Research Report

Supporting the Value Proposition of the Pharmaceutical Industry in Mexico

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Widening the Portfolio of Factors that Define the Value of Pharmaceuticals

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List of Abbreviations and Acronyms

abs	Absolut
AMIIF	Asociación Mexicana de Industrias de Investigación Farmacéutica, A.C. (Mexican Association of Pharmaceutical Research Industry)
avg	Average
bn	Billion
Canifarma	Cámara Nacional de la Industria Farmacéutica (National Chamber of the Pharmaceutical Industry)
CAGR	Compound annual growth rate
COFEPRIS	Comisión Federal para la Protección contra Riesgos Sanitarios (Federal Commission for the Prevention of Sanitary Risks)
Destatis	Statistisches Bundesamt Deutschland (Federal Office of Statistics Germany)
Eurostat	Statistical Office of the European Union
ESA	European System of Accounts
FDI	Foreign direct investment
GBD	Global burden of disease
GDP	Gross domestic product
GFCF	Gross fixed capital formation
GRAS	Graph-based language-independent stemming algorithm
GVA	Gross value added
IHME	Institute for Health Metrics and Evaluation
INEGI	Instituto Nacional de Estadística y Geografía de México (National Institute of Statistics and Geography)
IOT	Input-output table
MXN	Mexican Peso
n/a	Not available
OECD	Organisation for Economic Co-operation and Development
p.a.	Per annum (per year)
percentage points	pps
PV	Production value
R&D	Research and development
SCIAN	Sistema de Clasificación Industrial de América del Norte (North American Industry Classification System)
SCNM	Sistema de Cuentas Nacionales de México (Mexican System of National Accounts)
SNA	System of National Accounts
UN	United Nations
USD	US Dollar
WHO	World Health Organisation

List of Symbols

a_{ij}	Input coefficients of production sector $i \in [1; n]$ and $j \in [1; n]$
A	Matrix of input coefficients
c	Vector of consumption rate
C	Matrix of consumption coefficients
e_d	Direct employment effect
e_{d+i}	Sum of direct and indirect employment effects
e_{indi}	Indirect employment effect
e_{indu}	Induced employment effects
e_j	Coefficients of employment of production sector $j \in [1; n]$
e_t	Total employment effect (sum of direct, indirect and induced production value effects)
E	Matrix of employment coefficients
E_j	Employment of production sector $j \in [1; n]$
g_d	Direct gross value added effect
g_{d+i}	Sum of direct and indirect gross value added effects
g_{indi}	Indirect gross value added effect
g_{indu}	Induced gross value added effects
g_j	Coefficients of the gross value added of production sector $j \in [1; n]$
g_t	Total gross value added effect (sum of direct, indirect and induced production value effects)
G	Matrix of coefficients of the gross value added
G_j	Gross value added of production sector $j \in [1; n]$
i	Production sector, $i \in [1; n]$
I	Identity matrix
j	Production sector, $j \in [1; n]$
L	Leontief inverse matrix
n	Number of homogeneous production sectors
T	Technology matrix
w	Vector of compensation of employees
w_d	Direct effect of compensation of employees
w_{d+i}	Sum of direct and indirect effects of compensation of employees
w_{indi}	Indirect effect of compensation of employees
w_{indu}	Induced effects of compensation of employees
w_j	Coefficients of compensation of employees of production sector $j \in [1; n]$
w_t	Total effect of compensation of employees (sum of direct, indirect and induced production value effects)
W	Matrix of coefficients of compensation of employees

W_j	Compensation of employees of production sector $j \in [1;n]$
x	Vector of gross output / total demand
x_d	Direct production value effect
x_{d+i}	Sum of direct and indirect production value effects
x_{ij}	Input / intermediate consumption that production sector $i \in [1;n]$ demands from production sector $j \in [1;n]$
x_{indi}	Indirect production value effect
x_{indu}	Induced production value effects
x_t	Total production value effect (sum of direct, indirect and induced production value effects)
X_i	Gross output / total demand of production sector $i \in [1;n]$
X_j	Production value of production sector $j \in [1;n]$
y	Vector of final consumption
Y_i	Final consumption of production sector $i \in [1;n]$

Management Summary

This research study, conducted by the independent economic research institute WifOR, investigates the economic effects of the pharmaceutical industry and clinical studies in Mexico as well as its contribution to the total Mexican economy from 2008 to 2014. The analysis encompasses the calculation of the Economic Footprint and an examination of its results.
In addition to the direct economic effects, the Economic Footprint accounts for indirect and induced economic effects (spillover effects). Direct effects describe the immediate economic effects while the indirect effects arise due to the input or intermediate consumption of the object of investigation. Induced economic effects originate in the spending of income of the employees of the pharmaceutical industry and their suppliers. The computation of these effects is based on the System of National Accounts (SNA) and input-output analysis. In a first step, a satellite account of the pharmaceutical industry and the clinical studies are created and direct economic effects are derived. To determine the spillover effects, the so-called technology matrices of the intermediate consumption, expanded with the Keynesian multiplier, are computed. In addition to these economic effects, economic key indicators are derived.

Every loss of MXN 1.00 of gross value added (GVA) in the pharmaceutical industry results in a further loss of MXN 0.64 of GVA.

From 2008 to 2014, the pharmaceutical industry reached an average of MXN 90 billion of direct GVA p.a., which is equivalent to an average contribution to the Mexican gross domestic product (GDP) of 0.6 %. The indirect and induced GVA effects averaged at MXN 59 billion while the total effects averaged at MXN 149 billion. Notwithstanding, there is a declining trend: from 2008 to 2014, the total GVA effects declined by - 11.2 %, respectively, a decline of - 2.0 % p.a. The loss of MXN 1.00 of direct GVA entails a further loss of MXN 0.64 of indirect and induced GVA in 2014. Hence, the shrinkage of the pharmaceutical industry has further deteriorating implications for the economic performance of the rest of the Mexican economy.
The GVA rate is the ratio of GVA and the production value (PV). It is an indicator for the upstream value added stages that are integrated into the overall industry's economic activities. A high value added rate signifies a strong vertical integration, i.e. the object of investigation generates a relatively large share of GVA in its own industry. The pharmaceutical industry reached an average GVA rate of + 53.4 %. This rate increased from 2008 to 2014 by + 1.5 %. Compared to the manufacturing and the automobile industry, the pharmaceutical industry features a 1.8 times higher GVA rate. Given the high productivity of the pharmaceutical industry, its decline is even more alarming.

Each MXN 1.00 of GVA of clinical studies implicates another MXN 0.54 of GVA. The GDP impact of clinical studies increased by 27.5 % to MXN 161 billion (2008 to 2014).

The clinical studies, in contrast, grew their direct GVA from MXN 83 billion in 2008 to MXN 104 billion in 2014. The total GVA effects resulted in MXN 161 billion. The annual average growth rate of total GVA effects of clinical studies was + 4.1 %.

On average from 2008 to 2014, 341 thousand employees were dependent on the pharmaceutical industry and every new job in the pharmaceutical industry creates 3.3 additional jobs. Furthermore, the branch employs highly productive labour but there is still room for improvement regarding an international comparison.

On average from 2008 to 2014, the pharmaceutical industry directly employed 80 thousand employees and the spillover effects amounted to 262 thousand jobs. Hence, 341 thousand employees were dependent on the pharmaceutical industry's economic activity. Similar to the GVA, the employment effects diminished over the period of consideration. The yearly rate of reduction was - 1.7 %. Nonetheless, the multiplier is high: every new job in the pharmaceutical industry creates 3.3 additional jobs. The labour productivity is an indicator of the efficiency of the labour input in a production process. It is the ratio of GVA and employment. It is shown that the branch employs highly skilled and productive employees: On average, the pharmaceutical industry reached a labour productivity of MXN 1.1 million, which overshot the productivity of the manufacturing industry by a factor of 2.3 and the total Mexican economy by 3.4.

The employment of clinical studies remains on a stable level, reaching 57 thousand direct employees in 2014.

In 2008, 53 thousand people were employed with clinical studies. This number rose to 57 thousand employees in 2014. The indirect employment fell by 2 thousand persons as the multiplier was reduced from 2.0 to 1.8. Nevertheless, the induced employment effects advanced to 77 thousand in 2014.

The pharmaceutical industry is an important contributor to the Mexican GDP and labour market, though, the industry is contracting.

The shrinkage of the pharmaceutical industry is alarming for two main reasons. Firstly, the deterioration occurs during a simultaneous growth of the worldwide pharmaceutical industry (3.1 % p.a. between 2008 and 2012[1]) and the total Mexican economy (3.8 % between 2008 and 2014[2]). Secondly, the health status of the Mexican society is worsening[3]. For the society's well-being in economic and health wise terms, the shrinkage of the pharmaceutical industry should be investigated critically. Furthermore, since the output of the pharmaceutical industry aims at increasing the society's health status, alongside the Economic Footprint, further footprints for measuring the value of the pharmaceutical industry should be calculated. The Health Footprint evaluates the health outcome of the pharmaceutical industry and the Socio-Economic Footprint amplifies this analysis by socio-economic aspects. An overarching analysis of the impacts that accompany the three footprints on an institutional level is executed by the Institutional Footprint. The results of such investigations are crucial for governmental outreach in order to enhance the debate about policy instruments that ensure growth and job creation in the pharmaceutical industry.

[1] Cf. INEGI, 2015a ; Ostwald, Zubrzycki, & Knippel, 2015 ; The World Bank Group, 2015 ; own calculation.
[2] Cf. INEGI, 2015a ; own calculation.
[3] Cf. IHME, 2015 .

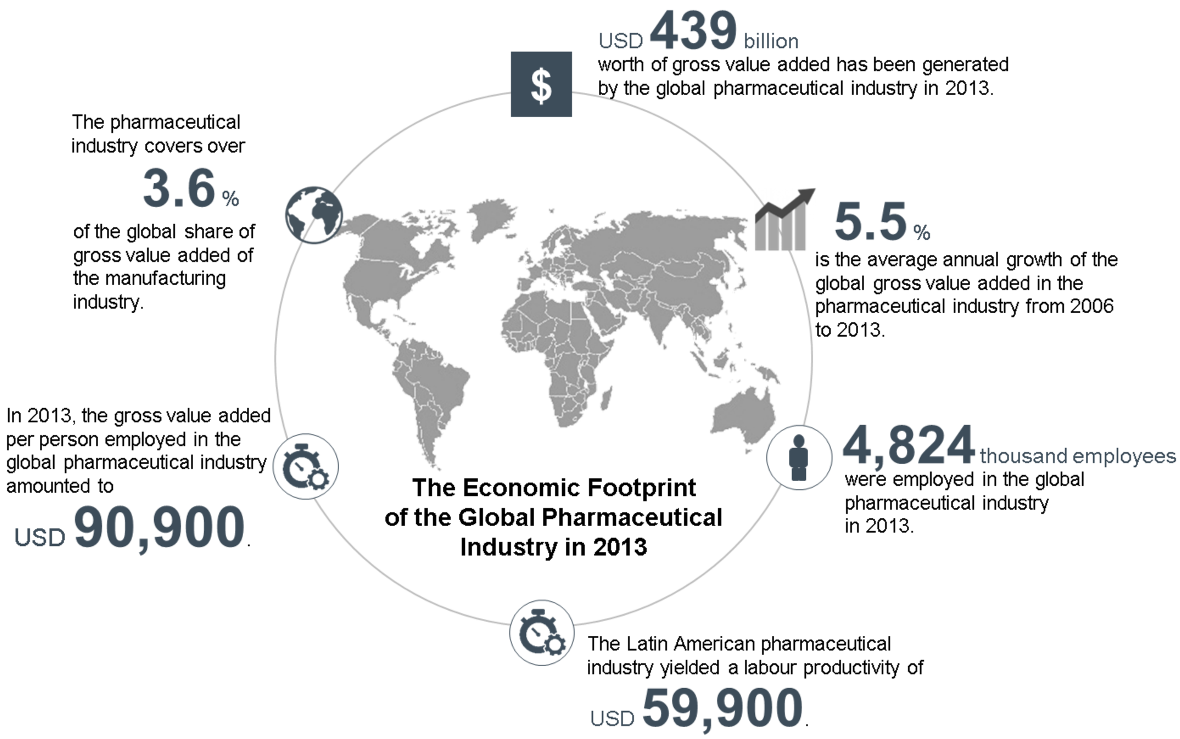
Introduction

This study, on behalf of the *Asociación Mexicana de Industrias de Investigación Farmacéutica, A.C.*, (AMIIF, Mexican Association of Pharmaceutical Research Industry), examines the impact of the pharmaceutical industry and clinical studies on the Mexican economy. AMIIF is the voice of the Mexican pharmaceutical industry, representing 43 leading pharmaceutical research-and-development companies in Mexico.[4] The *Economic Footprint* of the pharmaceutical industry and clinical studies is measured in order to quantify the macroeconomic contribution of these objects of investigation to economic growth and employment in Mexico from 2008 to 2014. With the hereby newly derived information and data, the public discussion is enriched, developing a new perspective on the pharmaceutical industry and its research and development (R&D). While the pharmaceutical industry is a subcategory of the chemical industry (which in turn is a subcategory of the manufacturing industry) clinical studies are statistical surveys during which study participants are tested for newly developed drugs or treatments. Clinical studies are not directly part of the pharmaceutical industry since they are commonly outsourced to separate institutions[5]. The economic activity of clinical studies is captured in the R&D sector but given its importance and funding to/by the pharmaceutical industry, its Economic Footprint should not be neglected.

As shown in Figure 1 below, the pharmaceutical industry contributes a considerable amount to the worldwide economy. In 2013, the sector generated USD 439 billion worth of gross value added. This value is equal to a share of 3.6 % of the global gross value added (GVA) generated by the manufacturing industry. Between 2006 and 2013, its annual growth was + 5.5 %. On a global scale, the pharmaceutical industry employed over 4.8 million people in 2013. The division of total worldwide GVA and labour force results in an average labour productivity of USD 90,900.

[4] Cf. AMIIF, 2014 .
[5] Cf. Canifarma, 2015 .

Figure 1: Worldwide Key Facts about the Pharmaceutical Industry, 2013, in USD and thousand persons.

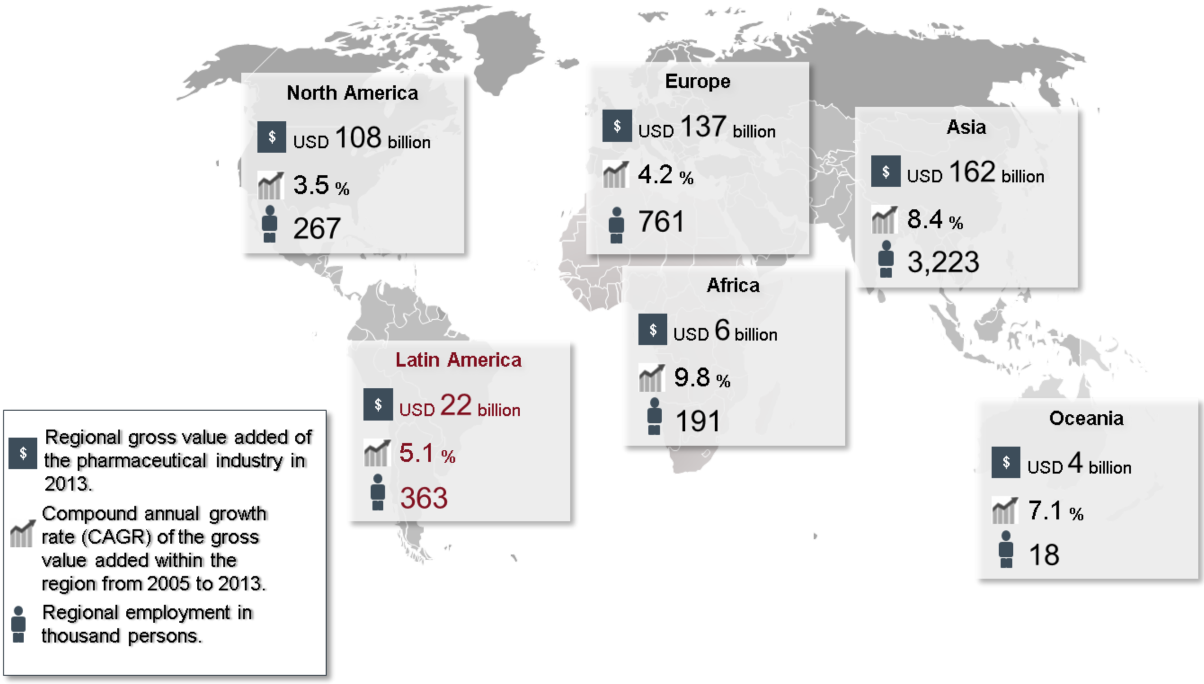


Source: The World Bank Group, 2015 ; own calculation; own illustration.

Narrowing the view to a comparisons between different world regions (cf. Figure 2), the following facts can be drawn: With around 0.6 %[6] of the country's gross domestic product (GDP) and approximately a quarter of its healthcare spending, the pharmaceutical industry of Mexico is the second largest in Latin America, behind Brazil.[7] On a worldwide scope, the Latin American pharmaceutical industry ranks behind Asia and Europe in terms of employment figures (cf. Figure 2). In terms of GVA, the Latin American pharmaceutical industry is substantially bigger than the industry in Africa and Oceania. Furthermore, its compound annual growth rate (CAGR) reached 5.1 % in 2013, surpassing the North American and European growth of the industry.

[6] Cf. INEGI, 2015a ; own calculation.
[7] Cf. Deloitte Mexico, 2015 .

Figure 2: Gross Value Added and Employment of the Pharmaceutical Industry by Continent, 2013, in USD billion and thousand persons.



Source: The World Bank Group, 2015 ; own calculation; own illustration.

To obtain an understanding of the pharmaceutical industry in Mexico, it should be stressed that the Mexican government, the healthcare system as well as the whole Mexican economy went through major changes in the last decade. The government was elected in 2012 and embarked on a package of structural reforms known as the *Pacto por Mexico*. The goal of this covenant is to foster GDP growth, productivity and income equality. According to the Organisation for Economic Co-operation and Development (OECD), these structural measures could increase the annual growth of the GDP per capita.[8] According to data from the Instituto Nacional de Estadística y Geografía (INEGI, National Institite of Statistics and Geography), the GDP of Mexico nearly doubled within the last 10 years (+ 96.5 % from 2004 to 2014)[9]. Nevertheless, the initial phase of the global financial crisis (2008 and 2009) had a significant negative impact on the Mexican economy with a negative GDP growth rate of - 3.1 % in 2009[10]. Mexico was confronted with two negative shocks simultaneously. First, a decline in demand for exports occurred especially from its main demander, the United States. Second, a reduced access to external financing transpired due to an increased risk aversion in consequence of the global crisis. However, Mexico managed to return to a positive GDP growth rate in 2010 and has been maintaining this positive growth ever since.[11]

In the long run, Mexico has been able to tame inflation, build a solid macroeconomic framework, open up to world markets, increase the life expectancy and lower the mortality rate and poverty of its inhabitants[12]. Notwithstanding, improvements, e.g. regarding corruption, which is

[8] Cf. OECD, 2015a .
[9] Cf. INEGI, 2015a ; own calculation.
[10] Cf. INEGI, 2015a ; own calculation.
[11] Cf. INEGI, 2015a .
[12] Cf. Sidaoui, Ramos-Francia, & Cuadra, 2010 .

deeply embedded in the Mexican economy and remains pervasive at any level of society, are possible.
Despite the fact that the GDP growth has been positive in the past five years, Mexico is confronted with challenging economic problems due to the exhaustion of fossil oil reserves and an ongoing war on drugs, which is extremely costly in terms of financial and personnel resources. Declining revenues from oil exports paired with increasing expenditures for the war on drugs is leading to a fundamental change in fiscal funding and may already become immanent in the near future. Once stable funding becomes impossible, major cut backs could become the only viable solution. The complex healthcare provision system, shouldered by a vast variety of different institutions in the public sector and the private insurance market as well as the universal healthcare coverage provided by the Mexican state, could become victim of the cuts. One of the governmental goals is the containment of healthcare costs. Therefore, despite Mexico occupying the market with the largest penetration of generic drugs in the world, the *Comisión Federal para la Protección contra Riesgos Sanitarios* (COFEPRIS, Federal Commission for the Prevention of Sanitary Risks), which is the nation's health regulator, encourages the use of generic drugs. Additionally, the Mexican government supports pharmaceutical companies to establish generic medicines at affordable prices. The low prices coupled with the country's network of free trade agreements awards Mexican pharmaceuticals with a competitive advantage, becoming more and more attractive for export[13].

In order to supply AMIIF with evidence-based data and information on the economic impact of the pharmaceutical industry and clinical studies in Mexico and in order to widen the portfolio of factors that define the value of pharmaceuticals, WifOR computes its Economic Footprint.
This approach is deeply roots in a present and ongoing dialog about the perception of the healthcare sector. As depicted in Figure 3 below, changes in perception occurred in several areas. For example, while previously being understood as a separated system for the provision of health related services, the healthcare sector is now perceived as an economic sector. In light of the emerging second health market, it has also become the theater for new methods of financing and compensating providers. Another main focus of interest within the new understanding is the creation of high-quality outcomes rather than the orientation on inputs that are needed to achieve these. All these shifts are driven and reinforced by the fact that the healthcare sector is perceived as a reliable guarantor for stable economic growth. Within this view the healthcare sector no longer represents a cost-factor which is accountable for huge public and private expenditures. Instead, it constitutes an investment in health that can promote growth and productivity. One prominent example regarding this is a recent statement by the Director-General of the World Health Organisation (WHO), Dr. Margaret Chan, concerning the first meeting of the high-level commission on health employment and economic growth. According to this *"The Commission calls for a change in the way policy-makers look at the health sector, not as a drain on resources but as a source of opportunities […]. Employment in the health sector can operate as a counterforce to the world's growing inequalities in income levels and opportunities."*[14].

[13] Cf. Deloitte Mexico, 2015 .
[14] Cf. WHO, 2016 .

Figure 3: Summary of the Worldwide Paradigm Shift in the Healthcare Sector.

OLD UNDERSTANDING	NEW UNDERSTANDING
Part of healthcare	Is the health economy
Instead of mainly public financing	New financing methods, second health market; new methods of paying providers (P4P)
Less of input orientation	Better quality, more outcome orientation
Instead of health care as cost factor	Growing sectors, increasing work force, new career opportunities
Instead of healthcare consumption	Investment in health to promote growth and productivity
Instead of separate silos, e.g. the Statutory health insurance	Health in all areas of life and lifelong; less fragmentation

Source: Henke, Neumann, & Schneider, 2010 ; own illustration.

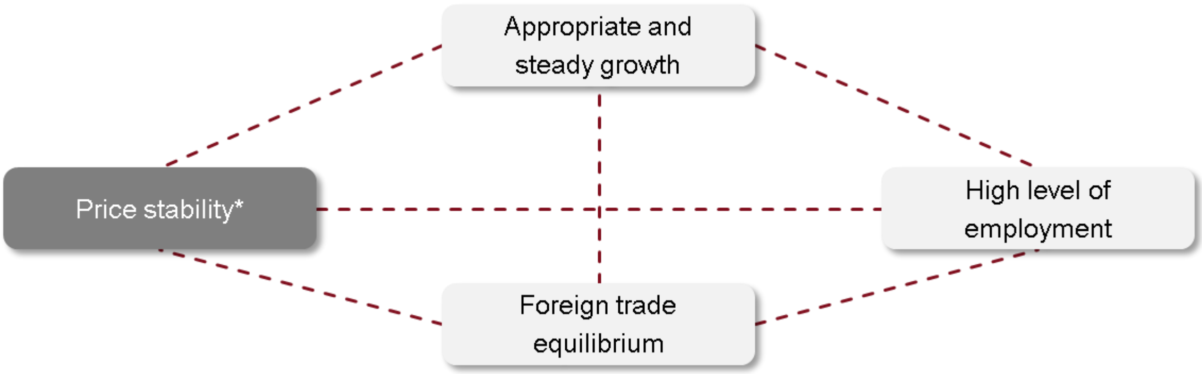
The study is structured as follows. First, insights on the methodology of the calculation of the Economic Footprint and the used data is given. Subsequently, the results of the calculation (direct, indirect and induced economic effects as well as further economic indicators) are illustrated and interpreted. Chapter *0 Heading Further: The Health, the Institutional and the Socio-Economic Footprint* points out limitations to the Economic Footprint and further research areas. The study concludes with summarising pivotal results and recommendations, emphasising the importance of the pharmaceutical industry for the Mexican economy.

Methodology and Database of the Economic Footprint

The Economic Footprint traces the direct, indirect and induced economic impact of an object of investigation and illustrates linkages to other industries. The System of National Accounts serves as its database while the input-output analysis is the foundation of the calculation method.

The Economic Footprint is a pool of key economic figures and indicators and its calculation aims at illustrating economic activities as well as linkages between the object of investigation – the pharmaceutical industry of Mexico as well as clinical studies – and the rest of the Mexican economy. The purpose is to investigate the main economic goals that should be aimed at by Mexican politicians. These goals are illustrated in Figure 4.

Figure 4: Main economic goals that should be aimed at by Mexican politicians.



Source: Own illustration. * Not of importance in the Economic Footprint due to non-transferability to industry and branches.

Hence, the System of National Accounts (SNA), which provides information about the activities of an economy, is a suitable framework and database for the evaluation. The SNA is a comprehensive accounting framework that depicts the characteristics and performance of an economy. The set of macroeconomic accounts as well as definitions, classifications and accounting rules are internationally agreed on. Differences in economies, i.e. differences in the structure or the development status, do not lead to a change in the internationally agreed standards because the heart of every economy is the production and consumption of goods and services.[15] The prevailing SNA was released in 2008 by the United Nations. The Mexican system of national accounts, the *Sistema de Cuentas Nacionales de México* (SCNM, Mexican System of National Accounts), which was also issued in 2008, is based on the SNA 2008[16].Furthermore, the European Union bases its system on the SNA, the *European System of Accounts* (ESA), however, its publication occurred in 2010[17].
Generally, the SNA can be divided into flow accounts (current and accumulated accounts), balance sheets and tables such as the supply table, use table and the input-output table. The

[15] Cf. UN, 2009 .
[16] Cf. INEGI, 2014b .
[17] Cf. Eurostat, 2013 .

current accounts record, among others, the production of goods and services, the generation of incomes as well as the use of incomes for consumption[18]. Balancing items include such key performance indicators as the GVA[19]. Supply and use tables are tables in form of matrices that trace supplies of goods and services from their origin, either a domestic or a foreign industry, to its intermediate or final use (including exports). The supply and use tables are always balanced and they are the groundwork for the input-output table (IOT).[20] Therefore, the IOT describes both, the sale and the purchase relationships between producers and consumers[21]. In the following, an introduction to input-output analysis as well as a more detailed description of the most important accounts and tables for quantification of the Economic Footprint is given.

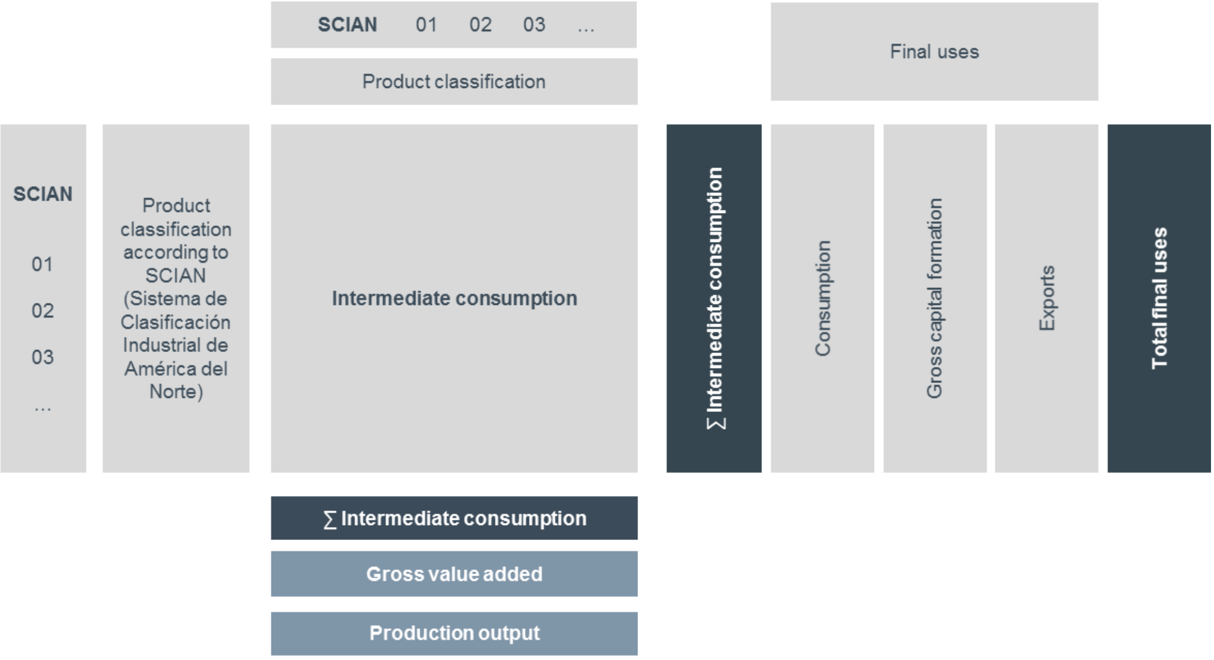
1.1 National Accounts and Input-Output Analysis

The input-output table provides information about the gross value added, production value, intermediate consumption, final uses and interlacing of industries. The table was developed by the economist Wassily Leontief in the 1970s.

The input-output analysis is an integral component of the SNA and seeks to describe the economic interlacing within an economy as well as the flow of goods with the rest of the world. The economist Wassily Leontief developed the input-output analysis and therefore received the Nobel Prize in Economics in the 1970s.[22] Within the input-output analysis, the input is the intermediate consumption, i.e. goods and services that are consumed, processed or transformed in/by the production process. Furthermore, inputs are understood as production factors such as labour and capital. On the other hand, outputs refer to the value of goods and services that are produced. Goods and services are also subsumed under the term *products*. The input-output table is a matrix that comprises information about the supply and use of diverse production areas.[23] A schematic picture of the IOT is given in Figure 5.

[18] Further accounts are not explained in detail since they will not be the focus in the later calculations.
[19] The GVA is defined as the difference of value of output and the value of intermediate consumption OECD, 2001 .
[20] Cf. UN, 2009 .
[21] Cf. OECD, 2015b .
[22] Cf. Nobelprize.org, 2015 .
[23] Cf. Destatis, 2010 .

Figure 5: Architecture of Input-Output Tables.



Source: Own illustration.

The matrix of intermediate consumption records the linkages of the intermediate consumption of the considered production areas. The columns show the value of intermediate inputs that are used in a production sector[24]. These inputs are either supplied by national production or by imports. The matrix of final uses refers to final products that do not circulate in the economy any more. It is indicated column wise whether the final use of the product is final consumption, gross fixed capital formation (GFCF) or export[25]. Apart from intermediate consumption or inputs, primary inputs are needed for production. These inputs are summarised in the matrix of the primary inputs. The primary inputs are measured along the components of the GVA: the depreciation, net taxes, compensation of employees and the net operating surplus.[26] Further information on the IOT, focusing the Mexican IOT employed, is given in chapter *1.4 Data Employed*.

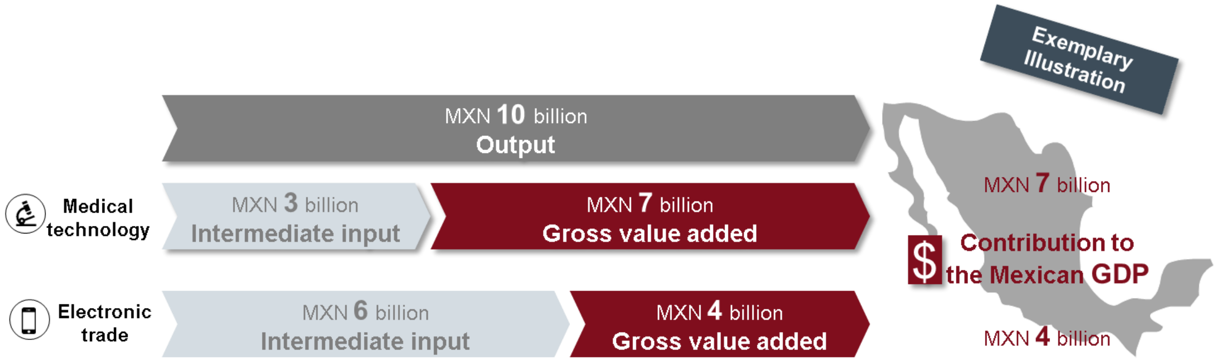
1.2 Introduction to the Economic Footprint and its Direct and Spillover Effects

The Economic Footprint includes direct, indirect and induced economic effects. Direct effects are directly generated by the object of investigation. Indirect effects are effects that arise due to the input the object of investigation demands from other economic agents and induced economic effects arise due to spending of income of the employees of the object of investigation.

[24] Cf. Heeger, 2013 .
[25] Cf. Holub & Schnabl, 1997 .
[26] Cf. Destatis, 2010 .

First, it should be pointed out that the very central figure of the Economic Footprint is the GVA and not the revenues. The GVA is an economic key figure that is used for assessment of the size and the performance of an economy, branches or even companies. The sum of the GVA of each producer is the GDP of the economy. Hence, the GVA indicates the amount of contribution to the GDP of an economy. The following figure illustrates the reasoning behind the utilization of the GVA instead of the revenues.[27]

Figure 6: Illustration of the Significance of the Gross Value Added and Revenue.



Source: Own illustration.

Figure 6 shows that two companies that generate the same amount of revenues or output[28] do not generate the same amount of GVA. In contrast to the revenues, the use of intermediate consumption is crucial for the generation of GVA since the GVA is defined as the difference of the value of output and the value of intermediate consumption. Using the revenue as a proxy for the PV, the medical technology yields a higher GVA (per employee) and hence contributes more to the GDP (per employee) than the car dealer does. Only the GVA, not the revenues, can give a picture about the economic performance of an economic agent.

Next to the GVA, the Economic Footprint pools further economical key figures, that are, among others, the following: [29]

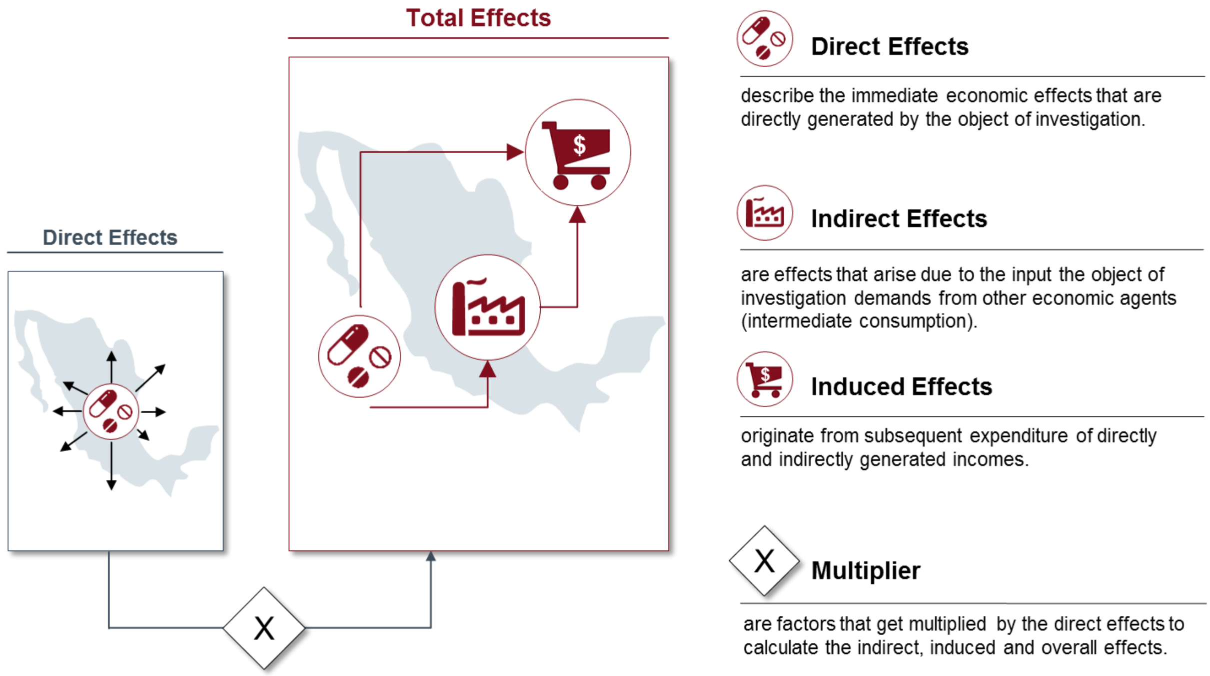
- » Production value or output: The production value, also referred to as output, is the total value of products created during the accounting period. The output is to be valued at the basic price, which is the price receivable by the producers from the purchaser.
- » Intermediate consumption or input: The intermediate consumption, also referred to as input, consists of goods and services consumed as inputs by a process of production. The goods and services are either transformed or used up by/in the production process.
- » Employment: Employment covers all persons engaged in productive activity that falls within the production boundary of the national accounts.
- » Compensation of employees: Compensation of employees is defined as the total remuneration payable by an employer to an employee in return for work done by the latter during an accounting period.

[27] Cf. Knippel, 2015 .
[28] In this example, the revenues equal the output, which must not always be the case.
[29] Cf. Ostwald & Knippel, 2013 ; UN, 2009 ; Eurostat, 2013 .

» Gross fixed capital formation: The gross fixed capital formation, or investment, consists of resident producers' acquisitions less disposals. Fixed assets are produced assets used in production for more than one year.
» Expenditures on research and development: Expenditures on research and development are recognised as capital formation of intellectual property.

These key figures, that describe the immediate economic effects that are directly generated by the object of investigation, are also called *direct economic effects*. Moreover, the Economic Footprint encompasses *indirect* and *induced economic effects* (cf. Figure 7). Indirect effects are effects that arise due to the input the object of investigation demands from other economic agents. Order placements result in an increase in economic activity among the commissioned agent. This stimulation leads to an enhancement of the supplier's GVA and further economic key figures, which are grouped under the term indirect effects. Induced effects originate from subsequent expenditure of directly and indirectly generated incomes. The compensation of employees that come from the object of investigation or that come about by the demand of the object of investigation leads to further demand in the economy. This demand also triggers GVA and further economic parameters, summed up under the term induced economic effects. The sum of indirect and induced economic effects is also called *spillover effect*. *Total economic effects* refer to the sum of all three effects. *Multipliers* are factors that get multiplied by the direct effects to calculate the indirect, induced and overall effects. The most important economic terms are listed in the *Appendix A: Glossary*.

Figure 7: Overview of the Economic Effects: Direct, Indirect and Induced Effects.



Source: Own illustration.

The *Appendix B: The Calculation Model of the Direct and Spillover Effects* explains the modelling and the calculation steps of the spillover effects in greater detail. The computation scheme of the PV effects, the GVA effects, the employments effects and effects of compensation of employees are outlined.

1.3 Further Economic Indicators of the Economic Footprint

Further economic indicators involve efficiency and productivity measures as well as investment intensity measures. The indicators of the object of investigation may be compared to other branches and the total Mexican economy.

In addition to the direct, indirect and induced effects, key economic indicators are computed. Their derivation involves a standardisation of the direct economic effects to the size of the object of investigation. The size may be either measured in terms of the economic performance (i.e. GVA) or in terms of the headcount (i.e. employment). Given the standardisation, it becomes possible to compare the performance of economic agents on different aggregation levels. Single agents can be compared with branches or with the national economy. In this research study, the pharmaceutical industry and clinical studies are compared with other branches and with the whole Mexican economy. Figure 8 summarises the considered key figures and indicators of the Economic Footprint.

The following economic indicators are computed and are summarised in Figure 8:

» Input rate: The input rate is computed by the ratio of the intermediate consumption and the output. It denotes the demanded inputs to produce the output. The lower the input rate, the more efficient is the production process regarding its requirements of inputs.

» GVA rate: The GVA rate is the ratio of the GVA and the output. This rate provides information about the share of output terminating in the gross value added. The higher the GVA rate, the more GVA is produced with an identical output.

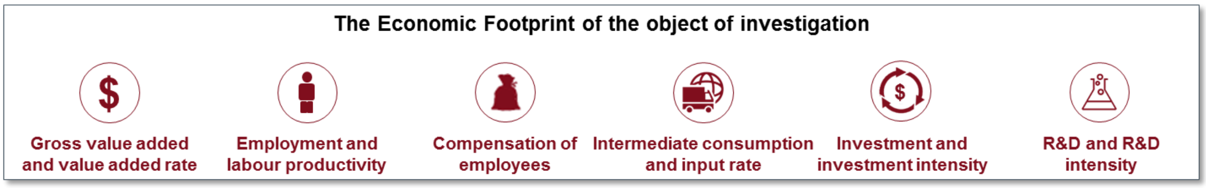
» Labour productivity: The labour productivity is calculated by the ratio of the GVA and the total employment. This ratio indicates how much GVA is generated by one employee. The higher this ratio, the more productive is the labour force.

» Average compensation of employees: The average compensation of employees or the compensation per employee is the ratio of total compensation of employees and total employment. It portends the average annual compensation that employees receive in return for their work.

» GFCF intensity: The GFCF intensity is the ratio of GFCF and the GVA. This indicator alludes the development of employment of capital, which is generally responsible for competitive advantage in the long run.

» R&D intensity: The R&D intensity is the ratio of R&D expenditures and the GVA. Similar to the investment intensity, this ratio indicates future technological change and hence gives an idea about the competitive advantage in the long run.

Figure 8: The Key Figures and Economic Indicators of the Economic Footprint.



Source: Own illustration.

1.4 Data Employed

INEGI publishes the input-output table, which is the base of the calculation of the Economic Footprint. Further data is taken from the database of the OECD and the Cámara Nacional de la Industria Farmacéutica (Canifarma, National Chamber of the Pharmaceutical Industry).

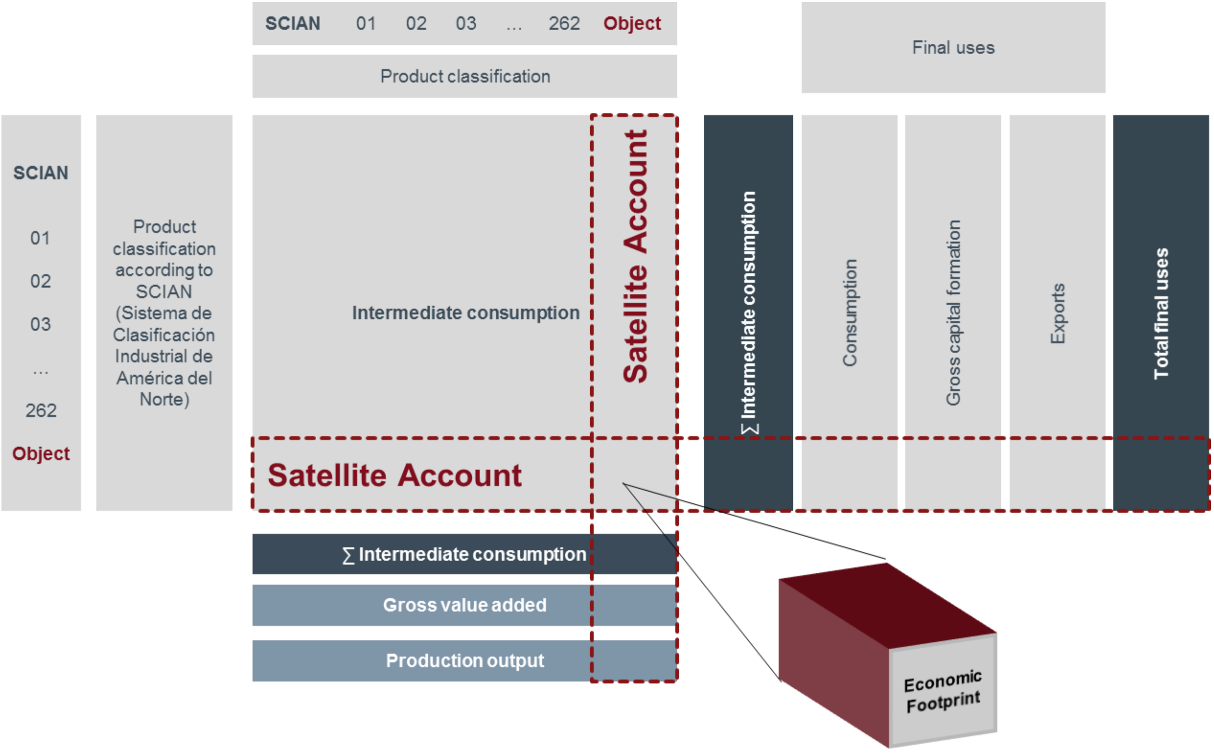
For the calculation of the Economic Footprint of the pharmaceutical industry and clinical studies, the main database is the IOT by sector, where the object of investigation is separated from. The Mexican IOT is classified according to the *Sistema de Clasificación Industrial de América del Norte* (SCIAN, North American Industry Classification System). SCIAN has five aggregation levels:

» Sector (two-digit level),
» Subsector (three-digit level),
» Industry group (four-digit level),
» Industry (fife-digit level),
» National industry (six-digit level).[30]

The IOT is available for the classification in sectors (distinction of 19 products), subsectors (distinction of 79 products), industry groups (distinction of 262 products) and national industries (distinction of 814 products)[31]. The pharmaceutical industry holds the SCIAN classification number 3254[32] and can be found in the IOT by industry group level (and the less aggregated tables). To make the calculation process more efficient, not the IOT on industry group level is used but the IOT on sector level with subsequent separation of the pharmaceutical industry from the manufacturing industry. Clinical studies are statistical surveys during which healthy people or patients are tested, investigating the effectiveness and the safety of newly developed drugs or treatments. This investigation is a prerequisite for their official approval and is mainly conducted by separate institutions and not by pharmaceutical companies.[33] Therefore, clinical studies are not captured in the accounts of the pharmaceutical industry but in the sector *professional, scientific R&D and technical services* (SCIAN classification number 54[34]). The following figure illustrates the separation of the object of investigation from the IOT.

[30] Cf. INEGI, 2014a .
[31] Cf. INEGI, 2015b .
[32] Cf. INEGI, 2014a .
[33] Cf. Canifarma, 2015 .
[34] Cf. INEGI, 2014a .

Figure 9: Separation of the Object of Investigation from the IOT.



Source: Own illustration.

Additional information on the classification of the production areas as to the SCIAN classifications on the sector level, including the subcategory of the pharmaceutical industry and clinical studies, representing the individual classification of IOT chosen for the calculation, can be found in *Appendix C: Database of the Economic Footprint*.

The IOT for Mexico is available for the years 2008 and 2012. For 2008, there are two IOTs available: a product-by-product and an industry-by-industry IOT[35]. The product by product IOT can be calculated with two different underlying assumptions. First, the *product technology assumption* (assumption A) states that irrespectively of the industry where it is produced, each product is produced with the same input structure. Second, the *industry technology assumption* (assumption B) claims that each industry has the same input structure, irrespectively of the product mix. Industry by industry IOT can also be calculated with two different assumptions: the *fixed product sales structure assumption* (assumption C) and the *fixed industry sales structure assumption* (assumption D). These assumptions work according to the industry and product assumption, however, they consider the sales structure instead of the production process. Whether product by product or industry by industry IOTs are utilized depends on the purpose. However, assumption A should be preferred to assumption B and assumption C should be preferred to assumption D.[36]

[35] Cf. INEGI, 2015b .
[36] Cf. Eurostat, 2008 .

The Mexican product-by-product IOT is computed with assumption B while the industry-by-industry IOT is complied with assumption C[37]. Therefore, the calculation of the Economic Footprint of the pharmaceutical industry and clinical studies is performed with the domestic industry-by-industry IOT. Unfortunately, at the time of calculation, only the IOT for the year 2008, but not 2012, was available. To keep consistency in the database, the available industry-by-industry IOT for the year 2012 is not used. Instead, the IOT 2008 is extrapolated with the *graph-based language-independent stemming algorithm* (GRAS). The extrapolation is conducted for the years 2009 till 2014. GRAS is an algorithm used for informational retrieval. This algorithm features retrieval effectiveness, generality and low computational costs.[38] Thanks to these features and given the fact that this algorithm outperforms further algorithms, it is considered as the state-of-the-art solution for statistical stemming[39]. The data input requirements to implement the GRAS are the row and column sums of the intermediate consumption matrix of the year of extrapolation. I.e. for the years 2009 till 2014, total national intermediate inputs in manufacturer's prices and the total intermediate demand by production area has to be known. From the database of the *Instituto Nacional de Estadística y Geografía de México* (INEGI, National Institite of Statistics and Geography), only the intermediate consumption in purchaser's prices is available. For the price transformation, it is assumed that the price ratio of manufacturer's and purchaser's prices remain constant over the period of consideration. Furthermore, it is assumed that the shares of intermediate demand among the production areas remain constant from 2008 till 2014. A full list of data used in the calculation of the Economic Footprint is exhibited in the *Appendix C: Database of the Economic Footprint*. The database for the Economic Footprint of the pharmaceutical industry originates in INEGI, only (cf. Table 2), while the computation of the Economic Footprint of clinical studies required further data published by the *Cámara Nacional de la Industria Farmacéutica* (Canifarma, National Chamber of the Pharmaceutical Industry) (cf. Table 3). The national revenues of clinical studies are computed by the difference of total sales and export of sales. This figure serves as an estimate of the output. The GVA of clinical studies is then estimated via the GVA rate of the R&D services sector.

[37] Cf. INEGI, 2014b .
[38] Cf. Paik, Mitra, Parui, & Järvelin, 2011 .
[39] Cf. Banchs, et al., 2013 .

Results of the Economic Footprint

The pharmaceutical industry has been shrinking in every four dimensions: output, gross value added, employment and compensation of employees. In contract, the clinical studies have been expanding. However, both objects of investigation are highly productive regarding its inputs and labour. Furthermore, both feature relatively high investments rates.

The Economic Footprint of the Mexican pharmaceutical industry and of clinical studies covers direct, indirect and induced economic effects of key economic figures. These effects in turn incorporate effects regarding the PV (or output), GVA, employment and compensation of employees. These effects of the pharmaceutical industry and clinical studies are described and visualised in chapters *1.5 Production Effects* to *1.8 Effects of Compensation of Employees*. Chapter *1.9 Further Economic Indicators* reveals further economic indicators such as the input rate, national input rate, GVA rate, labour productivities average compensation of employees, investment intensities, R&D intensities, export rates and net exports. Not only indicators of the pharmaceutical industry and clinical studies are considered, but these two objects of investigation are compared to further industries as well as the total Mexican economy. The additionally inspected industries are the *automobile industry*, *manufacturing industries* and *professional, scientific R&D and technical services* (SCIAN classification numbers 3361, 31-33 and 54[40], respectively). Reason behind this comparison is that first, the pharmaceutical industry is a subcategory of the manufacturing industry and clinical studies are part of the R&D sector. The automobile industry is chosen as this industry is a significant industry in terms of GVA generation[41].

The pharmaceutical industry experienced a sharp increase in PV, GVA, employment and compensation of employees from 2011 to 2012. However, after 2012, these key figures declined and reached the level prior to 2011. Over the total period of consideration (2008 to 2014), the key figures of the pharmaceutical industry declined. In contrast to these results, the key figures of clinical studies have been rising constantly, showing the importance of pharmaceutical R&D. Pharmaceutical R&D is crucial for combating health problems in Mexico, however, with a declining pharmaceutical industry, it cannot be guaranteed that the funding of clinical studies may be maintained in the future. *Appendix D: Tables of Results of the Economic Footprint* provides the complete set of data results.

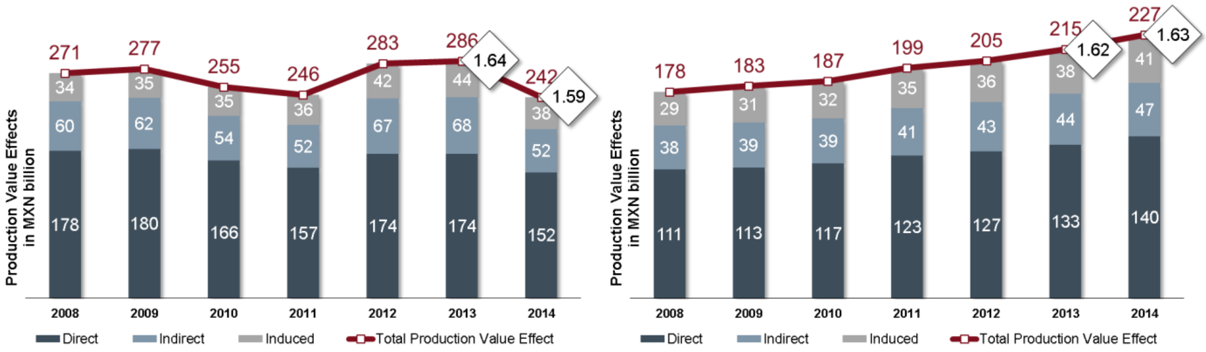
1.5 Production Effects

Every loss of MXN 1.00 of output in the pharmaceutical industry entails a further loss of MXN 0.59 of output in the Mexican economy. In contrast, every gain of MXN 1.00 of output of clinical studies results in further output of MXN 0.63.

[40] Cf. INEGI, 2014a .
[41] Cf. INEGI, 2015a .

From 2008 till 2014, the direct output of the pharmaceutical industry averaged at MXN 169 billion and in 2014, it amounted to MXN 152 billion (cf. Figure 10, left). To reach the total effects in 2014, the direct effect is multiplied by the factor 1.59. However, the total PV effect declined from 2008 to 2014 by - 10.8 % which is equivalent to an annual decline of - 1.9 %[42]. The decline of the direct PV is illustrated in Figure 11.
In case of the clinical studies, the direct PV increased from MXN 111 billion in 2008 to MXN 140 billion in 2014 (cf. Figure 10, right). The indirect and induced effects also rose over the period of consideration and total output effects reached MXN 228 billion in 2014, being equivalent to an average annual growth rate of total output effects + 4.1 %.

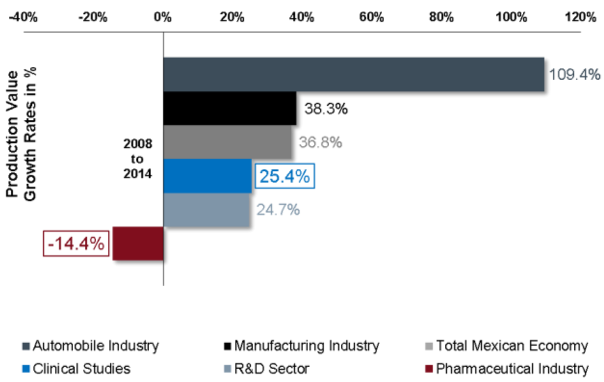
Figure 10: Direct, Indirect, Induced and Total Production Value Effects of the Pharmaceutical Industry (left) and Clinical Studies (right) in Mexico, 2008 till 2014, in MXN billion; Total Multiplier, 2013 and 2014.



Source: Canifarma, 2015 ; INEGI, 2015a ; INEGI, 2015b ; OECD, 2015c ; own calculation; own illustration.[43]

Among the demonstrated industries (cf. Figure 11), the automobile industry exhibits the highest growth with + 109.4 %. The other industries do not yield such high growth rates. The clinical studies just exceed the R&D sector by 0.6 percentage points (pps) and obtain a growth of + 25.4 %.

Figure 11: Comparison of Annual Direct Production Value Growth Rates in Mexico, 2008 to 2014, in %.



[42] All annual growth rates refer to the compound annual growth rate (CAGR).
[43] Due to rounding errors, overall sums of bar charts may not always add up correctly.

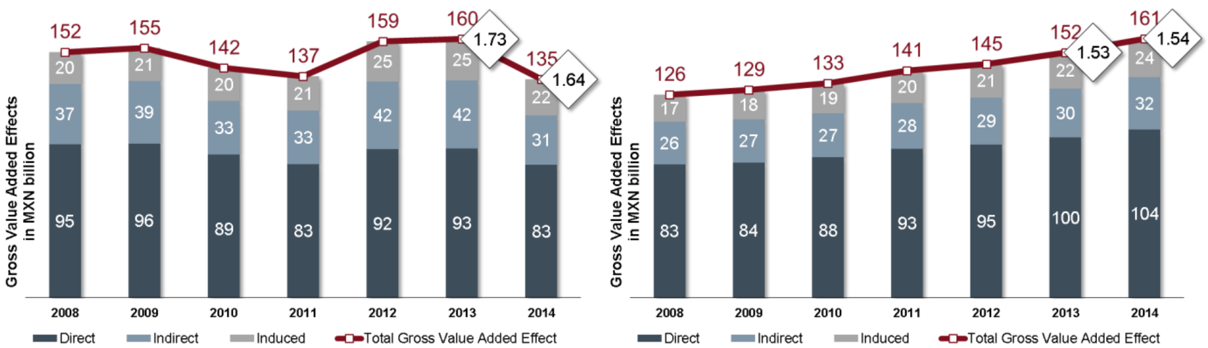
Source: Canifarma, 2015 ; INEGI, 2015a ; own calculation; own illustration.

1.6 Gross Value Added Effects

The pharmaceutical industry and clinical studies are important drivers and contributors to growth of GVA due to their multiplier effects. Every loss of MXN 1.00 of GVA in the pharmaceutical industry entails a further loss of MXN 0.64 of GVA. Each MXN 1.00 of GVA of clinical studies implicates another MXN 0.54 of GVA. The spillover effects have been increasing in relative terms as the GVA multiplier has been increasing in total by + 2.3 % and the GDP impact of clinical studies increased by 27.5 % to MXN 161 billion (2008 to 2014).

Figure 12, left, portrays the direct GVA effects as well as the spillover effects. The average direct contribution to the national GDP achieved MXN 90 billion from 2008 to 2014. The average contribution to the GDP in total terms was MXN 149 billion. In 2014, the pharmaceutical industry directly contributed MXN 83 billion to the Mexican GDP. The sum of the indirect and induced contribution to the national GDP achieved MXN 53 billion. Each Mexican Peso of direct GVA generates further MXN 0.37 of indirect and MXN 0.27 of induced GVA, yielding a total multiplier of 1.64. Similar to the PV, there has been a decline of the GVA effects from 2008 to 2014. The decline of the total GVA effects read on average - 2.0 % per annum (p.a.). The clinical studies, in contrast, produced success and grew their direct GVA from MXN 83 billion in 2008 to MXN 104 billion in 2014 (cf. Figure 12, right). The total GVA effects resulted in MXN 161 billion. The annual average growth rate of total GVA effects of clinical studies was + 4.1 %.

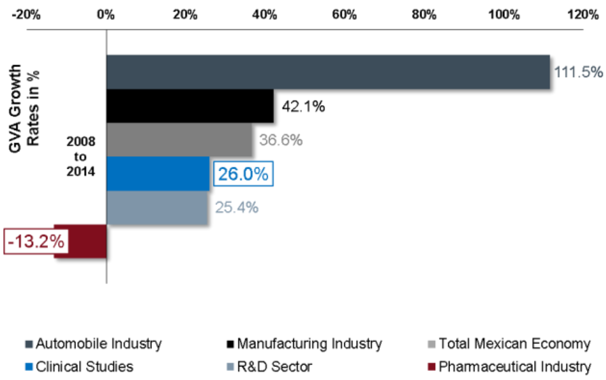
Figure 12: Direct, Indirect, Induced and Total Gross Value Added Effects of the Pharmaceutical Industry (left) and Clinical Studies (right) in Mexico, 2008 till 2014, in MXN billion; Total Multiplier, 2013 and 2014.



Source: Canifarma, 2015 ; INEGI, 2015a ; INEGI, 2015b ; OECD, 2015c ; own calculation; own illustration.

Figure 13 illustrates the annual growth rates of the direct GVA by industry from 2008 to 2014. Once more, the automobile industry possesses the highest growth rate among the considered industry with + 111.5 %. Only the pharmaceutical industry is not able to reach positive growth but contraction of - 13.2 % occurred from 2008 to 2014.

Figure 13: Comparison of Annual Direct Gross Value Added Growth Rates in Mexico, 2008 to 2014, in %.



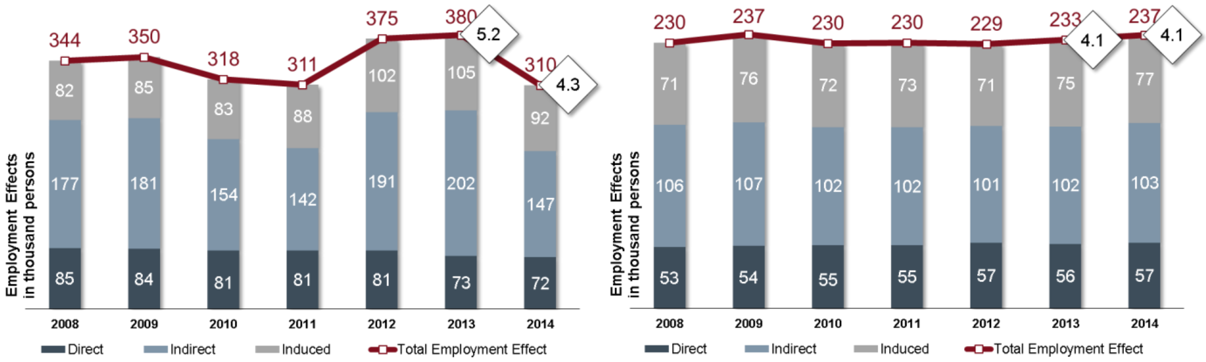
Source: Canifarma, 2015 ; INEGI, 2015a ; own calculation; own illustration.

1.7 Employment Effects

The pharmaceutical industry and clinical studies create employment. On average from 2008 to 2014, 341 thousand employees were dependent on the pharmaceutical industry. Due to indirect and induced multiplier effects, every new job in the pharmaceutical industry creates on average 3.3 additional jobs in further industries. The employment of clinical studies rests on a stable level, reaching 57 thousand direct employees in 2014.

In the fashion of the output and the GVA, the contribution to the labour market by the pharmaceutical industry diminished. While in 2008 85 thousand people were directly employed in the pharmaceutical industry, there only remained 72 thousand jobs in 2014 (cf. Figure 14, left). Thanks to the raise in the total multiplier from 4.1 in 2008 to 4.3 in 2014, the spillover effects of employment only fell from 260 thousand employed people to 239 thousand employees. Total employment effects amount to 310 thousand in 2014. Therefore, the pharmaceutical industry remains an important driver of employment and wealth in Mexico.
In 2008, 53 thousand people were employed with clinical studies (cf. Figure 14, right). This number rose to 57 thousand employees in 2014. The indirect employment fell by 2 thousand persons as the multiplier was reduced from 2.0 to 1.8. Nevertheless, the induced employment effects advanced to 77 thousand in 2014.

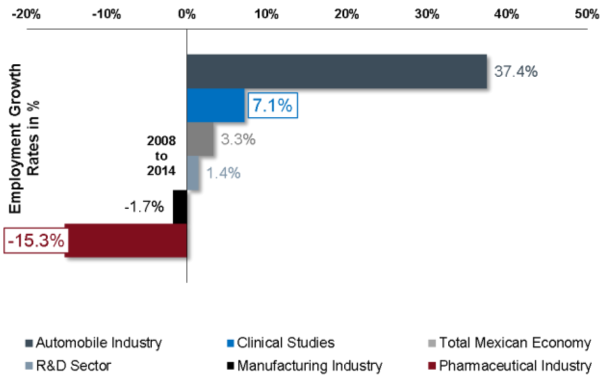
Figure 14: Direct, Indirect, Induced and Total Employment Effects of the Pharmaceutical Industry (left) and Clinical Studies (right) in Mexico, 2008 till 2014, in thousand persons; Total Multiplier, 2013 and 2014.



Source: Canifarma, 2015 ; INEGI, 2015a ; INEGI, 2015b ; OECD, 2015c ; own calculation; own illustration.

Generally, growth rates in employment reach a lower level than growth rates in output and GVA (cf. Figure 11, Figure 13 and Figure 15). Clinical studies experienced a growth in employment of + 7.1 % from 2008 to 2014, passing the growth rate of the total Mexican economy which reported a growth rate of + 3.3 %. The pharmaceutical industry does not hold a positive growth rate but the number of jobs within this industry reduced by - 15.3%. Due to the lower growth rates in employment (compared to growth in the GVA), it can already be supposed that the labour productivity increased over time. Further economic indicators will be pointed out in chapter *1.9 Further Economic Indicators*.

Figure 15: Comparison of Annual Direct Employment Growth Rates in Mexico, 2008 to 2014, in %.



Source: Canifarma, 2015 ; INEGI, 2015a ; own calculation; own illustration.

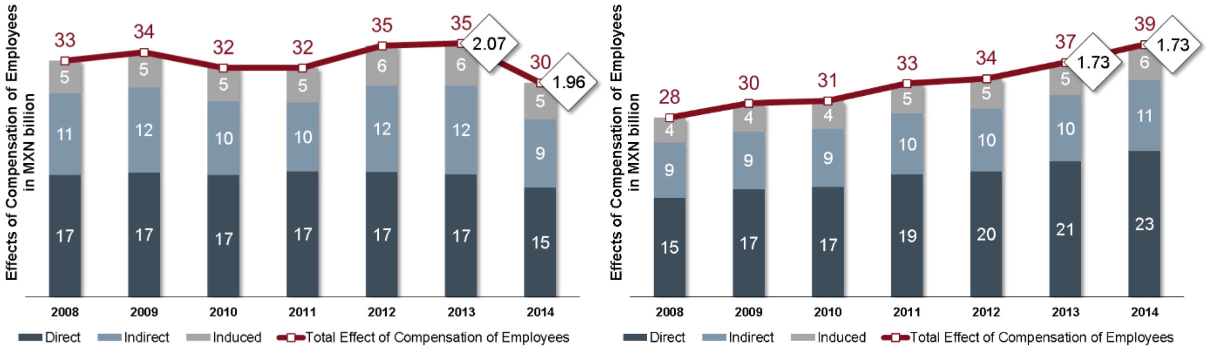
1.8 Effects of Compensation of Employees

The direct compensation of employees of the pharmaceutical industry has been constant from 2008 to 2013 and fell by MXN 2 billion in 2014. In case of the clinical studies, the total compensation of employees has been rising constantly.

From 2008 to 2013, the compensation of employees remained relatively constant; only in 2014, a reduction of compensation was recorded (cf. Figure 16, left). Direct compensation reached MXN 15 billion, instead of MXN 17 billion. Indirectly, MXN 9 billion of compensations were paid by the pharmaceutical industry in 2014, which is equivalent to a multiplier of 0.62. The induced effects reached a multiplier of 0.34, meaning MXN 5 billion of compensation of employees were induced by the economic activity of the pharmaceutical industry. Given the multipliers, a loss of MXN 1.00 of direct compensation of employees, a further loss of MXN 0.96 of compensation of employees occurs.

Regarding the clinical studies, compensation of employees has been rising sharply (cf. Figure 16, right). Direct compensation yield MXN 23 billion in 2014 while the compensation of the suppliers of clinical studies amounted to MXN 11 billion. The spending of incomes added another MXN 6 billion to the total compensation of employees, which achieved MXN 39 billion in 2014.

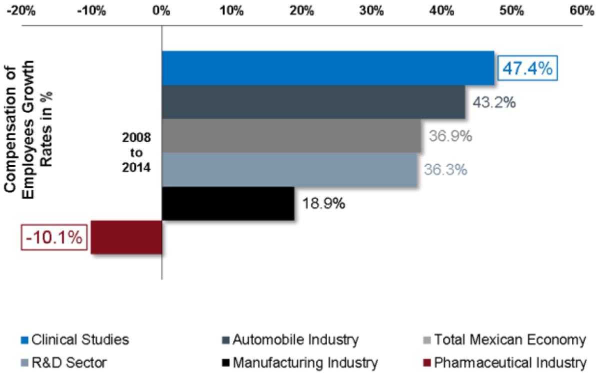
Figure 16: Direct, Indirect, Induced and Total Effects of Compensation of Employees of the Pharmaceutical Industry (left) and Clinical Studies (right) in Mexico, 2008 till 2014, in MXN billion; Total Multiplier, 2013 and 2014.



Source: Canifarma, 2015 ; INEGI, 2015a ; INEGI, 2015b ; OECD, 2015c ; own calculation; own illustration.

Concerning the growth of compensation of employees, the automobile industry is not ranking first but the clinical studies does (cf. Figure 17). Their growth reached + 47.4 % from 2008 to 2014. The automobile industry, the total economy and the R&D sector follow its lead. Compensation of employees in the manufacturing industry only grew by + 18.9 % and the pharmaceutical industry's direct compensation declined by - 10.1 % over the period of consideration. Similar to the comparison of growth rates of employment and GVA, the comparison of the growth rates of employment and compensation of employees results in the expectation of a growing average compensation of employees. This indicator will be discussed in the following chapter.

Figure 17: Comparison of Annual Direct Compensation of Employees Growth Rates in Mexico, 2008 to 2014, in %.



Source: Canifarma, 2015 ; INEGI, 2015a ; own calculation; own illustration.

1.9 Further Economic Indicators

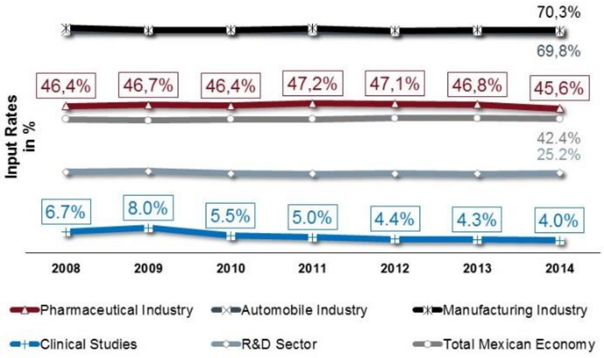
In order to complete the Economic Footprint, six economic indicators regarding efficiency, productivity and intensities are computed. The following chapters give a more detailed explanation of the indicators and their results for the pharmaceutical industry, clinical studies and further industries as well as the total Mexican economy.

1.9.1 Efficiency and Productivity Measures

The pharmaceutical industry and clinical studies are highly productive compared to further industries and the total Mexican economy. E.g. the labour productivity of the pharmaceutical industry exceeds, on average, the productivity of the total Mexican economy by a factor of 3.4. However, international comparisons show that there is still room for improvement. Furthermore, clinical studies pay out the highest compensations per employees.

The input rate is the ratio of the intermediate consumption and the output. The lower the input rate, the more efficient is the production process regarding its requirements of inputs. Figure 18 illustrates that the input rate of the pharmaceutical industry stayed on a constant level over the period of consideration. In comparison to the manufacturing and automobile industry (nearly identical), the pharmaceutical industry has a relatively efficient production process: its input rate is 1.5 times smaller.

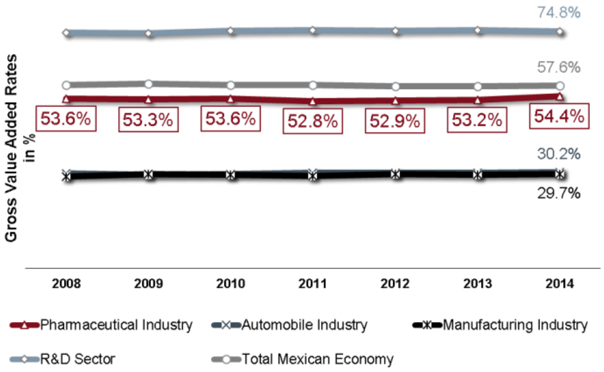
Figure 18: Comparison of Input Rates in Mexico, 2008 till 2014, in %.



Source: Canifarma, 2015 ; INEGI, 2015a ; own calculation; own illustration.

The GVA rate is the ratio of the GVA and the output. This rate provides information about the share of PV terminating in GVA. The higher the GVA rate, the more GVA is produced with a certain level of PV. Along with the input rate, it indicates the efficiency of a production process. A high rate should be aimed. Figure 19 portrays the GVA rates in Mexico by industry from 2008 to 2014[44]. The average GVA rate of the pharmaceutical industry is 53.4% which means that it is 1.8 times more productive than the automobile or the manufacturing industry, who experience nearly identical GVA rates. Or in other words, the pharmaceutical industry is turning more of its PV into GVA than the manufacturing industry or the automobile industry. Only the total economy and the R&D sector are able to reach higher GVA rates than the pharmaceutical industry. However, from 2008 to 2014 rates of the pharmaceutical industry increase by + 1.5 %. Of all sectors that were analysed, only the manufacturing industry was able to yield a stronger growth (+ 2.7 %). For all other industries, the rates were relatively constant yet an increase of 1.2 pps in the GVA rate of the pharmaceutical industry can be observed from 2013 to 2014.

Figure 19: Comparison of Gross Value Added Rates in Mexico, 2008 till 2014, in %.

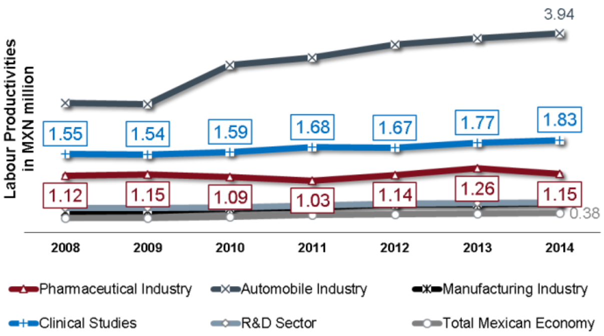


Source: INEGI, 2015a ; own calculation; own illustration.

[44] Data for clinical studies are not available but the GVA rate of the R&D sector is used to estimate the intermediate consumption of clinical studies. Therefore, the GVA rate of clinical studies is equivalent to the rate of the R&D sector.

A further indicator of measuring efficiency and productivity is the labour productivity. The labour productivity is calculated by the ratio of the GVA and total employment. This ratio indicates the amount of GVA generated by one employee and therefore, it measures the productivity regarding the factor input labour. The higher this ratio, the more productive is the labour force. Also in this case, the pharmaceutical industry is more productive than some of the further considered industries (cf. Figure 20). On average from 2008 to 2014, it has a 2.3 times higher labour productivity than the manufacturing industry and it overshoots the total economy by a factor of 3.4. Clinical studies are even more productive and yield a productivity of MXN 1.83 million in 2014.

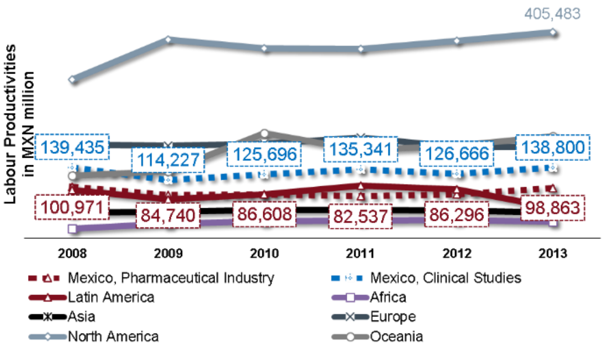
Figure 20: Comparison of Labour Productivities in Mexico, 2008 till 2014, in MXN million.



Source: Canifarma, 2015 ; INEGI, 2015a ; own calculation; own illustration.

Figure 21 displays labour productivities of the pharmaceutical industry of the six different continents – Latin America, Africa, Asia, Europe, North America and Oceania – and the Mexican pharmaceutical industry and clinical studies in USD. North America is, by far, the most productive continent in terms of labour. Its productivity reaches USD 405,483 in 2013 and is followed by the Oceanian and European labour productivity. The average labour productivity of the pharmaceutical industry in Mexico is as high as the Latin American productivity but exceeds Asia by a factor of 1.7. Clinical studies exceed the labour productivity of the Asian pharmaceutical industry, on average, by a factor of 2.4.

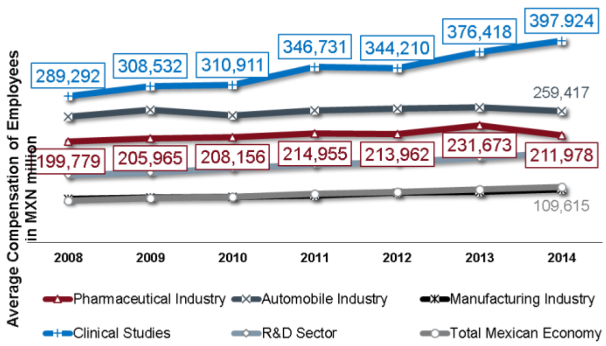
Figure 21: Comparison of Labour Productivities in the Pharmaceutical Industry by Continent, 2008 till 2014, in USD.



Source: Canifarma, 2015 ; INEGI, 2015a ; The World Bank Group, 2015 ; own calculation; own illustration.

The average compensation of employees or the compensation per employee is the ratio of total compensation of employees and total employment. It portends the average annual compensation that employees receive in return for their work. The pharmaceutical industry compensates an average employee with MXN 212.000 per year (cf. Figure 22). The compensation per employee rose constantly until 2013. In 2014, a reduction occurred. However, the compensation per employee was still on a significantly higher level than the compensations in the R&D sector, the manufacturing industry and the total economy. On average, the compensation per employee in the pharmaceutical industry was 2.2 times higher than in the total economy of Mexico. The automobile sector yields a higher compensation per employee in every year considered. Though, clinical studies pay out the highest compensation per employees among the considered industries. The compensation per employee has been rising constantly from MXN 290,000 in 2008 to MXN 398,000 in 2014, reaching an average compensation per employee of MXN 339,000 over the period of consideration.

Figure 22: Comparison of Average Compensation of Employees in Mexico, 2008 till 2014, in MXN.



Source: Canifarma, 2015 ; INEGI, 2015a ; own calculation; own illustration.

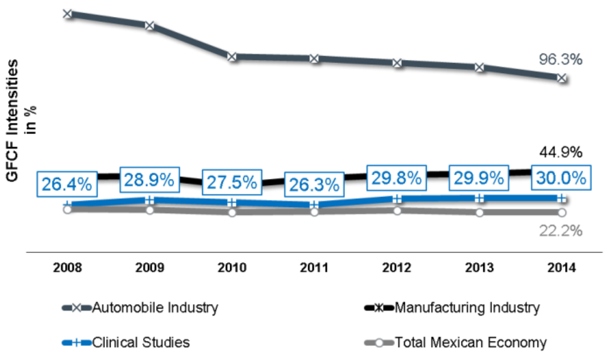
1.9.2 Investment Intensity Measures

In both investment measures, GFCF and R&D intensity, clinical studies and the pharmaceutical industry achieve higher results than the total Mexican economy. In case of the R&D intensity, both objects of investigation outreach all further considered industries. This high investment into R&D is realized in order to facilitate future innovations and even higher productivities.

An indicator for the future development of employment of capital and therefore for future competitive advantage is the GFCF intensity, which is the ratio of GFCF and GVA. Clinical studies invest on average 28.4 % of the generated GVA in GFCF, exceeding the rate of the total economy by 5.7 pps (cf. Figure 23[45]). However, the automobile industry invests by far more than clinical studies. Though, this rate has a declining trend.

[45] There is no data available for the pharmaceutical industry.

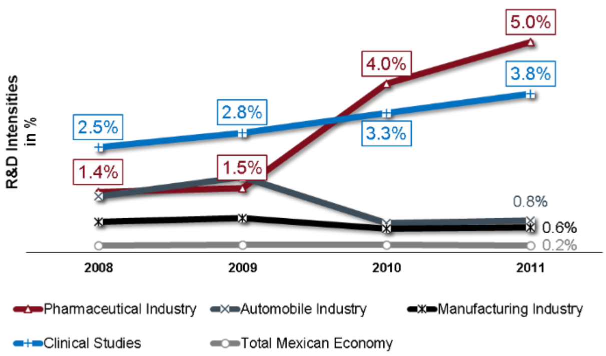
Figure 23: Comparison of GFCF Intensities in Mexico, 2008 till 2014, in %.



Source: Canifarma, 2015 ; INEGI, 2015a ; own calculation; own illustration.

A further indicator of investment intensity is the R&D intensity. It indicates future innovation as well as technological change and therefore also portends the competitive advantage in the long run. This intensity is computed by the ratio of R&D expenditures and the GVA. Since 2009, there is a sharp increase in the R&D intensity of the pharmaceutical industry and the indicator reached 5.0 % in 2011 (cf. Figure 24). Among the considered industries, it is the highest intensity. Thus, the pharmaceutical industry invests most of its GVA into R&D compared to the four other considered industries, possibly leading to a future competitive advantage. On average from 2008 to 2011, the intensity of the pharmaceutical industry was 4.4 times higher than in the manufacturing industry and 17.1 times higher than in the total Mexican economy. Also the clinical studies show a relatively high R&D intensity. In the beginning of the period of observation, its rate exceeds even the pharmaceutical industry but its growth was not as sharp, resulting in a slightly lower rate of 3.8 % in 2014.

Figure 24: Comparison of R&D Intensities in Mexico, 2008 till 2011, in %.

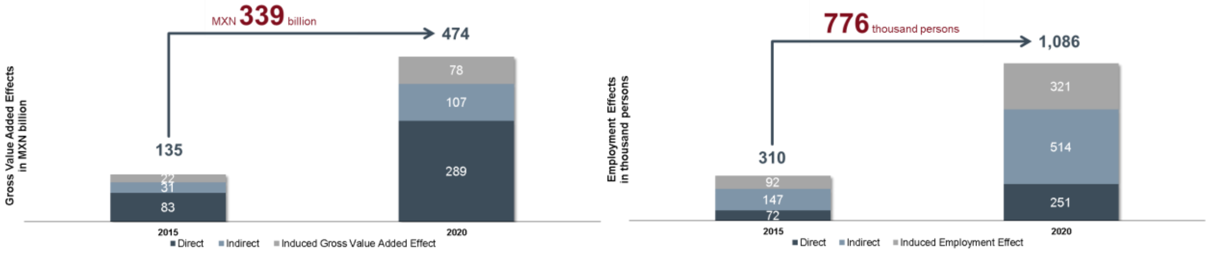


Source: Canifarma, 2015 ; INEGI, 2015a ; OECD, 2015d ; own calculation; own illustration.

1.10 Assumption-driven Projection of the Gross Value Added and Employment Effects to the year 2020

To illustrate the importance of investments in the pharmaceutical industry in Mexico, the following question has been implemented in a calculation model. How high are the GVA and the employment effects and how do these effects react to a rise of the investment into the pharmaceutical industry in Mexico? As an assumption the investments are increased within the model by MXN 1,500 million (equivalent to around USD 100 million) per year. Furthermore the calculation is based on a linear correlation between investment and GVA and employment.
In total the GVA effects might be elevated to MXN 474 billion (cf. Figure 25, left) till the year 2020. In case of the employment an increase in the investment might yield 776 thousand additional jobs (cf. Figure 25, right).

Figure 25: Projection of Gross Value Added (left) and Employment Effects (right) of the Pharmaceutical Industry and as a Result of an Increase in Investment, 2015-2020, in MXN billion (left) and in thousand persons (right).



Source: Own calculation; own illustration.

Finally an increase by MXN 1,500 million per year could raise the GVA by more than three times to MXN 474 billion and could lead to an employment effect of more than 1 million employees in the pharmaceutical industry in the year 2020.

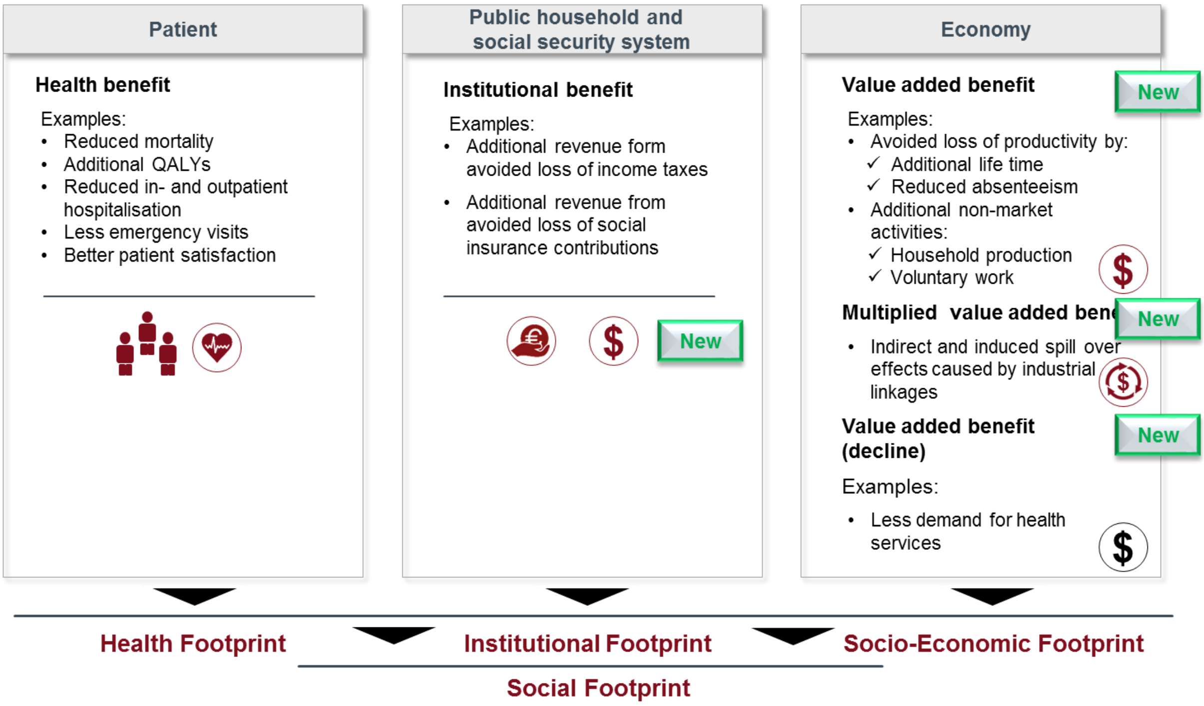
Heading Further: The Health, the Institutional and the Socio-Economic Footprint

In light of omnipresent fiscal resource restrictions, more then ever, the pharmaceutical industry is requested to justfy the prices of their products. In many countries around the world these price negotiations are driven by cost-benefit evaluations. In recent years, these evaluations have developed a distinct set of methodologies. There is, however, no valid approach, which is applied consistendly. While the scientific discourse on evaluation of costs is mostly exhausted, discusssions about the evaluation of the benefits is a timeless debate. By far, the most important benefit of innovative products is evoked by the direct health benefit on the individual level of a patient. However, from the perspective of a national economy, there are further benefits generated by a healthier population. With the Economic Footprint, AMIIF opend the first chapter of a book on changing the value proposition of the pharmaceutical indurstry in the future. WifOR has developed a methodology which allows for inference of the macroeconomic benefits from the pharmaceutical industry and clinical studies to the national economy of Mexico. However, the benefit beyond the economic benefit is constantly attracting more attention of policy and decision makers worldwide. Recently, in early December 2015, the German federal ministers for economic affairs impressively demonstrated this attention by publishing a resolution with important requests for the federal ministry of economic affairs. In this publication, it is demanded that for decision-making in health more attention should be given to the economic implications and the social benefits of improved population health[46]:

The Footprints as described in Figure 26 can deliver a solution to this request. From a macroeconomic perspective, there are three benefit dimensions of the pharmaceutical industry. The first dimension, the *Health Footprint*, focuses on the patient and the direct benefit that the he or she obtains from products of the pharmaceutical industry. The second dimension, the *Institutional Footprint*, focuses on the public household and the social security system. Here, the benefit is measured by financial savings and fiscal effects that the pharmaceutical industry produces for institutions of the public and private security systems. Finally, the third dimension focusses on the benefit the national economy receives. From a macroeconomic perspective, the benefit for a national economy is represented by key figures relevant for econimic growth such as the direct, indirect and induced effects. This footprint is called the *Socio-Economic Footprint*.

[46]Cf. Geschäftsstelle der Wirtschaftsministerkonferenz, 2015 ; own translation.

Figure 26: The Benefit Dimensions of the Pharmaceutical industry.



Source: Own illustration.

Each of these three benefit dimensions can be computed in the fashion of footprints. The *Health Footprint* represents a measurement tool, to assess the impact of the pharmaceutical industry on a patient's health status. It combines approaches of health technology assessment and epidemiological population modelling. With the *Health Footprint* WifOR may calculate benchmarking values that highlight the importance of the pharmaceutical industry in terms of its impact on the overall health status of Mexico. Based on real world evidence from clinical studies, systematic reviews and evidence-based medicine evaluations, the specific contribution of pharmaceutical therapies on the production of a healthier population can be modelled. The *Socio-Economic Footprint* is a combined evaluation of the impacts of the pharmaceutical industry regarding health related and economic outcomes. It is a country specific measurement of the direct and spillover effects that accompany the development of healthier populations. The estimate model is fed by results from the *Economic* and the *Health Footprint* and represents a holistic effect model for the evaluation of the socio-economic impact of the pharmaceutical industry, measuring the social benefit of indicators such as reduced mortality, morbidity or sick leave. Hence, the *Socio-Economic Footprint* quantifies the growth relevant GVA effects that are gained by a restored workforce. In conclusion the *Institutional Footprint* is an overarching evaluation of the impacts generated by a healthier population, with a special focus on the institutional effects. It quantifies the fiscal effects from the perspective of different institutions in the social security system that follow the restored and healthier workforce in terms of cost, tax and insurance reliefs.

Conclusion and Outlook

The quantification of the Economic Footprint of the pharmaceutical industry and clinical studies in Mexico has shown that the pharmaceutical industry is going through a challenging phase. The industry is shrinking, though it maintains and even enhances its high level of productivity and R&D investment intensity for a future competitive advantage. However, to support the value proposition of the pharmaceutical industry in Mexico even further, the portfolio of factors that define the value of pharmaceuticals has to be extended by the health benefit, institutional and multiplied value-added benefit. These benefits are quantified by the Health, the Institutional and the Socio-Economic Footprint.

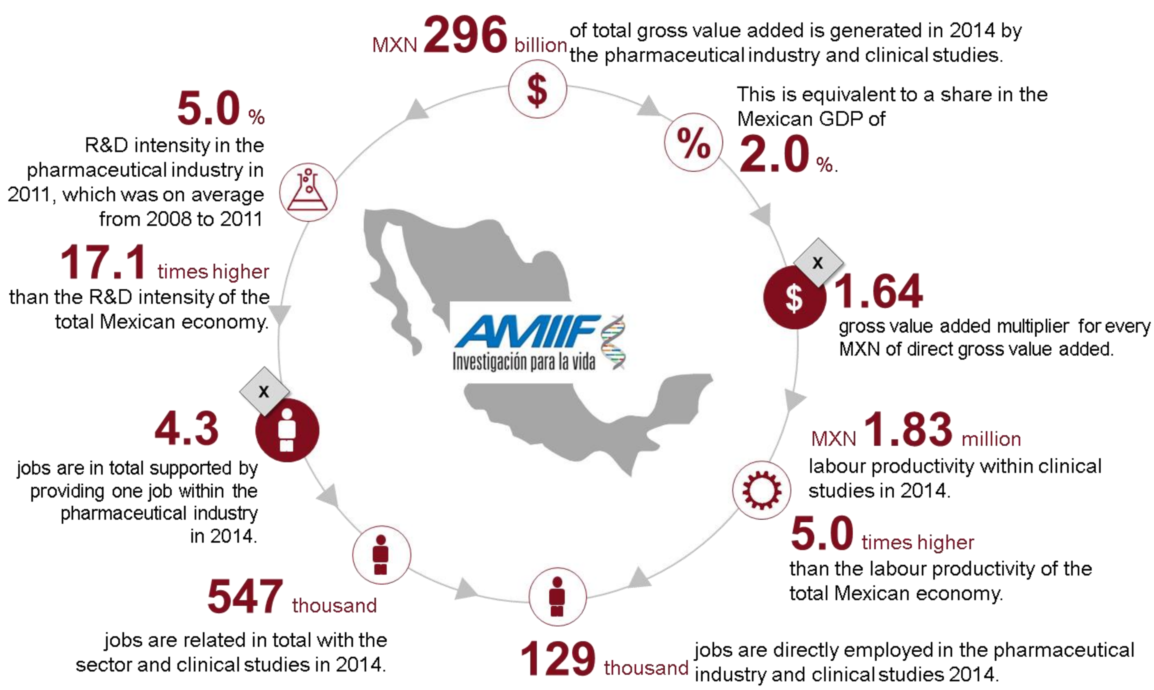
This study examines the impact of the pharmaceutical industry and clinical studies on the Mexican economy. The *Economic Footprint* of the pharmaceutical industry and clinical studies is measured in order to quantify the macroeconomic contribution of these objects of investigation to economic growth and employment in Mexico from 2008 to 2014. With the hereby newly derived information and data, the public discussion is enriched, developing a new perspective on the pharmaceutical industry and its R&D in clinical studies.

The Economic Footprint is a pool of key economic figures and indicators and its calculation aims at illustrating economic activities as well as linkages between the object of investigation – the pharmaceutical industry of Mexico as well as clinical studies – and the rest of the Mexican economy. Hence, the SNA, which provides information about the activities of an economy, is a suitable framework and database for the evaluation. The SNA is a comprehensive accounting framework that depicts the characteristics and performance of an economy. The input-output analysis is an integral component of the SNA and seeks to describe the economic interlacing within an economy as well as the flow of goods with the rest of the world. Within the input-output analysis, the input is the intermediate consumption, i.e. goods and services that are consumed, processed or transformed in/by the production process. Furthermore, inputs are understood as production factors such as labour and capital. On the other hand, outputs refer to the value of goods and services that are produced.

Next to the GVA, the Economic Footprint pools further economical key figures like the production value, the intermediate consumption, employment, compensation of employees, investment in GFCF and expenditures on R&D. All of these key figures describe immediate economic effects that are directly generated by the object of investigation. Hence they are also called *direct economic effects*. Moreover, the Economic Footprint encompasses *indirect* and *induced economic effects*. Indirect effects are effects that arise due to the input the object of investigation demands from other economic agents. Order placements result in an increase in economic activity among the commissioned agent. This stimulation leads to an enhancement of the supplier's GVA and further economic key figures, which are grouped under the term indirect effects. Induced effects originate from subsequent expenditure of directly and indirectly generated incomes. The compensation of employees that come from the object of investigation or that come about by the demand of the object of investigation leads to further demand in the economy. This demand also triggers GVA and further economic parameters, summed up under the term induced economic effects. The sum of indirect and induced economic effects is also called *spillover effect*. *Total economic effects* refer to the sum of all three effects. *Multipliers* are factors that get multiplied by the direct effects to calculate the indirect, induced and overall effects. The underlying model for the computation of the direct and spillover effects is the statistic open quantity model. Further economic indicators involve efficiency and productivity measures as well as investment intensity measures. The indicators of the object of investigation may be compared to other branches and the total Mexican economy. The statistical bureau of Mexico, INEGI, publishes the input-output table, which is the base of the calculation of the Economic Footprint. Further data is taken from the database of the OECD and Canifarma.

The pharmaceutical industry shrinks in the four dimensions: output, gross value added, employment and compensation of employees. In contrast, the clinical studies expand. However, both objects of investigation are highly productive regarding their inputs and labour. The average GVA rate of the pharmaceutical industry is 53.4 %, meaning that it is 1.8 times more productive than the automobile or the manufacturing industry, who experience nearly identical GVA rates. Furthermore, both industries feature relatively high investments rates. A summary of the key figures of the Economic Footprint of the pharmaceutical industry and clinical studies is given in Figure 27.

Figure 27: Summary of the Key Figures of the Economic Footprint of the Pharmaceutical Industry and Clinical Studies.



Source: Own illustration.

In conclusion, the Economic Footprint gives an insight on the economical dimension of the pharmaceutical industry and clinical studies. It is the first chapter of a story book, evaluating the value of pharmaceuticals. By far, the most important benefit of innovative products is evoked by the direct health benefit on the individual level of a patient. These benefits are not captured by the Economic Footprint but further caluclations of the Health, the Institutional and the Socio-Economic Footprint are required to provide a holistic value proposition of the pharmaceutical industry. The subsequent chapters are illustrated in Figure 28.

Figure 28: Stories to tell about the Value of the Pharmaceutical Industry.

Source: Own illustration.

As an overall outlook – based on the results of this study – the following recommendations are given to enable growth, employment, health and wealth in Mexico:

- » **More GVA should be created within Mexico.** This can be done by increasing the labour productivity and therefore the competitiveness. Also, more investments into the sector should be made to increase productivity and hence GVA. Furthermore, a centre of production of pharmaceutical goods should be developed that also produces for exports. This will also create more jobs within any kind of pharmaceutical companies and organisations.
- » **Foreign direct investment (FDI) to the Mexican pharmaceutical industry should be attracted.** This can be accomplished by creating attractive institutional frameworks for foreign investors. The goal with FDI is to achieve growth in terms of GVA instead of contraction of the industry. The close connection to the automobile industry should be used and enforced as a blue print.
- » **Mexico should be positioned as the R&D hub in Latin America.** R&D activities and especially clinical studies should be enlarged and Mexico should be promoted as a centre for innovations in healthcare in Latin America.

- **As a further step, the Social Impact (esp. Health, Socio-economic, Institutional and Sustainability Footprint) of the pharmaceutical industry should be measured.** The purpose is to quantify additional healthy life years. Additional healthy life years should also be a major policy objective of the government since a healthier population will be more productive. The aim must be to measure the impact of innovations on productivity and hence how innovations can reduce further productivity losses in the Mexican population. Furthermore, this analysis will gain new insights regarding a macroeconomic cost-benefit perspective.
- **Last but not least, the Economic Footprint should be updated on a regular basis in order to evaluate the effects of the measures taken.**

Appendix A: Glossary

Average compensation of employees	The average compensation of employees or the compensation per employee is the ratio of total compensation of employees and total employment. It portends the average annual compensation that employees receive in return for their work.
Basis price	The basic price is the price receivable by the producers from the purchaser.
Compensation of employees	The compensation of employees is defined as the total remuneration payable by an employer to an employee in return for work done by the latter during an accounting period.
Direct (economic) effects	Direct effects describe the immediate economic effects that are directly generated by the object of investigation.
Employment	The employment covers all persons engaged in productive activity that falls within the production boundary of the national accounts
Expenditure on research and development (R&D)	The expenditure on R&D is recognised as capital formation of intellectual property.
Gross fixed capital formation (GFCF)	The gross fixed capital formation, or investment, consists of resident producers' acquisitions less disposals. Fixed assets are produced assets used in production for more than one year.
GFCF intensity	The GFCF intensity is the ratio of GFCF and the GVA. This indicator alludes the development of employment of capital, which is generally responsible for competitive advantage in the long run.
GVA rate	The GVA rate is the ratio of the GVA and the PV. This rate provides information about the share of PV terminating in GVA. The higher the GVA rate, the more GVA is produced with an identical PV.
Indirect (economic) effects	Indirect effects are effects that arise due to the input the object of investigation demands from other economic agents (intermediate consumption).
Induced (economic) effects	Induced effects originate from subsequent expenditure of directly and indirectly generated incomes.
Input rate	The input rate is computed by the ratio of the intermediate consumption and the output. It denotes the demanded inputs to produce the output. The lower the input rate, the more efficient is the production process regarding its requirements of inputs.
Intermediate consumption	The intermediate consumption, also referred to as input, consists of goods and services consumed as inputs by a process of production. The goods and services are either transformed or used up by/in the production process.
Labour productivity	The labour productivity is calculated by the ratio of the GVA and total employment. This ratio indicates how much GVA is generated by one employee. The higher this ratio, the more productive is the labour force.
Multiplier	Multipliers are factors that get multiplied by the direct effects to calculate the indirect, induced and overall effects.

Production value (PV)	The PV, also referred to as the output, is the total of products created during the accounting period. The output is to be valued at the basic price, which is the price receivable by the producers from the purchaser.
R&D intensity	The R&D intensity is the ratio of R&D expenditure and the GVA. Similar to the investment intensity, this ratio indicates future technological change and hence gives an idea about the competitive advantage in the long run.
Spillover effects	Spillover effects are the sum of indirect and induced economic effects.
Total (economic) effects	Total economic effects are the sum of the direct and spillover effects.

Appendix B: The Calculation Model of the Direct and Spillover Effects

Since direct effects are effects that are directly generated by the object of investigation, these effects can be investigated by simple data collection. However, to analyse the spillover effects, various types of input-output models exist. These models can be classified into:

» Open and closed models,

» Quantity and price models,

» Statistical and dynamic models.[47]

If the variables of the input-output analysis are mostly independent, the underlying model is an open input-output model. This means that parts of the final demand are exogenous and remain constant throughout the whole analysis. Feedback of e.g. increase of income due to a rise in production are not considered. On the other hand, within closed models, all variables are endogenous and depend on each other.[48] Quantity models analyse the consequences of a change in final demand. Central to these models is how many and which type of intermediate consumption has to be produced to satisfy the final demand for goods. On the other hand, price models investigate the impact of alterations of prices of the intermediate consumption. Statistical and dynamic models differ in terms of the considered time periods. Statistical models do not model changes over time. The models only involve a single time period.[49]

In this research project, the *statistic open quantity model* is implemented to investigate the indirect and induced economic effects. Origin of this model is the domestic IOT, which is represented in the following system of equations:

$$\begin{array}{cccccccc} x_{11}+ & \dots & +x_{1j} & \dots & +x_{1n} & +Y_1 & = & X_1 \\ \vdots & & \vdots & & \vdots & \vdots & & \vdots \\ x_{i1}+ & \dots & +x_{ij} & \dots & +x_{in} & +Y_i & = & X_i, \\ \vdots & & \vdots & & \vdots & \vdots & & \vdots \\ x_{n1}+ & \dots & +x_{nj} & \dots & +x_{nn} & +Y_n & = & X_n \end{array} \quad (1)$$

where X_i represents the gross output or respectively the total demand of a sector i. It is the sum of the intermediate consumption that sector i demands from sector j, denoted by x_{ij}, and the final consumption of sector i, Y_i. To receive a linear correlation between the gross output X_i and the intermediate consumption x_{ij}, the input coefficients,

$$a_{ij} = \frac{x_{ij}}{X_j} \quad (2)$$

are derived. The input coefficient a_{ij} shows the share of contribution of product i to produce product j. The matrix of input coefficients A reads as follows:

$$A = \begin{array}{ccccc} a_{11} & \dots & a_{1j} & \dots & a_{1n} \\ \vdots & & \vdots & & \vdots \\ a_{i1} & \dots & a_{ij} & \dots & a_{in}. \\ \vdots & & \vdots & & \vdots \\ a_{n1} & \dots & a_{nj} & \dots & a_{nn} \end{array} \quad (3)$$

Equation (2) and (3) can be substituted into Equation (1):

[47] Cf. Holub & Schnabl, 1997 .
[48] Cf. Ostwald, Henke, & Kim, 2013 .
[49] Cf. Ostwald, Otte, Henke, Strauch, & Löser, 2013 .

$$
\begin{array}{ccccccccc}
a_{11}X_1 + & \dots & +a_{1j}X_j & \dots & +a_{1n}X_n & +Y_1 & = & X_1 \\
\vdots & & \vdots & & \vdots & \vdots & & \vdots \\
a_{i1}X_1 + & \dots & +a_{ij}X_j & \dots & +a_{in}X_n & +Y_i & = & X_i\,, \\
\vdots & & \vdots & & \vdots & \vdots & & \vdots \\
a_{n1}X_1 & \dots & +a_{nj}X_j & \dots & +a_{nn}X_n & +Y_n & = & X_n
\end{array} \tag{4}
$$

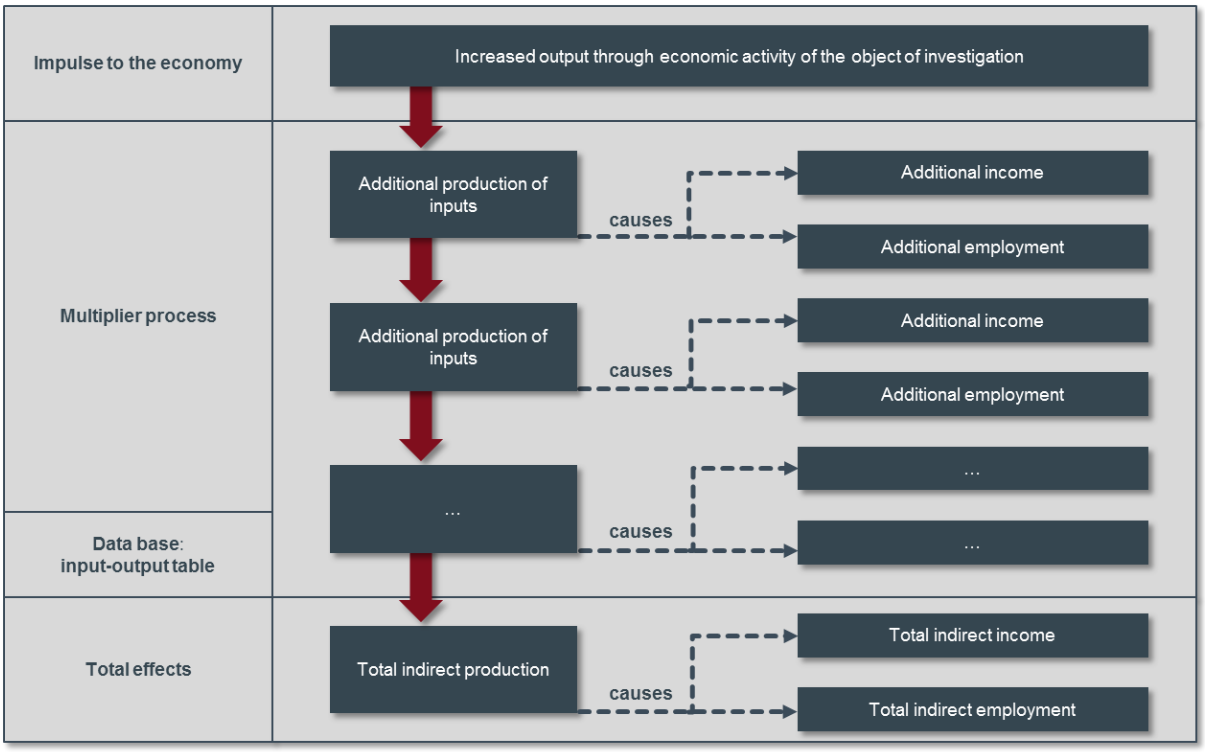
yielding the following equation in matrix notation:

$$Ax + y = x, \tag{5}$$

with x denoting the vector of gross output, y is the vector of final consumption.

In the present model, the economic impulse of the object of investigation towards the rest of the economy is assumed to be the PV. A change in the output leads to a change in the matrix of intermediate consumption. This in turn triggers economic activity in the supplying industries. This effect is the first round of effects. However, if the supplying industries increase their production, they also send out impulses to the economy and so on and so forth. There are infinitely many rounds of indirect economic effects which are mathematically represented by the boundary value of the Leontief inverse matrix. An illustration of the causality of the effect relationship is given in Figure 29.

Figure 29: Causality Regarding Investigation of the Indirect Effects.



Source: Own illustration based on Ostwald, Otte, Henke, Strauch, & Löser, 2013 and Ostwald, Henke, & Kim, 2013
.

To examine changes in gross output triggered by changes in demand, Equation (5) is solved for the gross output x:

$$x = (I - A)^{-1}y, \tag{6}$$

with I being the identity matrix. The first term is called the Leontief inverse matrix L:

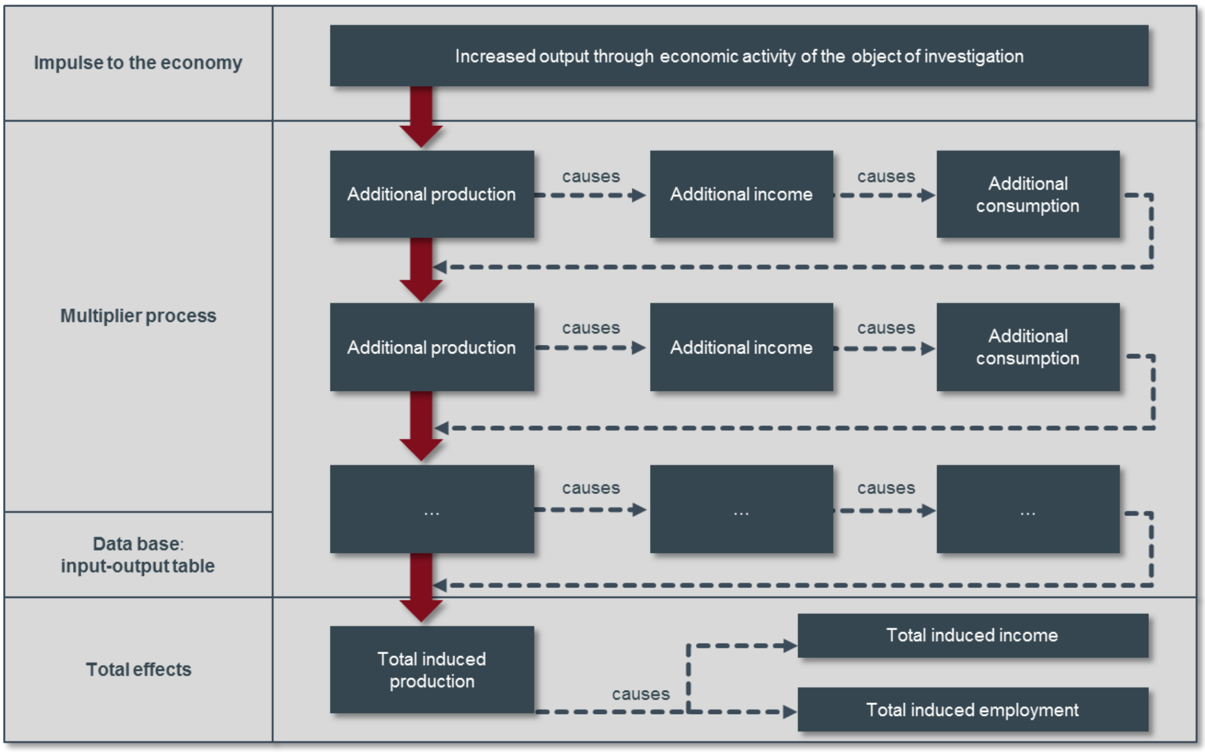
$$L = (I - A)^{-1}.$$ [50] (7)

Furthermore, the Leontief inverse matrix L is standardized, i.e. the main diagonal elements contain the value 1 only. This new matrix T, the technology matrix, is crucial for changes in output given a change in demand, hence it is crucial for calculation of the indirect effects:

$$T = L \times [diag(L)]^{-1} \quad (8)$$

To quantify the induced economic effects as a consequence of the economic activity of the object of investigation, the consumption demand is endogenised. The compensation of employees leads to an increased demand for goods and services across the economy, for which an enhanced production is needed. The compensation of employees for this enhanced production leads to a further increase in the demand. Theoretically, there are infinitely many rounds that are shown in Figure 30. However, the effects become smaller and smaller, since not the full income but only parts of it are spent for consumption.

Figure 30: Causality Regarding Investigation of the Induced Effects.



Source: Own illustration based on Ostwald, Otte, Henke, Strauch, & Löser, 2013 and Ostwald, Henke, & Kim, 2013
.

Similar to the indirect effects, a matrix of coefficients has to be derived to calculate the induced effects. However, this matrix C does not contain input coefficients (cf. matrix A), but rather consumption coefficients. These coefficients reveal information about how much is spent in terms of salaries and wages for the generation of a specific output. These coefficients are computed by the product of the vector of the consumption rate c and a vector of coefficients of the compensation of employees w:

[50] Cf. Ostwald, Henke, & Kim, 2013 .

$$C = c \times w, \quad (9)$$

where w is a vector consisting of the ratio of the compensation of employees in the production sector j, W_j, and the output of the production sector j, X_j:

$$w_j = \frac{W_j}{X_j}. \quad (10)$$

[51]

The standardized technology matrix for calculation of the induced economic effects then reads as follows:

$$T^* = L^* \times [diag(L^*)]^{-1}, \quad (11)$$

with:

$$L^* = (I - C)^{-1}. \quad (12)$$

Production Value Effects

To compute the PV effects, the technology matrices T and T^* are multiplied with the initial impulse, the PV X_j. First, the sum of the direct and indirect PV effect, x_{d+i}, is reached:

$$x_{d+i} = T \cdot X_j, \quad (13)$$

with X_j being equal to the direct PV effect, x_d:

$$X_j = x_d. \quad (14)$$

Subtraction of the direct effect, yields the indirect PV:

$$x_{indi} = x_{d+i} - x_d. \quad (15)$$

[52]

The following equation yields the total production effect:

$$x_t = T^* \cdot X_j, \quad (16)$$

from which the direct and indirect effects are subtracted to achieve the induced PV effect:

$$x_{indu} = x_t - x_{d+i}. \quad (17)$$

[53]

Gross Value Added Effects

To compute the value added effects, the model is expanded by a matrix G with the following elements on the main diagonal:

$$g_j = \frac{G_j}{X_j}. \quad (18)$$

The coefficients g_j result from the GVA of the production areas j, G_j, and the PV of the same production area j, X_j.

With these coefficients, the indirect and induced GVA effects are calculated (cf. Equation (20) and (22)):

$$g_{d+i} = G \cdot T \cdot X_j \quad (19)$$

$$g_{indi} = g_{d+i} - g_d \quad (20)$$

$$g_t = G \cdot T^* \cdot X_j \quad (21)$$

[51] Cf. Ostwald, Henke, & Kim, 2013 .
[52] Cf. Ostwald, Henke, & Kim, 2013 .
[53] Cf. Ostwald, Henke, & Kim, 2013 .

$$g_{indu} = g_t - g_{d+i}. \tag{22}$$

Employment Effects

The calculation of the employment effects operates similar to the calculation of the GVA effects. The model is expanded by a matrix E with the employment coefficients e_j on the main diagonal:

$$e_j = \frac{E_j}{X_j}, \tag{23}$$

where E_j represents the employment of the production area j and X_j being the PV of the production area j.

With these coefficients, the indirect and induced employment effects are calculated:

$$e_{d+i} = E \cdot T \cdot X_j \tag{24}$$

$$e_{indi} = e_{d+i} - e_d \tag{25}$$

$$e_t = E \cdot T^* \cdot X_j \tag{26}$$

$$e_{indu} = e_t - e_{d+i}. \tag{27}$$

Effects of Compensation of Employees Effects

Finally, the effects of compensation of employees are estimated. On the main diagonal of the matrix W, are the input coefficients of the compensation of employees, which are the ratio of the compensation w_j and the PV X_j of the production area j:

$$w_j = \frac{W_j}{X_j}. \tag{28}$$

With these coefficients, the indirect and induced employment effects are calculated:

$$w_{d+i} = W \cdot T \cdot X_j \tag{29}$$

$$w_{indi} = w_{d+i} - w_d \tag{30}$$

$$w_t = W \cdot T^* \cdot X_j. \tag{31}$$

$$w_{indu} = w_t - w_{d+i}. \tag{32}$$

Appendix C: Database of the Economic Footprint

Table 1: Classification of the Production Areas.

SCIAN Code	Description
11	Agriculture, hunting, forestry, fishing and related services
21	Mining and quarrying
22	Energy generation, transmission and distribution, supply of water and gas
23	Constructions and construction works
31-33	Manufacturing industries
32X	…
325	Chemical industry
325X	…
3254	**Pharmaceutical industry**
43-46	Wholesale and retail trade
48-49	Transport, postal and courier services and warehousing
51	Publishing and telecommunication services
52	Financial and insurance services
53	Real estate and rental services
54	Professional, scientific R&D and technical services
-	**Clinical Studies**
55	Advertising and market research
56	Employment services, travel agency, tour operator reservation and related activities
61	Education services
62	Human health and social work services
71	Arts and entertainment services, sporting and other recreation services
72	Accommodation and food services
81	Other services except governmental services and activities
93	Legal services, services of head offices and activities of extraterritorial organisations

Source: INEGI, 2014a .

Table 2: Database of the Economic Footprint of the Pharmaceutical Industry.

Data	Year	Features	Source
IOT	2008	Industry by industry Domestic Mexican Peso (MXN)	INEGI, 2015b

Intermediate con-sumption	2008 till 2014	Purchaser's prices MXN	INEGI, 2015a
Production value	2008 till 2014	Basic prices MXN	INEGI, 2015a
GVA	2008 till 2014	Basic prices MXN	INEGI, 2015a
Employment	2008 till 2014	Persons	INEGI, 2015a
Compensation of employees	2008 till 2014	Current prices MXN	INEGI, 2015a
Gross fixed capital formation (GFCF)	2008 till 2014	Current prices MXN	INEGI, 2015a
Expenditure on re-search and develop-ment (R&D)	2008 till 2011	Current prices MXN	OECD, 2015d
Tax wedge	2008 till 2014	%	OECD, 2015c
Household saving rate	2008 till 2009	%	OECD, 2012

Table 3: Additional Data Required for the Economic Footprint of Clinical Studies.

Data	**Year**	**Features**	**Source**
Total sales/revenues	2008 till 2014	Current prices MXN	Canifarma, 2015
Export of total sales	2008 till 2014	Current prices MXN	Canifarma, 2015
Number of employ-ees	2008 till 2014	Current prices MXN	Canifarma, 2015
Compensation of employees	2008 till 2014	Current prices MXN	Canifarma, 2015
Total R&D expenses	2008 till 2014	Current prices MXN	Canifarma, 2015
GFCF	2008 till 2014	Current prices MXN	Canifarma, 2015

Appendix D: Tables of Results of the Economic Footprint

Table 4: Direct, Spillover and Total Economic Effects of the Pharmaceutical Industry, 2008 till 2014.

Production value (output) effects in MXN million	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Avg**	**Growth abs**	**Growth %**	**Growth % p.a.**
Total effects	271,484	276,667	254,806	245,623	283,250	285,804	242,157	265,684	-29,327	-10.8%	-1.9%
Multiplier	*1.53*	*1.54*	*1.54*	*1.56*	*1.63*	*1.64*	*1.59*	*1.57*	*0.06*	*4.2%*	*0.7%*
Direct effects	177,626	179,771	165,914	157,279	174,104	174,226	152,048	168,710	-25,578	-14.4%	-2.6%
Multiplier	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*0.00*	*0.0%*	*0.0%*
Indirect and induced effects	93,858	96,896	88,892	88,343	109,146	111,579	90,108	96,974	-3,749	-4.0%	-0.7%
Multiplier	*0.53*	*0.54*	*0.54*	*0.56*	*0.63*	*0.64*	*0.59*	*0.57*	*0.06*	*12.2%*	*1.9%*
Indirect effects	59,991	61,711	54,283	51,856	66,773	67,987	52,099	59,243	-7,892	-13.2%	-2.3%
Multiplier	*0.34*	*0.34*	*0.33*	*0.33*	*0.38*	*0.39*	*0.34*	*0.35*	*0.00*	*1.5%*	*0.2%*
Induced effects	33,866	35,185	34,609	36,488	42,372	43,591	38,009	37,731	4,143	12.2%	1.9%
Multiplier	*0.19*	*0.20*	*0.21*	*0.23*	*0.24*	*0.25*	*0.25*	*0.22*	*0.06*	*31.1%*	*4.6%*
Value added effects in MXN million	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Avg**	**Growth abs**	**Growth %**	**Growth % p.a.**
Total effects	152,449	154,799	142,423	137,361	158,955	160,346	135,445	148,826	-17,005	-11.2%	-2.0%
Multiplier	*1.60*	*1.62*	*1.60*	*1.65*	*1.73*	*1.73*	*1.64*	*1.65*	*0.04*	*2.3%*	*0.4%*
Direct effects	95,161	95,740	88,848	83,002	92,074	92,612	82,640	90,011	-12,521	-13.2%	-2.3%
Multiplier	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*0.00*	*0.0%*	*0.0%*
Indirect and induced effects	57,289	59,059	53,576	54,359	66,880	67,735	52,805	58,815	-4,484	-7.8%	-1.3%
Multiplier	*0.60*	*0.62*	*0.60*	*0.65*	*0.73*	*0.73*	*0.64*	*0.65*	*0.04*	*6.1%*	*1.0%*
Indirect effects	37,498	38,503	33,360	33,039	42,115	42,260	30,582	36,765	-6,916	-18.4%	-3.3%
Multiplier	*0.39*	*0.40*	*0.38*	*0.40*	*0.46*	*0.46*	*0.37*	*0.41*	*-0.02*	*-6.1%*	*-1.0%*
Induced effects	19,791	20,556	20,215	21,320	24,766	25,474	22,223	22,049	2,432	12.3%	2.0%
Multiplier	*0.21*	*0.21*	*0.23*	*0.26*	*0.27*	*0.28*	*0.27*	*0.25*	*0.06*	*29.3%*	*4.4%*

Employment effects in thousand persons	2008	2009	2010	2011	2012	2013	2014		Avg	Growth abs	Growth %	Growth % p.a.
Total effects	344	350	318	311	375	380	310		341	-34	-9.9%	-1.7%
Multiplier	*4.1*	*4.2*	*3.9*	*3.8*	*4.6*	*5.2*	*4.3*		*4.3*	*0.3*	*6.4%*	*1.0%*
Direct effects	85	84	81	81	81	73	72		80	-13	-15.3%	-2.7%
Multiplier	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*		*1.0*	*0.0*	*0.0%*	*0.0%*
Indirect and induced effects	260	266	237	230	293	307	239		262	-21	-8.1%	-1.4%
Multiplier	*3.1*	*3.2*	*2.9*	*2.8*	*3.6*	*4.2*	*3.3*		*3.3*	*0.3*	*8.5%*	*1.4%*
Indirect effects	177	181	154	142	191	202	147		171	-31	-17.2%	-3.1%
Multiplier	*2.1*	*2.2*	*1.9*	*1.8*	*2.4*	*2.7*	*2.0*		*2.2*	*-0.1*	*-2.2%*	*-0.4%*
Induced effects	82	85	83	88	102	105	92		91	9	11.5%	1.8%
Multiplier	*1.0*	*1.0*	*1.0*	*1.1*	*1.3*	*1.4*	*1.3*		*1.2*	*0.3*	*31.6%*	*4.7%*
Effects of compensation of em-ployees in MXN million	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**		**Avg**	**Growth abs**	**Growth %**	**Growth % p.a.**
Total effects	32,788	33,963	31,773	31,761	34,853	35,136	29,734		32,858	-3,054	-9.3%	-1.6%
Multiplier	*1.94*	*1.97*	*1.88*	*1.83*	*2.01*	*2.07*	*1.96*		*1.95*	*0.02*	*0.9%*	*0.2%*
Direct effects	16,917	17,220	16,899	17,400	17,335	16,992	15,202		16,852	-1,715	-10.1%	-1.8%
Multiplier	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*		*1.00*	*0.00*	*0.0%*	*0.0%*
Indirect and induced effects	15,871	16,743	14,874	14,361	17,518	18,143	14,532		16,006	-1,339	-8.4%	-1.5%
Multiplier	*0.94*	*0.97*	*0.88*	*0.83*	*1.01*	*1.07*	*0.96*		*0.95*	*0.02*	*1.9%*	*0.3%*
Indirect effects	11,296	11,824	10,195	9,526	11,968	12,308	9,415		10,933	-1,881	-16.7%	-3.0%
Multiplier	*0.67*	*0.69*	*0.60*	*0.55*	*0.69*	*0.72*	*0.62*		*0.65*	*-0.05*	*-7.2%*	*-1.2%*
Induced effects	4,575	4,919	4,679	4,835	5,551	5,836	5,117		5,073	542	11.8%	1.9%
Multiplier	*0.27*	*0.29*	*0.28*	*0.28*	*0.32*	*0.34*	*0.34*		*0.30*	*0.07*	*24.5%*	*3.7%*

Source: INEGI, 2015b; INEGI, 2015a; OECD, 2015c ; own calculation.

Table 5: Direct, Spillover and Total Economic Effects of Clinical Studies, 2008 till 2014.

Production value (output) effects in MXN million	2008	2009	2010	2011	2012	2013	2014	Avg	Growth abs	Growth %	Growth % p.a.
Total effects	178,442	183,420	187,426	198,958	205,160	215,239	227,500	199,449	49,057	27.5%	4.1%
Multiplier	*1.60*	*1.62*	*1.60*	*1.61*	*1.62*	*1.62*	*1.63*	*1.61*	*0.03*	*1.7%*	*0.3%*
Direct effects	111,472	113,178	116,857	123,427	126,942	132,706	139,740	123,475	28,268	25.4%	3.8%
Multiplier	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*0.00*	*0.0%*	*0.0%*
Indirect and induced effects	66,970	70,242	70,569	75,531	78,218	82,533	87,760	75,975	20,789	31.0%	4.6%
Multiplier	*0.60*	*0.62*	*0.60*	*0.61*	*0.62*	*0.62*	*0.63*	*0.61*	*0.03*	*4.5%*	*0.7%*
Indirect effects	37,833	38,770	38,681	40,824	42,525	44,071	46,619	41,332	8,786	23.2%	3.5%
Multiplier	*0.34*	*0.34*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*0.33*	*-0.01*	*-1.7%*	*-0.3%*
Induced effects	29,137	31,472	31,888	34,707	35,693	38,462	41,141	34,643	12,003	41.2%	5.9%
Multiplier	*0.26*	*0.28*	*0.27*	*0.28*	*0.28*	*0.29*	*0.29*	*0.28*	*0.03*	*12.6%*	*2.0%*

Value added effects in MXN million	2008	2009	2010	2011	2012	2013	2014	Avg	Growth abs	Growth %	Growth % p.a.
Total effects	126,229	129,220	133,184	141,189	145,074	152,194	160,882	141,139	34,653	27.5%	4.1%
Multiplier	*1.52*	*1.54*	*1.52*	*1.52*	*1.53*	*1.53*	*1.54*	*1.53*	*0.02*	*1.1%*	*0.2%*
Direct effects	82,901	83,836	87,529	92,616	95,039	99,561	104,479	92,280	21,578	26.0%	3.9%
Multiplier	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*0.00*	*0.0%*	*0.0%*
Indirect and induced effects	43,328	45,383	45,654	48,573	50,035	52,633	56,404	48,859	13,075	30.2%	4.5%
Multiplier	*0.52*	*0.54*	*0.52*	*0.52*	*0.53*	*0.53*	*0.54*	*0.53*	*0.02*	*3.3%*	*0.5%*
Indirect effects	26,307	27,004	27,019	28,342	29,300	30,425	32,440	28,691	6,133	23.3%	3.6%
Multiplier	*0.32*	*0.32*	*0.31*	*0.31*	*0.31*	*0.31*	*0.31*	*0.31*	*-0.01*	*-2.2%*	*-0.4%*
Induced effects	17,021	18,380	18,636	20,231	20,735	22,208	23,964	20,168	6,943	40.8%	5.9%
Multiplier	*0.21*	*0.22*	*0.21*	*0.22*	*0.22*	*0.22*	*0.23*	*0.22*	*0.02*	*11.7%*	*1.9%*

Employment effects in thousand persons	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Avg**	**Growth abs**	**Growth %**	**Growth % p.a.**
Total effects	230	237	230	230	229	233	237	232	7	3.0%	0.5%
Multiplier	*4.3*	*4.4*	*4.2*	*4.2*	*4.0*	*4.1*	*4.1*	*4.2*	*-0.2*	*-3.9%*	*-0.7%*
Direct effects	53	54	55	55	57	56	57	55	4	7.1%	1.2%
Multiplier	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*1.0*	*0.0*	*0.0%*	*0.0%*
Indirect and induced effects	177	183	175	175	172	176	180	177	3	1.7%	0.3%
Multiplier	*3.3*	*3.4*	*3.2*	*3.2*	*3.0*	*3.1*	*3.1*	*3.2*	*-0.2*	*-5.1%*	*-0.9%*
Indirect effects	106	107	102	102	101	102	103	103	-2	-2.1%	-0.4%
Multiplier	*2.0*	*2.0*	*1.9*	*1.9*	*1.8*	*1.8*	*1.8*	*1.9*	*-0.2*	*-8.6%*	*-1.5%*
Induced effects	71	76	72	73	71	75	77	74	5	7.4%	1.2%
Multiplier	*1.3*	*1.4*	*1.3*	*1.3*	*1.2*	*1.3*	*1.3*	*1.3*	*0.0*	*0.3%*	*0.0%*

Effects of compensation of employees in MXN million	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Avg**	**Growth abs**	**Growth %**	**Growth % p.a.**
Total effects	28,040	30,199	30,615	33,274	34,106	36,622	39,405	33,180	11,365	40.5%	5.8%
Multiplier	*1.81*	*1.80*	*1.79*	*1.74*	*1.74*	*1.73*	*1.73*	*1.76*	*-0.08*	*-4.6%*	*-0.8%*
Direct effects	15,454	16,757	17,134	19,099	19,611	21,140	22,776	18,853	7,322	47.4%	6.7%
Multiplier	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*0.00*	*0.0%*	*0.0%*
Indirect and induced effects	12,586	13,442	13,481	14,175	14,495	15,482	16,630	14,327	4,044	32.1%	4.8%
Multiplier	*0.81*	*0.80*	*0.79*	*0.74*	*0.74*	*0.73*	*0.73*	*0.76*	*-0.08*	*-10.3%*	*-1.8%*
Indirect effects	8,613	9,004	9,110	9,522	9,766	10,284	11,033	9,619	2,420	28.1%	4.2%
Multiplier	*0.56*	*0.54*	*0.53*	*0.50*	*0.50*	*0.49*	*0.48*	*0.51*	*-0.07*	*-13.1%*	*-2.3%*
Induced effects	3,973	4,438	4,371	4,653	4,728	5,198	5,597	4,708	1,624	40.9%	5.9%
Multiplier	*0.26*	*0.26*	*0.26*	*0.24*	*0.24*	*0.25*	*0.25*	*0.25*	*-0.01*	*-4.4%*	*-0.8%*

Source: Canifarma, 2015; INEGI, 2015b; INEGI, 2015a; OECD, 2015c ; own calculation.

Table 6: Economic Indicators of Mexican Key Industries, 2008 till 2014.

National input rate in %	2008	2009	2010	2011	2012	2013	2014	Avg	Growth abs	Growth %	Growth % p.a.
Agriculture, hunting, forestry, fishing and related services	19.2%	24.1%	23.4%	19.0%	20.2%	23.6%	24.7%	22.0%	5.5	28.5%	4.3%
Manufacturing industry	35.4%	34.2%	31.2%	30.6%	29.8%	30.9%	29.1%	31.6%	-6.3	-17.7%	-3.2%
Chemical industry	26.6%	18.9%	15.2%	12.5%	3.3%	7.1%	6.8%	12.9%	-19.8	-74.4%	-20.3%
Pharmaceutical industry	34.3%	33.3%	32.7%	31.2%	30.5%	33.2%	29.6%	32.1%	-4.7	-13.6%	-2.4%
Automobile industry	69.5%	70.0%	69.8%	69.5%	69.5%	69.6%	69.5%	69.6%	0.0	0.0%	0.0%
Clinical studies	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
R&D sector	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total economy	29.5%	29.5%	28.3%	27.9%	28.0%	28.5%	27.7%	28.5%	-1.8	-6.0%	-1.0%
Input rate in %	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Avg**	**Growth abs**	**Growth %**	**Growth % p.a.**
Agriculture, hunting, forestry, fishing and related services	35.6%	37.8%	36.8%	36.9%	36.3%	37.1%	37.6%	36.9%	2.0	5.7%	0.9%
Manufacturing industry	71.1%	70.3%	70.5%	70.9%	70.3%	70.4%	70.3%	70.5%	-0.8	-1.1%	-0.2%
Chemical industry	68.7%	63.6%	64.3%	66.4%	61.1%	63.0%	68.4%	65.1%	-0.3	-0.5%	-0.1%
Pharmaceutical industry	46.4%	46.7%	46.4%	47.2%	47.1%	46.8%	45.6%	46.6%	-0.8	-1.7%	-0.3%
Automobile industry	70.0%	70.4%	70.3%	69.9%	69.9%	69.9%	69.8%	70.0%	-0.3	-0.4%	-0.1%
Clinical studies	6.7%	8.0%	5.5%	5.0%	4.4%	4.3%	4.0%	5.4%	-2.8	-41.1%	-8.4%
R&D sector	25.6%	25.9%	25.1%	25.0%	25.1%	25.0%	25.2%	25.3%	-0.4	-1.6%	-0.3%
Total economy	42.3%	41.8%	42.2%	42.2%	42.6%	42.5%	42.4%	42.3%	0.1	0.3%	0.0%

Value added rate in %	2008	2009	2010	2011	2012	2013	2014		Avg	Growth abs	Growth %	Growth % p.a.
Agriculture, hunting, forestry, fishing and related services	64.4%	62.2%	63.2%	63.1%	63.7%	62.9%	62.4%		63.1%	-2.0	-3.2%	-0.5%
Manufacturing industry	28.9%	29.7%	29.5%	29.1%	29.7%	29.6%	29.7%		29.5%	0.8	2.7%	0.5%
Chemical industry	31.3%	36.4%	35.7%	33.6%	38.9%	37.0%	31.6%		34.9%	0.3	1.0%	0.2%
Pharmaceutical industry	53.6%	53.3%	53.6%	52.8%	52.9%	53.2%	54.4%		53.4%	0.8	1.5%	0.2%
Automobile industry	30.0%	29.6%	29.7%	30.1%	30.1%	30.1%	30.2%		30.0%	0.3	1.0%	0.2%
Clinical studies	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	0.1%
R&D sector	74.4%	74.1%	74.9%	75.0%	74.9%	75.0%	74.8%		74.7%	0.4	0.5%	0.1%
Total economy	57.7%	58.2%	57.8%	57.8%	57.4%	57.5%	57.6%		57.7%	-0.1	-0.2%	0.0%
Average compensation of employees in MXN	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**		**Avg**	**Growth abs**	**Growth %**	**Growth % p.a.**
Agriculture, hunting, forestry, fishing and related services	9,400	9,923	10,425	11,092	11,404	11,986	12,541		10,967	3,141	33.4%	4.9%
Manufacturing industry	86,365	89,144	89,856	92,723	97,944	100,229	104,489		94,393	18,124	21.0%	3.2%
Chemical industry	193,476	208,029	207,620	219,520	225,385	236,832	233,440		217,757	39,963	20.7%	3.2%
Pharmaceutical industry	199,779	205,965	208,156	214,955	213,962	231,673	211,978		212,353	12,199	6.1%	1.0%
Automobile industry	248,886	261,755	250,393	261,143	264,586	266,459	259,417		258,949	10,530	4.2%	0.7%
Clinical studies	289,292	308,532	310,911	346,731	344,210	376,418	397,924		339,146	108,632	37.6%	5.5%
R&D sector	132,493	137,987	145,841	153,318	159,071	167,772	177,358		153,406	44,864	33.9%	5.0%
Total economy	82,668	87,222	90,539	95,507	99,983	104,887	109,615		95,774	26,947	32.6%	4.8%

Labour productivity in MXN million	2008	2009	2010	2011	2012	2013	2014		Avg	Growth abs	Growth %	Growth % p.a.
Agriculture, hunting, forestry, fishing and related services	0.06	0.06	0.06	0.07	0.07	0.07	0.08		0.07	0.02	28.5%	4.3%
Manufacturing industry	0.40	0.42	0.47	0.50	0.55	0.56	0.58		0.50	0.18	44.6%	6.3%
Chemical industry	1.13	1.15	1.20	1.19	1.38	1.44	1.28		1.25	0.15	13.1%	2.1%
Pharmaceutical industry	1.12	1.15	1.09	1.03	1.14	1.26	1.15		1.13	0.03	2.5%	0.4%
Automobile industry	2.56	2.53	3.31	3.45	3.71	3.84	3.94		3.33	1.38	53.9%	7.4%
Clinical studies	1.55	1.54	1.59	1.68	1.67	1.77	1.83		1.66	0.27	17.6%	2.7%
R&D sector	0.48	0.49	0.50	0.53	0.57	0.58	0.59		0.53	0.11	23.1%	3.5%
Total economy	0.29	0.29	0.31	0.34	0.36	0.37	0.38		0.33	0.09	32.2%	4.8%

GFCF intensity in %	2008	2009	2010	2011	2012	2013	2014		Avg	Growth abs	Growth %	Growth % p.a.
Agriculture, hunting, forestry, fishing and related services	2.4%	2.2%	2.1%	2.1%	2.1%	2.4%	2.7%		2.3%	0.3	11.4%	1.8%
Manufacturing industry	41.9%	41.9%	37.0%	40.7%	42.6%	43.4%	44.9%		41.8%	3.0	7.2%	1.2%
Chemical industry	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	-32.8%
Pharmaceutical industry	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
Automobile industry	131.8%	125.2%	108.0%	107.0%	104.8%	102.3%	96.3%		110.8%	-35.5	-26.9%	-5.1%
Clinical studies	26.4%	28.9%	27.5%	26.3%	29.8%	29.9%	30.0%		28.4%	3.7	13.9%	2.2%
R&D sector	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	-2.0%
Total economy	23.7%	23.6%	22.1%	22.6%	23.1%	22.0%	22.2%		22.7%	-1.5	-6.3%	-1.1%

R&D intensity in %	2008	2009	2010	2011	2012	2013	2014		Avg	Growth abs	Growth %	Growth % p.a.
Agriculture, hunting, forestry, fishing and related services	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
Manufacturing industry	0.7%	0.8%	0.6%	0.6%	N/A	N/A	N/A		0.7%	-0.1	-18.2%	-6.5%
Chemical industry	2.0%	1.8%	2.4%	2.7%	N/A	N/A	N/A		2.2%	0.7	32.7%	9.9%
Pharmaceutical industry	1.4%	1.5%	4.0%	5.0%	N/A	N/A	N/A		3.0%	3.6	249.3%	51.7%
Automobile industry	1.3%	1.8%	0.7%	0.8%	N/A	N/A	N/A		1.1%	-0.6	-42.5%	-16.9%
Clinical studies	2.5%	2.8%	3.3%	3.8%	N/A	N/A	N/A		3.1%	1.3	50.8%	14.7%
R&D sector	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A
Total economy	0.2%	0.2%	0.2%	0.2%	N/A	N/A	N/A		0.2%	0.0	8.1%	26%

Source: Canifarma, 2015; INEGI, 2015a; OECD, 2015d ; own calculation.

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