Global Profit) for each company. After completing the coefficient of correlation for each surveyed company, we calculated an overall average that represents the final result to answer the first hypothesis.

The second hypothesis, "*Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D increases their revenue than those who invest less"*. We calculated the coefficient correlation of the variables (R&D Global Expenditure with Global Revenue). To answer this hypothesis the process was the same as that used for the first hypothesis only that the dependent variable was (Revenue).

For the third hypothesis, "*Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D increases their productivity levels than those who invest less"* it was necessary to perform another analysis to measure the productivity based on R&D expenditures. Known as return on research capital, or RORC, the metric effectively measure the proportion of profits that are generated from R&D spending in a previous period. RORC tells us how much gross profit is generated for every dollar of R&D spent in the previous year. For this analysis, we used the ratio (Current Year Gross Profit) / (Previous Year R&D Expenditure).

In addition to the quantitative research described above, it was also necessary to perform some qualitative research in order to answer the second research question. Two telephone interviews with general managers in 2 high-tech healthcare companies in the Dominican Republic were conducted in order to develop a better understanding of the issues related to R&D that affect the competitiveness and innovation of our industries. Some questions were:

***1.*** What factors do you consider in making decisions about R&D? What influences the decision making process?

***2.*** What are the barriers to investing more resources in R&D in the Dominican Republic?

***3.*** What kinds of R&D does your company conduct or has conducted?

- ***Data Collection***

There are two sources of data for research, namely primary and secondary data. The primary data is relevant to the present study and usually collected by the researcher through communication methods or interaction with respondents and observation methods. For this study, survey techniques were used to answer the research questions and test the hypotheses. Secondary data was gathered from previous studies through various sources such as articles, information posted on the internet, organizational databases, and government surveys.

- ***Sample Selection***

According to the Ministry of Economy, Planning and Development of the Dominican Republic and the National Free Zones Council, in the last census of 2013, 26 companies that manufacture high-tech healthcare products operate in the country. As a result, using a sample size calculator from Raosoft[1], the recommended statistically sample size for the project was 25 with a 5% of margin error, confidence level of 95%, response distribution of 50%, and population size of 26. In this context, letters and e-mails were sent to the 26 companies (general managers) that represent the Medical and Pharmaceutical Industry of the Dominican Republic, explaining the research purpose and offering the opportunity to participate in the survey. A total of 10 companies rejected participation. This represents a response rate of 62%. The remaining 16 companies formed the basis of the sample for the study. These companies received a questionnaire online or a telephone interview requesting quantitative responses. The companies surveyed for this project were: B. Braun AG, Baxter, CareFusion, Covidien, Edward Lifescience, Fresenius-Fenwall, Hospira, Johnson & Johnson Dental Care, ConvaTec, Ecolab-Microtek, De

[1] http://www.raosoft.com/samplesize.html

Royal, Accu-Med Technologies, Arriol International, Oscor Caribe, CEA Global Dominicana, and Medsorb. The two interviews requested for this study were selected randomly, where Felipe Sandoval (General Manager-B.Braun Dominicana) and Miriam Aybar (General Manager/Fresenius-Fenwall Dominicana) were selected. The data collected directly from the companies represents the primary data of the present study.

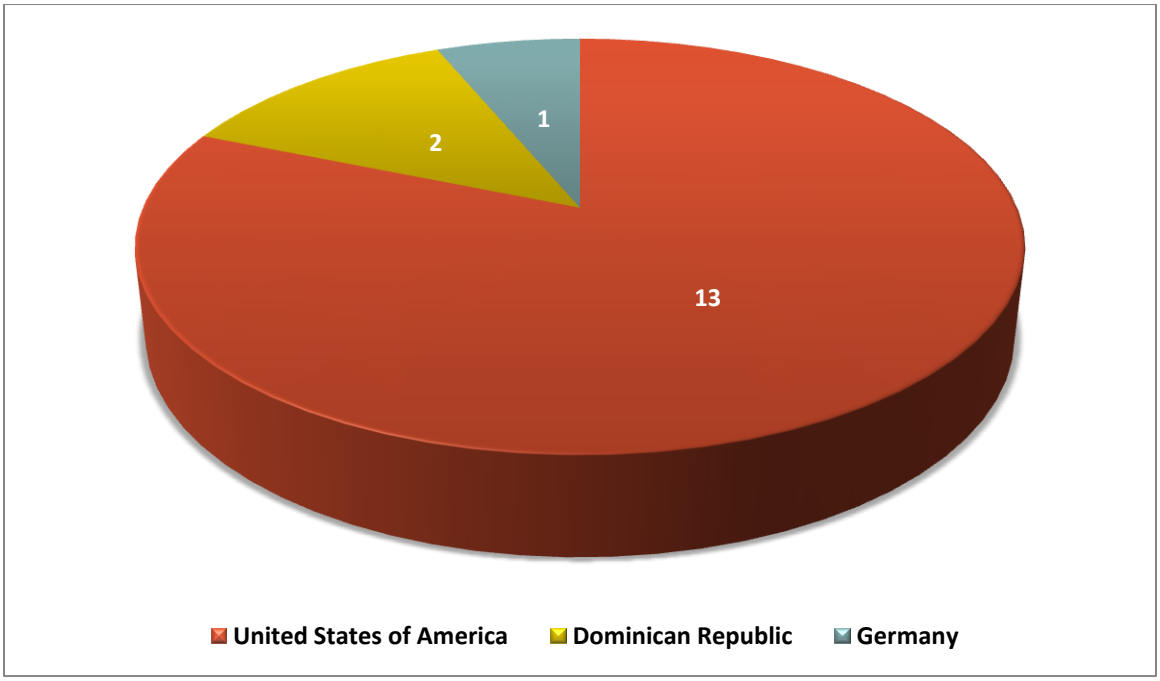
Additional, secondary data required for this study was obtained from the Annual Reports of: B. Braun AG, Baxter, CareFusion, Covidien, Edward Lifescience, Fresenius-Fenwall, Hospira, Johnson & Johnson Dental Care, Ecolab-Microtek, and ConvaTec. Other secondary data were provided by studies from: Innovation and Global Competitiveness Index 2015 by The World Economic Forum; Global Innovation 1000: Why Culture is Key 2011 by Booz & Company; Why "Low Risk" innovation is Costly 2011 by Accenture; and Foreign Direct Investment, The Transfer And Diffusion Of Technology, And Sustainable Development, 2011 provided by the United Nations Conference on Trade and Development.

# *Chapter 4: Results*

## *4.1 Collected Data*

What follows is a synthesis of the data collected in this study.

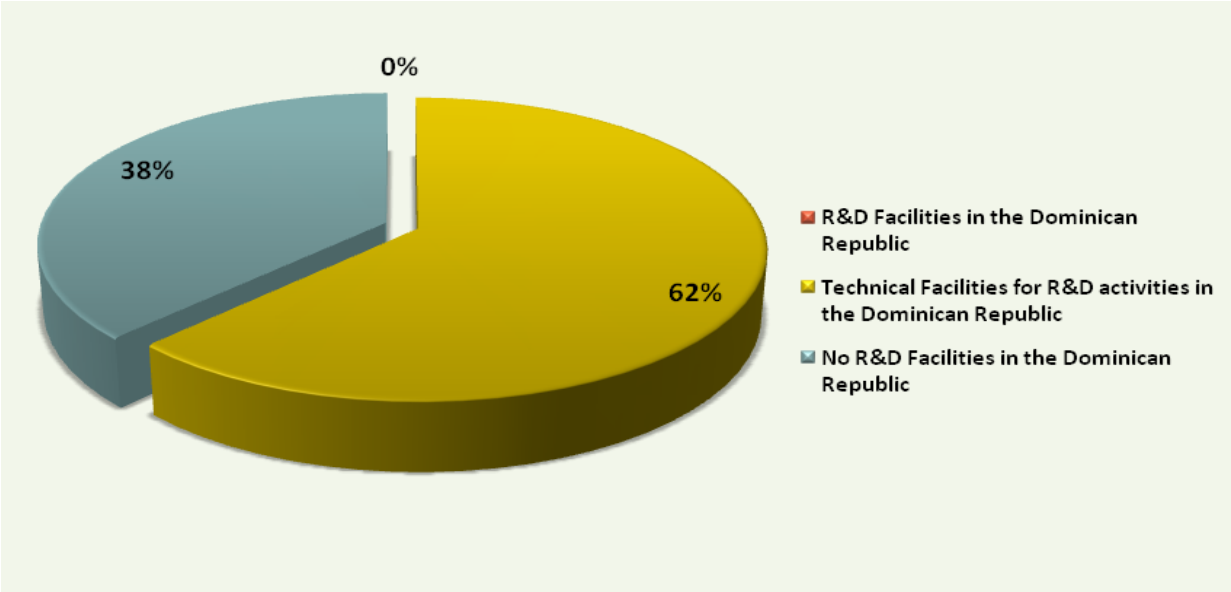
**Figure 4.1** Country of Origin of the Medical Manufacturers in the Dominican Republic (Survey)




*Source: by the authors*

In Figure 4.1, the results of the companies surveyed show that 81.25% or 13 companies have their Headquarter Office in the United States of America, 12.5% or 2 companies in the Dominican Republic, and 6.25% or 1 company in Germany.

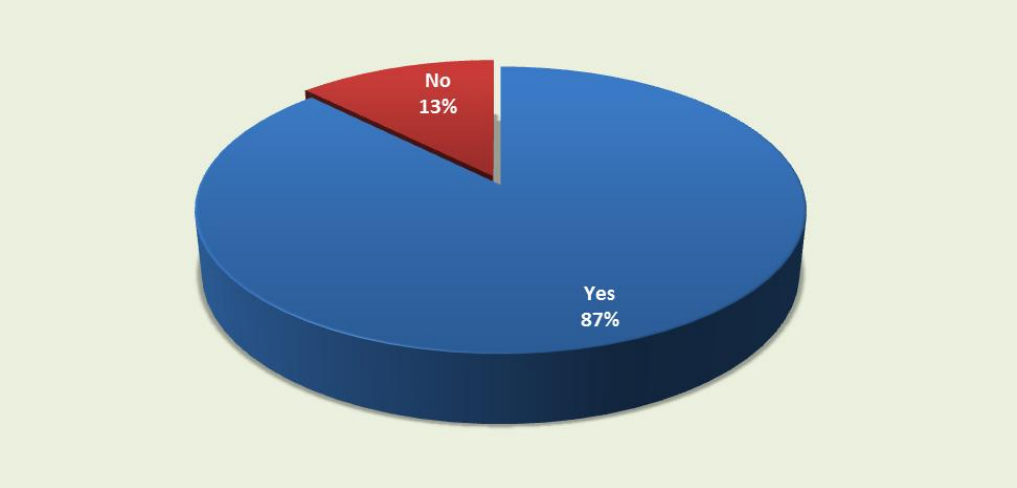
**Figure 4.2** Percent of Manufacturers of Medical Instruments with a R&D unit in the Dominican Republic.




*Source: by the authors*

In Figure 4.2, from the 16 companies surveyed 62% or 10 companies have a technical facility for R&D activities, and 38% or 6 companies don't have R&D facilities in the Dominican Republic. However, is necessary to consider that the statistics of this chart don't represent a complete or fully operative R&D unit during the whole year in the companies surveyed, due to many of the R&D activities are related to specific project required for a particular population, improvement of products and processes, and any customer specification. In this context, the manufacturing facility of the companies surveyed in this study, such as (Covidien, B. Braun AG, Baxter, Fresenius-Fenwall and Edward Lifescience) are supporting specific global process of research, design, development, and manufacturing of new or the improvement of existing products depending on the guidelines of the headquarter office.

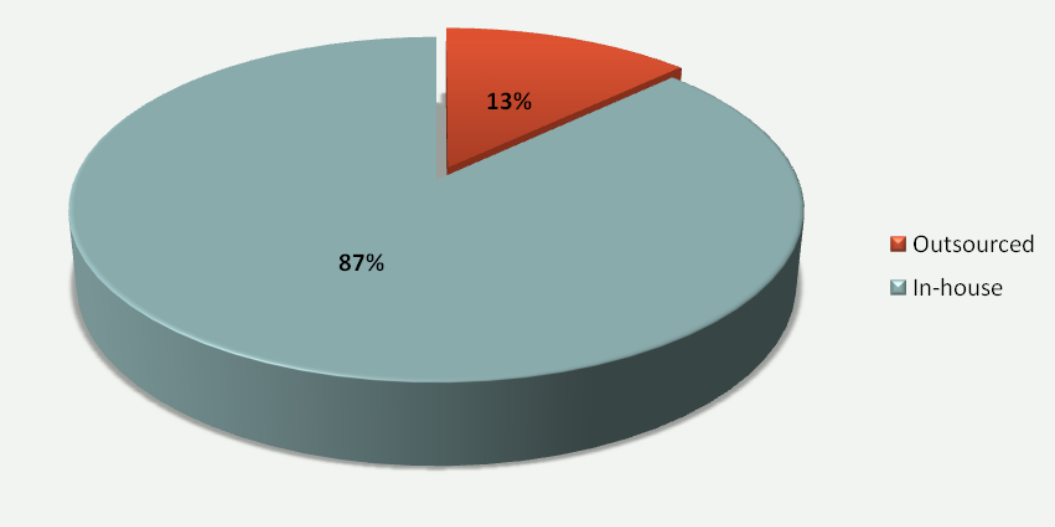
**Figure 4.3** Percent of Intensive R&D process performed by the Head Office.




*Source: by the authors*

In Figure 4.3, we can see that 87% or 14 companies perform their R&D process outside the country. The R&D process is developed globally using Innovation Centers to encourage a more flexible and dynamic innovation process. 13% or 2 companies are "manufacturer contractors"; they don't need to perform any R&D process, as patents, designs, and standards are supplied by the developer.

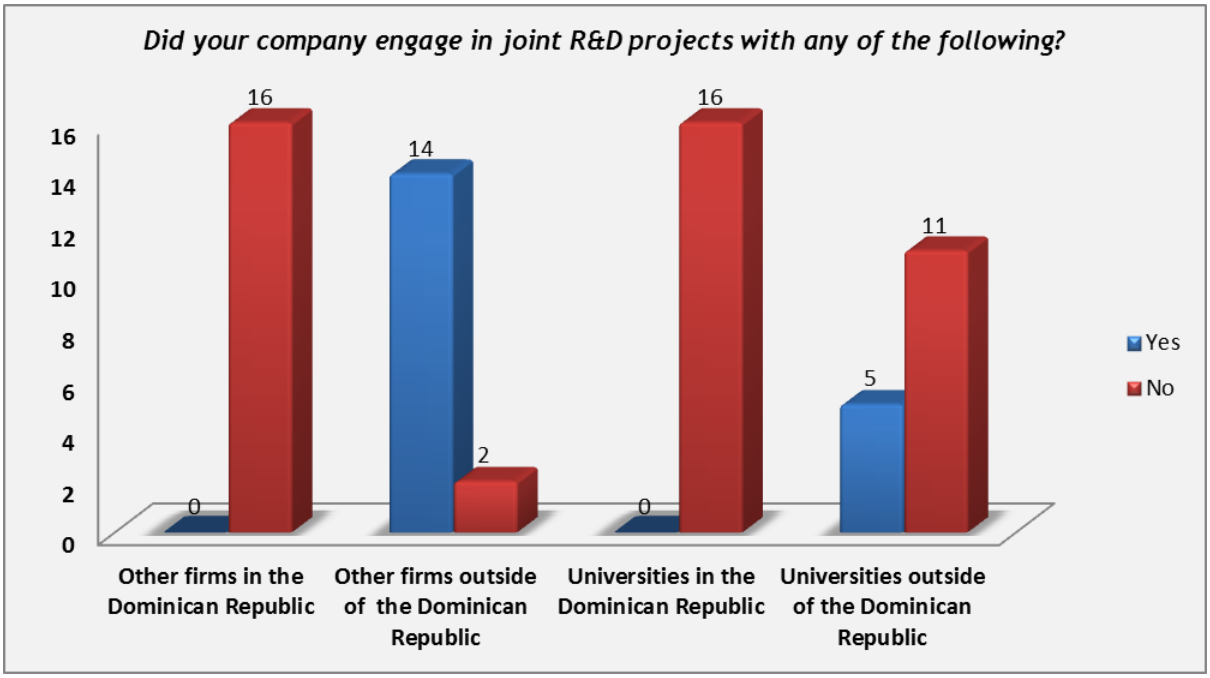
**Figure 4.4** Percent of R&D is performed in-house or outsourced.




*Source: by the authors*

In Figure 4.4, the result is similar to Figure 4.3, but the principal characteristic is the predominance to perform any R&D process "in-house".

**Figure 4.5** Did your company (Manufacturer of Medical Instrument) engage in joint R&D projects with any of the following?




*Source: by the authors*

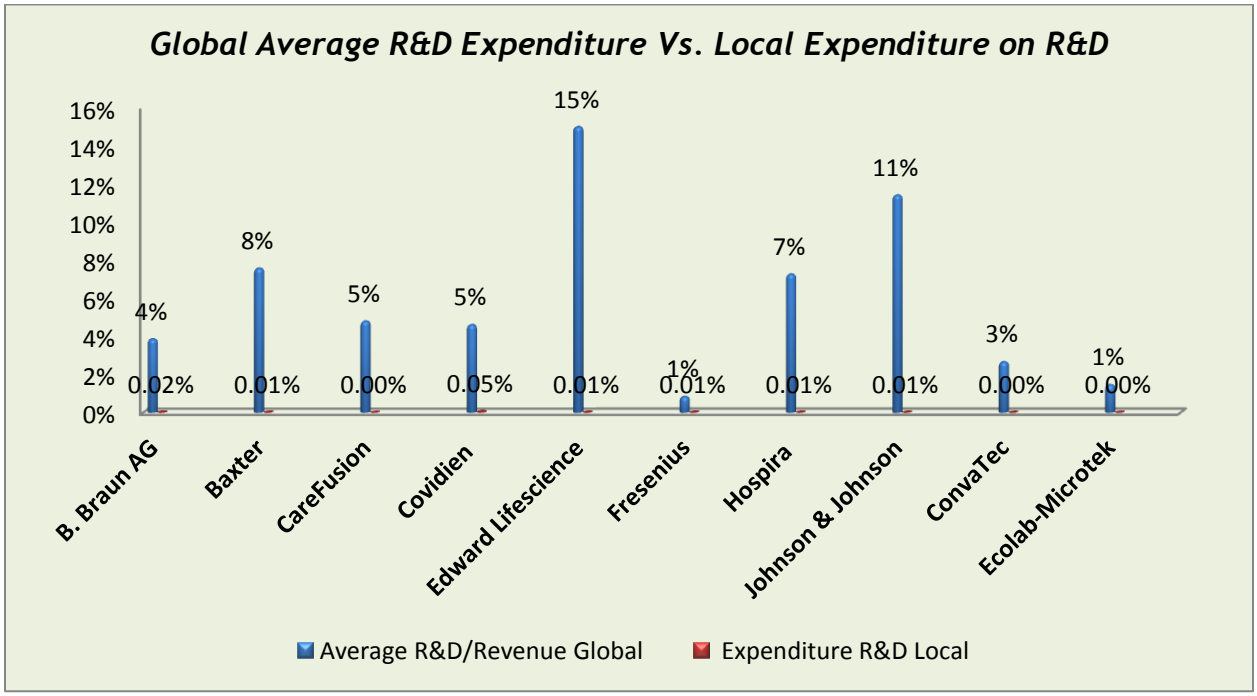
In Figure 4.5, as we can see that no companies in the medical and pharmaceutical sector work with universities or specialized firms in the Dominican Republic to perform any R&D process. Also, from the surveyed companies only 14 companies have worked with specialized firms outside of the Dominican Republic to perform any R&D process and 5 companies are engaged with specific research programs from international recognized universities outside of the Dominican Republic.

**Table 4.1** Overall variables of the companies surveyed.

| Companies | Years | Expenditure R&D Global (US$ Million) | Revenue (US$ Million) | Profit (US$ Million) | Ratio R&D/Revenue | Average R&D/Revenue Global | Expenditure R&D Local |
|---|---|---|---|---|---|---|---|
| **B. Braun AG** | **2010** | $ 196.37 | $ 5,581.57 | $ 350.08 | 4% | 4% | **0.02%** |
| | **2011** | $ 226.66 | $ 5,817.06 | $ 325.22 | 4% | | |
| | **2012** | $ 241.55 | $ 6,370.32 | $ 364.21 | 4% | | |
| | **2013** | $ 275.87 | $ 6,523.91 | $ 398.16 | 4% | | |
| **Baxter** | **2011** | $ 915.00 | $ 12,843.00 | $ 1,420.00 | 7% | 8% | 0.01% |
| | **2012** | $ 946.00 | $ 13,893.00 | $ 2,224.00 | 7% | | |
| | **2013** | $ 1,156.00 | $ 14,190.00 | $ 2,326.00 | 8% | | |
| | **2014** | $ 1,246.00 | $ 15,259.00 | $ 2,012.00 | 8% | | |
| **CareFusion** | **2011** | $ 146.00 | $ 3,440.00 | $ 249.00 | 4% | 5% | 0.00% |
| | **2012** | $ 164.00 | $ 3,598.00 | $ 293.00 | 5% | | |
| | **2013** | $ 192.00 | $ 3,550.00 | $ 385.00 | 5% | | |
| | **2014** | $ 190.00 | $ 3,842.00 | $ 417.00 | 5% | | |
| **Covidien** | **2011** | $ 447.00 | $ 10,429.00 | $ 1,632.00 | 4% | 5% | **0.05%** |
| | **2012** | $ 412.00 | $ 9,607.00 | $ 1,868.00 | 4% | | |
| | **2013** | $ 479.00 | $ 9,851.00 | $ 1,905.00 | 5% | | |
| | **2014** | $ 508.00 | $ 10,235.00 | $ 1,700.00 | 5% | | |
| **Edward Lifescience** | **2011** | $ 204.40 | $ 1,447.00 | $ 218.00 | 14% | 15% | 0.01% |
| | **2012** | $ 246.30 | $ 1,678.60 | $ 236.70 | 15% | | |
| | **2013** | $ 291.30 | $ 1,899.60 | $ 293.20 | 15% | | |
| | **2014** | $ 323.00 | $ 2,045.50 | $ 391.70 | 16% | | |
| **Fresenius** | **2011** | $ 96.53 | $ 11,844.19 | $ 978.52 | 1% | 1% | 0.01% |
| | **2012** | $ 110.83 | $ 12,570.52 | $ 1,071.15 | 1% | | |
| | **2013** | $ 111.63 | $ 13,800.28 | $ 1,186.81 | 1% | | |
| | **2014** | $ 125.81 | $ 14,609.73 | $ 1,109.89 | 1% | | |
| **Hospira** | **2011** | $ 300.50 | $ 3,917.20 | $ 357.20 | 8% | 7% | 0.01% |
| | **2012** | $ 258.80 | $ 4,057.10 | $ (9.40) | 6% | | |
| | **2013** | $ 303.60 | $ 4,092.10 | $ 44.20 | 7% | | |
| | **2014** | $ 301.70 | $ 4,002.80 | $ (8.30) | 8% | | |
| **Johnson & Johnson** | **2010** | $ 6,844.00 | $ 61,600.00 | $ 13,334.00 | 11% | 11% | 0.00% |
| | **2011** | $ 7,548.00 | $ 65,030.00 | $ 9,672.00 | 12% | | |
| | **2012** | $ 7,665.00 | $ 67,224.00 | $ 10,853.00 | 11% | | |
| | **2013** | $ 8,183.00 | $ 71,312.00 | $ 13,831.00 | 11% | | |
| **ConvaTec** | **2010** | $ 52.60 | $ 1,513.10 | $ (609.90) | 3% | 3% | 0.00% |
| | **2011** | $ 45.40 | $ 1,598.60 | $ (285.30) | 3% | | |
| | **2012** | $ 39.90 | $ 1,646.20 | $ (161.10) | 2% | | |
| | **2013** | $ 32.00 | $ 1,700.70 | $ (173.10) | 2% | | |
| **Ecolab-Microtek** | **2011** | $ 96.00 | $ 6,799.00 | $ 462.50 | 1% | 1% | 0.00% |
| | **2012** | $ 183.00 | $ 11,839.00 | $ 703.60 | 2% | | |
| | **2013** | $ 188.00 | $ 13,253.00 | $ 967.80 | 1% | | |

*Source: by the authors*

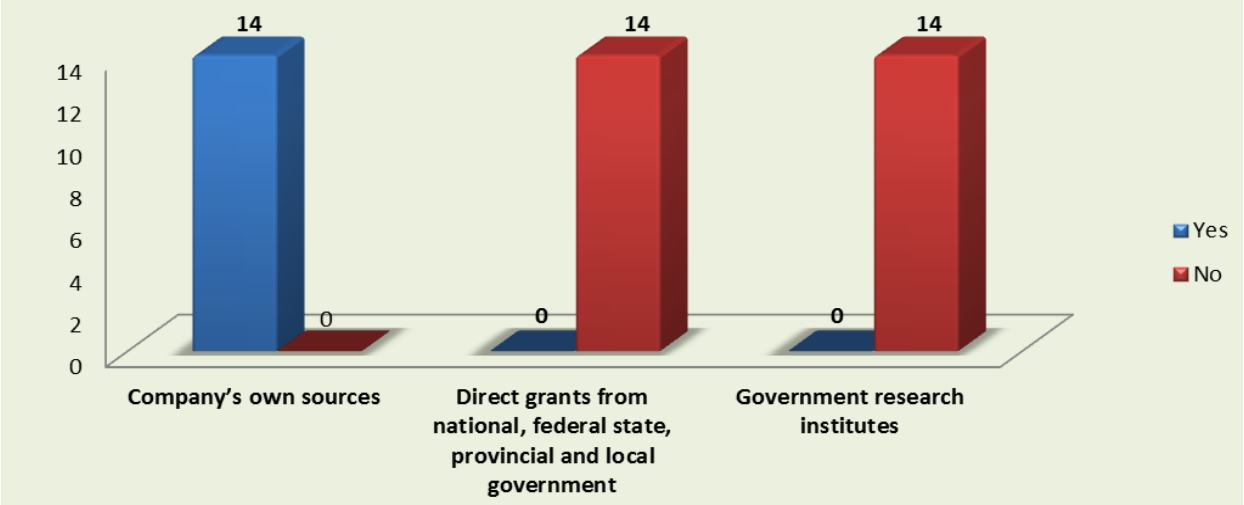
**Figure 4.6** Global Average R&D Expenditure vs. Local Expenditure on R&D.




*Source: by the authors*

Of the 16 companies surveyed only 10 agreed to provide an overall statistic about their R&D activities. This information is presented in Figure 4.6 and Table 4.1. As mentioned, these companies concentrated many of its R&D abroad. Figure 4.6 shows the Global Average R&D Expenditure vs. Local Expenditure in R&D by these companies from 2009 to 2014, according to the calculated ratio (R&D/Revenue) globally from each one; the highest percentage is invested by Edward Lifescience 15%, followed by Johnson & Johnson with 11%, Hospira with 7%, and Baxter with 8%. These percentages represent a strong commitment for these companies to invest on R&D activities. However, is necessary to consider that local expenditure in R&D activities is so low comparable to international expenditure. The Figure 4.6 indicates us that the overall expenditure in the Dominican Republic for the Sector Medical and Pharmaceutical is around 0.01% annually.

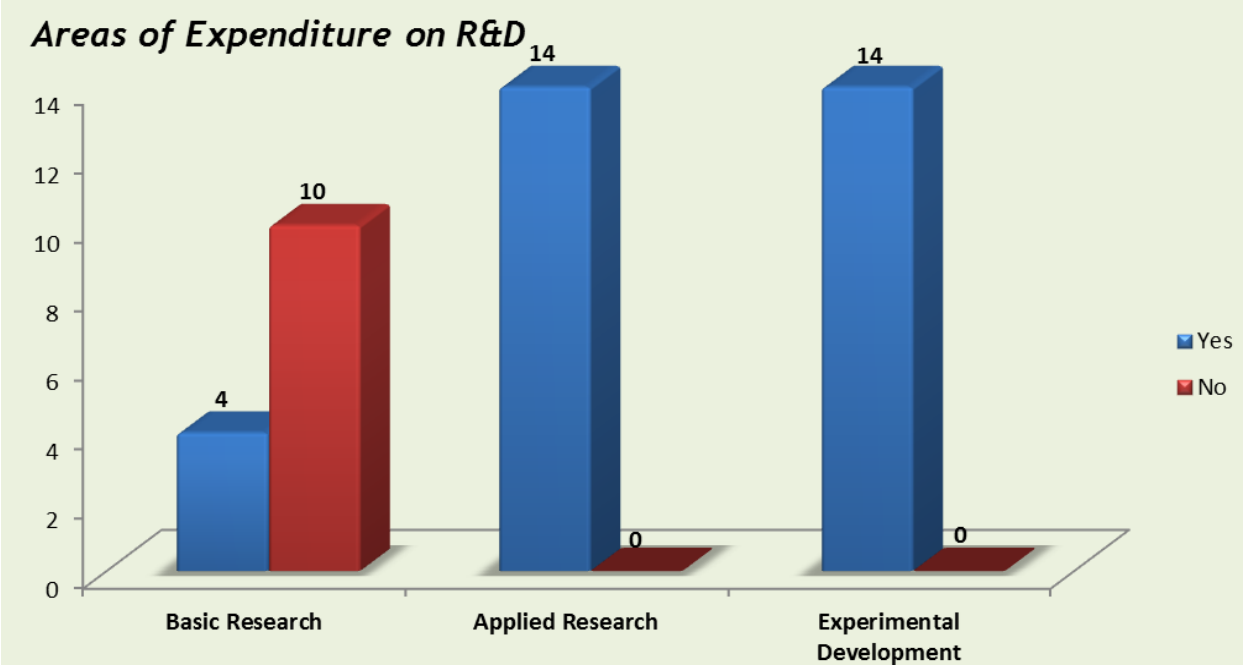
**Figure 4.7** Sources of Funds for R&D in the Dominican Republic.




*Source: by the authors*

In Figure 4.7, the principal source of funding for new R&D activity in the Dominican Republic is provided by the own company. So far, none of the companies surveyed have received subsidies from Dominican institutions or from the government of the Dominican Republic to perform any R&D activity.

**Figure 4.8** Areas of Expenditure in R&D by the companies surveyed.




*Source: by the authors*

As can be seen in the Figure 4.8, the principal areas of expenditure on R&D globally by the firms surveyed are: in the areas of applied research and experimental development. In this context, Covidien in the Dominican Republic is the only one that has 5 employees (engineers with Ph.D. and master's degree) in its plant of San Isidro working specifically on special projects in R&D assigned by the Headquarter office. The other 13 companies surveyed in the country only perform process innovation and product testing, which are performed by the General Manager or engineer managers in areas such as quality, process or products. None of the surveyed company registered a patent in the Dominican Republic in the last two years. Also, in the Dominican Republic there is no up-to-date information on the number of patents requested and granted, although available information seems to indicate little interest or capacity to patent and a high foreign participation in patent applications.

## *4.2 Interviews*

- **Interview with Felipe Sandoval** (General Manager B. Braun Dominican Republic)

1) **What factors do you consider in making decisions about R&D? What influences the decision making process?**

In our experience, we find that complexity in its many forms slows innovation. That is the reason why we encourage our organization to find innovative way to improve our process and suggest new ideas for products. Every company in this sector has a product development plan with major milestones and activities in place. For B. Braun innovation is our DNA, each year the company globally rewards creative ideas with the Innovation Prize. The brand value of "Innovation" in B.Braun also finds its expression in state-of-the-art production facilities; we will be investing US$2.9 billion worldwide between 2011 and 2015 in manufacturing facilities for all product areas, the largest investment program in our history. In general, our roadmap related to decision making about R&D we have: understand the customer ecosystem and prioritize customer needs, optimize project team resources, and align R&D processes to deliver cost-effective and differentiated products to the market.

2) **What are the barriers to investing more resources in R&D in the Dominican Republic?**

In perspective, is necessary to consider that innovation process in the Sector Medical and Pharmaceutical in the Dominican Republic is driven by building state-of-the-art

production facilities more than developing the product in the country. In general, the difficulty to install a sterilization facility for all the products manufactured in the Dominican Republic is related to the high costs of installation. If companies could sterilize and distribute directly into the local market, companies would save between 10 to 12 days in the process. Some other barriers are: low level of public investment in R&D; limited absorption and use of technologies by the public and private sectors.

***3)*** **What kinds of R&D does your company conduct or has conducted?**

We have a R&D technical facility that is supporting the process of design and development of new products globally. This includes: perform process innovation and test of product that are related with applied research.

- **Interview with Miriam Aybar (**Fresenius-Fenwall Dominicana**)**

---

1) **What factors do you consider in making decisions about R&D? What influences the decision making process?**

The principal focus of all our activities is to improve the quality of life for our patients by making advances in therapy and technology. Innovations from research and development are the key. Our commitment to research and development places the very best equipment at patients' disposable today and helps to shape the standards of tomorrow. Before starting any product development we ask: What can we do better?

2) **What are the barriers to investing more resources in R&D in the Dominican Republic?**

Inadequate policies and legal framework for promoting alliances between industry and universities for the protection of R&D activities and for attracting advanced technologies and investors.

3) **What kinds of R&D does your company conduct or has conducted?**

In 2013, 552 full-time employees were working in R&D worldwide. Most activities are carried out at the German sites Schweinfurt and Bad Homburg. Other R&D sites are in St. Wendel (Germany), Bucharest (Romania) and Krems (Austria). The global R&D organization coordinates cooperation and technology exchange between the various sites.

## *4.3 Hypothesis Testing*

**Table 4.2** Correlation Coefficient Test

| **Correlation Coefficient** | |
|---|---|
| **Variable** | **Correlation** |
| R&D Global Expenditure -Revenue | 0.9793 |
| R&D Global Expenditure -Profits | 0.9759 |

*Source: by the authors*

In this perspective, the analysis on Microsoft Excel of the correlation of the variables (R&D Global Expenditure-Revenue and R&D Global Expenditure-Profits) indicated us that variables are highly and positively correlated, this means that a change or improvement in one of the variable (R&D expenditure) has strong and direct effect on the other variables (Revenues and Profits). Also, we have evaluated the expenditures assigned for R&D activities for these companies in the Dominican Republic, but the average are so low to perform a significant analysis. For that reason, the analysis had to be performed by using the public Annual Reports from 2009-2014 of these companies. As we have explained, the manufacturing facilities that operate these companies in the Dominican Republic need to be considered as part of the global Research process and value chain of the companies.

Therefore, by using the global R&D expenditure made by each enterprise, we improved significantly the relevance of the data. This first analysis confirmed us our first hypothesis "*Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D, are more profitable than those who invest less*". The coefficient of correlation for (R&D Global Expenditure –Profits) is 0.9759; this means that variables are highly and positively correlated for the data collected.

The second hypothesis "*Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D increases their revenue than those who invest less*" is evaluated according to the global revenue by each company surveyed. The coefficient of correlation (R&D Global Expenditure –Revenue) for this hypothesis is 0.9793; this means that variables are highly and positively correlated for the data collected. For that reason, we confirmed our second hypothesis. However, R&D spending by itself does not guarantee profitability and strong stock performance; it's more about an extraordinary commitment to develop the right innovation culture, strategic alignment, and efficient processes inside the company that allow to exploit the potential of R&D expenditure effectively. According to the report (Global Innovation 1000: Why Culture is Key, 2011) by Booz & Company, companies should follow the lead of the most successful innovators in ensuring that the company's culture not only supports innovation, but actually accelerates its execution. They suggest first, make sure that the innovation strategy is clearly articulated, and communicated throughout the organization from the top all the way down to the lab bench. Second, align the technical community with top management, and give the technical leaders a real seat at the executive table. Third, ensure that the innovation agenda translates into a tangible action plan, clearly linked to a short, focused list of capabilities that will allow the company to stand out in the marketplace.

For the third hypothesis "*Companies of high-tech healthcare products in the Dominican Republic, which invest more in R&D increases their productivity levels than those who invest less*" was necessary to perform another analysis to measure the productivity based on R&D expenditures. Known as return on research capital, or RORC, the metric effectively measure the proportion of profits that are generated from R&D spending in a previous period. At the same

time, it gives investors a sense of whether recent R&D investments are contributing to financial performance or whether the company is just coasting on older innovations (Investopedia, 2013). RORC tells us how much gross profit is generated for every dollar of R&D spent in the previous year.

The ratio is expressed as:

$$\frac{Current\ Year\ Gross\ Profit}{Previous\ Year\ R\&D\ Expenditure}$$

**Table 4.3** RORC (return on research capital) for B.Braun Ag and Covidien.

| Companies | Year | Expenditure R&D Global (US$ Million) | Revenue (US$ Million) | Gross Profit | Profit (US$ Million) | RORC R&D |
|---|---|---|---|---|---|---|
| ***B. Braun AG*** | 2013 | $ 275.87 | $ 6,523.91 | $ 2,958.76 | $ 398.16 | $ 12.25 |
| ***Covidien*** | 2014 | $ 508.00 | $ 10,235.00 | $ 6,085.00 | $ 1,700.00 | $ 12.70 |

*Source: by the authors*

As we can see in the table 4.3, the companies B. Braun AG and Covidien were considered for this analysis because they are deploying some R&D activities in the country. For that reason, RORC ratio indicated us that B. Braun AG produced US$12.25 of gross profit in 2013 for every dollar that it spent on R&D globally and Covidien produced US$12.70 of gross profit in 2014 for every dollar that it spent on R&D globally. With this consideration, the expenditures for R&D made by these companies increased the productivity level overall and we have confirmed our third hypothesis.

# *Chapter 5: Conclusion and Recommendations*

## *5.1 Discussion and Conclusion*

As globalization intensifies, many multinational companies have internationalized their R&D activities; and new opportunities have been opened up for developing countries to attract R&D-intensive foreign direct investment (FDI). R&D is recognized as an important driver of economic and social progress worldwide. In this context, investing more in R&D is a way to improve innovation and economic growth, in order to increase the competitiveness of the Dominican Republic in the global market. Investing in R&D has great potential for benefiting broader society. This research project investigated whether R&D expenses have an effect on the profit, revenue, and productivity for companies of high-tech healthcare products in the Dominican Republic, and why some of these companies do not invest more in R&D.

The survey developed for this investigation project was answered by 16 of the 26 Medical and Pharmaceutical manufacturers in the Dominican Republic. This represented a response rate of 62%. Of the 16 companies that answered the survey, 10 companies have a technical facility for the global R&D process, and 6 companies don't have any kind of R&D or technical facilities for innovation process in the Dominican Republic. In this context, it's important to note that none of these companies have performed a significant R&D process in the country in the last 5 years. From this perspective, the facilities that these companies have in the country serve manufacturing process and supply chain capabilities. At the same time, some companies have been incorporated continuously new products and production processes with more complexity, including the adoption of vertical integration strategies for manufacturing

production materials and intermediate components, which has impacted positively on increasing the value added of exports.

For example, within the category of medical instruments, the most exported product was the apparatus for blood transfusion and intravenous, with a total value of US$671 million in 2013, occupying 73% of total exports of medical instruments. Within the group of manufacturers and exporters of these products highlights US-based multinational Fenwal Blood Technologies, Hospira, and the German company B. Braun.

The Dominican Republic made exports of medical instruments with a total value of US$952.03 million in 2013, ranking the 18$^{th}$ position worldwide according to the Observatory of Economic Complexity developed by the MIT (Massachusetts Institute of Technology), where the Dominican Republic is standing over countries such as Austria and Malaysia. At the same time, this makes the country the second largest Latin American exporter of these products. In this context, none of these companies sell their products in the local market; the reasons behind this decision are that each product need to pass a sterilization process and complete the assemble process in the most cases in United States, China or Canada. In general, the difficulty to install a sterilization facility for all the products manufactured in the Dominican Republic is related to the high costs of installation. According to CEO -B. Braun Dominican Republic-Felipe Sandoval, if companies could sterilize and distribute directly into the local market, companies would save between 10 to 12 days in the process. Although, Covidien was the first to install a sterilization plant in 2011 for specific products, however the final process of the product is terminated in the United States.

In the question “Did your company engage in joint R&D projects with any of the following?” of the survey, we saw that no companies in the medical and pharmaceutical sector work with universities or specialized firms in the Dominican Republic to perform any R&D process. In some cases, R&D is also considered the least internationalized segments of the value chain. According to the report (Foreign Direct Investment, The Transfer And Diffusion Of Technology, And Sustainable Development, 2011) provided by the United Nations Conference on Trade and Development, transnational corporations have been increasingly shifting their R&D activities to the developing world, though developed countries remain the main host locations of foreign R&D activities by transnational corporations. For example, the United States did not use much developing country affiliates in their foreign R&D activities, but they allocated globally 15% of their R&D activities in 2007. The foreign direct investment in R&D can bring various benefits to host countries. While the empirical evidence is limited, what exists suggests that when supported and complemented by proactive policies, such benefits as: promoting human resource development, creating knowledge spillovers, and upgrading industrial competitiveness – may have significant potential for technological learning in developing countries (UNCTAD, 2005).

However, according to the same report (Foreign Direct Investment, the Transfer and Diffusion of Technology, and Sustainable Development, 2011) provided by the United Nations Conference on Trade and Development, in many case transnational corporations do not have an interest in transferring knowledge to and supporting innovation in foreign affiliates beyond what is needed for their production process or product.

The government support to facilitate the acquisition or use of such technology and process of learning foreign technology is critical. Part of the success of transfer of technology at the firm level depends on the existence of the support from domestic institutes in adapting to new situations faced by local firms.

As we have analyzed, the companies surveyed concentrate their R&D programs outside the country because in this moment the Dominican Republic don't have the quality or the capacity through government or academic institutes to engage in complex R&D activities required by these firms. In the table 4.1 presented in this study about the Global Average R&D Expenditure vs. Local Expenditure in R&D by these companies from 2009 to 2014, according to the calculated ratio (R&D/Revenue) globally from each one; the highest percentage is invested by Edward Lifescience 15%, followed by Johnson & Johnson with 11%, Hospira with 7%, and Baxter with 8%. These percentages represent a strong commitment for these companies to invest on R&D activities, for example the biggest investor on R&D activities is Johnson & Johnson with US$8,183 million in 2013.

However, is necessary to consider that local expenditure in R&D activities in the Dominican Republic is so low compared to international expenditure. To answer our first research question the data analyzed indicates us that the overall expenditure in the Dominican Republic for the Sector Medical and Pharmaceutical is around 0.01% annually, where B. Braun and Covidien are increasing their efforts to implement effective R&D activities in the country, although this percentage is minimum, both companies have exports for above US$100 million annually in the country.

Also, the companies surveyed in the country only perform process innovation and product testing, which are performed by the General Manager or engineer managers in areas such as quality, process or products. None of the surveyed company registered a patent in the Dominican Republic in the last two years. According to the (World Competitiveness Report, 2015) developed by the World Economic Forum, the Dominican Republic ranks on the position 80$^{th}$ from 144 countries worldwide on patents applications/million population or 0.5 patent application/population million (see Table 5.1). The data provided by the World Economic Forum also shows that the pillar of innovation in the Dominican Republic is composed by capacity of innovation (53%), quality of scientific research institutions (41%), company spending on R&D (40%), university-industry collaboration in R&D (47%), and availability of Scientifics and engineers (40%).

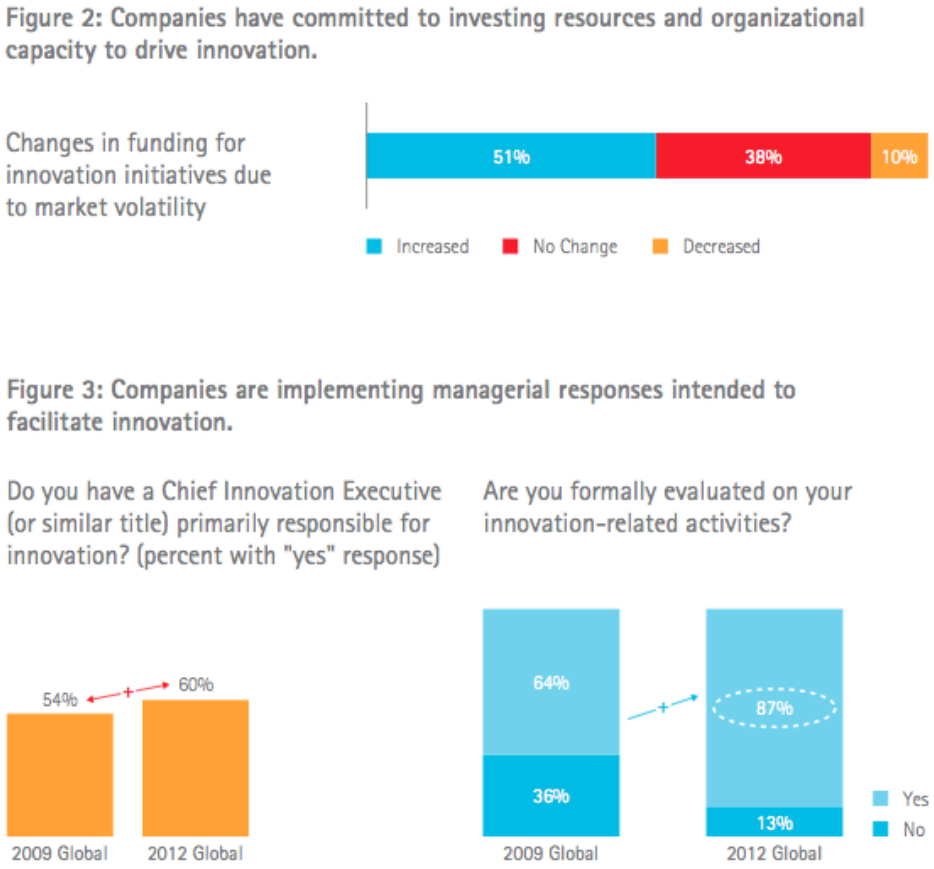
**Table 5.1** Innovation Index by the World Economic Forum-Dominican Republic 2015

| | 12th pillar: Innovation | | |
|---|---|---|---|
| 12.01 | Capacity for innovation | 3.7 | 74 |
| 12.02 | Quality of scientific research institutions | 2.9 | 113 |
| 12.03 | Company spending on R&D | 2.8 | 108 |
| 12.04 | University-industry collaboration in R&D | 3.3 | 94 |
| 12.05 | Gov't procurement of advanced tech products | 3.6 | 59 |
| 12.06 | Availability of scientists and engineers | 3.3 | 115 |
| 12.07 | PCT patents, applications/million pop.* | 0.5 | 80 |

*Note*. From the World Economic Forum. (2014). *The Global Competitiveness Report 2014-2015.*

Retrieved from World Economic Forum: www.weforum.org/issues/global-competitiveness

**Figure 5.1** Insights on Innovation




*Note.* From Accenture. (2013). *Why "Low Risk" innovation is Costly.* Retrieved October 2014, from Accenture: http://www.accenture.com/sitecollectiondocuments/pdf/accenture-why-low-risk-innovation-costly.pdf

However, it's important to note the evaluation in the report *Why "Low Risk" innovation is Costly* from Accenture; about the potential of innovation based on R&D activities, as we can appreciate in Figure 5.1, companies have committed in 51% to investing resources and organizational capacity to drive innovation also in time of market volatility. Thus, companies are willing to implement new managerial responses to facilitate innovation with the creation of the Chief Innovation Executive (CIE); in 2012 there were 60% of global companies with CIE.

In general, during this research we have found that the barriers to investing more resources in R&D in the high tech manufacturers sector in the Dominican Republic were:

- Low level of public and private investment in R&D;
- Limited absorption and use of technologies by the public and private sectors;
- Fragmented sources of human resources and limited access to cutting-edge knowledge;
- Unclear priorities for scientific and technological development in this sector;
- Inadequate policies and legal framework for promoting alliances between industry and universities for the protection of R&D activities and for attracting advanced technologies and investors;
- Limited interaction among industry, the universities and the Government;
- Limited channels for interaction between institutions for the development of knowledge and technology;

Today, the Dominican Republic is a hub for top medical technology companies which have chosen the country for manufacturing a wide range of sophisticated medical products, creating one of the largest clusters in healthcare manufacturing in the region. In this sense, the medical device industry in the Dominican Republic has played a key role in promoting and sustaining economic growth of the country, due to a significant and sophisticated network of experienced people and companies, whom are incorporating new and advanced manufacturing process. However, in the case of the transfer of technology from the universities to industry, it is necessary to develop the best strategies and policies that allow the universities and all researchers

involved in the R&D process, to pursue a future commercialization of their inventions or innovations.

This insight is a way to understand the actual situation of R&D in the Dominican Republic with the purpose for developing new strategies to foster new R&D program in the country. The data collected was used to gain a better perspective of the reality of R&D process in one of the most profitable industries (Medical and Pharmaceutical Industry). With this improved perspective, the information collected in this study will be submitted to government institutions, such as: PROINDUSTRIA (Center for Industrial Development and Competitiveness), ADOZONA (Dominican Association of Free Zones), and CONEP (National Council of Private Enterprise) as a contribution to the national policy in competitiveness. Also, the study could be used to open a debate forum in PUCMM about the possibilities to enhance the relationships between R&D, industries, and universities in the Dominican Republic.

As we have seen, the purpose of this research was to try to understand whether R&D expenses have an effect on the profit, revenue, and productivity for companies of high-tech healthcare products in the Dominican Republic, and why some of these companies do not invest more in R&D. The results of this research are conclusive in this matter, the analysis on Microsoft Excel of the correlation of the variables (R&D Global Expenditure-Revenue and R&D Global Expenditure-Profits) indicated us that variables are highly and positively correlated, this means that a change or improvement in one of the variable (R&D expenditure) has strong and direct effect on the other variables, in this case with Revenues or Profits. However, R&D spending by itself does not guarantee profitability and strong stock performance; it’s more about an extraordinary commitment to develop the right innovation culture, strategic alignment, and efficient processes inside the company that allow to exploit the potential of R&D expenditure

effectively. This study has showed also that cooperation in the Dominican Republic among (company-university-government) in the innovation system is ineffective. The companies surveyed concentrate their R&D programs outside the country because in this moment the Dominican Republic don't have the quality or the capacity through government or academic institutes to engage in complex R&D activities required by these firms. The overall expenditure in R&D in the Dominican Republic for the Sector Medical and Pharmaceutical is around 0.01% annually. In many developing and transition economies, international companies generally perform little R&D and don't promote new partnership inside the country. In this context, government policies need to encourage both domestic and foreign investments in building productive and adaptive capacities, fostering business linkages, enhancing spillover effects, and promoting technological advances. In this sense, when stakeholders of R&D and innovation activities share common values and trust, scientific and technological outcome tends to be maximized, leading to enhanced competitiveness. The internationalization of R&D by transnational corporations opens up new opportunities for developing countries as the Dominican Republic to enhance the development of its own innovative capabilities.

## *5.2 Recommendations*

- **Institutionalize R&D statistics.** Unfortunately, the current R&D statistics database in the Dominican Republic is outdated and this represents an important issue for policy planning to foster the national competitiveness. In this sense, is necessary to establish a sustainable R&D statistical system that contemplates better ways to measure innovation, R&D activity, and intangible capital. As a nation will be more effective to us promote innovative activity if we are able to measure its role in economic growth and social wellness.

- **Encourage public capacity in R&D by investing in local universities and research institutes.** A key challenge for developing countries is to strengthen their universities and public research institutes by recruiting adequate staff and providing them with adequate funding and equipment to carry out R&D and by providing postgraduate education in science and technology subjects, as demanded by foreign investors in R&D.

- **Create a Collaborative Research and Development Platform using Social Media**. A collaborative research and development social platform could bring together businesses and academic partners for projects that can lead to successful new products, processes and services.

- **Redesign Law 392-07 about Competitiveness and Innovation**. Enhance the capacity of the Law to promote Foreign Direct Investment (FDI) in areas of Research and Development that includes:
    - **Develop a better intellectual property rights regime.** The main drawback of R&D off shoring is the risk of intellectual property theft. Therefore, another priority for governments aiming to attract R&D through FDI (Foreign Direct Investment) is to develop a clear and enforceable intellectual regime.
    - **Fiscal incentives to business.** Fiscal incentives can include a favorable tax treatment for R&D expenditure, for example in the form of accelerated depreciation or import tariff exemptions.
    - **Creating clusters for fostering linkages.** The establishment of science and technology parks that can be used to create a more conducive environment for innovation and R&D in companies across the country, often in close proximity to universities and other public research institutions. Building a dynamic national innovation system where universities and public research institutes collaborate with firms is critical to attract R&D through FDI and to capture the associated knowledge spillovers.

- **Universities develop programs related to reverse Engineering.** The objectives of reverse engineering are usually to understand the structure and functioning of an object in order to make a new device or program. In this sense, a similar object is created in a different way by improving on it, where minor or incremental changes are the most frequent type of innovation activity in emerging economies and developing countries.

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## Appendix A: Survey *Research and Development Activities*

1. **Does your company have a dedicated R&D unit/department?**: Yes____ No____

2. **Is the R&D process performed by the Head Office?** Yes____ No____

3. **R&D is performed in-house or outsourced:** Yes____ No___

4. **Did your company engage in joint R&D projects with any of the following?**

| **Joint R&D Projects with:** | **Please indicate (Yes/No)** |
|---|---|
| Other firms in the Dominican Republic | |
| Other firms outside of the Dominican Republic | |
| Universities in the Dominican Republic | |
| Universities outside of the Dominican Republic | |

5. **Expenditure on R&D (US$) at least in the last five years:**

| ***Years*** | ***R&D Expenditure (US$)*** | ***% R&D in the budget*** |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

6. **The source of funds for R&D expenditure:**

| ***Source of Funds*** | ***Please Indicate (Yes/No):*** |
|---|---|
| Company's own sources | |
| Direct grants from national, federal state, provincial and local government | |
| Government research institutes | |

7. **Please indicate R&D expenditure in terms of the following categories:**

| ***Categories:*** | ***Please Indicate (Yes/No):*** |
|---|---|
| Basic Research | |
| Applied Research | |
| Experimental Development | |

8. **The numbers of employees working on R&D in the Dominican Republic:_____**

***9.*** **Type of employees working on R&D (researchers, technicians, staffs)**

| **Employed as:** | **Total** |
|---|---|
| PhD qualified researcher | |
| Other researcher | |
| Technicians | |
| Support Staffs | |
| **Total R&D staff** | |

***10.*** **Number of patents developed with R&D program in the Dominican Republic :_____**