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REGULATORY IMPACT EVALUATION GUIDE

Vol I. Methods and Methodologies

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Foreword

The Federal Commission of Regulatory Improvement (COFEMER) is the authority in charge of implementing and promoting good regulatory practices in Mexico. It promotes transparency in the design and implementation of regulations through the promotion of higher benefits than costs to society, by reviewing both regulatory proposals and existing regulations at the federal level, and also by promoting these practices at the subnational level.

One of the key aspects of a good regulatory policy has been the development of better tools for analysis of regulations, and regulatory cooperation has demonstrated its key value in promoting the best practices available. This is why COFEMER proposed to the Asia-Pacific Economic Cooperation (APEC) a project to develop guidelines on the use of methodologies to evaluate the impact of regulations.

This project was submitted to APEC by Mexico and supported by Peru and New Zealand, and is part of a wider strategy to promote a more efficient functioning of economies, more openness, transparency and competition. To achieve this, it is important to strengthen the capacities of public servants who implement regulatory measures that are aimed at promoting productivity and economic growth. The use of Regulatory Impact Assessment (RIA) or any kind of impact evaluation of regulations promotes this goal, since it prevents governments from imposing unnecessary costs on economic activity.

Regulatory reform aims primarily to the continuous improvement of the regulations citizens and entrepreneurs face on a daily basis, as well as ensuring the quality of regulatory proposals that the government develops and promotes. In this sense, regulatory reform establishes a system to ensure that regulations are according to the interest of the public in terms of promoting a smooth functioning of markets, increase competitiveness, create jobs, improve income distribution and, in general, raise the living standards.

In this sense, the regulatory reform is a key element to promote better conditions within our economies and make them more competitive internationally. It is a policy that allows productive and social activities to take place in the best possible environment, while the state fulfills its basic function of protecting citizens effectively.

That is why COFEMER has been seeking to work closely with APEC economies, in order to promote cooperation and exchange of experiences on regulatory improvement practices, specifically in the tools that promote productivity, competitiveness and economic development of our countries.

To this end, and with the help and knowledge of experts and participants of APEC economies, we have developed this Guide of Methods and Methodologies for Regulatory Impact Evaluation, which seeks to provide the necessary tools for economies to evaluate and develop regulations that promote market efficiency, ease of doing business and better conditions for our citizens.

We expect that this work and the efforts of regulatory cooperation among our economies can bring us closer, and help to develop stronger bonds that support our future development.

Virgilio Andrade Martínez

Head of COFEMER

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This Guide was elaborated by public servants of the Mexican Government, through the Federal Commission for Regulatory Improvement (COFEMER) with the support of Asia-Pacific Economic Cooperation (APEC) and its economies.

On December, 2012, APEC approved a project named "Development and implementation of methodologies to improve the quality of regulations and regulatory impact assessments for enhancing market openness, ensure transparency and promote economic growth". This project consisted in organizing three workshops in the Mexico City, during 2013, in order to identify methods and methodologies for conducting regulatory impact evaluation.

The aims were, mainly: share experiences and best practices in the evaluation of impact of regulations; identify methodologies for assessing the impact of regulation, and thereby improve the quality of regulation; and develop an education and training system for civil servants.

This document is a contribution from Mexico and APEC economies to the Regulatory Reform Policy in the world. Thus, Mexican Government, via COFEMER, wants to express its gratitude and acknowledgement to APEC and the public servants of APEC economies, for their participation and comments to the Guide, in the workshops and for making this project possible.

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INDEX

CHAPTER I

THE PROCESS OF THE REGULATORY IMPACT EVALUATION

Chapter I. The process of the regulatory impact evaluation

The State prime duty is to ensure the population's welfare; to do this it uses public policies, that is, actions to meet the demands of society in the form of rules, institutions, public goods or services. The kinds of actions that the government can implement are many and varied, regulation is one of these.

Regulation is defined as a set of rules established by the State aimed at influence economically and socially, which purpose is to ensure social welfare. Rights or obligations are created or limited by regulation in order to change the 'social outcome' that would have resulted in the absence of regulation.

The best regulations are those that effectively and efficiently address the needs of the population. The effectiveness implies that the regulation meets the initial objectives, and efficiency characterizes those regulations that generate the greatest social benefits at the lowest cost. Therefore, to ensure their quality it is necessary to evaluate the possible effects of regulation.

The development of better regulation involves a thorough analysis of certain social problem, in which the needs of the population are valued and several alternatives are proposed in response. The way to systematize this analysis is through regulatory impact evaluation, which is a logical process in which several alternatives are compared in order to choose the best way to solve a problem. The results or conclusions of the impact evaluation process are useful to guide and document the decision made by policy makers.

The impact evaluation process is especially relevant when it is considered that the public resources of the State are scarce, that is, there are constraints of budget and of another kind that obligate policy makers to choose only one measure to solve a problem. Therefore a systematic, transparent and holistic procedure is required to choose the alternative that generates the greatest social benefits at the lowest cost.

Below, there is a diagram illustrating the general process of the Regulatory Impact Evaluation.

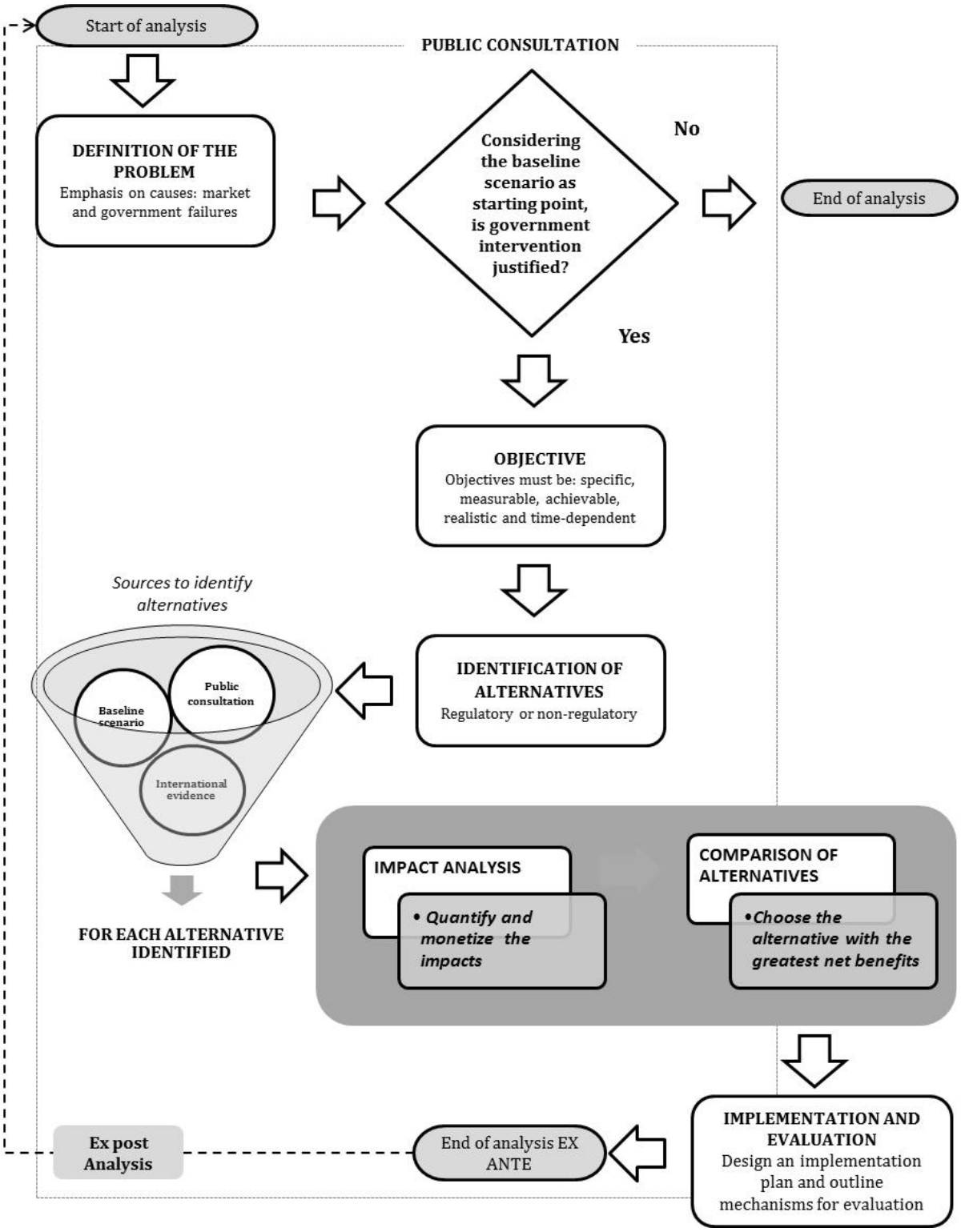
1.1 The Process

1) Identification and definition of the problem

The process of regulatory impact evaluation begins with the definition of the problem, which is what harms collective welfare, or could do so in the foreseeable future. Properly defining the problem will allow finding and making the right choice, whether regulatory or not. Much of the convenience of choosing certain methodology to evaluate the impact and defining the appropriate instrument of public policy to solve the problem lies in its definition.

Therefore, the definition of the problem requires explaining the cause of the problem, how significant it is, what is its magnitude, if the government has intervened before in some way to solve it and why the current situation is not sustainable in the absence of additional government intervention; that is, explaining the reason that supports that such intervention is necessary.

Diagram. Process of the regulatory Impact evaluation



Source: COFEMER

In the impact evaluation process it is essential to justify the State intervention. The existence of a problem does not necessarily mean that the State must intervene to solve it. There will be occasions in which the authority does not have the capacity or the resources to deal with it, so it is necessary to describe the fundamental reason why government action is indispensable, to do this it is necessary to answer the following questions:

- Does the State have the capacity to solve the problem?
- Is the problem a consequence of the existing regulation?
- If the problem involves a risk to the community, is the risk significant enough to require State intervention, or is it acceptable considering that the measures necessary to reduce it are too costly?

Most of the justification for government intervention falls on the concepts of market failures and government failures, although the government may also intervene when there is an imminent and significant threat to the population, or when certain social circumstances require a change, such as equality in income or gender.

Market failures occur when the market itself cannot efficiently allocate goods and services that the community requires in sufficient quantity and quality, which generates a decrease in the welfare of population. Among the main types of market failures are competition failures, externalities, public goods and information failures.

Competition failures occur when there are obstacles to free competition of producers in the market, that is, the prevalent market structure shows an excessive concentration of suppliers, which does not generate the necessary incentives for these to compete.[1] In these cases, it is common that the few industry participants use their market power to create barriers to entry that prevent new participants' inclusion. In this sense, the authority can use **economic regulation** to improve the efficiency of markets, as well as to prevent unfair practices that harm welfare, favoring dynamic markets that meet the needs of consumers. For other types of market failure –externalities, public goods and information failures (see the next box)–, the authority may resort to **social regulation**[2] to address these cases.

[1] When markets are concentrated it is more likely that suppliers collude and offer higher prices than those they would offer if they really competed. In other words, a likely consequence of poor competition in the market is that market prices increase excessively or that the quality of the goods exchanged decreases.
[2] In general, the main purpose of social regulation is to improve the welfare and safety of citizens and it may influence on the efficiency of markets only as an indirect consequence, unlike economic regulation aimed at directly improve the efficiency of markets.

Box: Market failures

In economic theory, the following are considered as the main market failures:

Externalities: They occur when an agent performs actions that produce indirect effects on other agents, which are transmitted by means other than the mechanisms of the market system (prices). A common example is the case of pollution caused by vehicles, which owners face the price of gasoline which does not include the environmental damage caused by the CO2 emission. In this situation the amount of gasoline produced is higher than desirable, from the social point of view.

Public goods: Public goods are those which nature presents two consumption characteristics: non-rivalry and non-exclusion. The non-rivalry principle implies that when a person consumes the good this does not affect or prevent the simultaneous consumption of other people. The principle of non-exclusion implies that it cannot prevent the consumption of the good to certain individuals. For this reason, an insufficient amount of this good is often offered in the market, as it is not possible to exclude those who do not contribute enough to their financing. An example of a public good is the street lighting.

Information failures: They arise when the consumers' choice is not efficient because they have incomplete or wrong information on some products. For example, it often happens that consumers do not have enough information to be able to distinguish between products or services with different qualities, so that their willingness to pay for products or services of higher quality is lower than that they would have if they had perfect information, so that companies could lose interest in continuing to offer these products and, therefore, create incentives to reduce the average quality of a good.

See Appendix 1 of the Chapter 1 for more examples.

In addition, government can also become one of the obstacles to the market to be in equilibrium and to goods and services to be offered in sufficient quality and quantity. This is known as **government failures**, and they occur in the political process to issue regulations, or when designing the institutions in charge of regulating.

A government failure means that it has failed in its task of regulating certain industry, which could generate excessive compliance costs on individuals (including the administrative burden and the substantial costs of compliance of regulation), reduced investment, unnecessary increases in prices, or that regulation simply does not solve the problem generated. Therefore, the presence of government failures justifies government intervention, though differently from market failures, where the policy maker will prefer to modify, delete or replace the current regulation by another government action.

When identifying the problem (mainly from the presence of market and government failures) it is necessary to explain how imperative is the State intervention for their solution, explaining always the causality, distinguishing, at all times, the causes of the symptoms. Tha is, when identifying the problem (mainly from the presence of market and government failures) it is necessary to explain whether State intervention is necessary for the solution, considering at all times the causes of the problem.

In Bardach´s words (2004), the problem definition must not include an implicit solution; it should be a clear and precise description that encourages the search for solutions.

If the State has previously intervened, even without success, -that is, that the public policy used did not produce the expected results because of an implementation failure or because it was poorly designed-, we must first assess whether the problem is solved just by using the means already available. So, in order to justify additional government action it must be explained that the current policies have not been sufficient to address a certain issue.

Also, the problem definition should be supported by **empirical evidence wherever possible**. This requires databases and other sources of information to describe its nature and magnitude. This is, if possible, the problem definition must rely on a rigorous statistical analysis, which allows a better understanding of the problem, as well as estimating the real impact that the government action could have.

It is therefore recommended that before elaborating the regulatory impact evaluation, the regulator should collect the qualitative and quantitative information available. However, is foreseeable that, in some cases, all the necessary information to conduct the EIR might not be available. Regarding this issue, the Chapters II and IV of this Guide provide a couple of methods (the Data Extrapolation Method and Benefits Transfer Method, respectively) that would be helpful for regulators to validate data and information coming from external sources, such as international evidence or research studies, so it can be used to conduct a EIR.

In this regard, when describing the nature and magnitude of the problem we must identify what is the **target population** for the government action. The target population refers to the population sector that will receive, directly, the effects (costs and/or benefits) of the intervention. It is necessary to consider that even if there is a clear and well-defined problem, if the affected population is too small it may happen that government intervention is not justified, considering that the costs of dealing with the problem significantly exceed the benefits obtained.

International evidence refers to the analysis and identification of similar problems in other countries, as well as to identify how those problems were solved and, if appropriate, the results obtained. This will be useful in most of the impact evaluation process; either because of a lack of empirical evidence to quantify the magnitude of the problem and to make extrapolations, if necessary, of the effects of the problem, or as part of the analysis of alternatives.

The importance of constantly resorting to international experience is that this will shorten and facilitate the impact evaluation process. This implies that it is not necessary to start from scratch every time. It is convenient to use international evidence when studying the problems and proposing possible solutions, as this facilitates the task.

Example of some of the problems and their possible causes[3]		
Problem	**Possible causes**	**Empirical evidence supporting the cause**
Rapid increase of environmental pollution in the city	• Increased emissions from industries located in the city • Rapid increase of the vehicle fleet in the city • Increase of imported used cars because of trade liberalization	In the last ten years the greenhouse gases emission increased by eight percent per year
Increased accidents in coal mines that exploit the firedamp	• Absence of regulation on working conditions in coal mines • Lack of supervision of working conditions in the mines • Lack of training of workers to operate and work in the mines	From 2010 to the present there have been 15 accidents in different mines, with the loss of little more than 250 workers and 50 workers injured. From the 20 coal mines in the country that use the firedamp, 75% have had an accident.

[3] Examples are fictitious; they only illustrate the identification of the problem and its causes.

2) Definition of the objectives of the regulation

After identifying the problem and its causes, the next step is to define the purpose or purposes of the intervention, and in the case, also the regulation objectives. We must define clear and specific objectives directly related to the identified problem and the reasons for the State to intervene. Without full understanding of what we want to achieve, it is impossible to define the best alternative to solve a certain problem. The definition of the objective is the link between problem identification and enunciation of several public policy alternatives and their subsequent comparison.

The objectives of the State intervention (regulatory or not) are defined as the expected result of a State action. Taking this into consideration, it is important that policymakers define the State intervention objectives in a clear, realistic, focused and effective way, concordant to the country's general policy goals. In this sense, each State action should satisfy the SMART criteria (specific, measurable, achievable, realistic and time-dependent) in order to ensure and protect the public interest.

A helpful tool to follow when setting objectives is the SMART criterion (acronym for Specific, Measurable, Achievable, Realistic and Time-dependent).

The SMART criterion requires:

i) **SPECIFIC.** To count on objectives sufficiently precise and specific, so that there is not a wide margin of interpretation;

ii) **MEASURABLE.** To define a desired future state under measurable criteria, so that it is possible to verify the success of the objective;

iii) **ACHIEVABLE.** To have staff able to achieve and carry out the objectives and goals set;

iv) **REALISTIC.** To propose ambitious goals and objectives, so that those responsible for them think of the objectives as meaningful, and finally

v) **TIME-DEPENDENT.** To establish specific dates or periods of time for compliance, otherwise the goals and objectives tend to be vague ideas of short term.

Furthermore, coherence between the regulatory objectives and the identified problem is crucial to evaluate later the regulation performance, that is, whether it is working or not.

3) Identification of regulatory and non-regulatory alternatives

There are often several alternatives of government action to meet the objectives, therefore, these should be considered in the process of regulatory impact evaluation to justify that regulation is the best alternative to solve a problem.

oOne of the first alternatives that we should consider is the **baseline scenario**. The baseline scenario shows what would happen if the State did not intervene. The baseline scenario is the point of comparison with which all public policy alternatives will be compared to identify the one that best fulfills the objective initially set. The comparison is done consistently in the present and in the future. For this reason, the construction of the baseline scenario considers the projection of current events; just as the rest of the state intervention alternatives will also project their impact on society.

For example, tuna fishing does not currently represent a major threat to this specie. However, considering that demand will double in the next ten years, it is likely that this level of exploitation does represent a risk. Therefore, the definition of the baseline scenario incorporates the increase in demand, as well as the absence of additional government intervention.

Properly establish the baseline scenario is essential to choose the correct impact analysis methodology, and thus determine what the best option for government action is. To properly define the baseline scenario we must consider whether the State has previously intervened to address this problem:

a) If the State has not intervened, the baseline scenario is the continuation of the current circumstances, adapting this scenario to future changes likely to happen (for example, increased demand in tuna fishing),
b) If the State has previously intervened, the baseline scenario reflects the continuation of this policy and its effects, without changing the existing regulation or issuing a new regulation (for example, if there had been a law banning tuna fishing at certain times of the year), and
c) If it is expected that the government action in force will come to an end (that is, the law is only valid in the first four years of the projection), it is convenient to define the baseline scenario considering these future changes, that is, that at certain time we will go back to the condition in which there is no government intervention.

Moreover, the available alternatives for decision makers does not only include regulatory actions, but also provide other kind of measures that are not regulatory, which generates the incentives needed to solve the problem and meet the objective through market mechanisms. Among these public policies are taxes, subsidies or licensing. Within the alternatives it is even considered a combination of these market mechanisms and the regulatory actions.

Next, the regulatory and non-regulatory schemes or alternatives that could be taken into consideration by regulators or public policy makers are presented and briefly described[4].

Status quo: It is a baseline scenario for comparisons with other regulatory alternatives. The status quo is helpful to evaluate what would happen in case of no State intervention.

Information Campaigns: This alternative consists on spreading more and better information among people and businesses, in order to modify their behavior and improve their consumption decisions.

Self-regulation: It refers to those codes of voluntary conduct formulated, developed and enforced by an industry, in order to solve a specific issue. The main assumption underlying this alternative is that markets can regulate themselves. This is a non-regulatory alternative since governmental action is either null or very limited.

Quasi-regulation: It is a set of rules developed by a specific industry and supported by the government, though the latter does not force their compliance.

[4] Flores, Manuel Gerardo y García, Jacobo. Regulatory Polucy Division. OECD, 2013. Workshop on competition assessment in Regulatory Impact Analysis (RIA). Regulatory and non-regulatory alternatives and less restrictive. Mexico City.2013. Available in the next link: http://www.oecd.org/gov/regulatory-policy/Sesión-3.2-Presentations.pdf

Market instruments: These instruments are designed to modify the behavior of regulated entities through economic incentives, for addressing market failures (externalities) via taxes, subsides and the opening of new markets.

Co-regulation: In this case, an industry/business chamber develops regulations in coordination with the government. The former supervise and sanction its compliance, while the latter provides its legal framework.

Performance-based regulation: It establishes goals, standards or incentives for specific results. It is more flexible than explicit governmental regulation, that's the way it promotes innovation, so it is especially relevant for high-tech industries. It is designed and supervised by government.

Explicit governmental regulation- "command & control": It fully guides the agent's behavior. In this case, the governmental actions go from following up its accomplishment, to the application of punitive sanctions in case of noncompliance.

Regulatory and non-regulatory alternatives

Diagram	Status quo	Regulatory			Non-regulatory			
		Explicit regulation of the government: Command and control	Regulation based on performance	Co-regulation	Market instruments	Quasi-regulation	Self-regulation	Information campaigns
Examples	Benefits do not justify the reduction of car accidents to zero	Regulation of markets and economic sectors	Quality standards such as Official Mexican Standards (NOMs in Spanish)	Quality standards formulated by the industry and supervised by the government	Taxes, subsidies, productivity bonuses and tradable property rights	Code of conduct of industry advertising of alcoholic beverages; Mexican Standards	Codes established by industry associations; Internal Rules of the Mexican Stock Exchange	Advertising campaigns, print advertising (pictograms) that seeks to reduce tobacco consumption

Source: Flores, Manuel Gerardo and García, Jacobo Pastor. Regulatory Policy Division. OECD, 2013.

So, in order to choose the alternatives that may solve the problem, we must consider the options proposed by stakeholders related to the problem, the international evidence and/or the baseline scenario, among others. To make a complete analysis, it is suggested to identify a wide range of options and assess, in detail, only the feasible alternatives to implement.

Although the regulatory impact evaluation considers public policy alternatives that are not regulatory, in the strict sense, this guide focuses on the study and quantification of the impact of regulatory policies.

4) Quantification of the impact of alternatives

For all analyzed alternatives we must consider both, positive and negative effects. The impact analysis and quantification of the regulatory alternatives is essential to compare them and choose the one that generates benefits greater than costs and the maximum benefit to society.

First, regulators must identify the benefits and the costs of regulation, considering those direct or deliberate and the indirect or unintentional; that is, those which are not the regulation purpose but are likely to happen.

It is also convenient to consider the type of impact generated: social or economic. The **social impact** is that in line with the environmental, labor, health and social security

settings; the **economic impact** is in line with the change in the welfare of the population resulting from a change in the competition conditions in the markets or in the access to population to certain goods.

The following table sets out some examples of social and economic impacts that can be considered in the impact evaluation process:

Examples of social impacts	
- Variation of the labor market and the employment	- Change in the air quality
- Modification of rules and rights related to work quality	- Harm to biodiversity, flora and fauna
- Support of social inclusion and protection of individuals' groups	- Change in the soil quality and its resources
- Change in the access to justice for private parties	- Change in the patterns of crime, terrorism and public safety
- Damage to public health	- Reduction or expansion of renewable or nonrenewable resources
- Access to education	- Environmental consequences caused by companies or consumers
- Climate changes	- Change in production, generation and recycling of wastes
- Restriction of transport	- Change in animal welfare
Examples of economic impacts	
- Change in the markets structure and functioning	- Change in the administrative burdens for businesses
- Change in the degree of competition between market participants	- Restriction or support for innovation and research
- Impact on competitiveness, trade and foreign investment	- Damage or benefit to consumers caused by a change in market prices
- Change in the operating costs for SMEs	- Damage or improvement on macroeconomic environment

Often, the State intervention has consequences of different nature, that is, it is no surprise that some regulations have social impact; and simultaneously, this policy may alter the markets composition and thus have an impact on competition. For example, an Official Mexican Standard (which is a standard aimed at protecting the safety of people) does not only have a social impact by reducing the risks to the population of a certain activity, but at the same time and often unintentionally, it can modify the market structure by restricting the share of some bidders who do not meet the defined standard, which can lead to an increase in the market price and, finally, on consumers' welfare. Therefore, when quantifying the costs and benefits of the regulatory alternatives we must consider both, the economic and the social impacts.

Once the type of impact is defined, we continue with its quantification. There are different methodologies that are useful at this point, specifically designed to study the social and economic effects. This guide extensively develops this stage of the impact evaluation, as we explain, and illustrate the different types of quantification methodologies according to the type of impact.

Measuring the social impact involves an additional difficulty, considering that in most cases there is neither a traditional market nor prices for most of the goods and services that are subject to these effects. For this reason, the quantification of social impact involves inferring the costs and the benefits generated by regulation, rather than observing them directly. Thus, the methods to measure the social impact are divided into two categories: direct methods and indirect methods. The direct or stated preference method uses surveys

to determine the willingness to pay (or the willingness to accept)[5] of consumers. On the other hand, indirect or revealed preference methods are those that analyze the behavior and actions of individuals and, through these, indirectly obtain the willingness to pay for a good or service. (See chapter IV)

On the one hand, the methods that measure the economic impact of regulation focus on the study of the effects of a change in prices on welfare. On the other hand, they also focus on the effect of a change in the market structure on prices and quantity or quality of the goods and services offered to the public. As an example of the first we have that the compensating variation method directly estimates how a change in price decreases or increases the welfare of the population (measured by its income level). As an example of the second, the concentration indices measure a change in the market structure that can modify its degree of concentration and thus indirectly affect the prices, quantity or quality of goods and services.

5) Choice of the best regulatory alternative

Every impact evaluation process converges on one point: choosing the alternative that solves best the problem. The comparison between public policy options is done considering the baseline scenario as a starting point, that is, once we estimate the costs and benefits produced by each alternative (including the baseline and the proposed regulations) we have to define a **decision criterion** that will allow classifying and choosing the best one. For example, a decision criterion could be to choose the most efficient alternative, or the one that generates the greatest benefits at the lowest cost.

The most important methods to compare options or public policy alternatives are:

a) Cost–Benefit Analysis
b) Cost–Effectiveness Analysis
c) Multi–Criteria Analysis
d) Profitability ratios

Cost-Benefit Analysis (CBA) is used when it is possible to monetize or quantify the costs and benefits generated by each public policy alternative. For this purpose, we must consider both, economic and social effects or impacts. In this case, the decision criteria are the cost-benefit ratio (the quotient of discounted costs divided into the present value of benefits) and the net benefits (or the difference between total benefits and total costs), so all alternatives are classified according to these criteria.

On the other hand, the **Cost-Effectiveness Analysis** works best when it is not possible to explicitly quantify or monetize the benefits of all public policies. However, it is assumed that the benefits generated by the different alternatives have the same unit of measure, though this is not monetary. In this case, the decision rule is to identify the public policy that generates the lowest cost per unit of benefit (through the cost-effectiveness ratio).

Multi-Criteria Analysis is the best option when there are costs and benefits that are both measurable and non-measurable. In this method we have to define simultaneously various decision criteria, instead of only one as in the two previous cases. The weights assigned to each criterion are subjectively defined or in a way subject to the advice offered by experts

[5] The *willingness to pay* is a concept that comprises the assessment made by individuals for an asset that lacks an established market. It aims at determining the price that people are willing to pay for the good. On the other hand, the *willingness to accept* is the amount of money people are willing to receive to compensate for the damage caused by the regulation.

on the subject. However, this aspect is considered as its main weakness, since the results of the application of the Multi-criteria analysis are not as solid as those of the other two methods.

Finally, **Profitability ratios**, such as Internal Rate of Return, Immediate Rate of Return and Equivalent Annual Cost (EAC), are tools to assess whether the proposed alternative is socially profitable, that is, to assess whether it is convenient to implement it, assuming that this representing a cost to society. In particular, the EAC is an indicator that shows the cost per year to own, operate and keep an asset over its useful life. It is often used to compare alternatives that generate the same benefits, but have different life span and costs, so, the lower the EAC, the better the regulatory alternative.

Thus, the comparison of regulatory alternatives is supported in the implementation of any of the four methods previously discussed. Considering the decision criteria used in each method, the regulatory alternatives are classified according to their observance, considering the baseline scenario as a starting point.

6) Design of an implementation plan for the regulation

Once we have identified the best alternative, we must develop an implementation plan for the regulation. This plan should consider the following:

- spread the results of the process, especially to those who are directly affected;
- establish, when appropriate, a grace period for the regulated to start their compliance;
- provide the regulated with technical and administrative advice on the regulation and its implications;
- train the government staff on the new government regulation, and
- estimate the financial resources necessary for its implementation.

7) Outline of the regulatory assessment

When making a regulatory impact evaluation it is important that regulators previously outline the indicators and the mechanisms through which they will evaluate the alternative chosen and implemented, in order to evaluate its performance after its implementation. These evaluations are usually called ***ex post* evaluations**, and they are carried out to identify whether a policy is performing well and, if necessary, find out what reforms should be made to improve performance. The *ex post* evaluation is useful as feedback to the work of the State and allows questioning how to do things better and ensure that regulations are effective and efficient.

Including evaluation indicators that show the results of a regulatory policy facilitates the evaluation and, at the same time, this ensures that decisions regarding the continuation or not of certain intervention are guided by previously established measures and that this is efficiently addressed. **An indicator is a point value, usually obtained from a ratio (division), which measures objectives.** In general, indicators are useful tools that indicate the existence or lack of progress on a specific project.

The main reasons why it is advisable to use indicators are:

1. ***They allow measuring the changes in the condition or situation over time.*** During the design of regulation, it is important to define the indicators that will allow us to evaluate the performance of regulation over time.
2. ***They facilitate focusing the results of the initiatives or actions.*** In this regard, the indicators can be used for different levels of objectives, from general to particular objectives of the regulation.
3. ***They provide information to make decisions*** on continuing, adapting, modifying or canceling the regulation in case it does not meet the goals previously established.

8) Access to regulation and public consultation

Public consultation allows knowing the opinion of the main stakeholders affected or benefited by the regulation, whether they are citizens, businesses, social organizations, representative associations, government and educational institutions, or business partners, mainly.

The public consultation process serves the regulatory impact evaluation as a tool to properly define the problem and its magnitude, identify the nature of the impacts, and generate regulatory alternatives. This allows stakeholders to provide inputs for evaluation, as they usually know how the regulation operates and the costs of compliance. It also allows the State to know about the needs of its regulated and improves their confidence in the process of regulation issuance.

In order to carry out the public consultation, governments should consider, as a prerequisite, giving free and unrestricted access to the regulation, in addition to collect feedback from stakeholders through various channels. Some channels that can be considered to gather information are:

1. Wide spread of the proposal for comments through Internet
2. Public meetings such as forums or workshops
3. Establishment of committees and/or commissions
4. Informal consultation with selected groups

Governments can set specific periods for comments of individuals, they can prefer to perform the consultation at the beginning of the proposal and/or during the development of a regulatory impact evaluation, and they can decide to define criteria for making the consultation.

Finally, it is important for governments to launch public consultations aimed at specific stakeholders or on specific topics in order to gather particular comments on a regulatory proposal, either from the affected/benefited stakeholders or from officials/institutions responsible for its implementation.

1.2 Scope and limitations of the Regulatory Impact Evaluation

The impact evaluation process is a tool that allows the ***ex ante*** analysis of the regulatory proposals, in order to assess whether a particular policy instrument should be issued or not; it can also function as an ***ex post*** assessment tool that allows reviewing the regulatory stock and identifying those regulations that do not meet their goal or do not solve the problems for which they were issued. In addition, the regulatory impact evaluation can be used for both, primary laws and subordinate regulations.

Finally, the regulator must consider that the *ex ante* regulatory impact evaluation involves hypothetical simulations, which often assume an optimizing behavior by market participants; sometimes, this might overestimate the benefits of the chosen alternative.

Moreover, the main limitations of the *ex post* regulatory impact evaluation focus on the need to have, at least, an *ex-ante* evaluation, in order to ensure that we have the complete information about the initial objectives of regulation, the problem it aimed to solve prior to its implementation and the initial level of the indicators with which we aim to assess its performance.

Also, evaluators can face lack of data, institutional restrictions and cultural barriers that result in political or administrative pressures to avoid the evaluation or to keep it closed (non-public).

The process of regulatory impact evaluation comprises, at least, the following elements:

1.3 PRE Evaluation (Quick-scan tool)

The process by which a Regulatory Impact Evaluation also called Regulatory Impact Assessment (RIA) is undertaken usually varies from country to country. In some cases, the process to follow consists on a *two-stage of evaluation,* which makes a distinction between a *full evaluation* and a *preliminary evaluation* (also referred in literature as *pre-RIA* or *quick-scan tool*). As noted by OECD (2008)[6], this *two-stage* approach is especially useful when a national government have scarce of human and/or technical resources to conduct a full evaluation for each regulation proposal. Even in the opposite case, the *two-stage* approach of evaluation promotes a more efficient use of resources, since it allows the regulatory authority to identify which proposals deserve more attention and, eventually, a full evaluation.

Despite the fact that the *two-stage* approach of regulatory impact evaluation does not significantly contribute to improve the quality of the final impact evaluation, it is helpful to focus only on the relevant regulations, in terms of their economic impacts, by providing some criteria to decide, whether or not, a regulatory proposal needs the elaboration of a full evaluation[7]. It permits governments to allocate efficiently the public resources.

The decision criteria to consider the elaboration or not of a full regulatory impact evaluation are the costs, as well as the potential impacts of the regulatory proposal on competition, market opening, employment, productivity, technological innovation and investment flows. It also considers the importance of the target population (regulated entities) and if the regulatory proposal is a commitment derived of an international agreement[8]. Australia, Mexico and Malaysia are examples of countries that have implemented or are implementing a tool to differentiate the impact of the regulatory proposals and thereby identify the regulations that must to provide a full evaluation. The following paragraphs give a brief description of each one of them.

[6] OECD (2008), *Building an Institutional Framework for Regulatory Impact Analysis (RIA): Guidance for policy makers.* Regulatory Policy Division, Directorate for Public Governance and Territorial Development.
[7] OECD (2006), *Determinants of quality in Regulatory Impact Analysis*. Regulatory Division, Public Governance and Territorial Development Department.
[8] OECD (2008), *Building an Institutional Framework for Regulatory Impact Analysis (RIA): Guidance for policy makers*. Regulatory Policy Division, Directorate for Public Governance and Territorial Development.

Australia[9]

The Regulatory impact evaluation process in Australia consists of two stages. The first one is known as *Preliminary Impact Assessment* (PIA), which is a requirement for all the regulatory proposals to assess its impact on firms (including public enterprises), consumers and the economic system in general. If the PIA identifies a ***significant negative impact*** associated with the regulatory proposal, the regulator is required to go with the second stage and elaborate a *Regulatory Impact Statement* (RIS).

The PIA consists on a brief description of the regulatory proposal, as well as some questions[10] to preliminary assess its costs and potential impacts. In order to identify whether the regulatory proposal generate significant negative impacts the regulator should take into consideration the size and importance of the sector affected by the proposal, the effect on the price of a good or service, and whether the proposal will impose any restrictions on operations within an industry, provide barrier to entry or exit, change the allocation of resources and/or change the regulatory burden.

Criteria to determine the significant impact of the regulatory proposals

Costs of the regulation. In order to determine the costs of the proposal, the respective costs of implementation, enforcement and administrative burden should be considered. The major three components of the cost evaluation in the PIA are:

> ***Broadness of cost impact*:** If there is a widespread cost impact across a large number of industries or if a large number of businesses and/or consumers in an industry incur the cost, the impact is likely to be significant. A proposal may be considered significant if the impact on the Western Australian economy is large, even where the proposal imposes only small costs per individual regulatory occurrence but these costs affect a large number of businesses or consumers.
>
> **Relative cost impact compared to business size:** A comparatively small cost impact on a large business may not be as significant as the same cost on a small business as there may be a disproportionate effect which may, for instance impact on the viability of the small business or its ability to deliver a service or product (such as imposing a flat fee). If the cost per business is substantial, it is also likely to be significant. These criteria would also apply to any administrative or enforcement cost on Government.
>
> **Frequency of cost impact**: Annual or reoccurring costs may be more significant than one-off costs. For example, a one-off business licensing cost, even if 'large', may not be as significant as an annual licensing fee of 'medium' size.

Restrictions on Competition. An analysis of the impacts arising from a restriction on competition should consider the following:

> **Barriers to entry or exit:** In determining the significance of negative competition impacts, consideration should be given to whether there are barriers to entry or exit. In general a proposal is likely to be considered to have a significant negative impact if it imposes controls that reduce the number of participants in a market or the incentives to compete in a market through the allocation of licenses, rights, entitlements, quotas or franchises, or restriction of secondary markets of any of the above.
>
> **Allocation of resources:** Consideration should be given to whether there are restrictions on operation within a market. If the regulatory proposal substantially alters or limits the way the commercial activities of a business are undertaken, or resources in the economy are allocated within a market, a significant impact may

[9] Government of Western Australia. *Regulatory Impact Assessment Guidelines for Western Australia* (2010). Disponible en: http://www.finance.wa.gov.au/cms/uploadedFiles/Economic_Reform/ria_guidelines.pdf

[10] These questions may refer to the nature and magnitude of the problem to solve, or to the objectives, alternatives, public consultation, implementation and evaluation of the proposed regulation.

exist. This type of regulation may alter the range, quality or availability of goods or services provided in the market (and consequently, increase prices) and is likely to be significant.

Effect on market function: If the regulatory proposal substantially alters or limits the way the commercial activities of a business are undertaken. Restrictive regulation may affect market function by way of determining the prices or charges for a particular good or service, setting hours of operations, size of premises, provision of specified facilities, geographical area of operations or means of advertising or promotion etc. These regulations are more likely to be significant if they change the operations of a business or market substantially

Soruce: Government Western Australia, Regulatory Impact Assessment Guidelines

Mexico

In Mexico, COFEMER has a set of filters to determine whether a proposal needs to make a regulatory impact evaluation or not, aiming at an efficient use of public resources. For that, there are some criteria that must be considered to determine the relevance of the **compliance costs** of the regulatory proposal and, therefore, if a Regulatory Impact Evaluation is needed.

Such decision criteria established in the "RIA Guideline's" are well known by all the public servants of the Federal Government, in the way that they determine by themselves if it is needed to conduct a Regulatory Impact Evaluation for each regulatory proposal and they submit to COFEMER for its approval.[11]

A regulatory impact evaluation must be submitted when the regulatory proposal:

i. It creates new obligations for individuals or makes stricter the existing obligations;

ii. It creates or modifies formalities (except when the amendment simplifies and facilitates the individual's compliance);

iii. It reduces or restricts rights or benefits to individuals or,

iv. It provides definitions, classifications, characterizations or any other term of reference that, together with other provision in force or a future provision, affects or may affect the rights, obligations, benefits or formalities of individuals.

Once the regulator, according to the previous criteria, has determined if the proposal needs the elaboration of a regulatory impact evaluation, an electronic tool named *Regulatory Impact Calculator* identifies the type of evaluation needed, based on the following questions:

1. What is the type of economic process associated with the proposal? (Foreign trade, domestic market, biddings and tenders, information technologies, real-estate development, foreign direct investment, credit, touristic development, etc.).
2. Identify the number of consumers or users of the product or service. (In the case that a regulation is not directly related to a product or service, the size of the population affected by the problem that the regulatory proposal aims to address is chosen)
3. How often the product is consumed? (In the case that a regulation is not directly

[11] For details, check the Mexican RIA guidelines on: http://www.cofemer.gob.mx/documentos/marcojuridico/acuerdos/AcuerdoPlazos26072010.pdf

related to a product or service, choose the problem's frequency or incidence)

4. How many economic entities will have to accomplish the regulatory proposal?
5. How often does the objective population (regulated entities) must comply with the regulatory proposal?
6. What is the type of economic activity affected by the proposal? (Manufacturing, trade, construction, education, agriculture and animal husbandry, transportation, mining, financial services, energy, etc.)
7. What type of costs would be generated by the regulatory proposal?
8. To what type of legal arrangement does the proposal belong to?
9. What would be the potential impacts of the proposal on competition and free competition?
10. Does the regulatory proposal might have an impact on any of the following sectors: Natural gas, carbon or black smoke; rail or air transports, telecommunications, electric energy, financial services, patents or pharmaceutical activities?

Once the questions were answered by the regulators, the *Calculator* determines if the regulatory proposal requires a *Moderate Impact Evaluation* or a *High Impact Evaluation*. The former consists on a general analysis (qualitative, in some cases) of 14 questions, to determine the overall costs and benefits of the proposal, while the latter refers to a full analysis of 20 questions which demands a more specific and detailed cost-benefit analysis.

Malaysia

In Malaysia, the quick-scan is the preliminary and optional process before undertaking a Regulatory Impact Assessment (RIA). It is an internal tool of scoping exercise used by organization to assess gaps, deficiencies and weaknesses in the information needed to elaborate RIA, as well as to identify any future problems. The benefits of the quick-scan are:

- **Understanding:** Clarifies the nature and extent of the problem to be addressed, and identifies factors that contribute to the problem.
- **Planning:** Identifies the likely resource and information requirements for preparing a full RIA.
- **Communication:** It summarizes key aspects of the problem in a way that can be easily understood by various audiences

The quick-scan tool consists of five exercises: 1) Definition of the problem, 2) identification of regulatory alternatives, 3) setting of performance measures and constraints, 4) scoring and selecting options, and 5) data requirements and stakeholder identifications.

Box: Performance indicators

Indicators can be of the following types:

Quantitative indicators: they are those which results are directly expressed through measurements in numbers or amounts, that is, they take fixed values expressing numerically the proportion they reflect.

Example:

$$MA_t = \frac{TA_t}{TT_t}$$

MA_t: Share of air transport in domestic cargo movement during year t.
TA_t: Millions of tons transported by air within the country during year t.
TT_t: Millions of tons moved in total by any means of transport inside the country during year t.

Qualitative indicators: they are those expressed through aspects that are not directly measured, such as opinions, perceptions or people's judgment about something, these answers can be usually expressed in an accounting way.

Example: an example of these indicators is the perception Index on public safety (IPSP in Spanish) published by INEGI. Though it is true that at the end the result is reflected in a number, it is also true that this number reflects a perception or opinion. IPSP is built with five partial indicators: 1. Speaking in terms of public safety, how safe do you feel now compared to 12 months ago (one year ago)? 2. How do you think that your safety will be within 12 months, compared to the present? 3. What do you think about public safety in the country nowadays compared to 12 months ago (one year ago)? 4. How do you think that public safety will be in the country within 12 months compared to the current situation? 5. How safe do you feel walking alone down the place where you live between 4 and 7 pm? In the first four questions respondents have five options to answer: much more safer/better, a little safer/better; same (nothing has changed)/same, more insecure/worse and much more insecure/worse. In the last question the answer choices are: very safe, safe and unsafe.

Direct indicators: they are those that directly measure the variables related to the objective to be measured.

Example: for a regulatory project aimed at decreasing the number of deaths from alcohol consumption in young people between 16 and 20 years, then a direct indicator is as follows:

$$MACt = \frac{DTPt}{TPt}$$

MAC_t: Mortality from alcohol consumption in target population in year *t*
DTP_t: Deaths from alcohol consumption for the target population (16-20 years) in year *t*
TP_t: Total population from 16 to20 years in time *t*

Indirect indicators: they are those which do not comprise the variables directly related to the objective to be measured and they use the indicator as a proxy, that is, they can be considered as a proxy when direct indicators are too difficult to measure, as they require a significant amount of money, time or very complex calculations.

Example: the GDP measurement meets the characteristics above; it requires high spending, time and complex calculations. In this sense, each month the National Institute of Statistics and Geography (INEGI) of Mexico provides the Global Indicator of Economic Activity (IGAE in Spanish), this would be a proxy indicator of the economic activity. This indicator includes preliminary information and does not include all of the activities that form the Quarterly Gross Domestic Product, so it should be considered as a trend or direction indicator of the Mexican economy in the short term and its growth rate may differ from that recorded by the GDP.

Positive indicators: They are those that indicate progress if their value increases.

Example:

$$AGRSC = \frac{SCt_2 - SCt_1}{SCt_1} * 100$$

AGRSC: annual growth rate of specialized cargo
SCt_1: specialized cargo in year 1
SCt_2: specialized cargo in year 2

Negative indicators: they are those that indicate a setback if their value increase.

Example:

$$AIR_t = \frac{IP_t}{TP_t} * 100$$

AIR: Annual illiteracy rate of the population of 15 years or more in year *t*.
IP: Population who does not read or write of 15 years or more in year *t*.
TP: Total population of 15 years or more in year *t*.

In this case, if the rate increases, then it indicates a reversal in the public policy focused on increasing the number of people who read and write.

Annex 1. Market Failres Examples

1. EXTERNALITIES

The 2010 Oil Spill in the Gulf of Mexico

On April 20, 2010, a massive explosion occurred in the Macondo oil rig in the Gulf of Mexico, which was operated by British Petroleum (BP) about 50 miles away from the coast of Louisiana. 36 hours later, a second explosion shook the rig again, causing it to sink. To May 27th, 2010, both incidents created a leak that spewed 798,000 gallons of crude oil per day into the water, resulting in the worst environmental disaster in the history of the United States of America.

This is a classic example of a **negative production externality**. Besides, its repercussions on the marine ecosystems and biodiversity, the negative shock spread to a number of economic activities, such as fishing, tourism and oil subsea exploration. The latter, reduced the crude oil production and pushed upward its international price, having a negative impact on international demand. Considering fines, cleanup costs, settlements, compensations and payments for a sort damages, the negative externality of the oil spill reached the sum of about 2.7 billion euros equivalent to 3.5 billion dollars[12]. By September 2010, expenditures for these items amounted to 11.2 billion dollars and the company´s estimation was in to 40 billion dollars.

This emergency situation demanded the intervention of the United States Federal Government. During 2010 and 2011, the US Environmental Protection Agency powers were divided, and a National Oil Spill and Offshore Drilling Commission was created in order to provide recommendations on how the impact of any future spills resulting from offshore drilling can be prevented. In addition, EPA announced in November 2012 the temporal banning of BP companies from participating in or receiving new federal contracts on drilling and production operations until the causes of the explosion were determined. Apart of these measures, new rules were promulgated by the US Congress on offshore drilling[13]. Even after these actions were taken, there is a consensus among experts about the need of more budget, specialized training and stronger regulatory improvement aimed at resolving the consequences of this accident, as well as preventing another similar oil spill to happen.

2. INFORMATION ASYMMETRY

Mexican Official Norm 005-SCFI-2005 on measuring the dispensing of gasoline and liquid fuels

In 2004, Mexican authorities identified that 90% of the fuel service stations all over the country did not provide to customers with full liters of gasoline. A 2005 survey, conducted by the Federal Attorney's Office of Consumer, demonstrated that 86% of the gasoline consumers did not rely on the service stations dispatch.

According to data from the Mexican National Metrology Center (CENAM) and from information provided by the producers of liquid fuels dispensaries, 26,213 out of 46,160 dispensaries (57% of them) were not equipped with any type of reliability device (such as encapsulated chips, system's main card, audit schemes and dispatch binnacles). In addition, the problem has grown: it was found that the computers and counters of the dispensaries were altered, permitting the unfair execution of different instructions so the dispensaries dispatch a volume of fuel that does not correspond to the paid amount for it, affecting this way the consumer's welfare.

This is a classic example of an **information asymmetry**. This type of market failure occurs when a product seller – in this case the dispensaries' franchisee – knows the product quality better than the consumer, who faces a disadvantage situation. This asymmetry of information could lead on a **moral hazard problem**, since the franchisee, taking advantage of his position, can alter the dispensary's software or hardware with the porpoise of not dispatching complete liters, defrauding on this way the consumer. This tend to be the often situation because the consumer is not likely to notice and prove the fraud.

This situation demanded the State intervention, in order to correct the market failure. Since 2006, the Mexican Government has implemented quasi-regulatory actions through the conclusion of agreements with the dispensaries producers, as well as taxation incentives to reduce unfair practices and improve the fuel dispensing service all over the country. In 2010, the Government decided to undertake more explicit regulation to solve this market failure, by issuing the *Official Norm 005-SCFI-2010 on measuring instruments-system metering and dispensing gasoline and other liquid fuels- specifications, test methods and verification products*.

[12] http://www.huffingtonpost.com/tag/bp-oil-spill-cost
[13] http://www.bp.com/en/global/corporate/gulf-of-mexico-restoration/investigations-and-legal-proceedings.html

CHAPTER II

STATISTICAL AND TECHNICAL CONSIDERATIONS OF THE IMPACT ANALYSIS

Chapter II. Statistical and technical considerations of the impact analysis

As described in the previous chapter, throughout the impact evaluation process we should consider including detailed and organized statistical information, wherever possible.That is, the identification of the problem and the setting of regulatory alternatives are recommended to be supported with data or empirical evidence to back them up. During the impact analysis the use of statistics is helpful because it allows us to identify and monetize the effects of regulation or other public policy.

Often, such information is organized into databases, which are a comprehensive collection of records systematically grouped and organized. Considering the above, this chapter is meant to explain the basics to create a proper database, assuming that resources to do so are scarce.

Likewise, it is also presented a guide to determine and characterize the effects produced by public policies such as regulation, in order to simplify the identification of costs and benefits this generates, and thus subsequently quantify and monetize them. At this point, we will realize that often the costs and benefits are not generated with the same temporality, which involves an additional difficulty in the analysis. In these cases, we have to discount the flows, or translate them into the same period of time, to make them comparable. Therefore, in this chapter we also explain how to discount the costs and benefits of regulation as an essential element of the impact analysis.

2.1 Database development

One way to organize the information required in the impact evaluation process is through **statistical databases**, which are a systematically ordered collection of information about a population group of interest, with fields and records as key elements.

A field is a feature of the target population that we try to capture, while a record refers to an individual or an element belonging to such population. For example, in a database of aircraft accidents, a field is: the "type of aircraft", "type of accident", "number of deaths", "number of injuries". While a record refers to the specific data observed: "Boeing 747" and "124 accidents per year."

The regulator can use various sources in order to obtain the required information, such as:

1. Information in databases existing within the government[14]
2. Information in the country databases different than the ones made by the government.
3. Similar information in other places in order to extrapolate the information
4. Making of surveys[15]

[14] It is possible that the database the regulator needs does not exist, but different government institutions may have part of the information that the analyst needs. In this case, the greatest problem that the regulator faces is resorting to the right agencies to get the information and then processing it.
[15] Method highly used in social regulation, example: Contingent valuation method.

The choice of each source will depend on the availability of information, resources and time. The fourth alternative is the most expensive, considering that making a survey requires more time and effort. Therefore, it is best to get data from other sources when possible, it may even be more feasible to obtain data from other populations and adapt it to the local context. For this purpose, we recommend the use of the benefits transfer method, which will be discussed later in Chapter 4.

2.2 Analysis of the target population and sampling techniques

Usually, the target population or the segment of population affected by the government action is too large, which avoids or hinders the direct study of all its elements. So, in order to facilitate data collection, it is convenient to consider only a subset of the total population. This subset is called **sample**. A sample is a group of elements selected from the population of interest and it is used to represent such population[16]; it is obtained to infer the properties of the whole. Choosing a sample has the advantage that it is not necessary to study the entire population to reach the same conclusions.

For the sample to be statistically valid, it must be **representative** of the total population, that is, it must have the same characteristics (statistical) observed in the total population. A representative sample can be **random**, meaning that all elements of the population have the same probability of being chosen. Such samples allow us to compare the results, that is, in a random sample the most important segments of the population are represented in the corresponding ratio[17]. If the sample is not random, it can happen that this is biased and, therefore, it is not representative.

In order to define the optimal number of elements that should make up the sample, we must consider the following:

1. Statistical significance level (α):[18] It is the risk we accept from making mistakes when presenting our results. The lower the significance level, the stronger the evidence that a fact is not due to mere coincidence (chance). The most common significance levels are 10%, 5% and 1%.
2. Variance (σ^2): It refers to the dispersion of values within the sample around the mean.
3. Sampling error (e): It is the possible difference between the result we get by asking a sample and the result we would get if we asked the total population. This value refers to the fluctuation we are willing to accept in our sample.

Having defined the previous parameters, we must use the following two formulas, as applicable:

i. When we know the population size, the sample size (n) is determined by the following formula:[19]

[16] Cochran, W. (1977). Sampling Techniques. 3era Edición. John Wiley & Sons
[17] Morales, P. (2012). Tamaño necesario de la muestra: ¿Cuántos sujetos necesitamos? Available in the next link: www.upcomillas.es/personal/peter/investigacion
[18] It is also known as type 1 error. In hypothesis testing, it is the probability of rejecting the null hypothesis when it is true.
[19] Source: Morales, P. (2012). *Tamaño necesario de la muestra: ¿Cuántos sujetos necesitamos?* (Universidad Pontificia Comillas de Madrid, 2012)

$$n = \frac{N}{1 + \frac{e^2(N-1)}{Z_{\alpha/2}^2 \sigma^2}}$$

Where,
N: Population size
$Z_{\alpha/2}$: Critical value of the normal distribution, taking into account the level of significance α.[20] Thus, for a 5% significance, this value is equal to 1.96.
σ^2: Population variance, defined as the possible variability within the population. It is very important to note that this parameter is usually unknown, so we should choose the greatest possible variance.[21]
e: Desired sampling error, expressed as a percentage. This parameter is defined by the one in charge of designing the sample, it is often defined as five or ten percent.

ii. When the population size is not precisely known, or when the population is too large,[22] the formula is more simple:

$$n = \frac{Z_{\alpha/2}^2 * \sigma^2}{e^2}$$

2.3 Extrapolation of the sample

The purpose of drawing a sample is inferring, from this, the characteristics of the target population. This requires extrapolating the characteristics of the sample, which means to apply the conclusions drawn from studying this subset to the entire population.

In order to extrapolate the characteristics of the sample, we just have to make an adjustment depending on the case. When the subset belongs to a homogeneous population, we only need to apply a **weighting of scale**, and when the total population is not homogeneous, or it is composed of several subgroups, we have to use a **proportional weighting**.

Weighting of scale. In order to expand the scale of the results of the sample to the population, these must be multiplied by the inverse of the sampling ratio (n/N). In the case of simple random sampling, where all the elements have the same probability of being selected, there is only one sample ratio, therefore, the total results of the sample are multiplied by this scale factor:

$$v = \frac{N}{n}$$

Where,
N: Population size
n: Sample size

Proportional weighting. In the case of stratified sampling, where the population is divided into several segments with one feature in common, we have to obtain proportional factors for each group and then these are multiplied by the scale factor. That is:

[20] The critical values of the normal distribution are available in tables of the standard normal distribution for the most common significance levels (1%, 5% and 10%).
[21] Under the assumption that the way to get the database is through dichotomous surveys, that is, where the only possible answers are yes or no, then we can state that the greatest possible variance (that is, the greatest diversity of responses) is that in which half of the subjects answer yes, and the other half answer no. So, knowing that the variance is the multiplication of the ratio of both types of responses, then: $\sigma^2 = (0.50) * (0.50) = 0.25$
[22] It is often assumed that a population is large when the number of elements is greater than 100,000.

$$w_k = v\pi_k$$

Where π_k, or proportion factor, is defined as:

$$\pi_k = \frac{N_k/N}{n_k/n}$$

Where
N_k: Population size of the stratum or group
n_k: Sample size of the stratum or group

Rewriting the weighting:

$$w_k = \frac{N_k/N}{n_k/n} \times \frac{N}{n} = \frac{N_k}{n_k}$$

The proportional weighting is useful when studying a large population made up of several subsets[23]. For example, a regulatory impact analysis applied to all companies in the country (target population) should consider the existence of several types (groups), such as micro, small, medium and large enterprises. They all share characteristics that identify them as part of a stratum of the population. So, the sampling will be collected within each type of enterprise, that is, we have to choose a subset within each group. Once we know the costs and benefits that affect the companies that made up the sample, these results should be extrapolated. This is done through the proportional weighting. We will exemplify this.

Example of the drawing of a representative sample

The purpose of this exercise is to determine the impact of a regulation aimed at increasing the safety of office workers. This regulation establishes that all enterprises, regardless of their size, must include a screen protector in their computer equipment to reduce the damage to the eye caused by the monitor light. In order to facilitate the measuring of the costs of regulation compliance, we have considered classifying the universe of enterprises into: micro, small, medium and large. So, what should be the sample size for the database to be representative?

As we saw above, to obtain the sample size for each enterprise stratum, we must know the value of the population variance:

Table: Relevant information

Classification by size	Population (N)	Standard deviation	Variance (σ^2)
Micro (mi)	3,804,310	0.4	0.16
Small (s)	250,834	0.3	0.09
Medium (me)	83,611	0.6	0.36
Large (l)	41,806	0.8	0.64
Total	4,180,560	0.55	0.3025

Source: COFEMER

[23] Maletta, H. (2007). "Weighting". Buenos Aires, Argentina. Recuperado el 3 de Septiembre de 2013, de http://goo.gl/Tvf3YM

It is also defined a margin of error of 3%, a significance level (α) of 5% and, thus, a $Z_{\alpha/2} = 1.96$. We obtain the sample size for each business stratum based on this:

Table: Sample size[24] (n_k)	
Micro (mi)	683
Small (s)	384
Medium (me)	1,509
Large (b)	2,564
Total	**5,140**

Source: COFEMER

Once we know the size of the sample, we can conduct a survey and find out how many protectors are required for each type of business. We get that micro enterprises purchase, on average, two protectors, the small fifteen, the medium fifty, and the large a hundred. Thus, considering that each protector costs $200, the sample cost is given by: $c_k = [p * q_k] * n_k$.

Table: Total cost of the sample

Business	Breakdown of the cost	Sample cost
Micro	$c = [\$200 * 2] * 683$	273,131
Small	$c = [\$200 * 15] * 384$	1,150,722
Medium	$c = [\$200 * 50] * 1{,}509$	15,089,264
Large	$c = [\$200 * 100] * 2{,}564$	51,286,010
Total		**67,799,128**

Source: COFEMER

Now that we know the sampling costs for each type of enterprise, it is necessary to extrapolate them to know the costs of the total population. To do this, we need to define the weighting of scale applicable to each group, so we will use the weighting of scale formula, that is, $w_k = \frac{N_k}{n_k}$:

Table: Expansion factor

Enterprise		Expansion factor (w_k)
Micro	$w_k = 3{,}804{,}310/683$	5,570
Small	$w_k = 250{,}834/384$	653
Medium	$w_k = 83{,}611/1{,}509$	55
Large	$w_k = 41{,}8060/2{,}564$	16

Source: COFEMER

Knowing the weightings, we can extrapolate the sample results to the total population by multiplying them by the expansion factor, that is $Cost_{pop} = cost_{sample} * w_k$

[24] Thus, using the formula $n = \frac{N}{1+\frac{e^2(N-1)}{Z_{\frac{\alpha}{2}}^2 \sigma^2}}$ for the micro enterprise size, we obtain that $\mathrm{n} = \frac{3{,}804{,}310}{1+[(.03)^2(3{,}804{,}310-1)]/(1.96)^2(0.16)} = 682.82 \approx 683$

Table: Extrapolation of costs

Enterprise	Extrapolation	Population cost
Micro	$= 273{,}131 * 5{,}570$	$1,521,342,203.53
Small	$= 1{,}150{,}722 * 653$	$751,666,136.99
Medium	$= 15{,}089{,}264 * 55$	$836,071,217
Large	$= 51{,}286{,}010 * 16$	$836,209,990
Total	**67,799,128**	**$3,945,289,547**

Source: COFEMER

2.4 Identification of costs and benefits of regulation

When making an impact evaluation, the regulator should try to identify most of the impacts of the regulation, whether negative (costs) or positive (benefits), as well as quantifying and monetizing them, as far as possible.

The European Commission provides the following guidance to identify the economic, social and environmental effects, depending on their origin:[25]

ECONOMIC IMPACTS	KEY QUESTIONS
Functioning of the internal market and competition	*• What impact (positive or negative) does the regulation have on the free movement of goods, services, capital and workers?* *• Will it lead to a reduction in consumer choice, higher prices due to less competition, the creation of barriers for new suppliers and service providers, the facilitation of anti-competitive behavior, emergence of monopolies or market segmentation?*
Competitiveness, trade and investment flows	*• What impact does the regulation have on competition of firms? Does it impact on productivity?* *• What is the impact on trade barriers?* *• Does it provoke cross-border investment flows (including relocation of economic activity)?*
Operating costs and business activity en small and medium enterprises	*• Will the regulation impose additional adjustment, compliance or transaction costs on businesses?* *• How does it affect the cost or availability of essential inputs (raw materials, machinery, labor, energy, etc.)?* *• Does it affect access to finance? Does it impact on the investment cycle?* *• Will it entail the withdrawal of certain products from the market?* *• Will it entail stricter regulation of the conduct of a particular business?* *• Will it lead to new or the closing down of businesses?*
Administrative burdens on businesses	*• Does the regulation affect the nature of information obligations placed on businesses (for example, the type of data required, reporting frequency, the complexity of submission process)?*
Public authorities	*• Does the regulation have budgetary consequences for public authorities at different levels of government, both immediately and in the long run?* *• Does it require the creation of new or restructuring of existing public authorities?*
Property rights	*• Does the regulation affect property rights?* *• At worst, will there be a complete loss of property?*
Innovation and development	*• Does the regulation stimulate or hinder innovation and development? Does it promote or limit academic or industrial research?* *• Does it facilitate the introduction and dissemination of new production methods and technologies?* *• Does it affect intellectual property rights?*

[25] European Commission (2009). "IMPACT ASSESSMENT GUIDELINES," SEC(2009) 92. pp. 33-38. Consulted on 22nd September, 2013 at:
http://ec.europa.eu/governance/impact/commission_guidelines/docs/iag_2009_en.pdf

	• *Does it promote greater productivity or resource efficiency?*
Consumers and households	• *Does the regulation affect the prices consumers pay?* • *Does it impact on consumers' ability to benefit from the internal market?* • *Does it have an impact on the quality, availability or choice of the goods or services consumers buy* • *Does it affect consumer information and protection?*
Specific regions or sectors	• *Does the regulation have significant effects on certain economic sectors?* • *Will it have a specific impact on certain regions or will the impact be disproportionate?*
International relations	• *How does the regulation affect investment flows? How does it affect the trade policy?* • *How does it affect the different specific groups (foreign and domestic businesses and consumers)?*
Macroeconomic environment	• *Does the regulation have consequences for economic growth and job creation?* • *How does it contribute to improving the conditions for investment and the proper functioning of markets?*
SOCIAL IMPACTS	**KEY QUESTIONS**
Employment and labor markets	• *Does the regulation facilitate new job creation?* • *Does it lead directly or indirectly to a loss of jobs?* • *Does it have specific negative consequences for particular labor groups* • *Does it have an impact on the functioning of the labor market?*
Standards and rights related to job quality	• *Does the regulation impact on job quality?* • *Will it affect workers' health, safety and dignity?* • *Does it directly or indirectly affect workers' existing rights and obligations (access to information and consultation of their labor status, protection against dismissal, the minimum conditions)?* • *Does it directly or indirectly affect employers' existing rights and obligations?* • *Does it facilitate or restrict restructuring, adaptation to change and the use of technological innovations in the workplace?*
Social inclusion and protection of particular groups	• *Does the regulation lead directly or indirectly to greater equality or inequality?* • *Does it affect equal access to services and goods?* • *Does it affect access to placement services or to services of general economic interest?* • *Does it affect specific groups of individuals (for example the most vulnerable or the most at risk of poverty, minorities, etc.), firms or other organizations?*
Gender equality, equality of opportunities, non - discrimination	• *Does the regulation affect the principle of non-discrimination, equal treatment and equal opportunities for all?* • *Does it have a different impact on women and men? Does the option promote equality of gender?* • *Does it entail any different treatment of groups or individuals directly on grounds of sex, racial or ethnic origin, religion or belief, disability, age, and sexual orientation? Or could it lead to indirect discrimination?*
Personal, private and family data	• *Does the regulation affect the privacy of individuals?* • *Does it affect the right to liberty of individuals? Does it affect the rights of the child?* • *Does it involve the processing of personal data or the concerned individual's right of access to personal data?*
Governance, participation, good administration, access to justice, media and ethics	• *Will the regulation affect the individual's rights and relations with the public administration? Does it affect the individual's access to justice?* • *Does it foresee the right to an effective remedy before a tribunal?* • *Does it affect the public's access to information?* • *Does it affect somehow the media, media pluralism and freedom of expression?*
Public health and safety	• *Does the regulation affect the health and safety of individuals or populations, including life expectancy, mortality and morbidity, through impacts on the socio-economic environment (working environment, income, education, occupation, etc.)?* • *Does it increase or decrease the likelihood of health risks due to substances harmful to the natural environment?* • *Does it affect health due to changes in the amount of noise, air, water or soil quality? Does it affect lifestyle-related determinants of health such as diet, physical activity or use of tobacco, alcohol, or drugs?* • *Are there specific effects on particular risk groups (determined by age, gender, disability, social group, mobility, region, etc.)?*
Access to and effects	• *Does the proposed option have an effect on the Access to education and on mobility*

on social protection, health and educational systems	*of workers?* *• Does it affect the access of individuals to public and/or private education or continuing professional training?* *• Does it affect the access to social, health or care services?* *• Does it affect universities and academic freedom or self-governance?*
ENVIRONMENTAL IMPACTS	**KEY QUESTIONS**
The climate	*• Does the option affect the emission of greenhouse gases (e.g. carbon dioxide, methane etc.) into the atmosphere?* *• Does it affect the emission of ozone-depleting substances (CFCs, HCFCs)?*
Use of energy	*• Will the proposed option affect somehow the use of energy or alters fuel consumption?* *• Does it affect the fuel mix (between coal, gas, nuclear, renewables etc.) used in energy production?* *• Will it increase or decrease the demand for transport, or how will this influence its modal split? Does it increase or decrease vehicle emissions?*
Air quality	*• Does the proposed option have an effect on air pollutants emission (acidifying, eutrophying, photochemical, etc.) that might affect the atmosphere, human health, damage crops or buildings or lead to deterioration in the environment (soil or rivers etc.)?*
Biodiversity, flora, fauna and landscapes care	*• Does the regulatory option reduce somehow the number of species, varieties or races in any area (that is. reduce biological diversity) or increase the range of species (for example, by promoting conservation)?* *• Does it affect protected or endangered species or their habitats or ecologically sensitive areas?* *• Does it affect migration routes, ecological corridors and/or buffer zones? Does it affect the value of the protected area or landscape?*
Water quality	*• Does the proposed option decrease or increase the quality or quantity of freshwater and/or groundwater?* *• Does it raise or lower the quality of waters in coastal and marine areas (for example, through discharges of sewage, nutrients, oil, heavy metals, and other pollutants)?* *• Does it affect drinking water resources?*
Soil quality	*• Does the option affect the acidification, contamination or salinity of soil, and/or soil erosion rates?* *• Does it lead to loss of available soil (for example, through building or construction works) or increase the amount of usable soil (for example, through land decontamination)?*
Land use	*• Does the option have the effect of bringing new areas of available land into use for the first time?* *• Does it affect land designated as sensitive for ecological reasons?* *• Does it lead to a change in land use (for example, the divide between rural and urban zones, or the change in type of agriculture)?*
Renewable or non-renewable resources	*• Does the regulatory option affect the use of renewable resources or does it lead to an inappropriate use of the same? Does it reduce or increase the use of non-renewable resources (groundwater, minerals, etc.)?*
Waste production, generation and recycling	*• Does the proposed option affect waste production (solid, urban, agricultural, industrial, mining, radioactive or toxic waste) or how waste is treated, disposed of or recycled?*
Environmental risks	*• Does the proposed option affect the likelihood or prevention of fire, explosions, breakdowns, accidents and accidental emissions?* *• Does it affect the risk of unauthorized or unintentional dissemination of environmentally alien or genetically modified organisms?*

Costs of regulation

The negative impacts are understood as the costs of regulation and, according to their nature, these can be classified as direct or indirect, as well as quantifiable or non-quantifiable, or according to the regulated subject into business costs, consumer costs, environmental costs, health and safety costs and government costs, among others.

Costs have the effect of reducing the welfare of an institution, a particular person, a specific group of the population, or the population in general. Therefore, the regulatory impact evaluation seeks to ensure that public policy alternatives to be implemented always generate more benefits than costs and the maximum benefit to society.

The International Standard Cost Model Manual[26] establishes a basic classification of the different costs that a regulation can generate, these are:

A. Direct financial costs: Direct financial costs: are the results of a direct and specific request of the competent authority to carry out a particular action. Normally, this is a transfer of money for the payment of fees. These costs include administrative expenses, taxes, permits, licenses, among others.

B. Long-term structural costs: refers to the operational and maintenance costs that continually, companies must meet to comply with the regulation. These costs must be covered while the regulation is in effect.

C. Costs of compliance: these are the costs caused by the regulation. These can be of two types: indirect financial costs and administrative costs.

1. ***Indirect financial costs:*** these refer to the essential costs of regulation, that is, the legal obligations imposed on businesses through regulations, standards and any legal instrument that seeks to ensure the public interest and should be directly and completely met.

2. ***Administrative costs:*** these are composed of administrative burdens and administrative or usual costs of business.

    i. ***Administrative burdens:*** these refer to the costs of information obligations of the regulation that businesses must comply because regulation requires to do so.

    ii. ***Administrative Costs (usual costs of business):*** these include administrative activities that businesses will continue to perform, even if regulations are removed.

On the other hand, regulators may consider the **opportunity cost** as another compliance cost; this is defined as the cost of the second best option that was not chosen. It can also be understood, as the cost in money or time incurred by the regulated to comply with regulation, rather than investing such resource (time and money) in activities that generate greater value added.

Similarly, losses in social welfare of consumers in a particular market or of citizens of a State can be identified as costs of regulation, for example a decrease in competition or in the supply of certain product, the increase in social inequality or the effects on income distribution in general. In addition, the macroeconomic impact that regulatory proposals might have can also be considered as cost of regulation.

[26] Consulted on 22nd September, 2013 at http://www.oecd.org/regreform/regulatory-policy/34227698.pdf

In the same way, implementing the regulation also generates costs to the government. The costs of enforcing the regulation, or "enforcement costs," are those arising from the verification or monitoring of the compliance with the standard, as well as its execution or implementation. Often, these costs can be of capital (or expenditures on equipment or machinery to implement the proposal), or operational (the resources necessary to enforce the compliance with the regulation). In this sense, the ideal is to include both types of costs, but considering only the incremental costs generated from the implementation of the regulation (Treasury Board of Canada Secretariat, 2008); that is, the costs of enforcing the regulation does not include the expenses that government pays as part of its daily operation, as these are regarded as sunk costs or non-recoverable.

The estimate of the costs of enforcing the regulation depends on the expected rate of non-compliance with the standard. If infringement of regulation is often expected (maybe because there are not enough incentives to do so) the authority will have to allocate more resources to its verification or monitoring. Therefore, the challenge is to design the regulation in such a way that it encourages its compliance, that is, provide the appropriate incentives for regulated entities to reduce the costs of verification and monitoring to a minimum.

Type of cost	Examples	
Direct financial costs	The payment of rights for a driving license	The payment of rights for a license to sell alcoholic beverages
Long-run structural costs	A regulation requesting the renewal from time to time of an insurance policy for citizens to drive	A regulation requesting the verification of CO_2 emissions of cars from time to time, so that they can run
Indirect financial costs or essential costs of regulation	In a regulation on workplace safety requesting businesses to equip their facilities with fire extinguishers, fire alarms and sprinklers. The cost of this equipment would be the indirect financial cost	An environmental regulation on air quality standardization requiring companies to modify the cars' engines they manufacture, in order to reduce the emission of pollutants
Administrative burdens	An impact regulation on sea transportation requiring shipping companies to send monthly reports on the amount of transported cargo	Filling of several registration forms and verification of requirements to apply for a permit to operate as a pharmaceutical company
Opportunity cost	In a regulation that involves processing a certificate of air operator by aircraft. The opportunity cost is the money that is not received when the aircraft is on the ground, until the certificate is obtained.	A regulation that restricts the amount of tons that a boat can carry regardless of its maximum capacity.

All the previous costs can be included in the evaluation or analysis, except for **usual business costs**, since, with or without regulation, these costs must be incurred by companies for their operation.

Box: Costs of compliance for Mexico

In Mexico, the Federal Commission for Regulatory Improvement (COFEMER) has the following criteria for identifying if a regulatory project has compliance costs:

i. It creates new obligations for individuals or makes stricter the existing obligations;

ii. It creates or modifies formalities (except when the amendment simplifies and facilitates the individual's compliance);

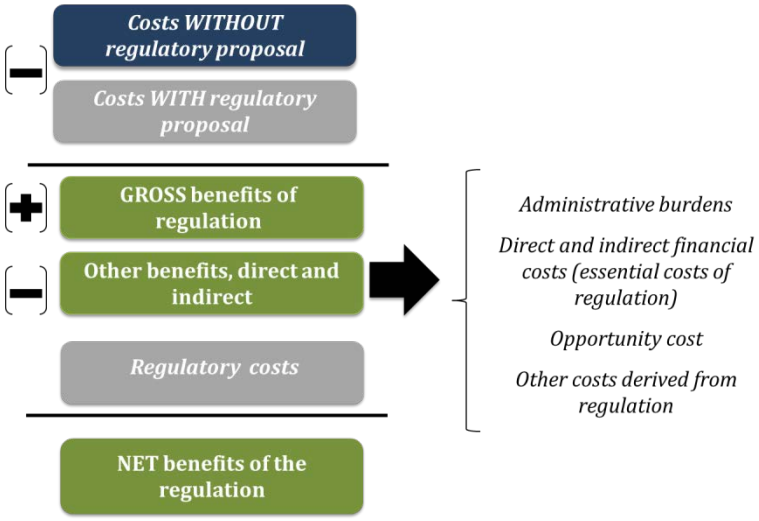
iii. It reduces or restricts rights or benefits to individuals or,

iv. It provides definitions, classifications, characterizations or any other term of reference that, together with other provision in force or a future provision, affects or may affect the rights, obligations, benefits or formalities of individuals.

Benefits of regulation

Benefits of regulation may include: a decrease in the number of accidents in the workplace, improvements in the population health or education, a reduction in costs to comply with certain administrative process or an improvement in the quality of a product.

In a broad sense, benefits are defined as the improvement of welfare population derived from the implementation of regulation; also, the costs avoided because of the implementation of a public policy are considered as benefits. One way to identify the benefits of regulation can be represented by the following formula:



However, as in the previous case, most of the times benefits cannot be directly quantified. In these cases we must resort to methods to infer the benefits derived from the government action, though these cannot be directly observed. Such is the case of environmental pollution or an improvement in the health of population; although these effects can be measured (by using tons of CO_2 emitted, in the first case, and by the extension of life expectancy, in the second), they are difficult to monetize. For those cases, in chapter four we provide some methods to monetize such effects and thus make them comparable with the costs of regulation to define the best alternative of public policy.

To make it simple, we can characterize the impacts that regulatory policies generate according to their origin: direct or indirect effects, or depending on whether they can be

directly monetized (quantifiable), or when we have the use of a specific method to do so (non-quantifiable).

Direct and indirect effects

One way to classify the effects is as direct or indirect. Direct effects are those causally related to the public policy objective, that is, a direct consequence of this, while indirect or secondary effects are byproducts, externalities, or effects derived from the public policy, different from the initial objective. The following table illustrates this classification, according to the type of regulation in question:

Table. Direct and indirect costs and benefits

Regulation	Regulation	Costs		Benefits	
		Direct	Indirect	Direct	Indirect
Social	**Rules determining the CO_2 emission standards in cars' exhaust**	The automotive industry invests in technology to produce more efficient exhausts	An increase in the price that consumers pay for a car	A decrease in the level of respiratory diseases resulting from high levels of CO_2	Homogenization of the quality of cars' exhausts that facilitate consumers the acquisition of automotive parts
Economic	**Rules determining labor safety in the iron and steel industry**	The industry incurs administrative and investment costs to improve workplaces	A decrease in labor economic benefits offered by companies	A decrease in deaths and accidents in workplaces	Increase in labor productivity, since the worker works best in a safer environment
Administrative	**Operating rules that government agencies must comply**	Compliance costs in administrative matters to implement the regulation	Losses in terms of citizens adaptation to the new specifications	Greater administrative efficiency, reduction in paperwork and redundant processes	Reduction of administrative and opportunity costs incurred by citizens and companies when interacting with the company

Quantifiable and non-quantifiable effects

Quantifiable impacts are those that can be easily identifiable in unit terms in the analysis, they can also be directly converted into monetary units. In contrast, the non-quantifiable costs and benefits include abstract and, to some extent, subjective aspects. For the latter, we can use impact quantification methods, which are meant to monetize such abstract aspects. These methods are extensively described in Chapter 4.

The following table goes back to the previous classification, so that effects are classified as direct quantifiable and unquantifiable, and indirect quantifiable and unquantifiable.

Table. Quantifiable and non-quantifiable costs and benefits

Regulation	Negative impacts (costs)				Positive impacts (benefits)			
Economic transfer program conditional on low-income people in deprived areas	**Direct:** Economic budget allocated to the program compliance		**Indirect:** Decreased wildlife		**Direct:** Decrease in drop-out of school and increase in medical visits; necessary conditions for economic transfers		**Indirect:** Increase in the level of private investment to boost industry and commerce in the region	
	Quantifiable	**Non-quantifiable**	**Quantifiable**	**Non-quantifiable**	**Quantifiable**	**Non-quantifiable**	**Quantifiable**	**Non-quantifiable**
	Economic costs of the installation and modernization of schools and hospitals	Opportunity cost of not investing in another social program	Reduction in revenues from tourism and agriculture in the region	Increase in CO_2 levels and noise pollution	Increase in the level of average wage in the region	Decrease in deaths from disease Increase in the level of regional labor specialization	Economic value of the investment Tax exemptions for companies investing in the region	Decrease in prices of goods for local consumption, as a result of greater competition

To sum up, quantifiable means that the policy effects can be directly monetized, as the information required exists in the market. For example, the economic costs of modernizing a hospital can be directly measured, just by adding up the costs reflected in the invoices. On the other hand, non-quantifiable impacts cannot be directly monetized, since they come from abstract elements for which there is no market. A clear example is the noise: there is no market to estimate the costs generated by this kind of pollution. There are methods to monetize the latter.

Therefore, both quantifiable and non-quantifiable impacts can be monetized, though in the case of the latter it is necessary to apply a method to do so.

2.5 Actual costs and benefits vs. transferences

We must avoid quantifying as costs or benefits aspects that are just an exchange or transfer of resources from one group to another. In this sense, it is important to clarify the difference between actual costs and benefits and transfers.

The **actual costs and benefits** represent the net gains or losses generated to society, while **transfers** only change how these resources are distributed, going from one social group to another.

Thus, the actual costs and benefits consider the monetary amount saved or avoided, lives saved, the increase or decrease in costs incurred by taxpayers, and the time saved and increased in life quality. On the other hand, when social benefits are offset by other losses these are called transfers.

For example, a tax reduction program for the elderly will provide a benefit of tax savings for some, but a cost (for the same amount) for others (in terms of taxes increase). Many government programs include certain types of subsidies from one group to another, and this should be clearly identified when possible. But from a global perspective, transfers do not increase total welfare, but they simply **redistribute** it.

2.6 On the inferences used for the evaluation

At the beginning of the analysis, it is recommended to establish the inferences of the parameters used in the evaluation of the regulatory proposal. This reduces the risk of manipulation of results when working with them and provides transparency to the analysis.

For anyone who has access to the regulatory impact evaluation to be able to identify and understand all the inferences considered by the regulator, it is suggested to draw up a table with the values of the variables and their behavior (under inference). There is an example below:

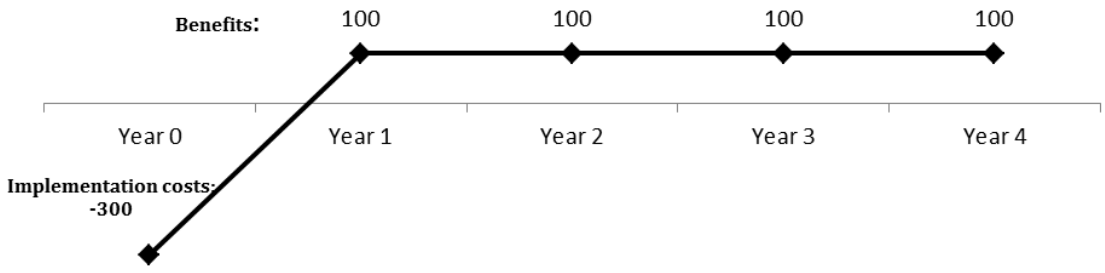
Table: Table of inferences

Variable	Used value	Inferences
Discount rate (r)	12%	It is directly taken from SHCP, considering the similarity of the regulatory project with the social investment of projects.
Inflation rate (i)	4%	Considering the moving average of the past 10 years, the inflation rate of 4% meets the needs of the project.
Population growth rate (g)	2.1%	Directly obtained from CONAPO predictions.
Evaluation horizon	30 years	Since it is a regulatory project unrelated to aspects of innovation, technology and/or growth of the country, its length is expected to be great, to discount future flows it is used a length of 30 years instead of perpetuity.

2.7 Discounting of costs and benefits

After identifying, classifying and monetizing the positive and negative impacts of each regulatory alternative, it is necessary to compare these effects to decide which the best option is. However, alternatives generate costs and benefits with different periodicities. There are cases in which regulation only generates costs when it is implemented and benefits in the following periods. The following figure illustrates this with a hypothetical example in which the implementation of the regulation generates costs of $300 only in the first period and benefits of $100 in the following years.

Image: Costs and benefits over time



In the example, the cost of implementing the regulation, $300, cannot be compared with the sum of the future benefits this generates, since they do not correspond to the same time period. That is why future benefits or costs should be discounted, that is, they must be translated into the same temporality to be comparable. Discounting involves assigning

a lower value to the cash flows generated in the future, comparing them with those of the present; for this reason these flows are divided between the discount rate. At this point, **it is convenient to consider costs and benefits as cash flows**, as these are money movements as well.

A cash flow is a series of currency movements affecting the development of the project over time. In the impact evaluation process, the cash flow reflects the monetary impact caused by the benefits and costs generated by each of the regulatory alternatives.

The cash flow of a regulation can be understood as follows:

Concept of costs (mop)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Investment in IT	$451.22	$225.61	$75.20	-	-	-
Personal	$149.20	$89.52	$59.68	-	-	-
Operating cost IT	$155.23	$155.23	$155.23	$155.23	$155.23	$155.23
Training cost	$441.56	$331.17	$220.78	$331.17	$220.78	$331.17
Miscellaneous	$77.62	$77.62	$77.62	$77.62	$77.62	$77.62
Annual flows of costs	**$1,274.82**	**$879.15**	**$588.51**	**$564.02**	**$453.63**	**$564.02**

The previous table shows the costs generated by the implementation of a regulatory policy. There are six periods; an annual flow of costs is generated in each, which is the sum of the costs incurred in this period. As we already mentioned, these flows must be discounted first, and then compare them with the benefits.

We use the following formula to discount the flows and bring them to present value (PV):

$$V_0 = \frac{V_t}{(1+r)^t}$$

Where:

- V_t is the value of a monetary amount over time t;
- r is the discount rate;
- t is the number of periods;
- V_0 is the **present value**; the result of discounting the flows in time zero (initial or basis);
- Discount factor: $\frac{1}{(1+r)^t}$

Considering that a regulatory proposal generates both costs and benefits through years, it is essential to obtain the **net present value (NPV)** of the regulatory proposal, which is the present value of benefits minus the PV of costs. This involves the use of the following formula:

$$\mathbf{NPV} = \sum_{t=o}^{T} \frac{\text{Benefits}_t}{(1+r)^t} - \sum_{t=o}^{T} \frac{\text{Costs}_t}{(1+r)^t} = \sum_{t=o}^{T} \frac{(\text{Benefits}_t - \text{Costs}_t)}{(1+r)^t}$$

It should be noted that the flows of both costs and benefits are not necessarily sequential, that is, they could be defined in nonconsecutive periods. Suppose that benefits are generated in periods 3, 5 and 12, so the formula of the PV of benefits is:

$$PV = \frac{V_3}{(1+r)^3} + \frac{V_5}{(1+r)^5} + \frac{V_{12}}{(1+r)^{12}}$$

The net flow is the difference between the flow of benefits and the flow of costs for each year. The following table illustrates the discount of the net flow, where negative flows are in red and, in these cases, the costs exceed the benefits. Note that the discounted value of the flow is lower than the original net flow.

Concept/Year	1	2	3	4	5	6
Annual flow of benefits	$ 777.78	$ 835.26	$ 874.72	$ 829.26	$ 846.41	$ 850.13
Annual flow of costs	$1,274. 82	$ 879.14	$ 588.51	$ 564.02	$ 453.63	$ 564.02
Net flow	-$ 497.03	-$ 43.87	$ 286.21	$ 265.24	$ 392.78	$ 286.11
Discounted flow	**-$443.78**	**-$34.97**	**$203.72**	**$168.56**	**$222.87**	**$144.95**

Box: Present value of perpetuity

In some cases, regulators are interested in issuing regulations that have no expiration period or that remain in force for long periods of time. In this regard, when the implementation period of a public policy is too long or it does not consider a finite horizon of operation, it is suggested to use the present value of perpetuity (PVP) to measure the impact of regulation, instead of using the present value.

So, the Present Value of Perpetuity (PVP) is the value of today of a series of equal flows that are expected to continue indefinitely in the future.

$$PVP_{=} \frac{A}{r}$$

Where:

- A: is the value of the flows in each period
- r: discount rate

Now, if we know that our flows will grow at a certain rate, for example, if we evaluate a regulatory proposal that depends on the population in each country, it is correct to assume that the flows will increase as much as the population rate.

On the other hand, **a growing perpetuity** is applied when it is expected to receive future flows that will grow at a constant rate over time. It must be noted that the discount rate will depend on the speed at which the value of the flows is close to zero.

Thus, the Present Value of Growing Perpetuity (PVGP) is obtained through the following equation:

$$PVGP = \frac{A}{r-g}$$

Where:

- g: is the growth rate at which perpetuity payments grow
- A: represents the payment at the end of each period of time
- r: is the discount rate

2.8 Evaluation horizon of regulatory alternatives

The evaluation horizon is the period in which it is expected that alternatives generate costs and benefits. Its definition will, invariably, modify the impact analysis, as it modifies the extent of the projection of the effects produced by each regulatory alternative: the higher the evaluation horizon, the greater the amount of effects to be considered. Therefore, the determination of the evaluation horizon will define the results in favor or against the regulatory proposal.

The following criteria help to define an evaluation horizon:

- ***The horizon must reach the point at which the contribution of discounted net benefits starts to be negligible.*** That is, the evaluation horizon ends when benefits and costs, brought to present value, contribute with minimum amounts to the total of net benefits. That is, the analysis should be extended as much as necessary to ensure that net benefits are not underestimated. When information is insufficient to identify the periods in which costs and benefits will be generated, it is advisable to use a long period as evaluation horizon (for example, New Zealand uses a period of analysis of twenty-years), as well as a perpetuity to discount the flows, as explained in the previous section.
- ***The horizon can be set for the period of the sunsetting clause of the regulatory action.*** There will be regulations that already have an expiration date, for example, there are regulations in which it is established that they only apply for the next ten years.
- ***The horizon limit can be extended to the point at which benefits and costs are separated by generational barriers.*** For example, if costs will be covered by the present generation, then only the policy benefits that this population will enjoy must be quantified.
- ***The horizon should be as long as the expected life of capital investments*** required by the regulatory policy or as long as the physical effects caused by the benefits.

Though it is quite difficult to define a single evaluation horizon for all kinds of regulation, the European Commission has established a guide [27] to do so; defining the length of horizon according to the regulated sector:[28]

Sector	Baseline evaluation horizon
Energy	**15-25 years**
Water and environment	30 years
Railway sector	30 years
Ports and airports	25 years
Roads	25-30 years
Industry	10 years
Other services	15 years

Sources: (European Commission, 2006) and (Anon., Miller & Robinson)

In addition to this, it also proposes the following table to define the evaluation periods of social regulation:

Time horizon by sector	
Sector	**Period of reference**
Environment: water	20-30
Environment: air (this varies according to the effect of the element, for example methane which can be from 20 to 100 years)	20
Health	20
Labor	10

Sources: (Anon., Miller & Robinson), (Department of Labor, 2013) and EPA

[27] "Guidance on the methodology for carrying out cost-benefit analysis" European commission, Working Document No. 4, 2006.
[28] This guide focuses on the evaluation of investment projects. Though an investment project is not the same as a regulatory project, there is evidence that shows that an alternative to estimate the evaluation period of standards requiring additional large capital investments is using the lifespan of capital (Office of Management and Budget, 2011). Therefore, the previous table can be useful when evaluating regulatory projects.

Finally, the RIAS Writer's Guide of the Government of Canada[29] points out that ***10 years is the evaluation horizon often used for regulatory projects***. However this will vary depending on the nature of the regulatory proposal and on the degree of available information.

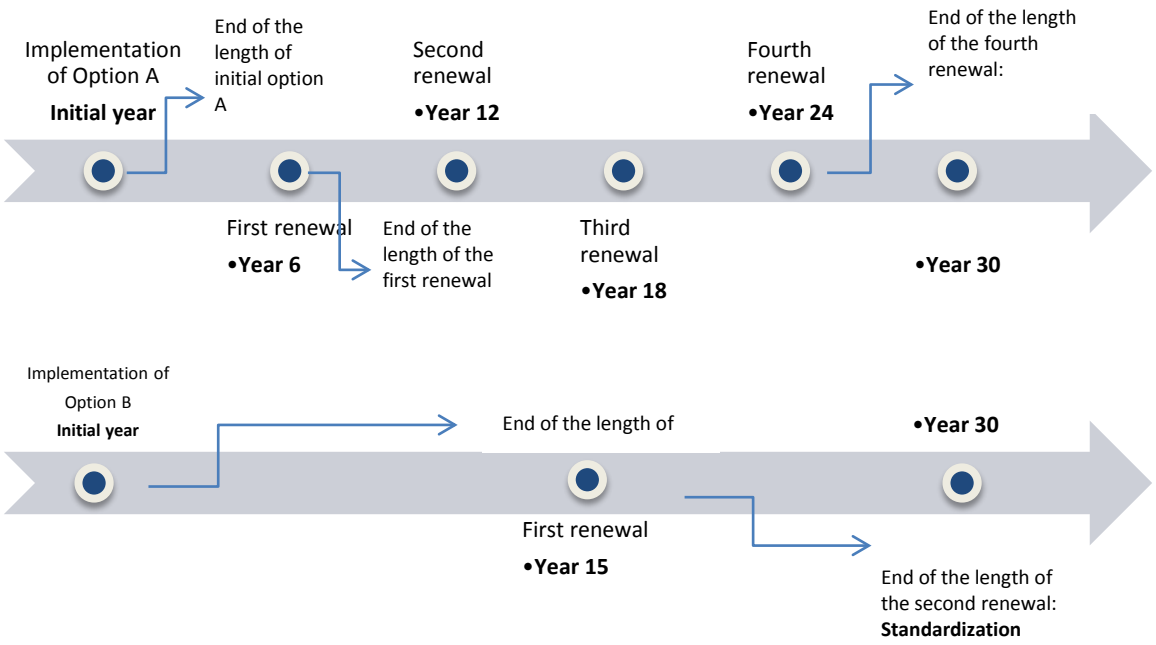
On the other hand, each regulatory alternative will often present a different time horizon. In these cases, we have to **standardize the temporality** of the alternatives by using as reference framework the longest one, and then it is necessary to bring these alternatives to present value by using the same evaluation horizon. This is called standardization because we get a measure in common (common denominator) as evaluation horizon.

For example, imagine that there are two regulatory alternatives, which purpose is to reduce environmental pollution. The first option seeks to implement a new technology in cars engines, and the other is to regulate the emission of polluting gases from the factories of the city.

Option A: Improve the technology of cars engines	Lifespan: 6 years
Option B: Regulate pollutant gases emission	Lifespan: 15 years

Performing a standardization implies that both policy options must be defined over the same evaluation horizon. We have two alternatives:

Figure 1:Standardization of the Regulatory improvement programs



On the other hand, if we implement option A three times (first application plus two renewals), then the improvement in the engines will have effect for 18 years, while implementing option B only once (first implementation) will have effect for 15-years. However, if we implement five times the improvement in the engines technology (first

[29] Treasury Board of Canada Secretariat, RIAS Writer's Guide, 2009. Consulted on 26th September, 2013 at http://www.tbs-sct.gc.ca/ri-qr/documents/riaswg-grrier/riaswg-grrier-eng.pdf.

implementation plus 4 renewals) this generates an effect that will last 30 years, while implementing the regulation of gases emissions twice (first implementation plus a renewal) will have effect for 30 years.

That is, standardize involves finding the common denominator in the two alternatives duration, and define a single evaluation horizon for both cases. Once we perform the standardization, we bring costs and benefits to present value in this evaluation horizon. However, in order to bring to present value it is necessary to know the costs generated from the implementation of alternatives. That is, we can mistakenly assume that costs will remain constant, or that improving cars technology and implementing the regulation of gases emission will cost the same in thirty years. In these circumstances, it is convenient to estimate the **future costs** bringing them to future value, and then bringing them to present value. Bringing to future value is a way to estimate how much it will cost to implement both alternatives, considering that we only know what it costs in the present.

In order to bring costs to future value we can use the inflation rate (let us suppose that it is 4%) or another rate that reflects the opportunity cost of money over time.[30] In this case, the values are:

Table: Flow scheme and future value

Period of time	Today	6 years	12 years	15 years	18 years	24 years	30 years
Future value (Option A)	$150.00	$189.80	$240.15	-	$303.87	$384.50	There is no application
Future value (Option B)	$ 350.00	-	-	$630.33	-	-	There is no application

Source: COFEMER

That is, by using a rate of 4%, $350 brought to future value at will worth $630.33 in 15 years; likewise, the $150 of today cost of project A will worth $303.87 within 18 years. Once we have the values in their corresponding years of implementation, we calculate the present value of such amounts by using a discount rate of 10%.

- Present value of the costs of option A =$ 427.35
- Present value of the costs of option B= $ 500.90

Considering that we are quantifying the implementation costs of both policies, we need the alternative with the lowest value, which is option A.

2.9 Discount rate

In order to make any regulatory impact evaluation, we must specify a discount rate (*r*), considering that costs temporality will hardly meet that of the benefits. The discount rate is the rate used to discount the flows, or the costs and benefits of regulation. In general, the discount rate should reflect the opportunity cost of implementing or postponing any benefit obtained from investment.[31]

Defining the discount rate is difficult, considering the diversity of policy proposals to be assessed. In particular, in the regulatory context, the discount rate is conceived as the

[30] It should be noted that, under the assumption that the discount rate and the rate to be projected is the same, there is no need to make any projection or discount.
[31] Baumol William, On the social rate discount (2001), American Economic Review.

social yield that would be expected from a regulation. Among the main approaches on the discount rate are:

Table: Discount rates

Discount rate	Characteristics	Advantages	Disadvantages	How to calculate it[32]
The social rate of time preference (OCDE, 2006)	It is the rate at which the social value of consumption decreases over time, that is, the rate of return (marginal rate of substitution) that makes society indifferent between consuming an x amount today, or consuming x* (1+r) the next period. This rate is different from the Individual marginal rate of substitution between consumption and saving.	This rate reflects social preferences (costs and benefits to society) and not only financial considerations; therefore, it is a recommended rate to evaluate the feasibility of regulatory proposals.	It is difficult to estimate, because of its statistical complexity and the data collection.	Ramsey equation: $r = \rho + \mu * g$
Discount rate of the social opportunity cost of capital (New Zealand Treasury, 2002)	The social opportunity cost of capital is the best alternative available to the private sector. So, considering that this rate determines the efficient level of resources allocation between the public and private sectors, the rate is based on the idea that **the best alternative of $1 of public investment is $1 of private investment.**	When investment decisions of government are efficient, the social opportunity cost is considered as alternative.	It is assumed a perfect level of government and markets efficiency, leaving out the tax implications, externalities and intergenerational altruism.	$\mathrm{WACC} = k_b * \frac{D}{(D+E)} + \frac{k_e}{1-T_c} * \frac{D}{(D+E)}$
Hybrid discount rate (rate of weighted pesos)	It is the rate that takes into account all sources of resources used for certain policy. That is, it is a rate that weights the social rate of temporal preference[33] and the social opportunity cost of capital.[34]	It is considered as a complete way of estimating the opportunity cost of public resources, as it considers social consumption preferences and the profitability of private investment.	It is difficult to determine the weightings for each rate, as well as its impact on the levels of consumption and investment.	$\tau = \alpha * \mathrm{WACC} + (1-\alpha) * r$
Shadow price of capital (Cline, 1992)	The shadow price of an asset is defined as the price that such good would reach in a perfectly competitive market, in the absence of any kind of distortion, such as taxes or externalities.	The value of the shadow price of capital depends only on the temporal preference rate, the opportunity cost of capital and the duration of the investment.	It does not include aspects of externalities, intergenerational consumption and taxes.	$\mathrm{Tspk} = \frac{r}{i}\left[\frac{1-(1+i)^T}{1-(1+r)^T}\right]$

Source: COFEMER

[32] You can obtain more information in the annex of this section.
[33] It must be used to take into account the cost of unrealized consumption.
[34] It must be considered to include the loss in private investments.

Canadian government[35] is a remarkable example of this, as it uses an actual rate of discount of 8%. This rate derives from the opportunity cost of the funds used to finance a regulation project. This rate reflects, largely, the yield that could have been obtained in other investment projects. On the other hand, another recurrent approach in that country is using a social discount rate, which is usually lower than 8%. This rate is often based on the rate of preference for temporal consumption, or the rate at which agents discount both, future consumption and projected growth of consumption, such rate is around 3%.

2.10 Inflation

As part of the analysis, it is important to consider the inflationary effect on flows over time. Considering that the price level does not remain constant, inflation is an element that we have to consider to compare the costs and benefits of different periods. If we intend to make an analysis in real terms, which is recommended, we must bring everything to constant prices, that is, we have to deflate the costs and benefits generated by the different policy alternatives. It is important to **keep in mind that costs and benefits must be compared in nominal or real terms, we cannot never mix real and nominal terms.**[36]

One way to convert the flows of different periods into constant prices involves the following elements:

1. ***Presentation of costs and benefits***. It is necessary to present a table of the costs and benefits that the policy or regulation alternatives are expected to generate. It is advisable to present these flows in nominal terms to convert them then into real.

Example: Presentation of flows in nominal terms

Table: Nominal flows

Year	*Benefits*	*Costs*	*Net benefits*
2011	100	160	-60
2012	125	100	25
2013	175	100	75
2014	250	100	150
2015	200	100	100

2. ***Choice of a base year***. We have to choose a year as a base to deflate or convert the flows of the referred periods into prices of such year. In a retrospective analysis, that is, when evaluating a policy or regulation in force, the regulator chooses a base year. Usually, the start of validity of a policy is chosen as base year.

3. ***Projected inflation.*** Considering that the analysis of costs and benefits includes projected values, we have to consider that inflation is also projected. In this regard, we could consider inflation for subsequent periods within the range projected by the Central Bank, or we could use the projections of international institutions like the International Monetary Fund or the World Bank.

[35] Canadian Cost-Benefit Analysis Guide: Regulatory Proposals. 2007, pp. 35-37. Consulted on 26th September, 2013 at the following link: http://www.tbs-sct.gc.ca/rtrap-parfa/analys/analys-eng.pdf

[36] It is useful to consider the following definitions:

- **Purchasing power:** It is the value of a currency expressed in terms of the goods and services that a money unit can purchase.
- **Nominal values (at current prices):** These are the flows presented in prices of the current period. They include the inflation value, that is, the change in prices from period to period.
- **Constant values (at constant prices):** These are the flows converted into prices of certain period in order to compare the value of the goods and services in terms of the purchasing power of that year.

4. ***Construction of an index to convert flows into constant prices.*** Once we know the projected inflation, we have to create an inflation index regarding the base year (which will be assigned a value of 100). This index will allow converting the flows into constant prices. The formula to construct the index is:

$$\text{Index}_t = (1 + \pi_t) * \text{Index}_{t-1}$$

Example: Suppose that the starting year of the policy to be implemented is 2011, and that we choose this as the base year. The inflation index is built from the inflation observed in 2011 and taking into account the projections for subsequent years.

Table: Inflation index

Year	*Inflation*	*Index*
2011	3.8%	100
2012	4.1%	104.1
2013	3.7%	107.9517
2014	3.2%	111.4062
2015	3.1%	114.8597

5. ***Conversion of flows into constant prices.*** Once we constructed the index, we have to deflate[37] the figures for different lifespans of the policy. The formula for deflating the flows is:

$$\text{Real flow}_t = \text{Nominal flow}_t * \frac{100}{\text{Inflation index}_t}$$

Example: Calculation of real values at prices of 2011

Table: Real value of prices

	Nominal values			Real values			
Year	Benefits	Costs	Net benefits	Benefits	Costs	Net benefits	Deflactor
2011	100	160	-60	100	160	(60)	1
2012	125	100	25	120.08	96.06	24.02	0.96
2013	175	100	75	162.11	92.63	69.48	0.92
2014	250	100	150	224.40	89.76	134.64	0.89
2015	200	100	100	174.13	87.06	87.06	0.87

Source: COFEMER

6. ***Use of rates to discount flows.*** Once the table with flows at constant prices is ready, it is necessary to discount the flows by using the appropriate discount rate; that is, expressing in real terms all the values is not equivalent to discount flows.

[37] Deflate: converting a figure expressed in nominal terms into a figure in real terms.

Annex 1. Quantification of the discount rate

1. Ramsey equation and the social discount rate

(Price, 1988) defines the social discount rate as the rate used by society to assign a relative weight to consumption or income at different points in time, so that for many years the social discount rate has been calculated through the Ramsey equation (Ramsey, 1928) and its different modifications (Scott, 1989) and (Pearce, 1999).

$$r_{Ramsey} = \rho + \mu * g$$

Where:

- *r* is the social discount rate through the Ramsey equation,
- ρ is the pure discount rate of individuals, which reflects the impatience of the same over time. (Scott, 1989) estimated the value of ρ=0.5%,
- μ is the elasticity of the marginal utility of income (consumption), that is, the percentage change in individuals utility due to a percentage change in income (consumption).
- g is the income growth rate or the growth rate of per capita consumption.

Taking as a basis the Ramsey equation, (The World Bank, 2008) estimated the discount rates for nine economies in Latin America, with the following results:[38]

Table: Estimate of the social discount rate for LA economies

Economy	Social rate	Economy	Social rate
Argentina	4.6%	**Honduras**	3.3%
Bolivia	5.7%	**Mexico**	4.4%
Brazil	7.3%	**Nicaragua**	4.6%
Chile	5.7%	**Peru**	4.9%
Colombia	4.7%		

Unfortunately, this technique requires parameters that need to be estimated and thus a large number of inferences, making it difficult to estimate.

2. WACC, CAPM and the social opportunity cost of capital[39]

The **social opportunity cost of capital** can be an estimator preferable and accessible to regulators in order to obtain an estimate of the social discount rate,[40] especially for those cases in which we want to estimate a rate representing the opportunity cost by sector.

Among the methods for calculating the social opportunity cost of capital, the Capital Asset Pricing Model (CAPM) is the most accepted and is used to calculate the expected return of capital for government departments, then it is used in the calculation of WACC in order to incorporate the capital structure and the debt of government departments into the discount rate (New Zealand Treasury, 2002). Under this model, the discount rate (the social opportunity cost of capital) includes the inherent risk in the economic sector for which it is being used, so that it can be expressed as the sum of the return/profit of a risk-free asset

[38] Results linked to growth expectations of each country.
[39] For more information, consult (New Zealand Treasury, 2002).
[40] Young, L. (2002). "Determining the Discount Rate for Government Projects". New Zealand Treasury, Working Paper 02/21. Available at: http://goo.gl/bsTvW

(in the case of Mexico, cetes rate at 28 days is often used) and the premium for taking such risk, where the premium is determined by the characteristics of the sector involved.

$$k_e = R_f * (1 - T_C) + \beta_e[r_m - R_f * (1 - T_C)]$$

However, adapting the formula to the circumstances of the government and considering that the latter does not pay corporate taxes, we have:

$$K_e = \frac{[R_f * (1 - T_C) + \beta_e[r_m - R_f * (1 - T_C)]]}{1 - T_C}$$

Where:

- k_e: Is the social opportunity cost of capital
- R_f: Is the risk − free rate
- β_e: Represents the coefficient of the non-diversifiable risk, or the magnitude to which investments respond in relation to market changes
- r_m: Is the expected rate of return of the market
- $r_{market} - R_f$: Is the risk premium
- T_C: Is the corporate tax rate

According to the last formula, (Lally, 1998) supported by the Trade Commission of New Zealand, based on international studies, concludes that the risk premium is 7.0%. In this line, government bonds at 10-years are often used as risk-free rate; New Zealand uses 6.4% nominal or 3.4% real rate (New Zealand Treasury, 2008).

Finally, the process of obtaining beta has a higher degree of complexity when evaluating regulatory policies on health, environment, national defense, etc. In this sense (New Zealand Treasury, 2008), it is advisable to use as a pragmatic solution the market average, in the case of New Zealand is 0.67 (Bao, 2008).

As mentioned before, once we get the CAPM, we incorporate it into the estimate of WACC (Weighted Average Cost of Capital):

$$WACC = k_b * \frac{D}{(D+E)} + \frac{k_e}{1 - T_c} * \frac{D}{(D+E)}$$

Where:
k_b: Is the cost of government debt
D: Is the government debt
E: Is the government capital
k_e: Is the social opportunity cost of capital

This rate is often used for discounting flows in the evaluation of a company, as it incorporates the opportunity cost of capital and the opportunity cost of issued debt, thus the WACC weights the costs of each of the sources of capital.

The New Zealand government estimated the WACC (real) for a set of sectors, obtaining the following results:

Table: Estimate of WACC and its applications

Beta	WACC(actual)	Sector/application
0.42	6.0%	Construction
0.65	8.0%	Infrastructure
0.82	9.5%	Technology

Source: (New Zealand Treasury, 2008)

3. Estimate of shadow price of capital

Although there are several alternatives to quantify the shadow price of capital, there is evidence (Universidad Autónoma de Barcelona, 2003) showing that (Cline, 1992) and (Marglin, 1963) models present reliable results that adapt to reality.

$$Tspk = \frac{r}{i}\left[\frac{1-(1+i)^{T}}{1-(1+r)^{T}}\right]$$

Where:

- r: Is the internal rate of return (IRR) of the project of investing $1 during T periods;
- i: Is the intertemporal discount rate.

CHAPTER III

METHODS TO ANALYZE THE IMPACT OF REGULATION

Chapter III. Methods to analyze the impact of regulation

The impact analysis requires identifying and quantifying the costs and benefits of regulation and other regulatory policy alternatives. In the previous chapter we explained how to identify and characterize the effects of regulatory alternatives, considering that they can be social or economic, direct or indirect and intangible. There will be times in which these effects are directly measurable, that is, there is a market to determine them, so that their definition is direct. The monetizable requirements of a new regulation are an example of this, such as the costs directly linked to the compliance of a formality or purchasing a new machine. But, it may also happen that the effects of regulation are not directly monetizable, as there is no market to set their price. This includes many social regulations aimed at reducing the harm to environment or increasing the health of population.

When the impact quantification is directly done, that is, when there is a market for this, the impact analysis is simple, as we just have to apply the methods discussed in this chapter to choose the best alternative of public policy. When this is not the case, we can quantify the effects by using the methods illustrated in Chapter 4. Later, we will be able to apply the impact analysis methods explained below.

So, in this chapter, we will explain first the **Cost Benefit Analysis** (CBA), the **Breakeven analysis**, and the **Cost-Effectiveness Analysis** (CEA), as these are the most important and most used approaches in the impact analysis.. Later, we will explain the **Multi-Criteria Decision Analysis** (MCDA), which is an alternative that incorporates both monetary and non-monetary estimate of costs and benefits. Then, we will discuss the **profitability indicators**, which serve as supporting tools when comparing the different regulatory alternatives. In this regard, the **Equivalent Annual Cost** (EAC) stands out, which purpose is to generate a measure for comparing the costs on an annual basis, when they are generated in different periods of time and more than once. As an additional analysis approach, this chapter includes a method for qualitative analysis.

Finally, it is important that the regulator considers that the choice of any of these methods will be defined by the resources we have, and by the type of analysis required. For cases that require a more complete or holistic analysis, that is, when the regulation generates a significant impact on several areas and we have enough resources to do so, the appropriate analysis would be the multi-criteria analysis.[41] The profitability indicators serve as complements of the CBA, CEA and MCDA, and they are used to the extent that the available time or resources allow it, always considering that these indicators, as well as the three main methods, can be complementary when justifying the choice of a particular public policy.

3.1 Cost-Benefit Analysis

The cost-benefit analysis (CBA) is one of the main tools used to analyze the regulatory impact. The CBA is a tool of economic analysis requiring the previous monetary quantification of the positive (benefits) and the negative (costs) effects generated by public

[41] By the end of this chapter there is an annex compiling several international experiences on this aspect.

policies, so that they can be compared by two criteria, mainly: the Cost-Benefit Ratio (CBR)[42] and the net benefits.

The CBR is defined as the quotient of the present value of benefits divided by the present value of costs. When the CBR is greater than 1, benefits outweigh costs. Therefore, the **decision criteria indicates that if we are studying the feasibility of implementing the regulation and the CBR is greater than 1, it will be convenient to do so; otherwise costs will be higher than benefits and the proposal should be reviewed in detail.** Similarly, when comparing several public policy alternatives, we will choose the one that presents the highest CBR.

On the other hand, the net benefits are the present value of the difference between benefits and costs. Any project that generates positive net benefits must be accepted, and when considering various public policy alternatives and only one can be implemented, the decision criteria will be one of the main criteria[43] to choose the project that generates the greatest net benefits.

CBA application:

The following steps describe, roughly, the CBA implementation:

1. Identify direct and indirect impacts of the regulatory alternatives

The first step of the CBA is to identify the positive (benefits) and negative (costs) impacts on social welfare generated by the regulation. These Costs and Benefits (C&B) can generate direct or indirect impacts, as discussed in Chapter 2. Thus, compliance costs of regulation are included, as they are primarily considered as direct costs.

a) ***Direct costs and benefits:*** The direct benefits and costs of regulation are those obtained specifically and exclusively from its implementation. The costs and benefits must be based on market prices, as they are the easiest to identify. However, in many cases, it is necessary to evaluate the costs and benefits when there is no market price, in such cases estimation is difficult and it will require specific methods to achieve such objective (these are explained in Chapter 4).

Example: Regulation of power plants emissions

In Chile, the emissions from power plants have caused a strong environmental pollution problem. In this situation, the government of that country decided to intervene to solve this problem. Therefore, it was proposed that the objective of the government action was to reduce greenhouse gas emissions from power plants. Among the different alternatives were:

Baseline scenario: a non-regulatory scheme based on self-regulation of the sector, that is, let the thermoelectric industry decide what the appropriate level of emissions is.

The first regulatory alternative to consider is a co-regulation scheme, that is, a regulatory scheme designed in coordination with the government.

Finally, it was proposed a performance-based regulation, that is, an environmental standard establishing levels of specific results.

[42] The CBR is the quotient of benefits divided by costs, measured in the same monetary unit.
[43] Among other criteria that will be used is the sum of the initial amounts or fixed costs, profitability indicators, as well as an analysis of the budget and political restrictions that the regulation implementation will imply.

Identification of direct C&B

In this case, benefits are generated from the improvement in health caused by emissions reduction, so the larger the emissions reduction from power plants, the greater the health benefit generated. Furthermore, we identified two types of direct costs, caused by the initial investment required by the industry to comply with the regulation, and by the costs generated from the reduction in the annual amount of power generated, needed to reduce polluting gas emissions.

b) ***Identification of indirect benefits and costs:*** In addition to the direct impacts caused by regulation, the CBA must consider the impact on stakeholders or agents indirectly involved in the regulation. In particular, indirect effects are identified by a distributional analysis, which aims to allocate all costs and benefits generated by the regulatory action to each agent or economic sector indirectly affected. At this point, it is important to analyze the impact on competition, that is, explain whether the regulatory proposal impacts on competition or increases market power.

Regulation of power plants emissions: Indirect C& B

In order to identify the indirect C&B, first we have to identify those stakeholders directly affected by the regulation. So, in our example those agents directly affected are the businesses in the thermoelectric industry and the inhabitants of the regions that will benefit from cleaner air. We can see that the direct impact of regulation already involves a wide spectrum of the population, so that indirect effects are reduced to impacts on competition, which analysis will be discussed in detail in Chapter 4. In this case, we can see that the regulatory options restrict the requirements to generate power in different ways. Thus, a performance -based regulation places very strict requirements on the use of clean technologies, leaving out of the market any business that does not meet them. This ends up increasing the market power of producers in the sector, as the business able to comply with the regulation are less.

c) ***Identification of the remaining compliance costs:*** After identifying direct and indirect C&B of regulation, we just have to consider compliance costs that have not been identified so far. Following the classification provided in Chapter 2, we can see that this step usually focuses on administrative burdens, and on direct financial costs (licenses, rights, etc.) as well.

Regulation of power plants emissions: Administrative burden

In this example, much of the costs of compliance have been already considered by identifying the direct costs, so that only the administrative burden and the direct financial costs are missing.

In this sense, self-regulation, being a non-regulatory scheme, does not generate administrative burdens. Moreover, both co-regulation and performance-based regulation require the regulated business to report its compliance costs before the regulation is implemented. Such formality would cost $10,000 in the case of co-regulation, and $50,000 in the case of performance-based regulation.

2. Quantify and monetize costs and benefits

Once we identified C&B, we have to quantify them. Many times, these C&B are easy to quantify, as they are naturally expressed in market prices; however, as we already mentioned, benefits do not often meet this condition, since there is no market for them. In such cases, we have to identify the good to be quantified and then use methods to monetize it. The main methods for this kind of C&B (as they will be discussed in detail in Chapter 4) are the following:

- **Revealed preference tests**

- Hedonic prices
- Defense costs
- Cost of travel
- Cost of Illness

- **Stated preference tests**

- Contingent valuation

Regulation of power plants emissions: Quantification and monetization

Based on the report on costs of compliance with regulation explained in the previous box, we have the following costs for each alternative:

Self-regulation (baseline scenario): This option characterizes by having the lowest costs, since the industry would only incur an investment of $429 million to improve its current equipment so that this pollutes less. While this would only reduce greenhouse gas emissions in such an amount that the cost of reducing the power generation is equal to $127 million per year.

Co-regulation: This option requires an expense on investment of $798 million resulting from changing obsolete machinery in the industry. Furthermore, costs of $335 million per year were incurred to reduce the amount of generated power, the necessary action to reduce emissions, plus to the costs of administrative burden.

Performance-based regulation: In this alternative, investment costs amounted to $1,035 million, derived from a technological update in the industry. In addition, expenses because of less power generation amounted to $707 million, plus the costs of administrative burden.

On the other hand, benefits were calculated by using the contingent valuation method, asking people about their willingness to accept for a decrease of one hour of polluting gas emissions caused by power generation. From this method we calculated the willingness to pay (WTP) per one hour less of emissions per year. So that, the more the hours of emission avoided by the different alternatives, the greater the benefits. Thus, self-regulation is the one that avoids less emissions hours, so its annual benefit is $1,477 million. Then, since co-regulation causes emission less emission hours per year, the benefit is $2,713 million. Finally, performance-based regulation results in an annual benefit of $3,818 million.

3. Define the evaluation horizon and determine the cash flows

The next step is to establish the appropriate evaluation horizon (defined in Chapter 2) in which alternative are expected to generate costs and benefits. Besides, we can determine the cash flows once we define this horizon, based on the characteristics of the C&B quantified.

Regulation of power plants emissions: Evaluation horizon and flows

The following table summarizes the costs and benefits generated by each alternative. The evaluation horizon was defined for 20 years, which corresponds to the lifespan of the technology that will be used as a result of implementing the best of the regulatory alternatives. The C&B are expressed in millions of pesos, for example, the administrative burden for performance-based regulation is $50,000 dollars, that is, 0.05 million pesos.

Different alternatives in million pesos			
Alternatives	**Baseline scenario (self-regulation)**	**Co-regulation**	**Performance-based regulation (environmental standard)**
Benefits from WTP (annual)	1,477	2,713	3,816

Cost of investment (year 0)	-429	-798	-1,035
Cost of power production (annual)	-127	-335	-707
Administrative burden (year 0)	0	-0.01	-0.05
Flows year 0	**-429**	**-798.01**	**-1,035.05**
Flows year 1 to 20	$1{,}477 - 127 = \$\mathbf{1{,}350}$	$2{,}713 - 335 = \$\mathbf{2{,}378}$	$3{,}816 - 707 = \$\mathbf{3{,}109}$

4. Discount the cash flows

As we already saw, the benefits and costs must correspond to the same temporality to be compared. To do this, we use the concept of net present value. In addition, we need to appropriately define the interest rate (see Chapter 2) at which such C&B are discounted.

Regulation of power plants emissions: NPV

$$NPV = -Vo + \sum_{t=1}^{20} \frac{(B_t - C_t)}{(1+r)^t}$$

Substituting data we obtain:

Self-regulation: $NPV = -429 + \frac{1477-127}{(1+0.06)^1} + \frac{1350}{(1+0.06)^2} + \frac{1350}{(1+0.06)^3} + \cdots + \frac{1350}{(1+0.06)^{20}} = \$15{,}055.39$

Co-regulation: $NPV = -798.01 + \frac{2713-335}{(1+0.06)^1} + \frac{2378}{(1+0.06)^2} + \frac{2378}{(1+0.06)^3} + \cdots + \frac{2378}{(1+0.06)^{20}} = \$26{,}477.46$

Environmental standard: $NPV = -1035.05 + \frac{3816-707}{(1+0.06)^1} + \frac{3109}{(1+0.06)^2} + \frac{3109}{(1+0.06)^3} + \cdots + \frac{3109}{(1+0.06)^{20}} = \$34{,}624.94$

5. Make a sensitivity analysis, when needed

In its simplest form, sensitivity analysis involves calculating how much the costs and benefits change if a variable of interest changes. This tool is used in all valuation approaches of projects reviewed in this chapter and for various types of regulations. Because of its complexity, this step will be explained and exemplified in detail in the final considerations of this chapter.

6. Make a decision based on the criteria and choose the best regulatory alternative

Finally, the decision is made based on the alternative that provides greater net benefits over time. Another decision criterion is the Cost-Benefit Ratio (CBR), that is, the quotient of benefits divided by costs, measured in the same monetary unit:

$$\text{CBR} = \frac{(\text{Present value of benefits})}{(\text{Present value of costs})}$$

Both decision criteria, the CBR and the net benefits, are useful to choose the most convenient alternative: only the regulatory projects with CBR greater than 1, that is, with a positive CBR, can be chosen. However, **it is important to keep in mind that the CBA is a tool that supports decision making but it is not a substitute, that is, the regulatory policy maker should not be guided only by the CBA, but also by incorporating "non-quantifiable" factors that justify the regulation, such as equity, potential health risks, environmental damage, personal safety, etc.**, as well as factors related to budget

restrictions (for example, High costs during the first 5 years that may cause barriers to entry) and political or cultural restrictions that make impractical the implementation or the proper functioning of the regulation intended to be issued.

Regulation of power plants emissions: Decision making

Finally, comparing the NPV of each alternative, we conclude that the performance-based regulation generates more net benefits over time, so that the regulator must choose such environmental standard to implement it.

Alternatives	Self-regulation	Co-regulation	Performance-based regulation
Net present value (million pesos)	$15,055.39	$26,477.46	**$34,624.94**

3.2 *The Breakeven Analysis*

The *breakeven* analysis is a tool for impact measurement, used when the benefits of a regulation are clear but its effectiveness is not at all[44]. This analysis is aimed at responding the following question: *how effective the regulation should be for its benefits* (*avoided human deaths, diseases, injuries, etc.*) *to justify its costs of implementation?* [45] Or, in other words, how many deaths, diseases or injuries should the regulation needs to prevent in order to equalize its costs of implementation?

The breakeven analysis is likely to be used when a new regulatory approach is being implemented and there is little or no basis in previous experience upon which to make estimates of likely effectiveness, or else past experience suggests that levels of effectiveness vary widely in ways that are not easy predictable[46].

The difference between the Breakeven Analysis and the Cost-effectiveness Analysis is that, while the first one aims to identify an effectiveness measure of the regulation by setting the equilibrium point (breakeven) where the benefits of the regulation equal its costs, the second one compares within a set of regulatory (or even non-regulatory) alternatives to determine which of them implies the lower cost, without this to be considered as a determining criterion to accept or decline regulatory (or non-regulatory) alternatives.

Breakeven calculation

There are two possible ways for regulators to determine when the benefits of a regulation justify its costs. The first consists on using an effectiveness measure, and the second by calculating the reduction of social losses attributable to the regulation.

A. Via an effectiveness measure of the regulation

First. To determine the compliance costs/ regulatory costs of the regulation

[44] OCDE (2008). Introductory Handbook for Undertaking Regulatory Impact Analysis. p-14. http://www.oecd.org/gov/regulatory-policy/44789472.pdf
[45] Ibidem
[46] OCDE (2009). *OECD Reviews of regulatory reform. Regulatory Impact Analysis: A tool for policy coherence*. p-73. http://books.google.com.mx/books/about/OECD_Reviews_of_Regulatory_Reform_Regula.html?id=kSV2rZT7mS4C&redir_esc=y

Under this approach, the first step for the regulator to follow is to identify, quantify and monetize the costs caused by the regulation, also known as compliance costs or regulatory costs.

Example: ***"Official Mexican Standard PROY-NOM-032-ENER-2013. Maximum consumption limits for equipment and appliances that require standby power. Test methods and labelling.*** *(For mor detail see Case 8, Vol. II)*

The cost-benefit analysis of the NOM -032-ENER-2013, regarding the issuing of a Mexican Official Norm which objective is to reduce the electrical standby power consumption through a more efficient electrical equipment and appliances for domestic and office usage, determined that the costs of compliance (regulatory costs) of this norm in 2012 were equivalent to **277 million pesos**.

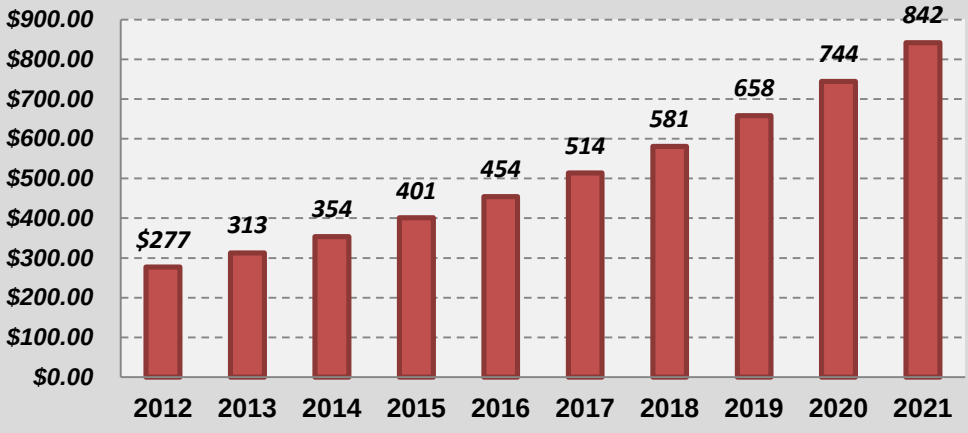
Assuming an annual increase of 5.15% in the compliance costs (regulatory costs) associated to the labeling, certification and laboratory tests for the electrical equipment and appliances, as well as an annual increase of 7.62% in the sales of such equipment and appliances, the compliance costs of the norm (regulatory costs) were estimated as follows:

Compliance costs (regulatory costs)

Year	Labeling (pesos)	Certification (pesos)	Laboratory tests (pesos)	Sales of equipment and appliances (units)	Total costs of compliance (millions of pesos)
2012	10.76	0.05	0.10	25,361,084	277
2013	11.32	0.05	0.11	27,293,788	313
2014	11.90	0.06	0.11	29,373,778	354
2015	12.51	0.06	0.12	31,612,279	401
2016	13.16	0.06	0.12	34,021,371	454
2017	13.83	0.06	0.13	36,614,053	514
2018	14.55	0.07	0.14	39,404,317	581
2019	15.30	0.07	0.14	42,407,220	658
2020	16.08	0.08	0.15	45,638,967	744
2021	16.91	0.08	0.16	49,116,996	842

Source: Prepared using data from SENER

Total compliance costs
Millon of pesos, 2012 - 2021



Source: Prepared using Data from SENER

Second. *To determine the monetary value of the effectiveness measure or indicator upon which the efficacy of the regulation is going to be calculated.*

Once the regulatory costs were monetized, the regulator needs to determine the degree of effectiveness to reach net benefits.

To determine the **effectiveness of a regulation** it is necessary to identify a measure unit to quantify the benefits of a regulation, for instance a measure that aims at preventing accidents and incidents from occurring can be measured through the number of avoided deaths, injuries and/or material damages. The effectiveness measure depends on the nature and type of regulatory proposal.

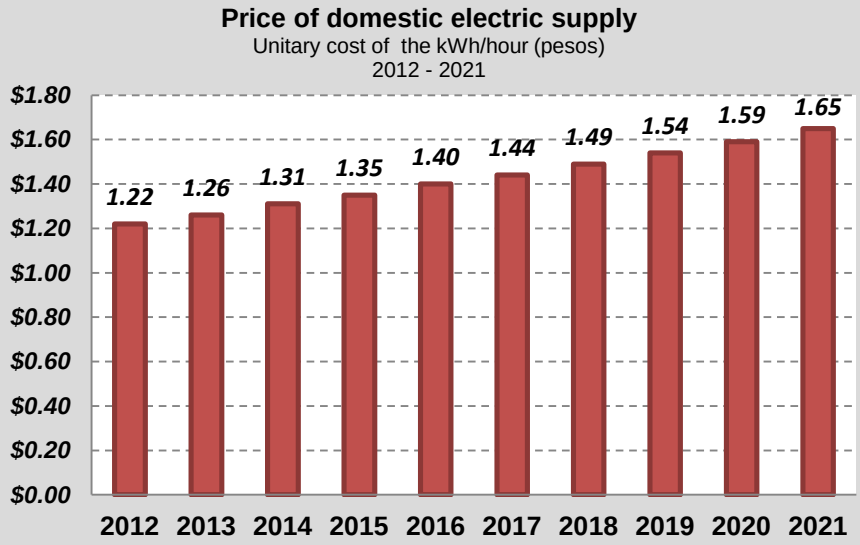
Example: ***"Official Mexican Standard PROY-NOM-032-ENER-2013. Maximum consumption limits for equipment and appliances that require standby power. Test methods and labelling.*** The standby power consumption of electric energy is measured in kilowatts/hour. Based on the fact that the price of domestic electric supply in the year of 2012 was of **1.22 pesos per kilowatt/hour**, there we have that:

Effectiveness measure/indicator = kilowatt/hour (kWh)
Cost per kWh = 1.22 pesos (year 2012)

Assuming that there is an annual rate of growth of the price per kWh of 3.37%, the kilowatt/hour was calculated till 2021 as follows:

Year	Cost per kWh (pesos)
2012	1.22
2013	1.26*
2014	1.31*
2015	1.35*
2016	1.40*
2017	1.44*
2018	1.49*
2019	1.54*
2020	1.59*
2021	1.65*

*Estimation



Fuente: Annex 1 of the High Impact MIR (28466)
http://207.248.177.30/mir/formatos/defaultView.aspx?SubmitID=394550

Third. *To determine the point of the regulation to breakeven, this is, the number of the effectiveness measure/indicator units required to justify the regulatory costs.*

The third and last step is intended to identify how many of the effectiveness measure/indicator units are required, for the compliance cost of the regulation to be justified. To determine the effectiveness the regulator needs to identify the unitary cost of the effectiveness measure/indicator and, considering the compliance cots (regulatory costs), use the following equation:

$$\frac{\textbf{\textit{Compliance Costs}}}{\textbf{\textit{Unitary cost of the effectiveness measure/indicator}}} = \textbf{\textit{Regulatory Effectiveness}}$$

(measured as the number of units avoided)

The number of effectiveness measure/indicator units resulting from the equation above is the number of units that, at least, the regulation needs to generate or avoid. This is a way to measure the effectiveness of the regulation because, if that number is not generated or avoided, the benefits of the regulation would not justify its costs, that is to say that the benefits of the regulation are less than its costs.

Example: ***"Official Mexican Standard PROY-NOM-032-ENER-2013. Maximum consumption limits for equipment and appliances that require standby power. Test methods and labelling.***
It has been estimated that, in 2012, the implementation of the official norm would generate compliance costs of **277 million pesos** and, if the cost per kWh in the same year is $1.22, the total number of kWh to save for the norm to be effective should be, at least, equivalent to **227.04 million of kWh**. This result was obtained from dividing the total of compliance costs (regulatory costs) by the cost per kWh. The following table presents the saving of standby power in terms of kWh for the norm to breakeven.

Breakeven calculation

	A	B	C	D	E	F
Year	Cost per kWh	**Annual standby power consumption** *(prior to regulation)*	**Annual standby power consumption** *(after regulation)*	**Total regulatory costs (labelling, certification, laboratory tests, etc.)**	**BREAKEVEN Number of saved kWh needed to equalize benefits and costs**	**Estimated kWh to be saved by the NOM**
	(pesos)	(kWh)	(kWh)	($)	(Column D/ Column A)	(Column B- Column C)
2012[/e]	1.22	811,451,383	397,524,271	$277,000,000.00	227,049,180.33	413,927,112
2013	1.26	1,684,741,417	825,342,857	313,000,000.00	248,412,698.41	859,398,560
2014	1.31	2,624,582,668	1,285,764,413	354,000,000.00	270,229,007.63	1,338,818,255
2015	1.35	3,636,046,836	1,781,273,526	401,000,000.00	297,037,037.04	1,854,773,310
2016	1.4	4,724,592,121	2,314,544,132	454,000,000.00	324,285,714.29	2,410,047,989
2017	1.44	5,896,092,679	2,888,453,937	514,000,000.00	356,944,444.44	3,007,638,742
2018	1.49	7,156,870,322	3,506,099,952	581,000,000.00	389,932,885.91	3,650,770,370
2019	1.54	8,513,728,629	4,170,815,202	658,000,000.00	427,272,727.27	4,342,913,427
2020	1.59	9,973,989,665	4,886,186,714	744,000,000.00	467,924,528.30	5,087,802,951
2021	1.65	11,545,533,48	5,656,074,874	842,000,000.00	510,303,030.30	5,889,458,614

B. Via the calculation of social losses

It may be the case that the benefits of the regulation are of different types. For instance, if a regulation objective is to prevent high-speed car crashes to happen, the effectiveness measure/indicator may be the number prevented deaths, lessons or material damages[47].

[47] Another example of such type of regulations is presented in the Case 7, Volume II of this Guide, regarding the *General Rules for Navigation in* Miguel Alemán *Dam(Valle de Bravo)*, in which, besides improving the safety in the navigation and the

For such cases, the calculation of breakeven using the equation presented above may be difficult since a homogenization of effectiveness measures/indicators is needed.

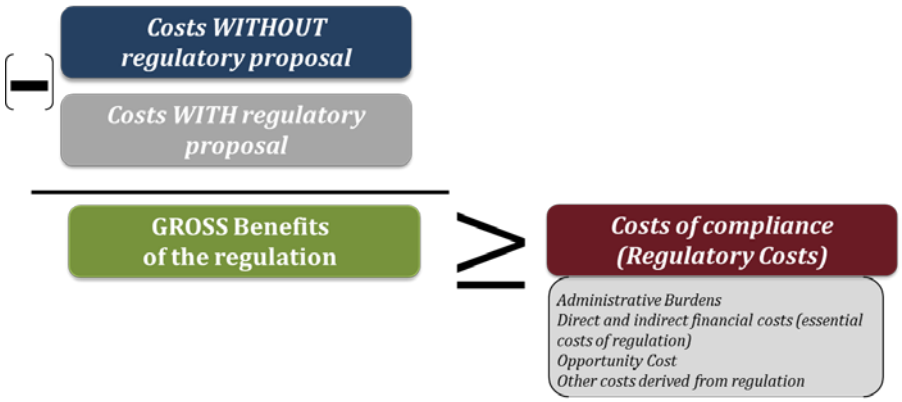
In this sense, another way to calculate the breakeven is via the monetization of social losses. According to LaTourrette & Willis (2007)[48] and Farrow & Shapiro (2009)[49], the calculation of breakeven needs to consider the social costs of the problem prior to and after the intervention of the regulatory authority (SC_b and SC_a, respectively). The difference of both costs, that is, the reduction of social losses attributable to the regulation, is equal to the gross benefits GB. Formally:

$$Gross\ Benefits = SC_b - SC_a$$

Once the gross benefits were calculated, it is assumed that the compliance costs or regulatory costs RC need to be equal or less to them for the regulation to be justified.

$$GB \geq RC$$

If the regulation meets this condition, then, from a financial approach, the regulatory costs are justified since the regulation reached the breakeven. In other words, and remembering the figure of Benefits of Chapter II, the effectiveness of the regulation can be determined with the following equation:



3.3 Cost Effectiveness Analysis

When making a CBA demands too many resources, or when results might be controversial (for example, assign a price to human life), it is advisable to apply the cost-effectiveness analysis (CEA). This analysis is an economic evaluation tool in which the costs of the alternatives are expressed in monetary terms, and they are compared with the benefits when they cannot be expressed in monetary terms (Robinson, 1993). In this sense, it is

prevention of accidents and incidents, the regulations is aimed at preserve the quality of the water supplied by the dam to the Cutzamala System.

[48] LaTourrette & Willis (2007). *Using Probabilistic Terrorism Risk Modeling for Regulatory Benefit-Cost Analysis: Application to the Western Hemisphere Travel Initiative Implemented in the Land Environment.* Center for Risk Management and Policy, Rand Corp., Santa Monica.

[49] Farrow & Shapiro (2009). *The Benefit-Cost Analysis of Security Focused Regulations.* http://www.umbc.edu/economics/wpapers/wp_09_101_DHSFarrowShapiro.pdf

advisable to use it for social regulations, especially those regulating issues of public health and safety, in which valid measures of effectiveness can be developed.

CEA application:

It is necessary to follow these steps to develop the CEA:

1. **Quantify the costs of each regulatory alternative.** The costs to be quantified in this analysis should only be the direct and tangible costs generated by the regulatory alternatives.

Example: The antismoking regulation in some countries dates from 1989. Its purpose was to reduce smoking and mortality related to it. Suppose that a regulatory project consisted mainly of four actions: increase in taxes, graphic labeling, massive campaigns and smoking banning in public places. A CEA was made to assess the relevance of this regulation, where the costs obtained for the four alternatives were:

Table: Costs of regulatory alternatives

Regulatory alternatives	Total costs (million dollars)
Increase on tobacco tax	$11,827
Graphic labeling of risk from tobacco consumption	$1,492
Massive campaigns to quit smoking	$147,559
Smoking banning in public places	$213,850

Source: COFEMER

2. **Identify the benefits of each regulatory alternative.** The regulator must define and choose a parameter or indicator to be considered as the measure of benefit through which he seeks to evaluate the regulation performance. The definition of this parameter can take various measures, such as the number of saved lives, avoided accidents and not emitted metric tons of CO_2, etcetera.

Example: The four regulatory alternatives mentioned use as benefits unit the **disability-adjusted life years** (DALYs), which is a composite indicator that measures life expectancy in years free of disease or physical injury. This measure is recommended by the World Health Organization.[50] The way to estimate the DALYs can be found in (Higashi et al., 2011) and in Chapter 4 of this guide.

3. **Quantify the effectiveness of each option.** After obtaining the direct costs and benefits of the regulatory alternatives, we apply the CEA formula. Specifically, we obtain the Cost-Effectiveness ratio (CER) by dividing the present value of the costs of the regulatory project between the quantitative measure of the benefits:[51]

$$\text{CER} = \frac{(\text{Present value of costs})}{\text{non} - \text{monetary measures of benefits}}$$

In this sense, the CER is an estimate of the cost in pesos incurred per unit of benefit achieved by the regulatory project implementation. **The analysis does not**

[50] World Health Organization. Regional Office for Europe. Health 21. The health for all policy framework for the WHO European Region. Copenhagen: European Health for All Series 6; 1996.
[51] Canadian Cost-Benefit Analysis Guide "Regulatory Proposals," Canada (2007)

evaluate the benefits in monetary terms, but it tries to find the lowest cost option to achieve the desired quantitative result.

Example: Now we will apply the CER for each alternative, which is presented in the following table:

Table: Effectiveness of regulatory alternatives

Regulatory action	NPV of total costs (million dollars)	Benefits in disability-adjusted life years (DALYs)	CER
Tax increase on tobacco	$11,827	4,050,000	$\text{CBR}_1 = \frac{\$11,827,000,000}{4,050,000} = 2,920$
Graphic labeling with warnings about tobacco consumption	$1,492	2,996,000	$\text{CBR}_2 = \frac{\$1,492,000,000}{2,996,000} = 498$
Massive campaigns to quit smoking	$147,559	1,873,000	$\text{CBR}_1 = \frac{\$147,559,000,000}{1,873,000} = 78,780$
Smoking banning in public places	$213,850	3,736,000	$\text{CBR}_1 = \frac{\$213,850,000,000}{3,736,000} = 57,240$

Source: COFEMER

4. **Interpretation of the result.** After applying the CER formula, the regulator must classify the alternatives considering their effectiveness**. Thus, the criteria to be used will be always choosing the lowest CER, that is, the one reflecting the lowest cost among the proposed alternatives.**

Example: In the table above, when ordering CERs from the lowest to the highest, the alternative of graphic labeling with warnings on tobacco consumption could be the most effective regulatory measure, as it costs $498 dollars per life year free of diseases related to tobacco, that is, this alternative has the lowest cost per unit of benefit.

3.4 Multi-criteria decision analysis

The multi-criteria decision analysis (MCDA) is a method used to address complex decision problems characterized by a mix of monetary and non-monetary objectives. **Its main feature is that its results are composed by the weighting and aggregation of different evaluation criteria**, which provides different ways to analyze a complex decision problem (Communities and Local Government, 2009).[52] MCDA can be retrospectively used (ex post analysis) for those policies in force, or prospectively used (ex ante analysis) to analyze policy options to be implemented in the future.

MCDA application

1. ***Establish the objectives to be evaluated with the MCDA***

Like other decision methods, the purpose of a DMCA is to find the option that best meets the initial objectives. We propose the following example to illustrate this method, in which the problem to be solved is climate change, so several public policy alternatives are

[52] In this section, we address the use of the deterministic MCDA, however, there are alternative methods that address the possible uncertainty existing in decision making, for more information on the methods applied in the MCDA, consult: http://eprints.lse.ac.uk/12761/1/Multi-criteria_Analysis.pdf

recommended, which general objective is to reduce the greenhouse gases emission into the atmosphere.

Example: We want to implement the AMCD to a set of policy options aimed at solving the problem of climate change by regulating the greenhouse gas emission (overall objective). In this case, the world population is considered as the target population; the interest group would be those companies and industries responsible for most of the greenhouse gases emission.[53]

The general objective of the policy can be broken down into the following secondary objectives:

Table: Secondary objectives
Reduce the annual increase in temperature
Reduce the impact on ecosystems
Reduce the annual increase in the sea level
Regulate annual level of SO_2 emissions
Regulate nuclear waste generation

Source: COFEMER

The common point between the secondary objectives is that they arise from the same general objective, which is to reduce the harmful gases emission into the atmosphere. The identification of objectives requires considering the implicit reasons of the existence of the policy in question, in terms of the problem or market failure it tries to solve. These objectives can be measured or not, and they may also be translated into monetary terms. For example, the objective "reducing the impact on ecosystems" lacks in its definition of an appropriate measure, this feature is covered by the evaluation criteria.

2. *Identify the evaluation criteria*

The evaluation criteria serve as the measure necessary to weigh the performance of the secondary objectives. Therefore, the evaluation criteria are closely linked to these objectives: if the objective is to reduce the annual increase in temperature, the appropriate approach is to evaluate the alternatives according to their effectiveness when reducing the annual temperature.

An important aspect that we have to consider is that the criteria are mutually exclusive, which means that the grades assigned by each of the criteria are independent of those assigned by others. That is, if two or more criteria are very similar, then considering both in the total grade awarded for each option is a way to overestimate the virtues or defects of such public policy alternative.

How can you identify two criteria that are not mutually exclusive? If we do not discover the relationship between criteria, this can usually be detected when assigning grades. If the regulator states that he cannot judge the grades on some criterion without knowing the grades of another, this is an indication that both criteria are **not** mutually exclusive.

[53] Para llevar a cabo el análisis, se ha recurrido a las proyecciones realizadas por distintos organismos e instituciones educativas usando el modelo de simulación Holmes/Ellis (Holmes & Ellis, 1997).

Example: Considering the secondary objectives initially set, it was decided to establish the following criteria:

Table: Criteria to be evaluated
Increase in temperature
Stress of ecosystem[54]
Increase in sea level
SO_2 emissions
Nuclear waste generation
Annual costs

Source: COFEMER

3. *Identify the options to be evaluated*

It is convenient to start with a reduced but diverse set of options. This prevents analyzing a large number of options that may be very similar, and that yield similar performance.
Example: Public policy options to control emissions are:

Table:Public policy options
Baseline scenario (no special control)
Global tax of USD$75 per emitted ton of CO_2
Global tax of USD$150 per emitted ton of CO_2
Global tax of USD $300 per emitted ton of CO_2
Standards on SO_2 emission
Promotion of nuclear energy through nuclear fuel subsidies
Promotion of biomass energy

Source: COFEMER

4. *Grade and evaluate the expected performance of each option according to the evaluation criteria*

Performance evaluation of public policy alternatives can be summarized by a matrix, which presents the evaluation of each option according to the criteria defined above (which can be quantitative[55] and qualitative), and thus determine the advantages and disadvantages of each alternative.

Example: A group of experts has calculated the performance of each policy option considering the previous criteria[56]

Table: Performance matrix of the example of environmental regulation

Policy options	Increase in global	Stress of ecosystem	Increase in sea level	SO_2 emissions	Nuclear waste (thousand	Annual costs (billion

[54] Measured as the number of hectares suffering from erosion.
[55] Within the quantitative criteria we can include indicators used in cost-benefit analysis: CBR, total costs, total benefits, among others.
[56] All values obtained are global estimates based on a simulation model of *Integrated Assessment Holmes/Ellis*. Bell ML, H. B. E. E. E. H. R. Z. (2001). "Journal of Multi-criteria Decision Analysis". *An evaluation of multi-criteria methods in integrated assessment of climate policy*, pp. 229-256.

	temperature (^{0}C)	(10^6 ha)	(cm)	(mill. ton/year)	ton/year)	USD$/year)
Baseline scenario	1.35	3229	26.2	159.5	11.7	0
$75 per CO_2 ton	1.33	3190	25.9	136.8	15.4	37
$150 per CO_2 ton	1.29	3095	24.2	118.8	19.3	142.7
$300 per CO_2 ton	1.15	2740	22.4	93.5	26	519.8
SO_2 emission standards	1.24	2977	24.3	149.9	22.2	62.1
Nuclear energy	1.25	3002	24.4	189.9	10.9	-3.6
Biomass energy	1.3	3121	25.4	153.4	11.6	7.1

Source: COFEMER

As we can see, this matrix summarizes the valuations given to each policy option according to the criteria defined. Thus, for example, it is expected that the environmental temperature increases by 1.35 degrees in the absence of government action (baseline scenario). Similarly, it is also expected that the implementation of standards on $S0_2$ emission only increases the sea level by 24.3 centimeters per year.

However, considering that with each criterion we obtain valuations in different scales, it is necessary to standardize these results to compare them. For example, the criterion of the increase in temperature fluctuates between 1.15 and 1.35, while the following criterion takes values from 2740 to 3229. As you can see, both criteria are not comparable, so we have to translate these valuations into the same scale. For this purpose, we suggest to use a scale of 0 to 100, where 100 represent the most desirable results, and zero the least. This scale does not always have to be equal (World Bank). Therefore, the assessments between the most and the least desirable receive values between zero and hundred.

Example: In order to compare the criteria we must standardize the valuation scales. This is known as grading, or assigning a grade to each of the policy options a score, which is a value between zero and one hundred, according to the valuation assigned by each criterion.

Let us start with the first criterion. The option showing the best performance is the one proposing a tax of $300 per CO_2 ton (as this causes the smallest increase in temperature among all the options, with 1.15°C), so that this gets a grade of 100. Moreover, the one with the worst performance is the baseline scenario (as this causes the greatest increase in temperature, 1.35°C), so that this is graded with zero.

Besides the best and worst alternative, the other options must receive a grade according to the new scale. As we already mentioned, the baseline scenario and the tax of $300 per ton are assigned a grade of zero and one hundred, respectively. Between these two options there is a variation from 0.20°C (1.35°C - 1.15°C). Considering the new scale, these 0.20°C are equivalent to a grade of one hundred points. The second best alternative is the implementation of standards on emissions, as this would increase total temperature by 1.24°C, that is, 0.11°C less than in the baseline scenario. Thus, by a cross-multiplication we can estimate that these 0.11°C are equivalent to a grade of 55 points:

Policy options	Increase in total temperature (^{0}C)	Grade
Baseline scenario	1.35	0
\$300 per CO_2 ton	1.15	100
Standards on SO_2 emissions	1.24	55

This exercise is repeated with the other options and criteria in order to fill the rest of the table:

Table: Grade of each option of the example of environmental regulation

Policy options	Increase in global temperature (^{0}C)	Stress of ecosystem (10^6 ha)	Increase in sea level (cm)	SO_2 emissions (mill. ton/year)	Nuclear waste (thousand ton/year)	Annual costs (billion USD$/year)
Baseline scenario	0	0	0	32	95	99
\$75 per CO_2 ton	10	8	8	55	70	92
\$150 per CO_2 ton	30	27	53	74	44	72
\$300 per CO_2 ton	100	100	100	100	0	0
SO_2 emission standards	55	52	50	41	25	87
Nuclear energy	50	46	47	0	100	100
Biomass energy	25	22	21	38	95	98

Source: COFEMER

5. *Weighting of criteria*

In this step, each criterion is assigned a weight in order to reflect its relative importance for the final decision. The regulator will hardly find an option that surpasses the rest in all the decision criteria, for this reason, the appropriate weighting of the evaluation criteria is essential for a right decision. These weights can be determined by consultants or by the regulator itself. The sum of the criteria weightings must be equal to one.

Example: The weightings determined by the group of experts on climate change were:

Table: Weighting of the criteria of the example of environmental regulation

Criteria	Weighting
Increase in temperature	0.09
Stress of ecosystem	0.09
Increase in sea level	0.09
SO_2 emissions	0.20
Nuclear waste generation	0.20
Annual costs	0.33
TOTAL	**1**

Source: COFEMER

6. *Combine the weightings and grades of each option*

Once the weightings are assigned, we should include the grades assigned by the criteria, and obtain a final score for each public policy alternative. The final score for a policy option is simply the weighted average of the grades assigned by all its criteria.

$$S_i = w_1 s_{i1} + w_2 s_{i2} + \cdots + w_n s_{in} = \sum_{j=1}^{n} w_j s_{ij}$$

Where $w_1, \ldots, w_n$ represent the weightings assigned to each criterion. Also, $s_{i1}, \ldots, s_{in}$, represent the grades assigned by each criterion from 1 to n, for the regulatory option *i*.

Example: After determining the weightings for the six criteria, we obtain the following final scores:

Table: Results of the example of environmental regulation

Policy options	Increase in global temperature (^{0}C)	Stress of ecosystem (10^6 ha)	Increase in sea level (cm)	SO_2 emissions (mill. ton/year)	Nuclear waste (thousand ton/year)	Annual costs(billion USD$/year)	Final score
Baseline scenario	0	0	0	6	19	33	**58**
$75 per CO_2 ton	1	1	1	11	14	30	**58**
$150 per CO_2 ton	3	2	5	15	9	24	**57**
$300 per CO_2 ton	9	9	9	20	0	0	**47**
SO_2 emission standards	5	5	5	8	5	29	**56**
Nuclear energy	5	4	4	0	20	33	**66**
Biomass energy	2	2	2	8	19	32	**65**

Source: COFEMER

7. *Analyze the results*

We can order the policy options from high to low, once we know the final scores. With this ranking we can draw general conclusions, which can be complemented with graphs of the scores obtained for each criterion.

Example: Finally, we order the different policy options according to the final score obtained. Note that in this example, the baseline scenario appears in the third place, above options like global tax on CO_2 emissions. This is explained by the weight assigned to the "costs per year" criterion.

Table: Ranking the options of environmental regulation

Policy options	Score	Ranking
Nuclear energy	66	1
Biomass energy	65	2
Baseline scenario	58	3
$75 per CO_2 ton	58	4
$150 per CO_2 ton	57	5
Standards on SO_2 emissions	56	6
$300 per CO_2 ton	47	7

Source: COFEMER

MCDA conclusion is that the best policy option is the promotion of nuclear energy through subsidies.

3.5 Profitability indicators and decision criteria

Often, making an in-depth analysis, as the one required by the previous methods, demands too many resources. A simpler alternative that can also be used as a complement to the above, are the following indicators of profitability.

3.5.1 Equivalent Annual Cost

The Equivalent Annual Cost (AEC)[57] is an indicator that shows the annual cost of owning, operating and maintaining an asset over its lifespan. Particularly, in the context of the public policies design, this indicator is usually used to compare alternatives that generate the same benefits, but present different costs and lifespan, more than once. Thus, the EAC is a more effective tool if we consider that the life of regulatory alternatives is different and the costs related to them will be incurred in more than one occasion; otherwise, the best option will be using the net present value[58].

The decision criterion is that the lower the EAC, the better the regulation alternative.

EAC application

a) Calculate the present value of the costs projected for each regulation alternative
b) Annualize the present value of the costs through the EAC formula, and thus compare the alternatives. We can do so through the following formula:

$$\mathrm{EAC} = \mathrm{PV}_{\mathrm{COSTS}} * \frac{(1+\mathrm{r})^{\mathrm{T}} * \mathrm{r}}{(1+\mathrm{r})^{\mathrm{T}} - 1}$$

Where T, is the time period or lifespan of each alternative, and *r* is the discount rate, measured as the opportunity cost of regulation, which can be defined as explained in Chapter 2.

[57] EAC can be used, mainly, to evaluate the costs of regulatory actions on matters of energy efficiency (for example, solar panels in Kuwait), technology or within health system in the medical equipment implementation.
[58] Smith, T. W. (1982). An historical perspective of net present value and equivalent annual cost. E.U.A.: The Accounting Historians Journal.

Example: Suppose a health regulator has considered two regulatory alternatives, which focus on improving health conditions in hospitals. Aware of the additional costs that this government action may cause, we propose to evaluate both options.

The first alternative is to ask hospitals to purchase new machines to sterilize surgical equipment. The initial cost of these machines is $20,000; their annual operating cost is $10,000; and the lifespan is 9 years. On the other hand, the second alternative involves remodeling the surgery rooms to adapt them to these new conditions. The initial cost of this is $25,000; its annual operating cost is $8,000 and the expected life is five years.

The regulator considers that both options meet the initial objective, so the question is: what regulation should be implemented?

a) Present value of the alternatives:

$$\mathrm{PV}_{\mathrm{COSTS\ alternative\ 1}} = +20{,}000 + \frac{10{,}000}{(1.1)^1} + \frac{10{,}000}{(1.1)^2} + \cdots + \frac{10{,}000}{(1.1)^9} = \$77{,}590.24$$

While for alternative 2 we have:

$$\mathrm{PV}_{\mathrm{COSTS\ alternative\ 2}} = +25{,}000 + \frac{8{,}000}{(1.1)^1} + \frac{8{,}000}{(1.1)^2} + \cdots + \frac{8{,}000}{(1.1)^5} = \$55{,}326.29$$

After obtaining the present value, we can consider that alternative two is the best option, as its costs are the lowest; however, since the lifespan of both assets is different, it is necessary to annualize the costs to compare them.

b) Annualize the results:

$$\mathrm{EAC}_{\mathrm{alternative\ 1}} = \$77{,}590.24 * \frac{(1+0.1)^9 * 0.1}{(1+0.1)^9 - 1} = \$13{,}472.81$$

While for alternative two we have:

$$\mathrm{EAC}_{\mathrm{alternative\ 2}} = \$55{,}326.29 * \frac{(1+0.1)^5 * 0.1}{(1+0.1)^5 - 1} = \$14{,}594.94$$

Since the EAC of the first alternative is lower (13,473 < 14,595), it is convenient to implement this regulation.

3.5.2 Internal Rate of Return

The Internal Rate of Return (IRR) is a profitability measure showing what would be the discount rate at which the discounted costs of the project equalize the benefits. The IRR rate functions as the rate of the regulatory project; this means that the IRR is not fixed by the person promoting the regulatory policy, but is implicit in the cash flow of the project.

In order to calculate the IRR it is necessary that the present value of the net benefits flow is zero:

$$\text{PVNBF} = \sum_{t=0}^{T} \frac{\text{Net benefits}}{(1+\text{IRR})^t} = 0$$

Example: Suppose we have three regulatory alternatives for handling dangerous substances. The three alternatives are described in the following table:

Table: Comparison between different alternatives of regulation

Regulatory projects	Valuation Period	Costs of implementation	Benefits per period
Standards on the handling of dangerous substances	10 years	-$50,000	$10,000
Safety standards on workers' clothing	20 years	-$75,000	$9,500
Safety standards at workplace	15 years	-$120,000	$15,000

Source: COFEMER

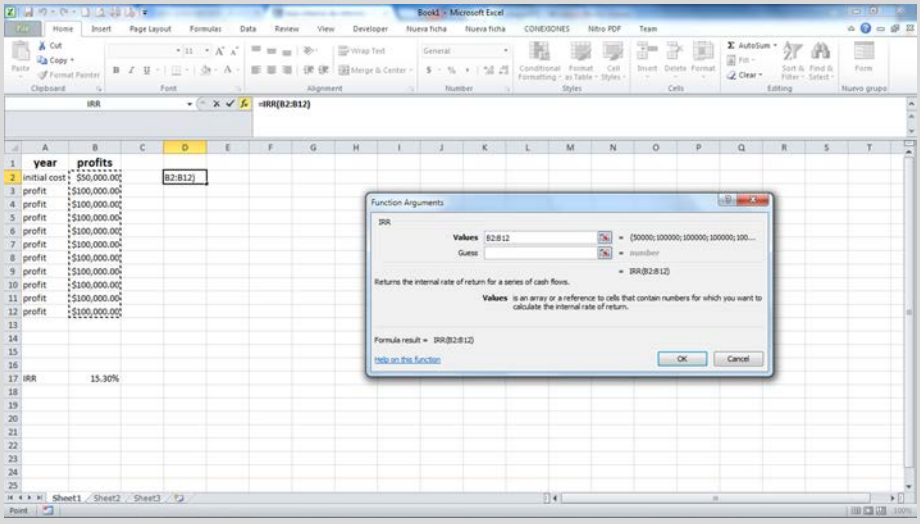
Based on this information and using the formula above, the calculation of the IRR of the first alternative would be as follows:

$$\text{PVNBF} = -50{,}000 + \frac{10{,}000}{(1+\text{IRR})^1} + \frac{10{,}000}{(1+\text{IRR})^2} + \frac{10{,}000}{(1+\text{IRR})^3} + \cdots + \frac{10{,}000}{(1+\text{IRR})^9} + \frac{10{,}000}{(1+\text{IRR})^{10}} = 0$$

We should do the same with the rest of the alternatives.

A simple way to calculate the IRR is using a financial calculator or Microsoft Excel. The calculation through the latter is explained below:

Calculation of the IRR by using Excel



1. - Enter all the cash flows, starting with the initial investment or the initial cost, and then enter all the benefits derived from the regulation.
2.- Within the financial formulas in Excel, there is the IRR function, which is shown in the box on the right.
3.- Once we opened the box, we enter all the cash flows, just as we did in the first step; that is, first the initial cost, and then the benefits.
4.- The formula will give us the value of the IRR.

One way to check that the calculation of the IRR is correct is by discounting the costs and benefits, assuming the IRR obtained as the discount rate. The result of the NPV must be equal to zero.

The results of the IRR calculation for the three alternatives of regulatory policy are presented below:

Table: Comparison between different regulation alternatives

Regulatory projects	Valuation period	Implementation costs	Benefits per period	IRR
Standards on the handling of dangerous substances	10 years	-$50,000	$10,000	15.10%
Safety standards on workers' clothing	20 years	-$75,000	$9,500	11.13%
Safety standards at workplace	15 years	-$120,000	$15,000	9.13%

Source: COFEMER

So, after analyzing the regulatory proposals, we can state that the project initially proposed is the most profitable, so we can expect that this proposal will be the one to be implemented. However, after calculating the IRR, we must submit such rate to a decision rule, so that, according to (Fontaine R., 2008), "it is convenient to make the investment when the discount or the interest rate that another project would generate is lower than the IRR, that is, when the use of capital in alternative investments 'pays' less than the capital invested in this project." Translating this into the social sphere, the decision rule is:

i. **If the IRR ≥ than the social discount rate,** the regulatory action is **accepted**, as the regulation represents greater or equal profitability to the minimum required.
ii. **If the IRR < than the social discount rate,** regulation is **rejected**, since the profitability is lower than the required.

Therefore, the decision rule establishes that if the IRR of the regulatory project does not exceed its opportunity cost, such regulation must be rejected. This happens with the second and third alternatives of the previous example, since, assuming a discount rate of 12%, only the first project is socially profitable.

3.5.3 Immediate Rate of Return (ImRR)

The Immediate Rate of Return (ImRR) is an indicator used to compare, period to period, the regulatory project we are trying to implement with the second best alternative of regulation, and at the same time identify the optimum period of the policy implementation. To obtain it, **it is necessary to know the structure of the benefits of the regulatory proposal, as we have to compare, period after period, the policy option with its opportunity cost.** The formula of the ImRR is very simple; we only have to divide the net benefits for each period by the investment (I), which in the case of a regulation would be its implementation costs.

$$\mathrm{ImRR}_t = \frac{\text{Net benefits}_{\ t}}{I}$$

The decision criterion is:

- If the ImRR_t in year "t" is greater than the return of the alternative, then "t" is the optimal time to operate.
- If the ImRR_t in year "t" is lower than the return of the alternative, then we should postpone the implementation of the regulation.

Usually, this analysis tool is more used in private analysis of investments, than in the impact analysis of the regulation since, usually, this is already defined by the time it is issued. For more information, consult the section on this concept in the book by R. Fontaine, E. (2008): *Evaluación social de Proyectos.*

3.6 Estimation of administrative burdens and their consideration in the regulatory analysis

In Chapter 2 we presented the different types of costs and benefits that may arise in the regulatory analysis through the methods previously developed (CEA, CBA, and MCDA). At the same time, the estimation of costs and benefits requires the methodologies presented in the next two chapters, which, by their nature, can be divided into methodologies used in the analysis of social regulation and methodologies used in the analysis of economic regulation. However, under these methodologies, information obligations imposed to citizens by regulation could hardly be quantified, that is, we can hardly assign a monetary value to administrative burdens.

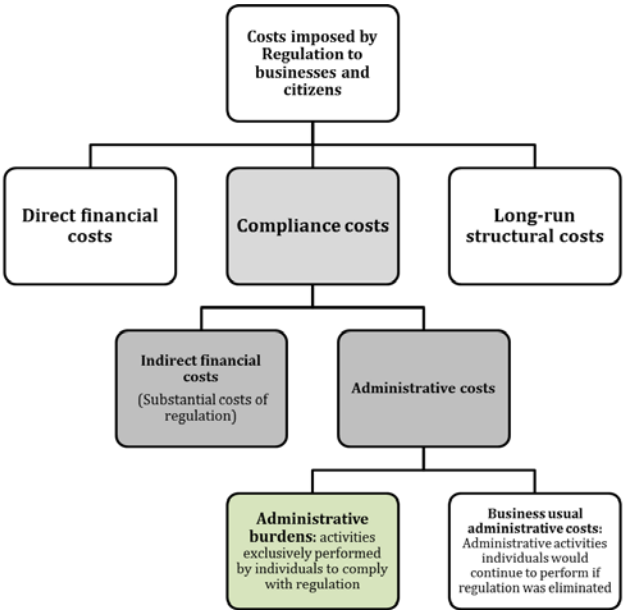
In this sense, though it is true that the regulatory impact evaluation involves measuring the effect of the regulations (social and/or economic) on the welfare of society, it is also true that administrative processes imposed by regulations on individuals, and especially on businesses, are processes that can often discourage the economic activity of a nation and thus affect the welfare of society, a reason why the regulatory impact evaluation should include the measurement of administrative burdens; therefore it is recommended that the regulatory agencies consider the administrative burdens as costs imposed by the regulatory proposals, as far as possible.

In order to measure the administrative burdens generated by a regulatory proposal , we require a methodology that suits the available information as formalities, processes, regulations or formats; being the Standard Cost Model the most used tool to achieve such purpose.

3.6.1 Standard Cost Model

The Standard Cost Model (SCM) is used to identify and measure the administrative burden of the regulation, generated by the processes and procedures that businesses and individuals must meet.[59] In this regard, we must note that the SCM measures the costs exclusively derived from the activities that the individual has to perform to comply with the regulation.

[59] SCM Network (2004), "*International Standard Cost Model Manual*", available at www.administrative-burdens.com.



Source: COFEMER, based on the International Standard Cost Model Manual and on the Europa Press Release[60]

According to the SCM Manual, the cost estimate is based on separating the activities that the usually efficient business[61] or the average individual has to perform to comply with the regulation. This involves assigning a monetary estimate to each of these activities that go from: the process of understanding the formality to complete it at the government offices. The SCM International Manual calls these activities standard activities, and these refer to those generic activities that the entrepreneur performs to meet the various steps and requirements in the process of a formality. In the original document these were divided into 16 activities.[62] For the model applied in Mexico there were some changes and these were consolidated in 8 standard activities that make up the **administrative burden**, these are:

1. Identification and understanding of requirements
2. Generation of new information
3. Collection of pre-existing information
4. Meetings with internal staff
5. Filling in of forms and/or making of applications and reports
6. Hiring of and meetings with external services
7. Creation and management of backup files
8. Payments, wait time in public offices and transportation

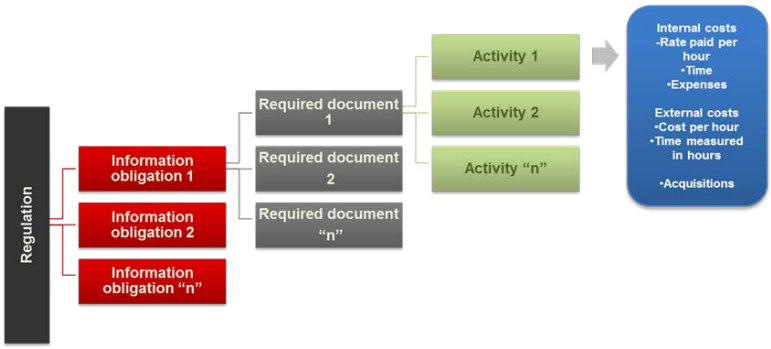
[60] Information available in the next link: http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/06/425&format=HTML&aged=1&language=EN&guiLanguage=en
[61] According to the SCM Network, the normally efficient business refers to businesses within the target group responsible for the administrative regulations in a normal way. In other words, businesses managing their administrative tasks as it can be reasonably expected.
[62] Idem 4.

In addition to this, the model involves the identification of:

1) The information requirements (formalities) of a regulatory proposal;

2) The identification of the required documents (requirements) for each information obligation;

3) The identification and quantification of standard activities to obtain each requirement (activities); and



4) The monetization of activities.

Thus, the main concept of the SCM is the average time it takes to an individual to complete an activity to comply with the regulation, therefore the basic combination to obtain the cost of a regulation comes from four basic elements: the first is the time (t) taken by the individual to meet the obligation, the second is the price or fee (w) per unit of time, usually determined by the wages of those involved in the process, the third is the target population (n) or specific population completing the formality, and the fourth is the frequency (f) with which the target population performs the fulfillment of the obligation in certain period of time. Thus, when combining these four elements we obtain an estimate of the cost of regulation.

- $\boldsymbol{Unit\ cost\ of\ formality} = [(\boldsymbol{t}) * (\boldsymbol{w})][(\boldsymbol{n})]$

The above considering that getting the unit cost of an information obligation (formality), we must add the costs of each requirement that is made up of the costs of each activity.

- $\boldsymbol{Added\ cost\ of\ formality} = [(\boldsymbol{t}) * (\boldsymbol{w})][(\boldsymbol{n})][(\boldsymbol{f})]$

Finally, the added cost of the formality is obtained by multiplying the unit cost by the frequency of use (all applications received) in certain time (which can be a year).

For example, we have the following administrative activity:

The standard establishes that any company wishing to import seeds needs a certificate issued by the Ministry of Health, which takes three hours for domestic businesses (t), the rate or hourly wage of the worker completing the formality is $100 pesos (w). Therefore, the cost is 3 x 100 = 300 pesos. If 100,000 businesses were subject to this requirement (n) then the cost of the formality is 30,000,000 = 300x100,000; in addition to the previous information we have that, on average, each business had to comply with the formality twice a year (f), then the added cost of the activity would be:

$$Added\ cost\ of\ formality = [(3) * (\$100)][(100{,}000)][(200{,}000)] = \$60{,}000{,}000$$

With these parameters businesses and citizens can calculate the average cost of complying with regulations; however, the SCM is based on the previous idea but its quantification involves different aspects since it weights the results in order to assign a different monetary value to the formalities according to:

- Income level of the individuals completing the formality;
- Type of legal instrument;
- Number of requirements and classification in new and pre-existing;
- Type of activity at which the formality is addressed.

After weighing the results, they are classified by the type of standard activity; the administrative burden falling on companies to comply with the issued regulations is the sum of these.

$$Administrative\ burden = \sum_{i=1}^{8} Standard\ activity_i$$

3.6.2 Adaptation of the SCM in Mexico

In addition, in Mexico it was included a measure to quantify the opportunity cost of complying with the information obligation, which mainly depends on the maximum period of resolution of the Government to give answer to the formality. In the case of information obligations of businesses for opening and/or operating, the daily capital cost obtained from the economic sector to which they belong is considered.

$$Opportunity\ cost = Resolution\ period * Daily\ capital\ cost$$

Where, the sum of the two concepts is called Total Economic Cost.

3.6.3 Results and application at international level

Though it is true that in this section we consider the estimation of the administrative burden as a relevant part of the regulatory analysis, it is also true that international experience has focused on using such estimates in isolation (regarding benefits) to develop regulatory improvement policies based on those instruments that generate greater burden on society.

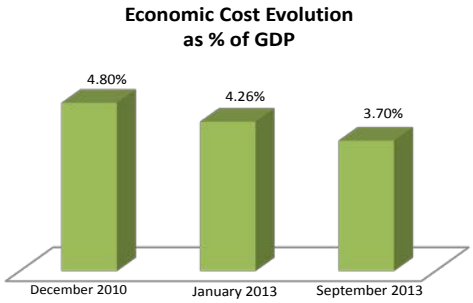
According to international best practices, reducing the administrative burden could reduce business costs; particularly, if a government succeeds in eliminating at least 25% of the cost of the administrative burden and in simplifying most of the remaining load, the economic impacts may have significant effects, for example, the Gross Domestic Product (GDP) could increase between 1 and 3%. In this regard, the Dutch Bureau for the Economic Policy Analysis estimates that a 25% reduction in the costs of administrative burdens would lead to an increase of 1.7% of GDP in Europe.

3.6.4 Estimate of administrative burdens in Mexico

In the case of Mexico, COFEMER used the standard cost model to estimate the administrative burden of federal regulation; this measure resulted in an amount equal to 4.8% of 2009 GDP foo 4,649 formalities derived from regulation as a whole on individuals. This exercise was performed by following the SCM. For the model applied in Mexico some changes were made and the 16 standard activities considered within the SCM Manual were consolidated into 8 major that comprise the administrative burden.

In addition, and in view of the need to measure the opportunity cost with the idea of having a more complete estimate of the costs of regulation faced by individuals and businesses it was decided to add to the SCM a measure that could represent the opportunity cost. This measure represents the time it takes to a government department or agency to grant the benefit or fulfill an obligation by the daily capital cost according to the subsector to which the formality belongs. The sum of both costs (administrative burden and opportunity cost) forms the economic cost of regulation.

Once the costing is done, COFEMER proposed the implementation of short-term measures with high economic impact and easy to execute, as a result of the analysis and identification process of areas of opportunity after finishing the initial measurement. It was found that by implementing improvements in 11% of the RFTS formalities (511 formalities) we could obtain a release of economic.



From this moment, COFEMER continued with the continuous measurement of the economic costs imposed by regulations; the most recent update of the measurement of the administrative burden of the total formalities registered in the RFTS at federal level was made in 2013. By January 2013, the costing of the 4,666 formalities registered in the RFTS accounted for 4.26% of GDP, that is, a decrease of 0.54% of GDP. In the latest update of June 2013, the costing of the 4,628 formalities registered in the RFTS accounted for 3.71% of GDP, a decrease of 0.55% of GDP.

3.7 *Qualitative analysis of the regulatory impact*

The qualitative analysis is a complementary analysis to the quantitative methods of the regulatory impact evaluation, and allows the regulator to have a wider vision of the regulatory process. This type of analysis is aimed to respond *how relevant is the regulatory impact? In which way does the impact take place? Under what circumstances and for what target population it is more likely to be effective?* Thus, the qualitative evaluation provides a deeper understanding of the decisions and choices resulting from any regulatory proposal, as well as the way it is assimilated by the target population and by those responsible of its implementation.

The qualitative evaluation of regulatory impact is particularly useful to identify the context in which the regulation takes place and the way it is received and assimilated by the target population (regulated entities). In addition, it is a tool to anticipate under what circumstances the regulation is more likely to reach the expected results, by determining the relevance of each regulatory action and the qualitative factors affected.

The qualitative analysis is, in this way, a framework to interpret the quantitative information and assess the circumstances that can facilitate or impede the consecution of the regulatory objectives[63]. Since it considers the opinion of the affected and beneficiated people, the qualitative analysis is inclusive and democratizes the regulatory process by giving it public credibility[64].

The following paper has been developed through exercises based on qualitative analysis of environmental regulations. In this sense, the following section of the guide is an effort to adjust such type of analysis to a more general methodology for the regulatory impact evaluation[65]. In the next paragraphs the steps to develop qualitative analysis of regulatory proposals will be presented and described.

First. Collection of relevant information

The collection of qualitative information is the first task of the qualitative analysis, and it is a subjective job, which requires direct contact between the regulator and the target population (regulated entities), for this reason, it can be done during the public consultation phase of the regulatory process (see Chapter I) through questionnaires, interviews, workshops, consultations and field research, in order to identify diverse qualitative aspects, such as:

- The economic, social and cultural context in which the regulation is going to be applied.
- The expectations, perceptions and, in general, the opinion of the target population and the authorities involved in implementing the regulation; and
- A description of the technical and technological processes associated with the regulatory proposal.

Since the main goal of this type of analysis is to understand and explain the point of view of the individuals involved in the regulation and, therefore, to be able to anticipate any circumstances that may facilitate or impede the regulatory objectives, policy makers need to adopt a flexible collecting information strategy in order to capture the social context in which the regulation is going to be implemented[66].

Since the nature of qualitative information is richer and more complex, it is necessary to take into account the following considerations:

[63] Garbarino & Holland (2009). *Quantitative and Qualitative Methods in Impact Evaluation and Measuring Results*. http://www.gsdrc.org/docs/open/eirs4.pdf
[64] Treasury Board of Canada. *Program Evaluation Methods: Measurement and Attribution of Program Results*. http://www.tbs-sct.gc.ca/cee/pubs/meth/pem-mep-eng.pdf
[65] An application of the method presented here can be found in Lijteroff (2011), *Environmental Impact Evaluation.* National University of San Luis, Argentina. http://sis.unsl.edu.ar/apuntes/bioseguridad/MEDIO%20AMBIENTE/CAPACITACI%D3N%20EVALUACIONES%20DE%20IMPACTO%20AMBIENTAL.ppt.
[66] UK Government (2007). *The Magenta Book: guidance and notes for policy evaluation and analysis.* Online version: http://www.civilservice.gov.uk/wp-content/uploads/2011/09/the_complete_magenta_book_2007_edition2.pdf

- In order to preserve the diversity and complexity of the information, you need to avoid generalizations and emphasize the relevant topics.
- Analyze the information using conceptual categories and hypothesis emerging from the information itself, rather than *a priori* theories and concepts.
- To explain the meaning of information according to the individuals' context, as well as the presence of some interactions or reactions in particular cases.

First. Collection of relevant information

Example: The *Miguel Alemán* Dam (Valle de Bravo, Mexico State).

In May 2012, an environmental contingency occurred in the *Miguel Alemán* Dam, located in the State of Mexico, neighboring Mexico City. It consisted on the sudden and accelerated proliferation of marine flora and anabaena algae within the dam, resulting in musty odor and taste in the dam water. Mexican authorities found that one of the causes of this problem was the internal combustion high power engines of the boats, which would contribute to the breaking of the cellular chains and membrane of such algae and, therefore, to its proliferation. This effect was considered as very relevant since the *Miguel Aleman* Dam provides 38% of the water flush of the Cutzamala System, the main water supplier of Mexico City and the metropolitan area. In addition, human and natural losses increased during 2012 and previous years as a result of shipping and boating accidents in the dam.

The described situation demanded the regulation of navigation in the dam, with three main objectives:

1) To ensure the safety of navigation and protect the human life.
2) To prevent accidents or incident in the dam,
3) To prevent, as far as possible, the water pollution

In order to accomplish these objectives, and once the environmental contingence was controlled due to the intervention of various governmental institutions, the Ministry of Communications and Transport (SCT) proposed issuing the *General Rules for Navigation at the* Miguel Aleman *Dam* to prevent future accidents and environmental contingences.

Other relevant facts:

- The Miguel Aleman dam is the biggest and most relevant of the Cutzamala System. Its water storage capacity is 394 million of cubic meters, with an extension of 2,900 hectares and an average depth of 21 meters, providing about 38% of its water flush (an annual average of 6 cubic meters per second).

- The metropolitan area of Mexico City is formed by territories of the States of Mexico and Hidalgo. According to a census elaborated by the agency of statistics of the Mexican Government (INEGI) in 2010, there is a population of ***20 million people*** (8.8 million in Mexico City).

Bibliography:

- *Regulatory Impact Evaluation Guide, Vol. II Case Studies*.
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http://207.248.177.30/mir/formatos/MIR_ImpactoModeradoView.aspx?SubmitID=392054

Second. Identifying regulatory actions and affected qualitative factors

Once the relevant information was collected, the next step is to elaborate an ***impact matrix***. The impact matrix is a qualitative analysis tool to identify the impacts generated by a regulatory proposal, and involves testing sub-components of a regulatory action against a series of affected factors. For its elaboration, it is necessary 1) to identify the regulatory actions of the proposal and 2) the identification of the affected qualitative factors.

For ***Regulatory Actions*** we could understand those actions in the regulatory proposal that impose costs, additional obligations, restriction of rights or administrative burdens to the target population. And for ***Qualitative factors,*** those characteristics of the social, economic, political and/or environmental context that may be affected by any of the regulatory actions.

Although some impacts may be well assessed by a quantitative methods(cost-benefit analysis, for instance), the main approach of the qualitative analysis is to identify the perception of the target population, as well as the affectation or improvement of their living, health, safety, economic and/or environmental situation.

Second. Identifying regulatory actions and affected qualitative factors
Example: Rules for Navigation at the *Miguel Aleman* Dam (Valle de Bravo, Mexico State).

Main regulatory actions of the proposal
The following regulatory actions were identified in the SCT proposal:

- ***"*Lake Card*" or* Seaman's Book *requirement to vessels drivers*.** Those documents identify drivers as personnel of the Mexican Merchant Marine, with at least the minimum necessary technical and practical skills for navigation.
- ***Regularization and registration of foreign.*** Since about 45% of vessels sailing in the dam are foreign-owned, this action strengthens an effective control over them.
- ***Prohibition of navigation to high power internal combustion engine vessels.*** This prohibition applies to slow boats with outboard engine with power up to 75 H.P. of 4 strokes, and fast boats with stationary engine up to 350 H.P.
- ***Division of the dam into 4 zones for different types of sailing activities.*** The first "*precautionary zone*", exclusive for vessel berthing, mooring, starting-up and parking; the second "*personal watercraft*", exclusive for personal watercrafts navigation; the third "*ski*"; and the forth "*sailing*", which corresponds to the areas not covered by the zones 1, 2 and 3. In the zone 4, where the algae proliferation was detected, the proposed regulation limits the sailing speed and the use of high power engines in order to prevent the breaking of cellular membrane and the proliferation of the anabaena algae in dry season.

Qualitative factors affected by the proposal
The factors that may be directly or indirectly affected by the regulatory proposal are:

- The safety in the dam navigation
- The prevention of accidents in the navigation
- Prevention of the water pollution.
- Tourism and recreation.

Third. Impact matrix

Once the main regulatory actions and affected factors are identified, the regulator needs to determine the specific impact of each regulatory action on each affected factor in an impact matrix, which is a double-entry table. Depending on the type and the objective of the regulatory action, the impact may be either positive or negative. The impact is considered positive if it implies an improvement, for instance, of the natural environment, the human safety or the conditions that promote business. By contrast, a negative impact refers to an affectation, for instance, of health, the natural reserves or as a barrier to free trade.

Regardless of the type (positive or negative), the impacts should be considered as significant if they:

a) have effects on the human safety or health;
b) have effects on the supply and/or availability of employment or any other economic resource;
c) are statistically significant, this is, if they affect the mean or variance of any environmental, economic and/or social indicator;
d) modify the structure and performance of markets, or of the natural or social systems;
e) put certain animal species under extinction risk;
f) are considered as relevant by the target population (regulated individuals)[67].

If the impacts meet at least one of the previous criteria, they need to be integrated in the impact matrix. Each impact in the matrix is a brief and detailed description of the expected effects of the regulatory action on the affected qualitative factors. For the impacts to be clear, it is recommendable to use adjectives, color codes, symbols and key words in its redaction to be able to identify them type and magnitude[68], for instance: *significant reduction of CO_2 emissions, remarkable increase of security in industrial complexes, expansion of the communications infrastructure at a local level, loss of forest resources, increase of tax collection, decline in business activity in the area, improvement in the provision of supplies, strengthening of institutional capacity,* etc.[69].

Once the impacts of each regulatory action were identified on each qualitative factor, the regulator should to elaborate an impact matrix, like the following one:

[67] This significance criteria for regulatory impacts is more widely shown by Beanlands, G.E. (1993), *Environmental assessment requirements at the World Bank;* and cited by Sánchez (1993), *Avaliação de impacto ambiental: situação atual e perspectivas.*

[68] Sánchez, Enrique (2002), *Evaluación de impacto ambiental.* UNESCO, Montevideo. Disponible en http://www.bvsde.paho.org/bvsacd/cd29/enriquesanchez.pdf

[69] Lijteroff, Rubén (2011), *Evaluaciones de impacto ambiental*. Bioseguridad y Gestión Ambiental. Departamento de Bioquímica y Ciencias Biológicas, Universidad Nacional de San Luis, Argentina. Disponible en http://sis.unsl.edu.ar/apuntes/bioseguridad/MEDIO%20AMBIENTE/CAPACITACI%D3N%20EVALUACIONES%20DE%20IMPACTO%20AMBIENTAL.ppt.

Regulatory Actions (i)	***Qualitative factors affected by the regulatory actions (j)***				
	QF_1	QF_2	QF_3	…	QF_m
RA_1	I_{11}	I_{12}	I_{13}	…	I_{1m}
RA_2	I_{21}	I_{22}	I_{23}	…	I_{2m}
RA_3	I_{31}	I_{32}	I_{33}	…	I_{3m}
…	…	…	…	…	…
RA_n	I_{n1}	I_{n2}	I_{n3}	…	I_{nm}

The matrix, has qualitative factors QF_j in the columns, and regulatory actions RA_i in the rows. **Each I_{ij} represents the potential impact of the *Regulatory Action i* on the *Qualitative Factor j***.

Third. Impact matrix elaboration

Example: Rules for Navigation at the Miguel Aleman Dam (Valle de Bravo, Mexico State).

Regulatory Actions		***Qualitative factors affected by the regulatory actions***		
		QF_1 *Safety in the navigation and prevention of shipping accidents and incidents at the dam*	QF_2 *Purity and cleanliness of the dam (prevention of water pollution)*	QF_3 *Indirect promotion of tourism and recreation activities*
RA_1	Lake Card *or* Seaman's Book *requirement to vessels drivers.*	I_{11} Increase of the navigation safety	X	X
RA_2	*Regularization and registration of foreign vessels.*	IP_{21} More control on the vessels navigating the dam	X	X
RA_3	*Prohibition of navigation to high power internal combustion engine vessels*	IP_{31} Reduction and prevention of accidents and/or incidents in the dam.	IP_{32} Reduction of pollutants emission to the water (benzene, toluene, xylene).	X
RA_4	*Division of the dam into 4 zones for different sailing activities.*	IP_{41} Reduction and prevention of accidents and/or incidents in the dam.	IP_{42} Reduction of probability of algae proliferation.	IP_{43} Increase in touristic and recreation activities.

As the impact matrix suggests, the regulatory action RA_4 ***Division of the dam into 4 zones for different sailing activities*** is the one with more qualitative impacts (3), affecting not only the safety in the dam navigation (FC_1), but also the prevention of water pollution (FC_1) and the tourism and recreation activities (FC_3). Also, the matrix suggests that the qualitative factor QF_1 ***Safety in the navigation and prevention of shipping accidents and incidents at the dam*** would be the more affected by the regulation.

Fourth. Scoring the impacts

Once the impacts were identified in the impact matrix, by scoring them it is possible to determine the ones with the most qualitative relevance. Depending on the type of regulatory actions and the factor affected by them, each action would have a distinct impact.

The scoring consists on determining the numerical relevance of each regulatory impact I_{ij}, based on impact parameters such as *intensity* (In), *extension* (Ex), *time of manifestation of first effects* (Ma), *persistence* (Pe), *synergy* (Sy), *accumulation* (Ac), *cause-effect relation* (Ef) *and periodicity* (Pr) of the impact. With these impact parameters, the regulator will get a **global score of 100 points** for each regulatory impact, which would be obtained according to the following table and the next section of this headland (examples included):

Impact parameter	Score	Impact parameter	Score
Intensity (In)	**Max = 36**	**Extension (Ex)**	**Max = 24**
Very low	1	Punctual	1
Low	2	Partial	2
Medium	4	Extensive	4
High	8	Very extensive	8
Very High	12	**Critical**	**+4**
Extra (3 In)		***Extra (2 Ex)***	
Time of manifestation of first effects (Ma)	**Max =10**	**Persistence (Pe)**	**Max = 10**
Long term (> 5 years)	1	Fleeting (< 1 year)	3
Medium term (1 - 5 years)	3	Temporal (1 - 3 years)	5
Short term (< 1 year)	5	Permanent (> 3 years)	10
Immediate term	10		
Synergy (Sy)	**Max = 5**	**Accumulation (Ac)**	**Max = 5**
Irrelevant	1	Simple	1
Moderate	3	Accumulative	5
High	5		
Cause-effect relation (Ef)	**Max = 5**	**Periodicity (Pr)**	**Max = 5**
Indirect	1	Irregular	1
Direct	5	Periodical	3
		Continuous	5
		Global Score	**Max = 100**

If one or more of the impact parameters do not apply to the regulatory proposal that is being analyzed, the regulator may discard some of them and adjust the scores to obtain as maximum a score of 100 for each impact.

Criteria for scoring the impacts

- **Intensity (In)**

This impact parameter determines the degree of influence that a regulatory action has over a qualitative factor. Considering that the objective of any regulatory action is to

ensure and promote the social welfare[70], the intensity can be defined as the positive impact the regulatory action causes on the qualitative factor.

Intensity levels of the regulatory impact	
Very low	The effect of the regulatory action on the affected factor is minimal.
Low	The effect of the regulatory action on the affected factor is low.
Medium	The effect of the regulatory action on the affected factor is partial.
High	The effect of the regulatory action on the affected factor is high.
Very High	The effect of the regulatory action on the affected factor is very high.

Note that, if the regulatory action has a negative impact on the affected factor, it can be measured in the same way and with the same scores as if it would be positive.

The score for this parameter is:

Intensity	**Very low**	**Low**	**Medium**	**High**	**Very high**
Score	*1*	*2*	*4*	*8*	*12*

Due to its relevance for the evaluation, the intensity parameter score is multiplied by 3 ($3In$).

Example:

Assessing the potential impact $\boldsymbol{I_{41}}$ of the regulatory action $\boldsymbol{RA_4}$ ***Division of the dam into 4 zones for different sailing activities*** on the qualitative factor $\boldsymbol{QF_1}$ ***Safety in the navigation and prevention of shipping accidents and incidents at the dam***.

Parameter: Intensity

The division of the dam into 4 zones for different sailing activities responds to the need to regulate the maritime traffic and to prevent accidents/incidents to occur. A specific activity was assigned to each zone (the first one, a common area for berthing; the second one, exclusive for water bikes and jet skis; the third one for ski; and the forth for sailing). Although the division of the dam into zones doesn't eliminate at all the risk of new accidents, it significantly reduces the probability of them to happen, or either to be severe, by avoiding, for example, skiers to be wounded by jet skis, or preventing them to crash against sailboats. Due to this, the impact of the regulatory action $\boldsymbol{RA_4}$ on the qualitative factor $\boldsymbol{QF_1}$ is considered as very high, getting a **score of 12**.

The next table shows the intensity score of each regulatory impact:

Potential Impact	I_{11}	I_{21}	I_{31}	I_{32}	$\boldsymbol{I_{41}}$	I_{42}	I_{43}
Intensity	High	High	Medium	High	**Very high**	Very high	Medium
Score (3 In)	8 x 3 =24	8 x 3 =24	4 x 3 =12	8 x 3 =24	**12 x 3 =36**	12 x 3 =36	4 x 3 =12

[70] "*What is the regulation?*". COFEMER website: http://www.cofemer.gob.mx/contenido.aspx?contenido=89

- **Extension (Ex)**

This impact parameter refers to the influence area expected to be impacted by the regulatory proposal. It may be economical or geographical, in terms of the target population affected. The extension can be expressed in terms of percentage. If the regulatory impact is very limited, it is considered as punctual, in contrast to a widespread impact (for instance in the whole economy), which is considered as very extensive.

Extension level of regulatory impact	
Punctual	The regulatory action affects a specific geographical area, or just one market.
Partial	The regulatory action affects two geographical areas or markets.
Extensive	The regulatory action affects more than two geographical areas or markets.
Very extensive	The regulatory action affects all or almost all the geographical areas or markets.

The score for this parameter is:

Extension	**Punctual**	**Partial**	**Extensive**	**Very extensive**	**Critical**
Score	*1*	*2*	*4*	*8*	*+4*

If the regulator considers that the regulatory impact extension is highly relevant or critical, it can be quantified by summing 4 units to the original score (for instance, an extensive critical impact score would be 4 + 4 = 8). **Due to its relevance for the evaluation, the extension parameter score is multiplied by 2 ($2Ex$).** For the previous example, where the extension is extensive and critical (4+4 = 8), the total score would be 8 x 2 = 16.

Example:

Assessing the potential impact I_{32} of the regulatory action RA_3 ***Prohibition of navigation to high power internal combustion engine vessels*** on the qualitative factor QF_2 ***Prevention of the water pollution***.

Parameter: Extension

The prohibition of navigation to high power internal combustion engine vessels results on a less dispersion of pollutant particles in the water of the dam. This impact is punctual because it regulates the aquatic traffic just in the Miguel Aleman dam. Although the extension of the regulation is punctual, it is considered as critical since this dam provides 38% of the Cutzamala System water flush that goes to Mexico City. In this way, **the extension score is equivalent to 2(1+4) = 10.**

The next table shows the extension score of each regulatory impact:

Potential Impact	I_{11}	I_{21}	I_{31}	I_{32}	I_{41}	I_{42}	I_{43}
Extension	Punctual	Punctual	Punctual	**Punctual - critical**	Punctual	Punctual – critical	Partial
Score (2 Ex)	1 x 2 =2	1 x 2 =2	1 x 2 =2	**(1+4) x 2 =10**	1 x 2 =2	(1+4) x 2 =10	2 x 2 =4

- **Time of manifestation of first effects (Ma)**

This parameter refers to the time lag between the implementation of the regulation and its first effects to show up. The score of this parameter is:

Time of manifestation	Long term More than 5 years	Medium term From 1 to 5 years	Short term Less from 1 year	Immediate term
Score	*1*	*3*	*5*	*10*

Example:

Assessing the potential impact $\boldsymbol{I_{21}}$ of the regulatory action $\boldsymbol{RA_2}$ ***Regularization and registration of foreign vessels*** on the qualitative factor $\boldsymbol{QF_1}$ ***Safety in the navigation and prevention of shipping accidents and incidents at the dam***.

Parameter: Time of manifestation of first effects

The registration of foreign vessels permits the identification of vessels that meet the security requirements. Since the regulatory proposal establishes a term of six months for the registration of such vessels, the time of manifestation would be in the short term, getting a **score of 5**.

The next table shows the extension score of each regulatory impact:

Potential impact	I_{11}	$\boldsymbol{I_{21}}$	I_{31}	I_{32}	I_{41}	I_{42}	I_{43}
Time of manifestation of first effect	Short	**Short**	Immediate	Immediate	Immediate	Immediate	Medium
Score (Ma)	5	**5**	10	10	10	10	3

- **Persistence (Pe)**

This parameter refers to the expected time for the effects of the regulatory action to remain, from its very first implementation. The parameter can be expressed in terms of time (for instance, two years). The persistence of a regulatory impact would be fleeting if it remains for a year or less, temporal if it remains between one and three years and permanent if its effect lasts for three years or more.

In this sense, it is worth to consider if the regulatory proposal has any *sunset clause* (also known as *sunset provision*) to be able to identify for how long its impact would last.

Persistence levels of the regulatory impact	
Fleeting	It implies and sporadic affectation of the factor (maximum duration of one year).
Temporal	It implies an affectation of the qualitative factor that lasts from more than one to three years.
Permanent	It implies an affectation of the qualitative factor that lasts form more than three years.

The score for persistence is:

Persistence	Fleeting	Temporal	Permanent
Score	*3*	*5*	*10*

Example:

Assessing the potential impact $\boldsymbol{I_{32}}$ of the regulatory action $\boldsymbol{RA_3}$ ***Prohibition of navigation to high power internal combustion engine vessels*** on the qualitative factor $\boldsymbol{QF_2}$ ***Purity and cleanliness of the dam (prevention of the water pollution)***.

Parameter: Persistence

Since the prohibition of navigation to high power vessels is permanent, its effects on the prevention of water pollution are permanent as well, getting this impact a **score of 10.**

In this case, the regulatory proposal does not establish any sunset clause, making its effects permanent. The only exception is the potential impact $\boldsymbol{I_{43}}$, regarding the increase of touristic activities due to the division of the dam into 4 zones, which would help to temporary increase the tourism in Valle de Bravo but, to get a permanent positive effect on tourism, complementary governmental actions are required.

The next table shows the persistence score of each regulatory impact:

Potential impact	I_{11}	I_{21}	I_{31}	$\boldsymbol{I_{32}}$	I_{41}	I_{42}	I_{43}
Persistence	Permanent	Permanent	Permanent	**Permanent**	Permanent	Permanent	Temporal
Score (Pe)	10	10	10	**10**	10	10	5

- **Synergy (Sy)**

This parameter refers to the capacity of the regulatory action to strengthen or intensify the positive effect of another regulatory action(s), of previous actions or even future proposed actions; this is a regulatory action is synergic if its effects are superior when implemented simultaneously to other regulatory action(s).

Synergy levels of the regulatory impact	
Irrelevant	The regulatory impact does not intensify any additional impacts.
Moderate	The regulatory impact intensifies at least one additional impact.
High	The regulatory impact intensifies two or more additional impacts.

The score for synergy is:

Synergy	**Irrelevant**	**Moderate**	**High**
Score	*1*	*3*	*5*

Example:

Assessing the potential impacts $\boldsymbol{I_{32}}$ **and** $\boldsymbol{I_{42}}$ of the regulatory actions $\boldsymbol{RA_3}$ ***Prohibition of navigation to high power internal combustion engine vessels*** and $\boldsymbol{RA_4}$ ***Division of the dam into 4 zones for different sailing activities***, on the qualitative factor $\boldsymbol{QF_2}$ ***Purity and cleanliness of the dam (prevention of the water pollution)***.

Parameter: Synergy

In June of 2012, prior to issuing the *Rules for Navigation at the* Miguel Aleman *Dam* a cleaning of the dam was performed. It consisted on the application of activated charcoal and the removal of algae to purify the dam water and to remove any musty odor and/or taste. Both the prohibition of navigation to high power vessels and the division of the dam into 4 zones, continued and reinforced the mentioned water cleaning, reason why their synergy level is high, getting both a **score of 5**.

Potential impact	I_{11}	I_{21}	I_{31}	$\boldsymbol{I_{32}}$	I_{41}	I_{42}	I_{43}
Synergy	Moderate	Irrelevant	Moderate	**High**	High	**High**	Moderate
Score (Sy)	3	1	3	**5**	5	**5**	3

- **Accumulation ($\boldsymbol{Ac}$)**

This parameter refers to the capacity of the regulatory impact to increase and reinforce itself during time. This generally occurs when the regulatory action generates changes in the customs and habits of the target population that require time to be assimilated[71].

	Cumulative levels of the regulatory impact
Simple	The regulatory impact does not increase or reinforce itself during time.
Cumulative	The regulatory impact increases and reinforces itself during time.

The score for accumulation is:

Type of impact	**Simple**	**Cumulative**
Score	*1*	*5*

[71] An example of a regulation with cumulative impact is the *Ruling of the Law of Organic Residues of the Mexican Federal District* (2008), by which the population of Mexico City was instructed to separate organic from inorganic wastes, and thereby promoting their recycling and better management. In case of noncompliance, economic penalties would be faced. In this sense, the regulatory impact is cumulative since the wastes separation is expected to become a daily and common habit, with the resulting reduction of noncompliance levels. For further information, check http://www.transparenciamedioambiente.df.gob.mx/index.php?option=com_content&view=article&id=181%3Areglamento-de-la-ley-de-residuos-solidos-del-distrito-federal&catid=55%3Aresiduos-solidos&Itemid=445

Example:

Assessing the potential impact $\boldsymbol{I_{11}}$ of the regulatory action $\boldsymbol{RA_1}$ "**Lake Card" *or* Seaman's Book *requirement for vessels drivers*** on the qualitative factor $\boldsymbol{QF_1}$ ***Safety in the navigation and prevention of shipping accidents and incidents at the dam***.

Parameter: Accumulation

The expertise and skills to drive a vessel are ensured by requiring drivers to have a *Lake Card* or *Seaman's Book.* Once in force, the requirement is expected to systematically improve the driver's aptitudes, as well as promoting the sharing and spreading of good driving practices, reinforcing safety in the navigation during time. With this, the regulatory impact may be considered as cumulative, getting a **score of 5**.

Potential Impact	I_{11}	I_{21}	I_{31}	I_{32}	I_{41}	I_{42}	I_{43}
Type of impact	**Cumulative**	Simple	Simple	Simple	Cumulative	Cumulative	Simple
Score (Ac)	**5**	1	1	1	5	5	1

- **Cause-effect relation ($\boldsymbol{Ef}$)**

This parameter indicates whether the effect of the regulatory action affects a qualitative factor on a direct or indirect way. The impact is considered as direct when the effect is generated by the action, and indirect, if there is another effect causing the impact, usually because of interdependencies among factors

.

	Cause-effect relation of the regulatory impact
Indirect	The regulatory action does not have a direct influence on the affected factor. The impact is transmitted by a secondary affected factor.
Direct	The regulatory action has a direct influence on the affected factor.

The score for cause-effect relation is:

Cause-effect relation	**Indirect**	**Direct**
Score	*1*	*5*

Example:

Parameter: Cause-effect relation

All the regulatory actions considered on the *General Rules for Navigation at the* Miguel Aleman *Dam* have a direct impact on the affected qualitative factors, thus getting a **score of 5**, except from the potential impact I_{43} of the RA_4 ***Division of the dam into 4 zones for different sailing activities*** on the qualitative factor QF_3 ***Tourism and recreation activities*** which is considered indirect, getting a **score of 1**.

Potential impact	I_{11}	I_{21}	I_{31}	I_{32}	I_{41}	I_{42}	I_{43}
Cause-effect relation	**Direct**	**Direct**	**Direct**	**Direct**	**Direct**	**Direct**	**Indirect**
Score (Ef)	**5**	**5**	**5**	**5**	**5**	**5**	**1**

- **Periodicity (Pr)**

This parameter refers on how often the regulatory effect occurs. The periodicity of the regulatory impact may be irregular, periodical or continuous.

Periodicity of the regulatory impact	
Irregular / Discontinuous	The regulatory impact takes place on an irregular/discontinuous way during time.
Periodical	The regulatory impact is recurrent and occurs every certain time (for instance, every two months).
Continuous	The regulatory impact is continuous during time.

The score for the periodicity parameter is:

Periodicity	**Irregular, discontinuous**	**Periodical**	**Continuous**
Score	*1*	*3*	*5*

Example:
Assessing the potential impacts I_{11} and I_{21} of the regulatory actions RA_1 **"Lake Card" *or* Seaman's Book *requirement for vessels drivers*** and RA_2 ***Regularization and registration of foreign owned* vessels**, on the qualitative factor QF_1 ***Safety in the dam navigation***.

Parameter: Periodicity

Both the registration of foreign vessels and the Lake Card /Sea Book requirement for drivers were established as permanent rules. Due to the prior, their impact on the safety in the navigation and the prevention of accidents is continuous, getting a **score of 5**.

However, **the impacts I_{11} and I_{11} are periodical** since both of them show up mainly in holiday season (**score = 3**). **The impact I_{42} is irregular** as it is deeply related to the drought season (**score = 1**).

Potential impact	I_{11}	I_{21}	I_{31}	I_{32}	I_{41}	I_{42}	I_{43}
Periodicity	**Continuous**	**Continuous**	Continuous	Continuous	Periodical	Irregular	Periodical
Score (Pe)	**5**	**5**	5	5	3	1	3

Fifth. Obtaining the total score of the regulatory impact

As seen above, to each potential impact I_{ij} corresponds a score of intensity In_{ij}, extension Ex_{ij}, time of first effects to show up Ma_{ij}, persistence Pe_{ij}, synergy Si_{ij}, accumulation Ac_{ij}, cause-effect relation Ef_{ij} and periodicity Pr_{ij}. Therefore, once the parameters are scored, the following equation permits the regulator to determine the total score of each qualitative impact:

$$\boldsymbol{I_{ij} = \pm(3In_{ij} + 2Ex_{ij} + Ma_{ij} + Pe_{ij} + Si_{ij} + Ac_{ij} + Ef_{ij} + Pr_{ij})}$$

This equation shows that the qualitative assessment of a regulatory impact is equal to the sum of its qualitative parameters. The plus-minus sign ($\pm$) denotes whether the regulatory impact is positive or negative. In case the impact is positive, the sum of scores would be positive, but negative if the regulator determines that the impact is negative.

Example: Scores of the regulatory impacts of the Rules for Navigation at the Miguel Aleman Dam (Valle de Bravo, Mexico State).

Potential Impact	**Parameter Scores**								**Total Score of each regulatory impact**
	3 In	*2 Ex*	*Ma*	*Pe*	*Si*	*Ac*	*Ef*	*Pr*	
I_{11}	24	2	5	10	3	5	5	5	**59**
I_{21}	24	2	5	10	1	1	5	5	**53**
I_{31}	12	2	10	10	3	1	5	5	**48**
I_{32}	24	10	10	10	5	1	5	5	**70**
I_{41}	36	2	10	10	5	5	5	3	**76**
I_{42}	36	10	10	10	5	5	5	1	**82**
I_{43}	12	4	3	5	3	1	1	3	**32**

After the qualitative impact assessment is completed, the relevance level of each regulatory impact can be determined, for instance, according to the following tabulator:

Impact Score I_{ij}	**13-25**	**26-50**	**51-75**	**76-100**
Relevance level	***Irrelevant***	***Moderate***	***Significant***	***Highly significant***
Color code	***Blue***	***Green***	***Yellow***	***Red***

Example: Significance of the regulatory impacts of the *Rules for Navigation at the Miguel Aleman Dam*.

Regulatory Actions RA_i		**Affected Qualitative Factors QF_j**		**Regulatory Impact**	**Score**	**Impact Relevance**
RA_1	Lake Card *or* Seaman's Book *requirement to vessels drivers.*	FC_1	*Safety in the navigation and prevention of shipping accidents and incidents at the dam.*	I_{11}	59	*Significant*
RA_2	*Regularization and registration of foreign vessels.*	FC_1	*Safety in the navigation and prevention of shipping accidents and incidents at the dam.*	I_{21}	53	*Significant*
RA_3	*Prohibition of navigation to high power internal combustion engine vessels*	FC_1	*Safety in the navigation and prevention of shipping accidents and incidents at the dam.*	I_{31}	48	*Moderate*
		FC_2	*Purity and cleanliness of the dam (prevention of water pollution).*	I_{32}	70	*Significant*
RA_4	*Division of the dam into 4 zones for different sailing activities.*	FC_1	*Safety in the navigation and prevention of shipping accidents and incidents at the dam.*	I_{41}	76	*Highly significant*
		FC_2	*Purity and cleanliness of the dam (prevention of water pollution).*	I_{42}	82	*Highly significant*
		FC_3	*Tourism and recreation activities*	I_{43}	32	*Moderate*

Once obtained the relevance of each regulatory impact it is possible to determine which the most relevant regulatory proposal is.

Example: Relevance of the regulatory impacts of the *Rules for Navigation at the Miguel Aleman Dam*.

As seen above, this regulatory proposal consists on four different actions affecting three qualitative factors, with a grand total of seven qualitative impacts. Two of them are highly significant, three are significant and two are moderate.

The most relevant qualitative impacts of this regulatory proposal are:

1) The impact I_{42} of the division of the dam into 4 zones for different sailing activities, on the prevention of water pollution (score = 82).
2) The impact I_{41} of the division of the dam into 4 zones for different sailing activities, on the safety in the dam navigation (score = 76).
3) The impact I_{32} of the prohibition of navigation to high power engine vessels on the prevention of water pollution and the purity and cleanliness of the dam (score = 70).

Sixth. Score Matrix and criteria to determine the impact relevance

With the score matrix it is possible to determine the relevance of the regulatory actions and of the qualitative factors affected by them. To do so, the written impacts of the ***impact matrix*** (***third step***) should be substituted by the respective scores obtained in the ***fifth step***. Additionally, it is necessary to add two rows and to columns to the matrix.

Regulatory Actions (RA_i)	**Qualitative Factors affected by the Regulatory Actions** (QF_j)					**Relevance of the Regulatory Actions**	
	QF_1	QF_2	QF_3	…	QF_m	***Total impact of*** RA_i	***Weighted average impact of*** RA_i
RA_1	I_{11}	I_{12}	I_{13}	…	I_{1m}	$\sum_{j=1}^{m} I_{1j}$	$\frac{\sum I_{1j}}{m^*}$
RA_2	I_{21}	I_{22}	I_{23}	…	I_{2m}	$\sum_{j=1}^{m} I_{2j}$	$\frac{\sum I_{2j}}{m^*}$
RA_3	I_{31}	I_{32}	I_{33}	…	I_{3m}	$\sum_{j=1}^{m} I_{3j}$	$\frac{\sum I_{3j}}{m^*}$
…	…	…	…	…	…	…	…
RA_n	I_{n1}	I_{n2}	I_{n3}	…	I_{nm}	$\sum_{j=1}^{m} I_{nj}$	$\frac{\sum I_{nj}}{m^*}$
Total impact on the affected QF_j	$\sum I_{i1}$	$\sum I_{i2}$	$\sum I_{i3}$	…	$\sum I_{im}$		
Weighted average impact on the affected QF_j	$\frac{\sum I_{i1}}{n^*}$	$\frac{\sum I_{i2}}{n^*}$	$\frac{\sum I_{i3}}{n^*}$	…	$\frac{\sum I_{im}}{n^*}$		

The two new columns are for the sum of scores (total impact of the regulatory action) and the weighted average score of each regulatory action. The two new rows are for the total

sum of scores (total impact on the affected qualitative factor) and the weighted average score of each affected qualitative factor.

a) Total impact of the regulatory action RA_i

This criterion determines ***which one is the regulatory action with the most relevant qualitative impact of all the regulation***, and it is determined with the horizontal sum of scores of each regulatory action. For instance, the total impact of the regulatory action RA_1 would be equal to:

$$I_{11} + I_{12} + I_{13} + \cdots + I_{1m} = \sum_{j=1}^{m} I_{1j}$$

The regulatory action with the highest sum of scores can be considered as the one with the most relevant qualitative impact of the regulation.

b) Weighted average impact of the regulatory action RA_i

The weighted average impact considers only the number of qualitative factors affected by a regulatory action. It is different from the total impact since there are regulatory actions that affect more qualitative factors than others, and the total sum of scored may not reflect the real impact of each regulatory action[72].

Due to the prior, the weighted average impact of the regulatory action RA_1 would be equal to its total impact divided by m^*, where m^* is the number of qualitative factors affected by that regulatory action. Formally:

$$\frac{\sum_{j=1}^{m} IP_{1j}}{m^*}$$

There may be cases in which the weighted average impact criterion confirms the order of importance found with the total impact criterion, like our example of the *General Rules for Navigation in Miguel Aleman Dam*. **Despite this fact, the regulator needs to consider that, in some other cases; the regulatory action with the highest total impact may not be the one with the highest weighted average impact**.

c) The total impact on the affected qualitative factor QF_j

With this criterion it is possible to determine ***which of the qualitative factors affected by the regulation is the most relevant***, and it is determined with the vertical sum of scores of each qualitative factor. For instance, the total impact on the affected qualitative factor QF_1 would be equal to:

$$I_{11} + I_{21} + I_{31} + \cdots + I_{n1} = \sum_{i=1}^{n} I_{i1}$$

The most relevant affected qualitative factor would be the one obtaining the highest vertical sum of scores.

[72] The distinction between simple averages and weighted averages is useful when making comparisons between averages calculated each one on a different number of observations. In this case, the comparison is between the relevance of the qualitative impact of each regulatory action, since some regulatory actions affect a larger number of qualitative factors.

d) The weighted average impact on the qualitative factor QF_j

This indicator considers that some qualitative factors are affected by more regulatory actions than others, so the total sum of scores may not necessarily reflect which is the most relevant.
Due to the prior, the weighted average impact on the qualitative factor QF_1 would be equal to its total impact divided by n^*, where n^* is the number of regulatory actions that affect it. Formally:

$$\frac{\sum_{i=1}^{n} IP_{i1}}{n^*}$$

Example: Score Matrix of the *Rules for Navigation at the Miguel Aleman Dam*.

The impacts of the impact matrix are replaced by the obtained scores to get the Score Matrix.

Regulatory Actions	***Qualitative Factors affected by the Regulatory Actions***			***Total impact of RA_i***	***Weighted average impact of RA_i***
	QF_1 *Safety in the navigation and prevention of shipping accident at the dam.*	QF_2 *Purity and cleanliness of the dam (prevention of water pollution)*	QF_3 *Indirect promotion of tourism and recreation activities*		
RA_1 *Lake Card or Seaman's Book requirement to vessels drivers.*	$I_{11} = 59$	X	X	$\sum I_{1j} = 59$	$\frac{\sum I_{1j}}{1} = 59$
RA_2 *Regularization and registration of foreign vessels.*	$I_{21} = 53$	X	X	$\sum I_{2j} = 53$	$\frac{\sum I_{2j}}{1} = 53$
RA_3 *Prohibition of navigation to high power internal combustion engine vessels*	$I_{31} = 48$	$I_{32} = 70$	X	$\sum I_{3j} = 118$	$\frac{\sum I_{3j}}{2} = 59$
RA_4 *Division of the dam into 4 zones for different sailing activities.*	$I_{41} = 76$	$I_{42} = 82$	$I_{43} = 32$	$\sum I_{4j} = 190$	$\frac{\sum I_{4j}}{3} = 63.3$
Total impact on the affected QF_j	$\sum I_{i1} = 236$	$\sum I_{i2} = 152$	$\sum I_{i3} = 32$		
Weighted average impact on the affected QF_j	$\frac{\sum I_{i1}}{4} = 59$	$\frac{\sum I_{i2}}{2} = 76$	$\frac{\sum I_{i2}}{1} = 32$		

Example: Score Matrix of the *Rules for Navigation at the Miguel Aleman Dam*.

Criteria to determine relevance

a) **Total impact of the regulatory action**. According to the ***Total impact of*** RA_i column, the most relevant regulatory action of the *General Rules for Navigation at the Miguel Aleman Dam* is the regulatory action RA_4, regarding the ***division of the dam into 4 zones for different sailing activities***, which total impact is equal to ***190 points***. The second most relevant is the action RA_4, regarding the ***prohibition of navigation to high power internal combustion vessels***, which total impact is equal to ***118 points***.

b) **Weighted average impact of the regulatory action**. For this particular case, the weighted average criterion confirms what was found by the total impact of regulation. This is that, the most relevant regulatory action of the *General Rules for Navigation at the Miguel Aleman Dam* is the regulatory action RA_4, regarding the ***division of the dam into 4 zones for different sailing activities***, which score is ***63.3 points***.

c) **Total impact on the affected qualitative factor**. According to the ***Total impact on the affected*** QF_j row, the most relevant qualitative factor affected by all the regulation is the QF_1, regarding the ***safety in the dam navigation***, which total impact received is equal to ***236 points***, and followed in importance by the QF_2, regarding the ***prevention of water pollution***, equal to ***152 points.***

d) **Weighted average impact on the qualitative factor**. The weighted average criterion shows that, although the QF_1 is the one receiving the highest total impact, its weighted average impact is just equal to ***59 points***, besides the QF_2 which weighted average impact is greater, equal to ***76 points***. In other words, **the regulatory actions affecting the qualitative factor QF_2 have a greater impact than the ones affecting the QF_1.**

3.8 Final considerations

3.8.1 Sensitivity analysis

An ex ante analysis of regulation requires projecting the effects or impacts generated by regulatory alternatives. This projection implies anticipating what happens in the future, as it should be assumed the subsequent behavior of the variables that define the benefits and costs, as well as other parameters such as the discount rate. An estimate of this type involves a margin of error, because it is not possible to say exactly what will be the value of a variable we do not know at this time. Therefore, this risk factor should be included in the analysis; the way to do this is through sensitivity analysis.

Sensitivity indicates the extent to which a variable can be modified due to changes in the parameters that define it. Thus, the net benefits are sensitive to changes in the discount rate, in costs and in benefits. At the same time, costs will be sensitive to changes in the inflation rate or in the availability of certain goods. For example, suppose that compliance

costs increase according to the inflation rate, which will remain constant at 4%. Like any inference, this can be met or not, that is, there is a chance that inflation behaves in this way or in another.

In general, the sensitivity analysis comprises the following steps:

1. Identify uncertain variables and the possible values they can take
2. Define the minimum and maximum values that each variable can take
3. Explore the sensitivity of the result of each entry variable and identify for which values can be reversed

Therefore, the sensitivity analysis[73] incorporates uncertainty about the future behavior of the parameters in the impact evaluation. This analysis is used to explore the ranges of values that regulatory effects can take, so that we can determine how reliable results are in case any parameter does not behave as we had initially inferred. In our example, the sensitivity analysis allows to determine how the compliance costs will increase and, therefore, the net benefits of regulation when the inflation rate changes.

Similarly, the discount rate is also a parameter which variation can potentially change the result of the analysis. For example, consider a regulatory proposal which implementation costs are estimated at $1,300 billion pesos. The estimated benefits (in million pesos) for the years after implementation are:

Table: Benefits of regulation

Year 1	Year 2	Year 3	Year 4
$\mathbf{\$100}$	$\mathbf{\$200}$	$\mathbf{\$500}$	$\mathbf{\$1,000}$

Thus, the accrued benefits (in case we do not apply any discount factor) will be equivalent to $1,800 billion pesos. However, as we saw above, there are reasons to discount the benefits over time: with a discount rate of 5%, benefits at present value are:

$$\frac{\$100}{(1+0.05)^1}+\frac{\$200}{(1+0.05)^2}+\frac{\$500}{(1+0.05)^3}+\frac{\$1{,}000}{(1+0.05)^4}=\$1{,}531.26$$

We obtain the net present value by discounting the costs, this is equal to:

$$\text{NPV} = \$1{,}531.26 - \$1{,}300 = \$231.26$$

Now, when we change the discount rate and increase it to 12%, benefits at net present value are:

$$\frac{\$100}{(1+0.12)^1}+\frac{\$200}{(1+0.12)^2}+\frac{\$500}{(1+0.12)^3}+\frac{\$1{,}000}{(1+0.12)^4}=\$1{,}276.74$$

In this way, we obtain:

[73]Robert N. Stavins, "On the value of formal assessment of uncertainty in regulatory analysis", John F. Kennedy School of Government, Harvard University

$$\text{NPV} = \$1{,}276.74 - \$1{,}300 = -\$23.26$$

This example shows the sensitivity of compliance costs to changes in the interest rate, and as we can see, incorporating the uncertainty existing in the discount rate definition can reverse the result of the CBA, like in this case.

Due to the complexity involved in this type of analysis, its use is not always recommended. However, its implementation helps to consolidate the analysis and strengthen its conclusions. In fact, the choice of the best alternative is often changed from its use. In the case of CBA and CEA, the variable of interest is usually the discount rate, though estimates in benefits and costs also tend to change for the analysis of scenarios.

However, the sensitivity analysis application is not exclusive to these two methods. We can also use it in the ADMD and in the profitability indicators such as the IRR or EAC. Its application in the ADMD is used to modify the weightings assigned to each criterion. Returning to the example in the section on this method, the weightings assigned to each criterion could vary: the increase in temperature could increase from 0.09 to 0.33, and the weighting of the annual costs could go from 0.33 to 0.09. The results of this variation are illustrated in the following table:

Criteria	Initial weighting	Final weighting
Increase in temperature	0.09	0.33
Stress of ecosystem	0.09	0.035
Increase in sea level	0.09	0.035
SO_2 emissions	0.20	0.20
Nuclear waste generation	0.20	0.20
Annual costs	0.33	0.09
TOTAL	**1**	**1**

The scores matrix would be the following:

Policy options	Increase in global temperature (^{0}C)	Stress to ecosystem (10^6 ha)	Increase in sea level (cm)	SO_2 emissions (mill. ton/year)	Nuclear waste (thousand ton/year)	Annual costs (mm USD$/year)	Final score
Baseline scenario	0	0	0	6	19	9	**34**
$75 per CO_2 ton	3	1	1	11	14	8	**38**
$150 per CO_2 ton	10	2	5	15	9	6	**47**
$300 per CO_2 ton	**33**	**9**	**9**	**20**	**0**	**0**	**71**
Standards on SO_2 emissions	18	5	5	8	5	8	**48**
Nuclear energy	17	4	4	0	20	9	**54**
Biomass energy	8	2	2	8	19	9	**48**

As we can see, the final scores are sensitive to changes in the weightings, which is relevant when choosing the best alternative by using the ADMD. After modifying the

weightings, we obtain another result, since now the $300 tax gets the highest score in relation to other alternatives.

A variable of the sensitivity analysis is the presentation of scenarios where the parameter or the variable of interest assumes different values. Three scenarios are usually generated:

1. **Pessimistic scenario:** Within this we will incorporate the values that may lead the CBA to a lower limit. For example, supposing that every year costs increase by a percentage, or that benefits are of a percentage lower than expected. Also, we take into account discount rates higher than those representing the opportunity cost.
2. **Neutral scenario:** This scenario is directly obtained in the CBA made by regulators, that is, it is the scenario that justifies a "normal" behavior of the parameters and their values.
3. **Optimistic scenario:** Unlike the pessimistic scenario, as the name implies we can enter justifications for a reduction in costs, an increase in benefits (including a growth rate over time for the same), lower inflation, lower discount rate, among other variables that will lead the CBA value to a maximum or cap.

The justification for the three scenarios and their corresponding variables will be essential to the accuracy of the results obtained. Each scenario is assigned a probability of occurrence.

Example: Application of sensitivity analysis in the IRR

The following is the application of sensitivity analysis to the IRR example, considering the three scenarios proposed before.

Table: Application of the sensitivity analysis in the IRR

Regulatory projects	Scenarios	Results	Probability of occurrence of scenarios	Expected return
Standards on the handling of dangerous substances	Pessimistic	12%	33.33$\bar{3}$%	**15.19%**
	Neutral	**15.10%**		
	Optimistic	18.50%		
Safety standards on workers' clothing	Pessimistic	6.50%	33.33$\bar{3}$%	**9.71%**
	Neutral	**11.13%**		
	Optimistic	11.50%		
Safety standards at workplaces	Pessimistic	9.0%	33.33$\bar{3}$%	**11.37%**
	Neutral	**9.13%**		
	Optimistic	16%		

Source: COFEMER

In this example, we assume that the probability of occurrence of each scenario is the same (that is, 1/3 for each), though we could use other methods to estimate the probability of occurrence of each option (such as the Monte Carlo method). The expected return is obtained in the following way:

$$\text{Expected retur} = \left(\text{Ret} * \text{Prob}_{\text{pessimistic}}\right) + \left(\text{Ret}_{\text{Neutral}} * \text{Prob}_{\text{Neutral}}\right) + \left(\text{Ret}_{\text{Optimistic}} * \text{Prob}_{\text{Optimistic}}\right)$$

After estimating the expected return, we can conclude that the standards on the handling of dangerous substances (the first option) show the highest expected return. Note that after implementing the sensitivity analysis, the regulation of safety standards on workers' clothing (the second option), which was previously considered the second best alternative, proved to be the worst. Finally, the third option improved its return.

3.8.2 Monte Carlo method in regulation

The Monte Carlo method is a technique used for impact evaluation of regulatory policies by simulating multiple scenarios (it can estimate up to 10,000 scenarios) in which the important and determining variable(s) of the impact of regulation change according to the distribution of probability assigned. That is, the most important variables for the definition of costs and benefits of the regulatory policy will change and assume values with certain probability. The result is that we will have estimated a thousand or ten thousand "versions" of the future scenario from the application of this method.

Consider the following example. Imagine we are trying to measure the impact of a regulation intended to considerably reduce environmental damage. The impact of this policy will be measured by estimating the net benefits, which are the difference between the generated benefits and costs. We will assume that the benefits of this regulation will always be constant and equal to 1 million pesos, while costs vary from 500,000 to 1.2 million pesos. The application of the Monte Carlo method will generates thousands of scenarios from the variation in costs (at least one thousand must be estimated), inferring that the probability that this parameter assumes certain value is the same in each case. Mathematically, this is expressed as follows:

$$\mathrm{P}(\mathrm{Costs} = 500{,}000) = \mathrm{P}(\mathrm{Costs} = 501{,}000) = \cdots = \mathrm{P}(\mathrm{Costs} = 1.2\ \mathrm{million})$$

Thus, we will obtain thousands of versions of the net benefits, which can be positive or negative, depending on the value assumed by the costs. The sign taken by the net benefits will decide whether the impact of the regulatory policy is positive or not. In other words, the decision rule when applying this methodology is the same used so far: it will be convenient to implement a regulatory policy if net benefits are positive.

CHAPTER IV

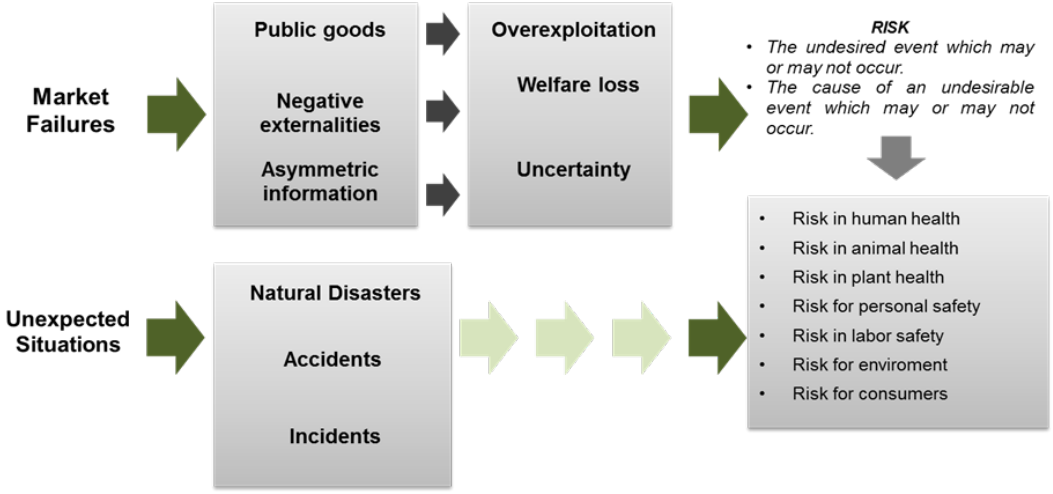
METHODOLOGIES TO QUANTIFY COSTS AND BENEFITS IN SOCIAL REGULATION

Chapter IV: Methodologies to quantify costs and benefits in social regulation

As we mentioned in the first chapter of this guide, the State seeks to impact or influence the individuals' actions through regulation, in order to guide them toward a more desirable behavior, in an effort to prevent or reduce the impact of factors that can potentially reduce the welfare of the population.

Particularly, **social regulation** protects the public interest of factors such as market failures or unpredictable events. Market failures result in imbalances that favor the offer of a smaller quantity or lower quality of goods and services in the market, which can be translated into threats or potential harms that may compromise the welfare of population. For example, over-exploitation of certain natural resources, which can be considered as public goods, can cause a permanent damage to the ecosystem and environmental imbalance, which can result in a risk to society.

In addition, risk can also arise from events that are not easily predictable, such as natural disasters, which impact and probability of occurrence are previously unknown; in this case, social regulation is also in charge of reducing the potential harm that these events may cause to the community.



Therefore, the social regulation is the tool the government counts on to prevent risks or reduce their impact on society. The main feature of these regulations is that they are intended to avoid, transfer, reduce, mitigate, eliminate or hold back the risks derived from market failures or unexpected situations.

In general, risks are the possibility of occurrence of an unpleasant or unfortunate event. Risks arise in many areas: economic, financial, environmental, labor, health, social security and public safety.

4.1. Design of social regulation considering the level of risk

Efficient regulatory policies should incorporate the risk assessment in its design, so that the differentiation based on the level of risk is one of the most important attributes to make better regulations, always taking into account that the available resources to implement the government actions are scarce. In this regard, the State has mainly two approaches in the design of regulatory policies: the Precautionary Principle and the Risk-Based Regulation.

4.1.1 The Precautionary Principle (PP)

The PP refers to the design of regulations aimed at reducing potential risks without exactly knowing the causal relationships and the probable effects of regulation. That is, it proposes the design of a flat regulation (the same rule applies for everybody) without directing resources according to the level of risk.

This approach is characterized by the extremely conservative behavior of regulators, as they try to avoid any kind of risk, even if this disproportionately restricts the economic or social activities that are causing it, so avoiding a risk can be too costly for society, and therefore, when issuing the regulation.

Another important feature of PP is that it requires little information to support its decisions, which at the same time implies a brief analysis of the consequences of the proposed regulation. **In this sense, the precautionary principle is useful in the presence of a risk which probability of occurrence is unknown and potentially generates a considerable damage to society.**

An example of the precautionary principle application in Mexico was when the *outbreak of AH1N1 influenza* occurred, which led the Ministry of Health to impose the maximum degree of restrictions to society in order to prevent a pandemic. The restrictions included the suspension of diverse economic activities to avoid meetings of people, so concerts were postponed or canceled, cinemas and restaurants were closed, and labor was suspended for a few days in the Mexico City and surroundings, among other actions.

It was not possible to reduce the security measures and chose a regulation approach that would not require the prohibition of activities, until information was disclosed and the Mexican government knew more accurately the real magnitude of the risk.

From this, it derives that **the precautionary principle should not be used in all cases**, since it generates inefficiencies and deficiencies that violate the logical process of decision under uncertainty, that is:

- It does not take into account the opportunity costs of the precautionary measures
- It does not take into account the potential benefits of adopting different measures
- Complicates the problem of establishing priorities based on a rational criterion

4.1.2 Risk-based regulation (RBR)

The RBR involves the development of public policies intending resources for supervision and monitoring according to the level of risk, based on a proper assessment of the risk(s), so it is necessary that the regulator is duly informed (qualitative and quantitatively).

The essential question of this approach is: **what types and levels of risk the regulator is prepared to tolerate?**

To answer this question, the regulator must measure the risks through a **risk analysis**, a tool useful to identify the existence of a potential threat to the population (human, animal and/or plant) to determine how likely it is that these dangers materialize, and define which

measures are appropriate to decrease the probability of occurrence of an undesirable event.

In this context, **risk** can be defined as:

> *"The probability of occurrence of an event, impact or adverse consequence multiplied by the result of such event in damages or loss"*
>
> *Or,*
>
> *"The probability of not getting the expected result of a choice made multiplied by the result of such event in damages or loss"*

The RBR requires studying the risks nature and magnitude to ensure that the regulatory action is properly designed, which implies that the regulation intends more resources to the dangers of greater social impact and with higher probability of occurrence (that is, higher risk). In summary, **the way regulatory resources are intended when we resort to RBR depends on three factors: *the probability of risk, its potential impacts and the way in which the State wants to manage risk***.

For example, a regulation could establish the requirement that vessels transporting fuels have to do so using double bottom tanks in order to avoid spills that could damage the marine environment. However, this measure would be too expensive for ships transporting food or other products that do not endanger the ecosystem, as their impact or potential damage is considerably minor. Therefore, in these circumstances, a regulation made under the RBR principles will be stricter when risk is greater (when impact is greater), that is, when there is a high probability that an accident could endanger the environment, and choose a less strict regulation when the load is not too risky and there is low probability that the risk materializes.

Moreover, risk analysis involves classifying and assigning them a probability of occurrence. The following table shows examples of this classification:

Category 1	Category 2	Description
Imperceptible	**Acceptable**	Danger will be likely in exceptional circumstances
Possible	**Low**	Danger will be likely in certain more probable circumstances
Moderate	**Moderate**	Risk is clearly posible
High	**High**	There is a high probability of occurrence of the risk

The RBR requires classifying the different types of risk to identify how it should regulate them. Once the risk is classified, the regulator will be able to do the following:

- **Avoid the risk:** the regulator forbids the performance of the activity causing the risk.
- **Reduce the risk:** the regulator seeks to reduce the probability and the impact of the risky event.
- **Accept the risk:** the regulator accepts the risk implied by certain event.

- **Transfer the risk:** the regulator looks for a third person that accepts the risk in exchange for some compensation.

Moreover, in this process of choosing and taking risks, the regulator is exposed to make mistakes. Since the resources to be allocated are scarce, the regulator must choose where to direct them. It is clear that the regulator knows that he cannot supervise all the enterprises in all their activities and at all times, so he will have to make decisions and, therefore, take risks. This seems logical, or even trivial, but it is not. Precisely, what the precautionary principle does –as-it is more rigid– is providing equal treatment to all enterprises in all scenarios; in addition to choose overregulation in view of a situation difficult to assess. That is why governments are in the dilemma of subregulate or overregulate, that is, making a **type I error** or a **type II error**. This situation poses a great dilemma for the regulator, which is explained in the following figure.

Minimizing errors	**Type I error**	Fail in regulation (***subregulation or non regulation***) when it is required to do so; this generates damages or losses.
	Type II error	Regulate when there is no need to do so ***(overregulation)*** or regulate more than necessary, promoting more risks and reducing benefits.

Overregulation occurs when the risk assessment of the regulator is positively biased, that is, the regulator allocates too many resources to regulate an activity that does not deserve so. In contrast, **subregulation** can occur when the regulator overlooks potential risks and does not allocate sufficient resources to mitigate them. The occurrence of type I error leads to potential risks for population, while the Type II error involves overregulation that may reduce the access to goods and services necessary for the population, which also means risks and reduction of social welfare.

In this regard, it should be understood that zero risk is unattainable and undesirable, as the **public policy costs** increase as risk decreases, so it is very expensive to bring uncertainty to zero, which was originally addressed. Moreover, as long as resources used to minimize the risk are limited, there is an implicit opportunity cost, since such resources could always be intended for other kind of activities that could be socially more beneficial.

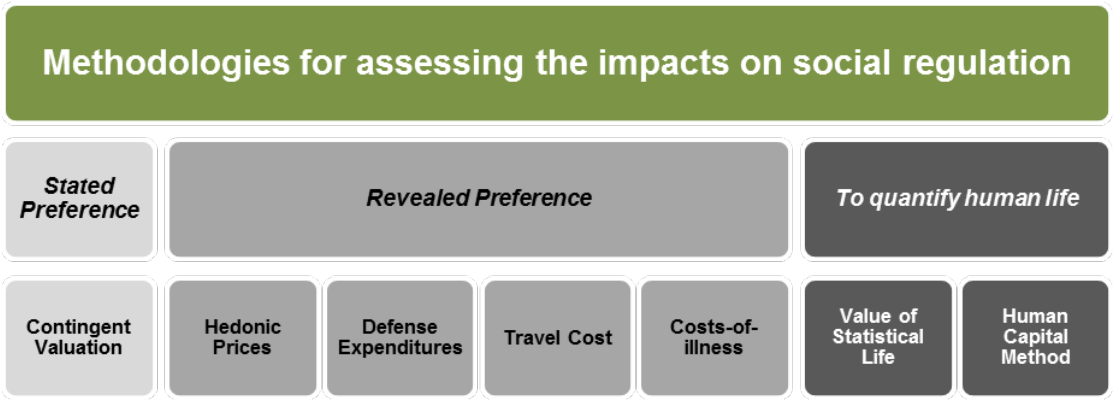
4.2 Impact evaluation of social regulation

On the other hand, measuring and quantifying the impact is a fundamental part of the process of regulatory impact evaluation. Some methods of impact analysis, such as the Cost-Benefit Analysis (CBA) or the Cost-Effectiveness Analysis (CEA), require the monetary estimation of both, costs and benefits. However, this task is complicated because many of the objects of social regulation **are not market goods** and, as such, they are neither purchased nor sold at regular markets.

Example of this type of goods are the human lives that are intended to save with a regulation that seeks to double the strength of the roofs of cars, because it has been proven that the majority of traffic fatalities are due to their extreme weakness. Thus, considering that the benefits of this hypothetical regulation are expressed in human lives and clearly the compliance costs are monetary (manufacturer's cost to double the strength

of car roofs); then, is required to translate the benefits and the costs to the same measurable unit to analyze the impact of the regulatory proposal (using any of the methods discussed in Chapter III). For this purpose, there are several methodologies that monetize the benefits of social regulation, which will be analyzed and studied in this chapter.

The **impact evaluation of social regulation** uses methodologies that translate individuals' actions, preferences or information within society, into monetary values. The idea behind most of these methods is to find the value that an individual assigns to a good, either directly, when individuals express the amount of money they are willing to pay for it, or indirectly, from their behavior, which allows inferring their valuation of these resources.

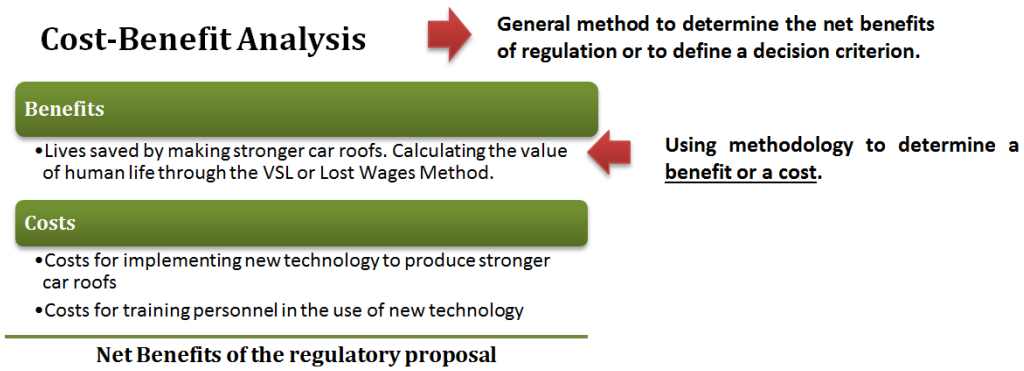


Source: COFEMER

The methods used to directly express the monetary amount are known as **direct methods or stated preference**, because the individual states his preference for certain good; while all those expressing his valuation through actions are known as **indirect methods or revealed preference**. Furthermore, the **methods for quantifying human life** have a special feature: they allow estimating the monetary value of human life, both directly (lost wages caused by death) and indirectly (WTP or WTA estimate to reduce the risk of death).

The methods that make up this chapter are based on the concepts of willingness to pay and willingness to accept. The **willingness to pay (WTP)** is the maximum amount a person wants to pay to obtain a benefit or to avoid a decrease in welfare derived from the implementation of a public policy; while the **willingness to accept (WTA)** is the minimum amount an individual is willing to accept as compensation for a decrease in welfare derived from a public policy implementation, or as compensation for not receiving a benefit generated by the same.

Finally, it is worth noting that **the methodologies described in this chapter are used to monetize the benefits or costs generated by the regulatory proposal (so it's only part of the impact analysis, and does not constitute it completely)**, whose results should be integrated into the application of methods such as Cost-Benefit Analysis, Cost-Effectiveness Analysis, or the Equivalent Annual Cost to determine the net benefits generated by regulation, as shown in the following figure:



Source: COFEMER

4.3 Direct or stated preference methods in the impact evaluation of social regulation

Stated preference methods or direct methods use surveys to determine people's WTP and WTA for some good which economic value is not directly observed. These methods help to design, specify and present hypothetical scenarios for the survey respondents to state their preferences for such goods.

4.3.1 Contingent Valuation Method (CVM)

The CVM is a direct or stated preference method that uses surveys, under different formats and a structured design, in order to get the value of a good through the individuals' willingness to pay/accept (WTA) for this. It is often used to value goods that, because of their nature, we cannot monetize through market transactions (non-commercial goods).

The contingent valuation method or hypothetical method is called so because it uses information about people's behavior in hypothetical circumstances[74]. A contingent valuation study requires the design of a hypothetical scenario for the good to be valuated, comparable to the *status quo*. In this methodology the pollster asks the individuals about the price they would pay for acquiring the concerning good under the conditions described, revealing his willingness to pay for it. In general, the CVM is used to obtain the valuation of environmental and public goods, as well as of goods that does not have a defined market (non-defined market), such as recreational services, natural areas and cultural goods.

CVM application

First.	Identify the good to be evaluated in the regulation
Second.	Determine evaluation approach: ex ante or ex post
Third.	Define the hypothetical scenario to evaluate the good
Fourth.	Define and select the sample to be polled
Fifth.	Define the mode of payment in the hypothetical scenario: an annual payment, the value of

[74] Blomquist, J. C. (2005). The use of contingent valuation in benefit-cost analysis.

an admission to a particular area, an increase in prices, etcetera.

Sixth. Choose the type of questions that will make up the survey

Seventh. Choose the order of the questions[75] and the supporting material to be used

Eighth. Make the survey. It is important to clearly present the good to be valued, as well as the hypothetical scenario and the effects of the disturbance, since the answer largely depends on how the elements are presented.

Ninth. Apply the survey to individuals

Tenth. Determine the WTP through an average:

$$\mathrm{WTP}_{\mathrm{average}} = \frac{1}{\mathrm{n}}\sum_{\mathrm{i}=1}^{\mathrm{n}} \mathrm{y_i}$$

Where n is the number of interviews conducted, and y_i is the amount expressed by the individual *i*.

Eleventh. Obtain the welfare measure by applying the average WTP to the inferences of the regulation

$$\text{Welfare measure} = \overline{\mathrm{WTP}} * \mathrm{P}$$

Where *P* represents the number of private goods affected by the policy.

Considerations on the survey development

The development of the survey to be applied constitutes a central part in the CVM implementation. Surveys should be designed in such a way that minimize biased answers and maximize the likelihood of obtaining accurate valuations that neither overestimate nor underestimate the valued goods. The development of a survey in the CVM should consider the following points:

- It is important to consider the context and circumstances of the respondents to determine the approach from which the survey will be made: in the *ex post* approach it is assumed that the person knows or has experienced the situation presented and this is asked about his willingness to pay to improve the situation; while in the *ex ante* approach the person has never experienced the hypothetical situation presented and this is asked about his willingness to pay to improve the current situation or prevent future damage.
- The order in which questions are asked and the supporting material are important to guide respondents through a logical process.
- In order to obtain appropriate answers we should make the right choice on the survey questions, that is, it is important to choose a type of question that allows individuals to properly express their WTP. The types of questions are:
    1. **Open-ended questions:** are direct questions about the aspects that the pollster wants to know, which can be freely answered; for example, how much are you willing to pay for this product?

       Many times, open-ended questions may not be appropriate because the respondent will hardly have a figure in mind of the value of the good or product to be evaluated.
    2. **Dichotomous format:** involves asking whether or not a person would be willing to pay certain amount of money to change the status quo. In this sense, the survey can be presented in detail; that is, ask about a specific amount for a good.
    3. **Auction format:** In this format, the pollster offers an initial amount and asks the respondent if he would be willing to pay such amount; if the answer is positive the initial amount rises to a maximum, if the answer is negative it is reduced to the minimum the respondent agrees to pay.
    4. **Multiple format:** The survey offers several options as answers. The advantage of this versiont is that the interviewer can choose the "appropriate" interval of response and thus avoid extreme

[75] Andersson, Henrik; Svensson, Mikael (2010) "Scale sensitivity and question order in the contingent valuation method" Cahiers du LEERNA, Toulouse.

valuations.

- By placing individuals in hypothetical situations, some responses may exceed the respondents' posibilities to pay, therefore, it is necessary to count on questions we can use as a "lock" to ensure the accuracy of the questions and avoid biases in individuals valuations.
- In order to avoid an overestimation of the WTP and the free-rider problem, it is important to include in the survey questions like: Will your quality of life be affected if you incur the spending? Where would you get the money from: savings, cutting off other expenses? What kind of costs would have to cut off? Etcetera.
- The survey application depends on the financial resources and the time we have. There are three ways to applying a questionnaire:[76]

  a) Personal interviews

  b) Telephone interviews

  c) Post interviews or by mail

Practical example: The "Exxon Valdez" oil spill in Alaska

On March 23, 1989, the Exxon Valdez ship was leaving Alaska bound for Long Beach, California, with a cargo of 200,962,720 liters of crude oil. Three hours later the oil tanker hit the Prince William strait. This caused a fracture of 11 cargo tanks, spilling more than 40 million liters of crude, causing one of the largest and most catastrophic environmental accidents.

As part of the actions taken to contain the effects of the spill, a study was conducted by using the CVM, which consisted on informing the respondent about the effects of the spill, as well as the characteristics of a program (Escort ship plan) that could prevent another disastrous effect, and how the respondent could pay a compensation to implement the proposed cleanup program.

First. In this case, the good to be valued is a cleaning program of the oil spill.

Second. The approach of the survey will be ex post, as this is about the implementation of a cleaning program in the future.

Third. The hypothetical scenario involves implementing a cleaning program for oil spill that improves the status quo conditions (spill) and avoids the negative effects of another disaster of the same nature, in the future.

Fourth. In order to obtain the value of the program, a random sample of the 50 states of USA and the District of Columbia were surveyed.

Fifth. Because of the nature of the problem, it was agreed that the mode of the hypothetical payment would be by a single tax on oil companies working in the area of Alaska, and a single payment by local families.

Sixth. The questions of the survey were dichotomous and multiple. The main question is: whether the survey respondent would vote for or against the program. It also included questions that explore the specific reasons for the vote in order to identify possible biases.

[76] The method most recommended by studies is, withouh doubt, personal interviews. However, the application of a peliminary or proof survey is necessary to make adjustments to the final version, as this helps the pollster clear doubts that may aise after analyzing the survey data.

Seventh. Eight. Ninth. In order to avoid biases in the answers, the survey included the following sections:

a. Preliminary questions to present the hypothetical scenario elements and inform about the spill and its consequences.

b. Description of the Prince William strait; in this section the previous section was contextualized through maps and pictures.

c. Description of the wildlife and the implications of the spill on it. Pre-and post-incident information on the most affected animal species was presented.

d. Explanation of an Escort ship plan; at this point it was made a description of the cleaning program for reducing the probability of a future accident.

e. Questions of valuation; in this section the mode of payment under the hypothetical scenario was informed and a series of questions to determine the willingness to pay for both, a single payment and through a federal tax, was conducted.

Tenth. Eleventh. Once the survey was developed and applied, the WTP to prevent another oil spill like the Exxon Valdez was obtained, considering the costs of the proposed cleaning program. From these data, the following resolutions were obtained:

- The agreements between the State of Alaska, the U.S. Government and Exxon on the oil spill were divided into three parts, coming to the amount of USD $1.15 billion. As punishment for its environmental crime, Exxon was ordered to pay USD$150 million, but 125 million were deducted because of the company cooperation to repair the damage. Of the remainder, 12 million were to the NAW Conservation Fund, and 13 million to the National Victims Fund. As part of the compensation for damages set out in the regulation, Exxon agreed to pay USD $100 million more. This amount was divided between the federal and the state governments.
- As part of the civil agreement, Exxon agreed to pay to the affected residents USD $900 million over 10 years to fund an evaluation program of permanent impact and cover, in general, the negative externalities that the inhabitants of the region and its surroundings suffered as a result of the spill.
- The amount of the aggregate loss for the spill was estimated between $4.9 and $7.2 billion dollars. These amounts reflect the will of the people WTP to prevent another oil spill like the Exxon Valdez.

4.4 Indirect or revealed preference methods in the impact evaluation of social regulation

Contrary to the stated preference method, **indirect methods** or **revealed preference** base their result on the individuals' behavior to obtain the value of those goods that lack a traditional market. The general idea is that the actions taken by individuals indirectly reflect the value they assign to certain good, in other words, individuals reveal their willingness to pay through some activity or behavior.

The right estimation of the goods lacking a market determines the effectiveness of public policy as, in view of the existence of limited resources, policy makers have to choose first what policies they are going to implement, a decision determined by those regulations that generate more benefits or reduce costs more.

4.4.1 Hedonic Prices Method (HPM)

The HPM is an indirect method that allows breaking down the implicit price of each of its attributes, through the difference in the value of a commercial good (understood as a set of attributes), and thus the willingness to pay for these. That is, the HPM estimates the value of a feature that does not have a monetary value in the market, through the difference in prices of the goods which prices inherently depend on that feature.

The HPM is useful when we need to value a good for which there is no established market (non-commercial good). Under this methodology, such good will be considered as a characteristic or attribute of the private good (commercial good), and its value will be determined by the change observed in the price of the private good, assuming that the rest of the characteristics of the private good are almost identical. The inference behind this methodology lies in the fact that the price of a private good depends on its characteristics. Thus, in view of a change in any of these characteristics (keeping the other without any change) we should observe a change in the price of the private good. This change will represent the valuation (WTP) that individuals assign to that feature.

Application of HPM

First. Identify the attribute to evaluate in regulation

Second. Identify the private or commercial good that has the attribute

Third. Identify the unit of measure with which it is intended to evaluate the attribute

Fourth. Collect and order the sample data on the feature and prices of the private good. Strictly speaking, the characteristic we want to valuate is the only thing that has to change, as well as the price of the private good taken as reference

Fifth. In case the attribute or feature presents many values, we have to obtain ranges for the unit of measure of the same

Sixth. Determine the prices average of the private good for each value of the evaluated feature, or for each range, if applicable.

Seventh. Obtain the willingness to pay for changes in value or range of the evaluated feature (WTP). For obtaining the WTP, we must subtract the average prices for each pair of adjacent levels or ranges.

Eighth. Obtain the average WTP. The WTP can be positive or negative, depending on the way the attribute or feature is measured.

Ninth. Obtain the welfare measure by using the average WTP to the inferences of the regulation

$$\text{Welfare measure} = \overline{\text{WTP}} * \text{P}$$

Where *P* represents the number of private goods affected by the policy.

Limitations of HPM

In practice, one of the most common problems of this method is that the regulator hardly finds "similar" data to compare with. The estimate for this type of cases will be made through an econometric approach and a rigorous statistical basis on part of the regulator that is outside the scope of the objectives of this guide.[77]

Practical examples: Obtaining the value of silence

PE 1. In a horizontal condominium where there are 20 houses with exactly the same characteristics, the house located at the southern end of the condominium is adjacent to a busy avenue, while the house on the north end is located next to the recreational area of the residential development. When collecting data on the value of properties within the condominium, we realize that the house located next to the recreational area is priced at $2,500,000 pesos, while the one located at the southern end worths $2,200,000 pesos. Taking into account these prices and the similarity in features, we could say that the value assigned to silence, a feature that the house on the southern end does not have, is $300 thousand dollars.

PE 2. In Mexico, the Ministry of Environment and Natural Resources (SEMARNAT in Spanish) established the NOM-079-SEMARNAT-1994[78] in order to establish the maximum permissible limits of noise emission of new cars at factory. Thus, the regulation will reduce noise by five decibels (dB) in some areas of the Mexico City. It is estimated that this regulatory proposal will have an impact in approximately 5,000 residential homes. Below we present the HPM, step by step, to evaluate the benefit generated by the noise level reduction.

First. In this exercise, the attribute or feature to evaluate is the SILENCE (in a positive sense) or NOISE (in negative sense).

Second. The environmental noise or silence is an attribute (feature) that determines the price of residential homes (either private or commercial).

Third. The unit that can measure noise is called decibel (dB).

Fourth. In order to assess the costs generated by noise or the benefits of silence, we obtain data from homes with three bedrooms, two bathrooms and two parking spaces in different housing areas, and we obtain noise levels for these homes:

Table: Order of the sample by level of noise (dB)

	Price (pesos)	Rooms	Bathrooms	Parking places	Malls	Noise (dB)
House 1	1,700,000.00	3	2	2	Sí	50
House 2	1,800,000.00	3	2	2	Sí	50

[77] The approach of econometric regression is the most accepted among academics. This approach attempts to find a vector of parameters that fits, in the best way possible, to the values of the explanatory variables (features) of the observations with their respective observed prices. Under the econometric approah, the approach of the relationship between the price of the private good and its features is performed by an equation in the following way:

$$\text{Price} = \beta_0 + \beta_1 x_1 + \cdots + \beta_k x_k + \varepsilon$$

Where x_1 …x_k are the features of the private good, which contribute to generate the value of the private good. Under this approach, coefficient β_k, represents the WTP for a marginal change in the feature x_k.

[78] http://biblioteca.semarnat.gob.mx/janium/Documentos/Ciga/agenda/PPD02/DO2294n.pdf

House 3	1,500,000.00	3	2	2	Sí	55
House 4	1,650,000.00	3	2	2	Sí	55
House 5	1,350,000.00	3	2	2	Sí	60
House 6	1,100,000.00	3	2	2	Sí	60
House 7	1,050,000.00	3	2	2	Sí	65
House 8	1,150,000.00	3	2	2	Sí	65
House 9	950,000.00	3	2	2	Sí	70
House 10	850,000.00	3	2	2	Sí	75

As we can see, the only feature that changes is the noise level, the variable to which we want to assign a monetary value.

Fifth. Now we determine the noise level ranges.

Table: Determining ranges

Ranges	Noise (dB)	Frequency[79]
R1	50-54	2
R2	55-59	2
R3	60-64	2
R4	65-69	2
R5	70-74	1
R6	75-79	1

Sixth. For each range we obtain the average price of the private good, which in this case refers to the price of the residential houses.[80]

Table: Average values

Range	Noise (dB)	Calculation of average price (pesos)	Average price (pesos)
R1	50-54	$= \frac{1{,}700{,}000 + 1{,}800{,}000}{2}$	1,750,000
R2	55-59	$= \frac{1{,}650{,}000 + 1{,}500{,}000}{2}$	1,575,000
R3	60-64	$= \frac{1{,}350{,}000 + 1{,}100{,}000}{2}$	1,225,000
R4	65-69	$= \frac{1{,}050{,}000 + 1{,}150{,}000}{2}$	1,100,000
R5	70-74	$= \frac{950{,}000}{1}$	950,000.00
R6	75-79	$= \frac{850{,}000}{1}$	850,000.00

Seventh. The willingness to pay for a change in the noise level, the evaluated feature, is obtained as follows:

[79] Number of houses that fit within this range
[80] To make it simple, in this example we used few elements in the sample. In real life, the social regulator has to collect enough data to obtain representative results of the population he wants to evaluate.

Average price of R1 minus the average price of R2 = $\overline{R1} - \overline{R2}$

Table: Calculation of the WTP

	WTP (pesos)	When noise chanes from:
$\overline{R1} - \overline{R2}$	$175,000.00	(50 – 54) to (55-59)
$\overline{R2} - \overline{R3}$	$350,000.00	(55 - 59) to (60-64)
$\overline{R3} - \overline{R4}$	$125,000.00	(60 - 64) to (65-69)
$\overline{R4} - \overline{R5}$	$150,000.00	(65 - 69) to (70-74)
$\overline{R5} - \overline{R6}$	$100,000.00	(70 – 74) to (75-79)

Eighth. After obtaining the different willingness to pay over the sample, it is necessary to obtain the average:

$$\overline{\mathrm{WTP}} = \frac{\sum_{\mathrm{i}}^{\mathrm{N}} \mathrm{WTP_i}}{\mathrm{N}} = \frac{(175 + 350 + 125 + 150 + 100)(\text{thousands})}{5} = 180 \text{ thousand}$$

Where *i* represents the WTP for changes in the feature.

On average, an individual is willing to pay $180,000 pesos more for reducing by 5 dB[81] the noise level of a home.

Ninth. In order to measure the benefits of the policy, the regulator must multiply the average of the WTP by the number of homes that will be impacted (benefited). Considering that the regulatory proposal will approximately impact on 5,000 residential houses, we have that:

$$\textbf{Welfare measure} = \overline{\mathbf{WTP}} * \mathbf{P}$$

Where *P* represents the number of private goods impacted by the policy; in this case, *P* is the number of residential houses in Mexico City. Thus:

$$\textbf{Benefits of the policy} = \mathbf{180,000} * \mathbf{5,000} = \$\,\mathbf{900\ million\ pesos}$$

This represents what the nhabitants of the Mexico City are willing to pay to get a residential home with lower noise level; therefore, this corresponds to the benefits generated by the public policy. Thus, if the cost of the regulatory project is greater than $900 million pesos, then this will not be socially or economically viable.

[81] It should be noted that many times we can find data in which the difference in prices is not necessarily positive. Thus, in the example previously discussed there may be cases in which houses in noisier areas are more expensive. This can occur due to market distortions or external factors that are not being considered. To correct these factors we use more developed econometric models to "control" the effect of other variables that may affect the WTP.

4.4.2 Travel Cost Method (TCM)

The TCM is an indirect method through which we obtain the willingness to pay for a good that has no monetary value in the market (usually environmental) when estimating its value as the addition of the costs that visitors are willing to pay to enjoy the good. In this way, the value of an environmental good is estimated by adding the value of time spent traveling and the stay in the facilities (lost working hours or lost profits), plus the travel expenses, the cost of admission and the stay.

This methodology comes from studies made by the mathematician and economist Harold Hotelling, who suggested the correlation between what people spend to visit a destination and the value of that place, so that travel costs are used as an alternative tool to estimate the monetary value of such place or natural resource.

The TCM estimates the value of a good by adding the costs that visitors are willing to pay to enjoy certain recreational space. Usually, travel costs are determined based on the distance, means of transport, conditions of use, place of origin, the time allocated to the enjoyment of the place (including travel time) and the lost wages. The benefits obtained are determined with the information collected, and they are taken as as a representation of the value of the natural or environmental good or service.

Application of travel cost method

First. Outline the areas of the good or location to be evaluated according to their geographical division.

Second. Obtain more specific information on visits and the target population of the place. In this case, we obtain the relationship between visits per year and the population of the area, by a ratio:

$$\text{Rate of visits} = \left(\frac{\text{Visits per year}}{\text{Population of the zone}}\right) * 1000$$

Third. Quantification of the costs of travel. These costs cab be direct (transportation, accommodation, etc.) and indirect (time, wage, etc.). Total costs are obtained by adding both types of costs.

Fourth. Relate the total costs of travel and the rate of visits to obtain a trend. This trend is graphically represented by a straight line, which describes the relationship between the points that those variables show.

Fifth. Estimate the equation of the line, which shows the relationship between total costs of travel and visits rate. The equation of the line can be obtained by a simple regression between the costs of travel and the visits rate. This can be done in Excel by choosing the option "add a linear trend line" when plotting the data on a graph.

Sixth. From the relationship established in the previous step, it is possible to determine new rates of visits when there is an increase in travel costs. So, in this step, new costs are quantified and, from here, the new rates of travel. This will give rise to the estimate of demand.

Seventh. With the new rates of visits we can derive the visits per year by using the following formula:

$$\text{Visits per year} = \frac{\text{Rate of visits} * \text{Population in the area}}{1000}$$

Eighth. With the visits per year obtained in the previous step, we can derive the aggregate demand function, which defines how the number of visits per year decreases when the total cost of travel increases. The aggregate demand function is obtained by adding the total number of visits to the recreational place to certain price.

Ninth. Aggregate demand is used to determine the consumer surplus, which is a measure of welfare that allows us quantifying the benefits generated from the implementation of a public policy. To obtain the surplus we have to plot on a graph the demand function by using the different points obtained in the previous step. The surplus will be the triangular area under the demand curve.

Limitations of the method

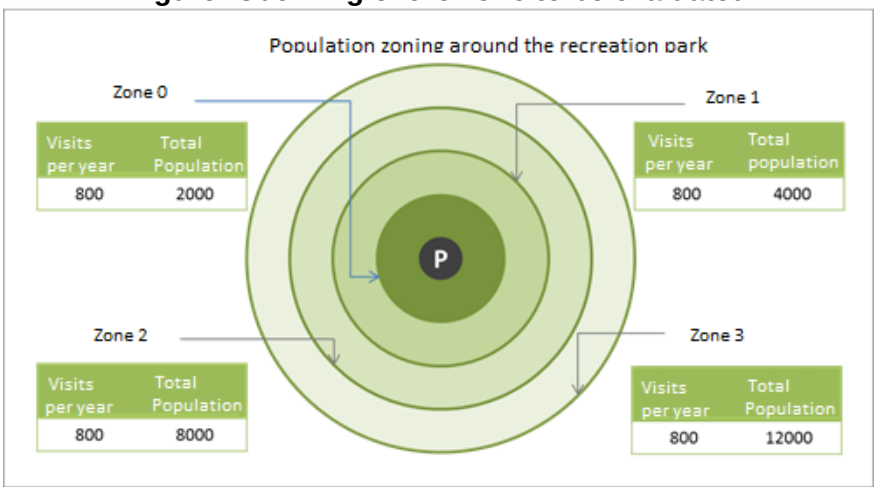
To estimate the demand in this methodology we should use more complex methods than a linear estimate. Particularly, it is best to make a multiple regression that includes most of the variables that determine the travel costs, as well as other variables that may affect the demand for the good or place. The use of this kind of tools requires significant technical knowledge and skills, which is usually costly.

Practical example: Evaluation of a recreational park

Consider that we have a recreational park we want to renovate. This is a tourist park, so that people around visits the place constantly. To cover maintenance costs, the government is considering charging an admission fee, but it does not know the benefits that this good generates to the population. In this case, the TCM is a useful tool to measure these benefits from accessible data for the government.

First. In the following figure, we can see the classification by areas within15 km of the recreational park.

Figure: Outlining of the zone to be evaluated



Source: COFEMER

Second. We obtain the number of visits and the total population by area:

Table: Number of visits and population by zone

Zone	Visits per year	Population in the zone
0	800	2,000
1	800	4,000
2	800	8,000
3	800	12,000

Source: COFEMER

In addition, we obtain the following ratios for each zone:

Table: Rate of visits			
Zone	**Visits per year**	**Population in the zone**	**Rate of visits**
0	800	2,000	400
1	800	4,000	200
2	800	8,000	100
3	800	12,000	66.67

Source: COFEMER

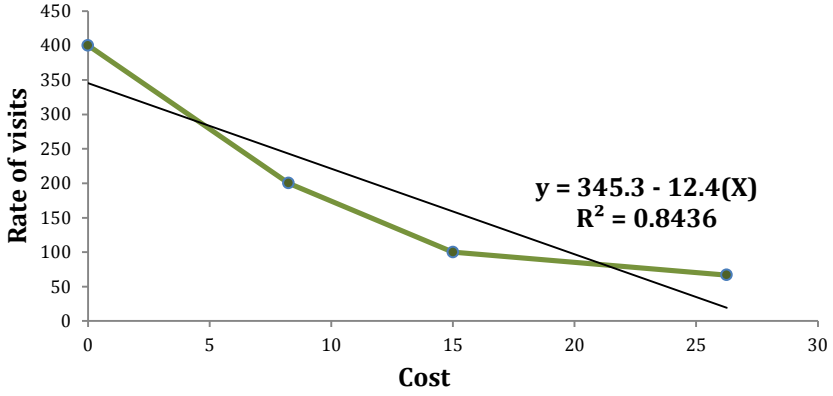
Third. It is considered a cost of each type. Direct cost: the distance (measured in kilometers), and indirect: the time (measured in minutes). The cost of each kilometer is $0.3, while the cost per minute is $0.15. Total costs are obtained by multiplying the distance traveled by the cost involved in travelling each kilometer, plus the multiplication of the time spent in travelling by the cost of each minute.

Table: Distance and cost of travel					
Zone	**Travel**		**Distance * Cost ($0.3 x km)**	**Time * Cost ($0.15 x min)**	**Total cost of travel**
	Distance (km)	**Time (min)**			
0	0	0	0	0	0
1	15	25	$5	$3.75	$8.25
2	30	40	$9	$6.00	$15.00
3	50	75	$15	$11.25	$26.25

Source: COFEMER

Fourth. For each area, we plot on a graph the rate of visits on the y-axis, and the total costs of travel on the x-axis. Each point corresponds to a zone. The first point corresponds to zero zone, which rate of visits is 400 and the corresponding total cost of travel is zero.

Graph 1: Rate of visits/Total cost of travel



Source: COFEMER

Fifth. From this graph, we obtain the equation of the line: y = 345.3 - 12.4(X), which indicates that by each peso the total cost increases, the rate of visits decreases by 12.4.

Sixth. We consider increases of $5 in admission costs to incorporate them into total costs of travel; the result is called total costs per scenario.

Table: Total costs per scenario

Zone	Total cost + Admission cost					
	Free admission	**$5 x admission**	**$10 x admission**	**$15 x admission**	**$20 x admission**	**$25 x admission**
0	0	$5	$10	$15	$20	$30
1	$8.25	$13.25	$18.25	$23.25	$28.25	$38.25
2	$15.00	$20	$25	$30	$35	$45
3	$26.25	$31.25	$36.25	$41.25	$46.25	$56.25

Source: COFEMER

Once the new total costs are estimated, which we called total cost per scenario, we must quantify again the rates of visitas. To do this, we replace the total costs per scenario in the equation of the line obtained: **y = 345.3 - 12.4 (X)**. These new rates consider the cost of admission to the recreational park. We can identify a negative value, which means that there are no incentives to make the trip.

Table: New rates of visit

Zone	$5 x admission	$10 x admission	$15 x admission	$20 x admission	$25 x admission
0	283.22	221.15	159.09	97.02	-27.11
1	180.81	118.74	56.68	-5.39	-129.52
2	97.02	34.96	-27.11	-89.18	-213.31
3	-42.63	-104.70	-166.76	-228.82	-352.95

Sorce: COFEMER

Seventh. To estimate the number of visits to this site we use the formula previously used to calculate the rate of visits. In this case, we use the new rates of visits and the same population in the zone we use at the beginning. The negative values represent a point where it is not feasible for consumers to make the trip, so we do not take them into account to obtain the aggregate demand.

Table: Visits considering the new rates of visit

Zone	Visits* (Free admission)	Visits* ($5)	Visits* ($10)	Visits* ($15)	Visits* ($20)	Rate of visits* ($25)
0	800	566.43	442.30	318.17	194.04	-54.22
1	800	723.23	474.97	226.71	-21.54	-518.06
2	800	776.16	279.64	-216.88	-713.4	-1,706.44
3	800	-511.51	-1,256.29	-2,001.07	-2,745.85	-4,235.41
Total	**3200**	**2065.82**	**1196.91**	**544.88**	**194.04**	**0**

Source: COFEMER

Eighth. Now, we have to obtain the aggregate demand, for which we only require adding all the visits to certain admission price. In the first case, at an admission cost of $5, total visits, adding all the zones, is equal to 2065.82, and when admission increases to $10, the total number of visits is equal to 1196.91.
Aggregate demand is described in the following table:

Table: Demand of recreational park

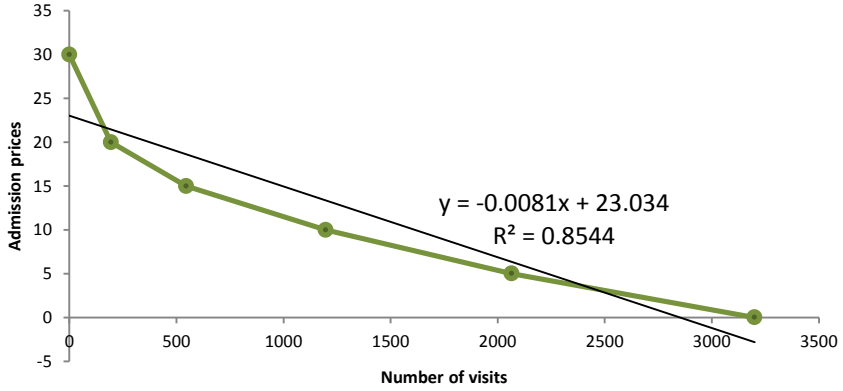
Price (y)	Number of travels (x)
$ -	3,200

$ 5	2,065.82
$ 10	1,196.91
$ 15	544.88
$ 20	194.04
$ 25	0

Source: COFEMER

Ninth. Then, we present the estimate of the consumer surplus.[82] Before obtaining the surplus we have to obtain the demand curve, so we get a line as close as possible to the points defined by the aggregate demand; this is estimating a linear demand. In this example, we obtained the following graph.

Graph: Demand of the recreational park (estimate)



Source: COFEMER

The equation of the demand is: $P = 23.023 - 0.0081Q$. From this equation, we estimate the consumer surplus. Considering the intersection points $(P = 0, Q = 2{,}843.70)$ and $(P = 23.034, Q = 0)$, which were obtained from the line equation, the surplus is:

$$\text{Consumer surplus} = \frac{(23.034 * 2{,}843.70)}{2} = 32{,}750.93$$

The consumer surplus is used as a representation of the WTP for travelling to this destination, so, we can see this surplus as a way to measure the benefits of the government action. Thus, in this case benefits are equal to $32{,}750.93$; which should be compared with the costs of implementing the policy of renovation to verify that it is socially profitable.

4.4.3 Defense Expenditure Method (DSM)

The DEM is an indirect method through which people willingness to pay for preventing harm is estimated. This method considers that the costs incurred by a person in order to avoid damages to his welfare can be regarded as the indirect agent valuation of the good in question.

[82] For modeling purposes, it is assumed that demand is linear; otherwise we have to estimate the nonlinear equation of the demand curve and apply a definite integral of [0, ∞) to calculate the area below the curve and obtain the individuals benefits.

The DEM is based on the fact that if people are willing to incur costs to avoid damages to an environmental good or service, then these goods or services must be worth at least the amount that people pay to avoid such damage. (Ecosystem Valuation, 2006).

Application of DEM

First. Identify the damages caused by the external factor

Second. Identify which are the private goods used or the actions taken to prevent or mitigate the damage and its market value. To identify these goods or actions, we have to take the following into account:

i. ***Medical care actions (MCA)***: All those medical products used to reduce or nullify the damage.

ii. ***Acquisition of preventive or substitute goods (APSG)***: These are all those goods purchased to reduce or nullify the damage.

iii. ***Acquisition insurance (AI)***: The spending incurred by people when contracting insurance for transferring the risk of damage.

Third. Identify which population group makes the spending and the distribution of the group in case the external factor has a differentiated impact within this. It is convenient to determine specific and measurable criteria for identifying the differentiated impact on the population group.

Fourth. Determine how much the external factor causing damage will be reduced after the State intervention (whether regulatory or not), and to what extent the target population will be benefited from this reduction.

Fifth. Collect information to quantify and monetize the spendings that individuals have to make to reduce or prevent damage.

Sixth. Application of the formula and obtaining of the DSM.

$$\text{DSM} = \text{Target population} * (\text{defence spending})$$

Where:

$$\text{Defence spending}_t = \text{MCA}_t + \text{APSG}_t + \text{AI}_t$$

Where:

$\text{MCA}_t = \text{Actions of medical care}$

$\text{APSG}_t = \text{Aquisition of preventive or substitute goods}$

$\text{AI}_t = \text{Aquisition of insurance}$

t= period

Limitations of DEM

Among the DEM limitations is the fact that it is not always possible to assume that people are willing to incur different types of costs to avoid damages caused by the loss of a particular environmental service. Sometimes, it is more realistic to assume that the damage inevitably occurs, and that people pay replacement costs of damaged good. For these cases there is a replacement cost methodology. The replacement cost approach is often used as an estimate for damage to the environment, and it is particularly useful when

evaluating the cost related to damage to tangible assets which repair costs and replacement are measurable.

Practical exercise

We want to establish a regulation to reduce the noise from aircraft engines, through special filters in the turbines, in order to avoid the damage this causes to the neighbor towns. To this end, we will identify, quantify and monetize the amount of expenses that people living near the airport incurs because of nuisances caused by the noise by acquiring preventive goods (defense spending).

First. We can consider the noise caused by aircrafts at an airport as external factors. The noise can be measured by the unit called decibel (dB). The damage caused by the external factor can occur through a nervous system disturbance, loss on the monetary value of tangible gods, ear damage, and etcetera.

Second. In this case, it is identified that neighbors can minimize noise by placing insulating windows, that is, by acquiring preventive or substitute goods. To do this we can account the noise-insulating windows acquired by the population living near the airport.

Third. The population group affected by noise is the houses near the airport. In this case, the impact on population is differentiated. The distance at which the aircraft noise stops affecting the individuals' welfare could be an objective criterion to differentiate the impact. After finding such distance, we have to identify the affected areas or populations. In this example, we can assume that the noise affects a radius of five kilometers. Houses are located according the following basis:

- 5 000 houses in the first two kilometers,
- 10 000 houses in two to four kilometers,
- 14 000 houses between kilometer four and five.

Making a total of 29 000 homes affected by noise.

Fourth. The regulatory proposal aims to reduce environmental noise caused by aircraft by five decibels, which will prevent that, at a radius of five kilometers around the airport, houses do not require noise insulating windows.

Fifth. Prices of noise insulating windows are around $1,000 per window and, on average, damaged houses have five windows. At the same time, it is estimated that 80% of the affected population have these windows (or would be willing to buy them).

Sixth. Applying the inferences of the case to the formula, we obtain that defense costs are fully covered by the purchase of windows. Thus, remembering that we have an average of five windows affected by house, at a cost of $1,000 per window, defense spending for the acquisition of preventive or substitute goods is $5,000 pesos per household.

$$\textbf{Defence expenditure per house}_t = \textbf{APSG}_t = 5 * \$1,000 = \$5,000$$

Moreover, considering that it affects 29 000 houses and only 80% incur the windows expense; therefore, we can conclude that the target population is of 23,200 houses. By applying the formula, we obtain that the people spend 116 million pesos on the purchase and installation of soundproof windows, as shown below:

$$\text{DSM} = \text{Target population} * (\text{Defence spending})$$

$$\mathbf{DEM_1 = (29,000 * 0.80) * (\$5,000) = \$116\ million}$$

These 116 milion are the benefits that would be obtained by implementing the proposed regulation.

4.4.4 Cost-of-illness Method (COI)

The cost-of-illness Method (COI) is an indirect method through which we obtain the individuals' willingness to pay to improve their health. This willingness to pay is indirectly reflected in the medical costs incurred by a person in order to avoid, reduce or deal with the illness.

One way to assign a monetary value to health is through the cost of illness (COI) method, which is based on the individuals' willingness to pay to improve health. In this case we use the expenses incurred by the individual to avoid the illness as a proxy for the willingness to pay. We must remember that in those goods lacking a market, the average WTP defines its monetary value. Therefore, this method is recommended to evaluate the impact of health regulations.

COI application

First. Identify the direct costs, which are directly related to the illness, that is, these are the costs incurred to counteract the damages to health. At the same time these costs are divided into medical costs and non-medical costs; the differentiation is attributed to whether resources have been directly spent in the medical treatment or not.

Second. Add the direct costs per event in the following way:

$$\text{Direct costs per episode} = C_O + C_H + C_D$$

Where:

C_A = Outpatient costs
C_H = Costs of hospitalization and medical care in the hospital
C_D = Direct costs of home care, including the drug prescription

Third. Identify the indirect costs, which are incurred due to the illness and are not directly related to the medical services.

Fourth. Add the indirect costs per event in the following way:

$$\text{Indirect costs per event} = V_p * (L_p + S_c)$$

Where:
V_p = value of production83 per day according to the work of the affected
L_p = Loss in production due to illness in days
C_p = Loss in production due to cares subsequent to illness in days

Fifth. Estimation of the COI through the following formula:

$$\text{COI} = \text{Number of events}_t * (\text{Direct costs per event}_t + \text{Indirect costs per event}_t)$$

1st Obtaining of benefits.

Limitations of the COI

The main disadvantage of this method is that it does not consider various components of the WTP, especially intangible and hard to evaluate elements such as the fear of getting a illness, visible wounds on the face or body, the sadness of deadly diseases in relatives or children, etc. Though this element can be essential when it comes to serious illness, it is not often considered as it is hard to find studies that take into account this kind of costs.

Practical exercise: Fires caused by cigarettes

A regulation proposal by the Canadian government seeks to reduce or prevent fires caused by cigarettes. Particularly, it is proposed that manufactured cigarettes have a lower probability of ignition. In this case, it was determined that burns are damages to health caused by cigarettes. It is estimated that this regulation will decrease accidents in 20%. At the same time, it is known that 1,500 cases of burns per year are due to accidents caused by cigarette. The average salary of a Canadian is $200 dollars; burns require 10 days of hospitalization, on average, and four days of home care.

First. Home aWTPtations to comply with treatment would be a medical cost of illness, while medicines would be a medical cost.

Second. Direct costs are:

Direct costs

$$C_A = \$150$$
$$C_H = \$2500$$
$$C_D = \$800$$

$$\text{Direct costs per event} = C_A + C_H + C_D = 150 + 2500 + 800 = \$3{,}450 \text{ dollars}$$

Third. The lost salaries per days not worked, the loss in productivity, etcetera.

Fourth. Indirect costs are:

Indirect costs

$$V_p = \$200$$
$$L_p = 10$$
$$C_p = 4$$

$$\text{Indirect costs per event} = 200 * (10 + 4) = \$2{,}800 \text{ dollars}$$

Fifth. Considering that the previous costs are per event, we have to multiply these costs by the number of events that occur in a year, this is 1,500.

$$\text{COI} = 1500 * (3{,}450 + 2{,}800) = 9{,}375{,}000 \text{ dollars}$$

Sixth. Considering that the regulatory proposal intends to reduce in 20% the number of accidents by burns, then its benefits are:

$$\text{Annual benefits} = 20\% * (\$9{,}375{,}000) = \$1{,}875{,}000$$

[83] The salary per day is often used as Vp, assuming that the individual is paid for his production.

4.5 Methods to quantify human life in social regulation

As we have seen, the main objective of social regulation is to protect or ensure human life through better welfare conditions, so that it is essential to quantify its value in monetary terms. Although this approach may generate controversy, by the fact that it is translating human life into monetary terms, it is indispensable to determine which public policies are more efficient.

4.5.1 Human Capital Method (HCM) or Lost Wages Method

The Human Capital Method allows estimating the value of human life[84] by calculating the present value of the lost wages a person stops to receive throughout his life as a result of damage, or the loss of life.

The calculation of lost wages refers to the wages an individual may not receive as a result of the consequences of an accident, whether these are injuries or death.

Application of the HCM

First. Identify the target population and its characteristics.

Second. Determine the relevant variables of the study for the terget population: (i) average life expectancy (T) ; ii) the final year of life (t_0); (iii) determine the years lost by death or disability (T-t_0); and, the wage.

Third. Projecting the wages of lost years by using the expected inflation rate.

Fourth. Quantify the impacts of the regulatory proposal, bringing expected wages to present value (discounted human capital) and multiplying them by the annual average of deaths/injuries:

$$\text{Discounted humano capital} = \left[\sum_{t=1}^{T} \frac{\text{expected wage}_t}{(1+r)^t}\right] * (\text{Annual average of deaths/injuries})$$

Where:

r= discount rate
t= lost years

Limitations of HCM

It must be noted that the method is easy to apply because the data can be obtained in a simple way; however, the calculation of the monetary value can be complicated in some cases, for example, the cost of a child's life is difficult to quantify as we do not know the income this could obtain; on the other hand, the method could be interpreted as unfair, since in the case of elderly people the perceived valuation would be less.

Practical exercise

It is intended to issue a regulatory proposal to control the ignition level of tobacco products, since it was found that most of the fires are caused by ignited cigarettes.

[84] Understood as the opportunity cost of a human life.

Therefore, the regulation is intended to decrease the speed at which the cigarette butt causes a fire; that is, reducing the ignition level. The proposal seeks to reduce the number of firefighters dead because of fires. It is estimated that an average of 1,500 firefighters die each year from burns or severe intoxications in the line of duty.

First. In the example, the target population is firefighters. Among the characteristics of this population is that they are 35 years old, on average.

Second. Suppose that life expectancy is 75 years, so that we get a T = 75. Moreover, initial lost wages begins at t_0(35 years); so the diference between T-t_0 is the number of lost years, which is equal to 40. The anual wage that firefighters receive is $100,000 pesos.

Third. Taking $t_0 = 35$ as initial year, and using an expected inflation rate of 5% per year (often the inflation rate is not constant in time; it is recommended to use oficial data provided by government), we project the following wages:

Year t	Projected wage
0 (35 years)	100,000
1	105,000
2	110,250
3	115,762.5
…	…
…	…
39 (75 years)	**670,475.12**

Source: COFEMER

Fourth. Moreover, once we have the estimated wages, it is necessary to bring all amounts to present value, a situation known as **human capital discount**. In this case, we assume that the discount rate is $r = 6\%$. Subsequently, the human capital discount is multiplied by the average number of deaths per year, which in our example is 1,500 firefighters. Also, suppose that it is estimated that the implementation of the proposed regulation will reduce the number of firefighters who die from fire burns or intoxication by 60%, that is, 900 firefighters saved their lives.

Therefore, the value of human life discounting lost wages is equal to:

$$\text{Discounted HC} = \left[\sum_{t=1}^{T} \frac{\text{expected wage}_t}{(1+r)^t}\right] * (\text{Annual average of deaths/injuries})$$

$$\text{Discounted HC} = (\$3'155{,}569) * (900) = 2.84 \text{ billion pesos}$$

The regulatory proposal expects benefits for human capital savings of 2.84 bp due to the decrease in deaths of 900 firefighters.

4.5.2 Value of Statistical Life (VSL)

The Value of Statistical Life (VSL) is a methodology used to estimate the benefits that people get after the decreased risk of death or the cost generated by the loss of a human life. The VSL estimates an approximate value of human life from the maximum amount of money that people are willing to pay (WTP) to reduce the risk that puts them in a dangerous situation, or also the minimum amount people are willing to accept (WTA) to increase this risk. This assessment is done through indirect methods, such as buying insurance, the wage gap in high risk jobs, etcetera.

Ideally, the VSL should be calculated for each regulation in particular, taking into account the types of risks discussed and the context of those affected (Department of Finance and Deregulation. Australian Government). However, this method requires a lot of human and material resources, which makes unlikely its quantification in each regulatory proposal. In this case, it is possible to use international experience and, if applicable, the extrapolation of data (Chapter 2).

Application of VSL method through the WTP

First.	Identify the target population and its characteristics.
Second.	Identify the risk faced by the target population.
Third.	Obtain the individuals WTP to reduce the risk faced by certain percentage.
Fourth.	Calculate the Value of Statistical Life through the WTP ($\mathrm{VSL_{WTP}}$) with the following formula: $$\mathrm{VSL_{WTP}} = \left(\frac{1}{\mathrm{p}}\right) \times \mathrm{C}$$ Where *p* is the value at which it is possible to reduce the probability of death, *C* is the maximum quantity the individual is willing to pay to reduce to 0 the probability of death, and $\left(\frac{1}{\mathrm{p}}\right)$ is the number of times the individual must pay *C* to eliminate the probability of death.
Fifth.	Quantify the impacts of the regulatory proposal by applying the $\mathrm{VSL_{WTP}}$ as a measure of benefits or costs, according to the analysis approach.

Limitations of the VSL_{WTP}

It should be mentioned that the application of the method can be complicated, because there are times in which, because of the nature of the economic sector in which the regulatory proposal stands, it is not possible to count on data for quantification. In these cases, it is necessary to build hypothetical scenarios.

Practical examples

PE1. Consider that a person is willing to give up $10,000 in exchange for reducing the 1% probability of death in a car accident. Then, to reduce the probability of this kind of death by 100%, the individual is willing to pay $\$10{,}000 * 100 = \$1{,}000{,}000$. That is, the individual assigns to his life a value equivalent to $\$1{,}000{,}000$.

PE2. In Mexico, it is intended to issue a regulation at national level to include airbags in factory cars as, according to the National Council for the Prevention of Accidents (CONAPRA in Spanish), 16,000 people die each year in car accidents. The proposal is expected to decrease the figure by 35%. VSL was used to quantify the benefits to evaluate the impact of regulation:

First. In this case, the target population is people who drive a car, and could be saved if the regulatory proposal is implemented.

Second. The potential risk faced by drivers is the probability of dying in a car accident, which is equal to 0.8%, according to traffic statistics.

Third. In cars dealerships there is data indicating that an individual who just bought a new car is willing to pay $2,000 for including air bags in his car, which reduces the risk of death by 0.2% (that is 0.002). Thus, with the air bag, the probability of death decreases to 0.6%.

Fourth. Substituting the previous data in the VSL formula, we obtain:

$$\mathrm{VSL_{WTP}} = \left(\frac{1}{\mathrm{p}}\right) \times \mathrm{C} = \left(\frac{1}{0.002} * 2{,}000\right) = \$1{,}000{,}000$$

Thus, if the individual is willing to pay $2,000 to reduce the probability of death by 0.2%, then we can say that the VSL is equivalent to $1,000,000.

Fifth. From the 16,000 people who die in car accidents, this regulatory proposal will prevent 5,600 deaths (16,000 * 0.35), so it is expected that the implementation of the regulatory proposal generates benefits by:

$$\textbf{Regulation benefits} = 16{,}000 * 0.35 * 1{,}000{,}000 = \$5{,}600{,}000{,}000$$

4.5.3 Quality Adjusted Life Years (QALY)

QALYs are indicators that, together with the VSLY, allow the monetary quantification of the additional years of life quality that a person can obtain as a result of an improved lifestyle.

The QALY estimates how many years of additional life quality a person can receive as a result of a regulatory proposal. Though the QALY is used in medical research, in recent years the regulatory impact evaluation has used it to monetize the benefits generated by a regulatory improvement in health.

This method models the utility that people's health state usually generates them. This utility is represented on a numerical scale from 0 to 1, where 0 represents the benefit of "dead" state and one the utility of "living in perfect health." To determine the exact value of QALY we just multiply the value of the utility related to certain state of health by the years spent in that state. Thus, the QALY is expressed in terms of "years lived in perfect health":

half a year lived in perfect health is equal to 0.5 QALY (0.5 years × 1 Utility), the same as 1 year of life lived in a state with utility of 0.5 (1 year × 0.5 utility).[85]

The QALY allows obtaining an index that can be used in the cost-effectiveness analysis and in multi-criteria analysis. However, when we use it together with the VSL, we can obtain results in monetary terms, which may be helpful when applying the cost-benefit analysis.

Application of QALY

First. Describe or characterize the possible states of health or disease conditions and estimate their length.

Second. Assignment of values to each health state. We must assign a value $(\mathrm{v_i})$ between zero and one to each health state. Often, the values assigned to a health state are taken from research carried out for similar populations.

Third. Obtaining QALY by using the following formula:

$$\mathrm{QUALY} = \sum_{\mathrm{i}} \mathrm{v_i} \times \mathrm{t_i}$$

Where:
i represents each health state
$(\mathrm{t_i})$ is the estimated length of each state
$(\mathrm{v_i})$ is the value assigned to each health state

Fourth. Obtaining of the annual VSL. This value is obtained by dividing the VSL value between the average number of the remainder years to live:

$$\mathrm{VSLY} = \frac{\mathrm{VSL}}{\mathrm{T}}$$

Fifth. Where T is the average number of remainder years to live for a person at that age. The way to determine this number is from the population life expectancy and by using the individual's age:

$$\mathrm{T} = [\mathrm{E(life)} - \mathrm{Age}]$$

Sixth. Determining of the monetary QALY:

$$\text{Monetary QALY} = \mathrm{QALY} * \mathrm{VSLY}$$

Seventh. Quantification of the benefits of the regulatory proposal.

Practical example: Reduce the rate of HIV infection

Suppose that we intend to implement a regulation to reduce the 50% of the HIV infection rate. It is known that every year 5,000 people get infected with this virus in the country.

First. A person infected at birth experiences three different health states, which are assigned a duration:

Health state $(\mathrm{e_i})$	Length (t_i)
Respiratory disease	13.5
Regular health	35
Good health	25

Source: COFEMER

[85] Drummond MF, O'Brien B, Stoddart GL, Torrance GW: Methods for the Economic Evaluation of Health Care Programmes. 2nd edition. Oxford Medical Publications: Oxford; 1997.

Second. Each health state gets a value between zero and one.

Health state (e_i)	Value (v_i)
Respiratory disease	0.25
Regular health	0.62
Good health	0.90

Source: COFEMER

Third.

$$\text{QALY} = (v_1 \times t_1) + (v_2 \times t_2) + (v_3 \times t_3) =$$

$$(0.25 * 13.5) + (0.62 * 35) + (0.90 * 25) = 47.575 \text{ years}$$

Fourth. A newborn will have a T = 73.5, which is the average life expectancy in Mexico. To obtain the VSLY, we divide the VSL of 6 million pesos between 73.5 years:

$$\frac{\$6{,}000{,}000}{73.5 \text{ years}} = \$\,81{,}632.65 \text{ pesos}$$

Fifth.

$$\text{QALY}_{\text{monetary}} = 47.575 * \$\,81{,}632.65 = \$3{,}883{,}673.32$$

Sixth. Considering that regulation plans to reduce to 50% the number of cases per year, that is, reduce from 5,000 to 2,500 the people infected with HIV, then the total benefits of implementing this regulation are calculated as follows:

$$\text{Benefits} = (47.575 * \$\,81{,}632.65 * 2{,}500) = \$\,9{,}709{,}183{,}675$$

4.5.4 Disability-Adjusted Life Years (DALY)

A DALY is a composite indicator that combines the Years Lived with Disability (YLD) and Years of Life Lost (YLL). Together with the VSLY, DALYs allow monetizing the lost years of healthy life, either due to premature death or due to the time lived with disability. To account both elements, this methodology requires assigning numerical weights to the diverse nonfatal consequences of different illnesses and injuries.

Just as the QALY, it will be necessary to use the VSL to estimate the benefits generated by regulation in monetary terms. Otherwise, only the cost-effectiveness and the multi-criteria analyzes would be useful.

The YLD consider the gravity of the disease (defined in a range of 0-1) and the average length of the disability, which can vary depending on the age at which the incapacitating disease occurs. Furthermore, the YLL use the number of deaths and the life expectancy by age group, the latter as a benchmark for the years lost by not reaching the life expectancy (Miguel A. Gómez Albores, 2009). Thus, in order to obtain the DALYs it is necessary to add the YLL to the YLD.

Application of DALY

First. Identify the target population, which suffers from some kind of disease. However, only one particular case is analyzed,

Second. Estimate of YLD, which depends on the parameters r, K, β, C. The calculation of the YLD only differs from YLL in the addition of "D"[86] (the weighting of the disability) at the beginnig of the formula:

$$\text{YLD} = D\left\{\frac{KCe^{ra}}{(r+\beta)^2}\left\{e^{-(r+\beta)(L+a)}[-(r+\beta)(L+a)-1] - e^{-(r+\beta)(a)}[-(r+\beta)(a)-1]\right\}\right\} + \frac{1-K}{r}\left(1-e^{-rL}\right)$$

Where:

r = Social discount rate = 0.03
K = Modulation factor of the weighting per age = 1
β = Parameter of the weighting function per age = 0.04
C = Constant = 0.1658.
e = 2.72 (approximately)

Where D can take the following values:

Values of D

Type	Description	Value
0	Absence of disability	**0**
1	Limitation on the performance capacity in at least one activity of the following areas: recreation, education, procreation and labor	**0.096**
2	Limitation on the performance capacity for most activities in one of the following areas: recreation, education, procreation and labor	**0.22**
3	Limitation on the capacity to perform activities in two or more of the following areas: recreation, education, procreation and labor	**0.400**
4	Limitation on the capacity to perform in most of the activities in all the following areas: recreation, education, procreation and labor	**0.600**
5	Need for assistance in daily instrumental activities, such as preparing food, shopping or housework.	**0.810**
6	Need for assistance in daily personal activities, such as eating, personal hygiene and dressing	**0.920**
7	Death	**1**

Source: Murray C. J. L.: Quantifying the burden of disease: the technical basis for disability-adjusted life years; Bulletin of the WHO, 1994.
Note: Limited capacity in performance is arbitrarily defined as a reduction in capacity of 50% or more.

Third. We calculate the YLL, which depends on the parameters $[r, K, \beta, C]$, and is calculated by using the following formula:

$$\text{YLL} = \frac{KCe^{ra}}{(r+\beta)^2}\left\{e^{-(r+\beta)(L+a)}[-(r+\beta)(L+a)-1] - e^{-(r+\beta)(a)}[-(r+\beta)(a)-1]\right\} + \frac{1-K}{r}\left(1-e^{-rL}\right)$$

[86] The severity of disability weighting allows comparing the years of life lost because of a disease and its sequelae with the years of life lost due to premature death corresponding to parameter "D."

Where:

a = Age of death;
L = Standard life expectancy at age "a"

Fourth. Considering that the value obtained by the previous formula corresponds to the time of death of the person, this must be discounted and brought to time when the disease began by using the following expression:

$$\text{YLL at the beginning of the disease} = \text{YLL} * e^{-rs}$$

Where "s" is the number of years to be discounted, "y" is the age of death, and "x" is the momento when the disease started. Then, s = (y-x).

Fifth. We add the YLD and the YLL to obtain the DALY.

Sixth. By using the annual VSL, we obtain the benefits of regulation in monetary terms.

Practical exercise: Reduce the incidence of diabetes

Suppose we want to implement a regulation to reduce in 10%the number of people who get diabetes. It is known that, in Mexico, one person gets sick with *diabetes mellitus* at 35 years of age, on average; suffers from this disease for ten years and dies as a result of this condition. In Mexico, the life expectancy of a person is 79.13 years. It is estimated that this disease affects one million people each year.

Lifetime horizon after getting the disease

Disease
35 years

Death
45 years

First. The target population is the people who get sick with diabetes each year.

Second. It is estimated that this person will live ten years, that is, L = 10. To estimate the YLD we just replace the parameters previously established, considering that D = 0.6. In this case, the YLD = 6.95. This means that this person has lost 6.95 years of healthy life due to the disability caused by such disease.

Third. Considering that, on average, a person of 45 years has 34.13 years left to live, then L= 34.13. The rest of the parameters are defined in the same way: K = 1; C = 0.1658; r = 0.03; a = 35; β = 0.04; e = 2.72 (approximately). Therefore, when replacing YLL in the formula, the total lost years from age 45 is 19.97.

Fourth. When discounting the YLL calculated at the age of 45, we use the following formula:

$$\text{YLL at the age of } 45 = 19.972 * \exp^{-0.03*(45-35)} = 14.80$$

Therefore, since the beginning of the disease at the age of 35, the total number of YLL due to premature death is 14.80.

Fifth. Once we have the YLL, we add the YLD to obtain the DALY:

$$\mathbf{DALY = YLL + YLD = 21.75}$$

Sixth. The annual VSL would be the same as in the previous example:

$$\frac{\$\mathbf{6,000,000}}{\mathbf{73.5\ years}} = \$\,\mathbf{81,632.65\ pesos}$$

If the regulatory policy does reduce by 10% the number of cases (100,000 cases), then the benefits of the regulation amounts to:

$$\text{DALY of the regulation} = 21.75 * 100{,}000 = 2{,}175{,}000\ \text{years}$$

And the benefits in monetary terms amount to:

$$\mathbf{Monetary\ benefits = 2,175,000.00} * \$\mathbf{81,632.65} = \$\mathbf{177,551,013,750}$$

4.6 Benefits Transfer Method (BTM)

The BTM consists of transferring the information derived from previous research to a new study. The basic objective is to estimate the benefits of a regulatory proposal, adapting information from studies in another context. This method has the advantage that it is a lower cost alternative to the methods seen so far.

Many times, the estimation of benefits through the previously analyzed methodologies may depend of the available resources, such as time, personnel and budget. The BTM offers a cheaper alternative to conduct a large study on a particular topic. This method involves taking estimated values from previous studies (study case) and applies them to a new area of interest (policy case).

However, this method works better under certain assumptions:

- Goods that have no market value, assessed in the original study, should be comparable to the property of the studio to perform (use the value of the Amazon jungle to evaluate the Bosque de Chapultepec is wrong, but it may be congruent to evaluate the jungle of Chiapas).
- Populations affected by the valuation of the property without market value should be very similar, in terms of demographics, market size, environmental features (and if applicable), distributive effects, etc.
- The assignation of property rights in both places should be similar, in a manner that uses the same measure of welfare. That is, the appropriate valuation method for the two zones must be the same: willingness to pay with willingness to pay, hedonic prices with hedonic prices, travel costs to travel costs, etc.

Therefore, the steps for using the BTM are:

Implementation of BTM by value transfers

First. Select the original study. This choice is made by thorough review of previous studies, bearing in mind the circumstances under which this method works.

Second. Transferring values. The easiest way to do this is by taking the benefits estimated in the original study, and then transferring it to the study to be performed. An alternative is to take an average of several relevant studies and apply their findings.

Third. Whereas the values obtained from the study are not denominated in the currency of the country in which the impact assessment is done, you may use an exchange rate adjusted for Purchasing Power Parity (PPP) to transfer the benefits. In this sense, a source of this information is the World Bank's website (http://data.worldbank.org/indicator).

Fourth. Also, you should make the inflation adjustment when the time period of the original study does not correspond to the period in which the impact assessment is performed. To make this adjustment, you can use an index such as the National Index of Prices and Quotations or (INPC, in spanish).

Exercise: Building a highway through a nature reserve.

Suppose that in Mexico, the government want to evaluate a regulation that allows building roads in a natural reserve, which is widely used by cyclists. Thus, given that the corresponding government agency does not have the resources nor the time to does a valuation through indirect methods, the government's agency decide to perform the study using the BTM.

First. The Mexican regulators found some cases from the United States that estimate the willingness to pay (WTP) of cyclists in the Allegheny National Forest in Pennsylvania. Thus, the agency concludes that a study performed by the Environmental Protection Agency (EPA) is the one that best suits what the government wants to estimate, and also meets the assumptions of the BTM.

Second. The selected study, determined that the WTP of cyclists is $34 dollars per day

Third. According to the World Bank, the peso/dollar parity was 7.18 in 2006. So the WTP in PPP-adjusted pesos at 2006 is:

$$\text{USD}\$34 * \$7.18 = \$244.12 \text{ pesos per day.}$$

Fourth. The former price is only valid if the year of the policy case is the same of the study case. So, is that not the case, we need to transfer the 2006 value to real prices of 2013 (when policy case is conducted). This requires adjusting the price of the study case by inflation, so we can get the corresponding real value (this procedure was seen in chapter II):

$$\text{Real Value}_{\,t} = 244.12 * \frac{133.48}{\mathbf{100}} = \$\,325.85$$

Where 133.48 is the INPC published by INEGI, by January 2013. On the other hand, the Real Value is the WTP of 2006, translated in terms of 2013.

$$\mathbf{WTP_{2013} = \$325.85\ pesos\ of\ 2013}$$

This WTP can be used in the analysis to be carried out, it has been adapted to the circumstances of the Mexican context.

Other approach for transferring values from study cases to the policy case is the Function Transfers Method (FTM) and the meta-analysis method[87]. The FTM includes other factors that influence the determination of the value of a property without market value. This method consists in adapting the benefit function of the study case into the characteristics and conditions of the place where it is to conduct the study.[88]

Example: Get the VSL by the Profit Function

One of the most important methods discussed so far is the method of the Value of Statistical Life (VSL). This method is often difficult to implement, so commonly are used to BTM to use information from other countries and adapt to the local context. In these cases, the estimated values are used in previous studies and is designed that function well estimate relates to factors that influence the calculation of that value.

For example, in the study "The true cost of road crashes: Valuing life and the cost of a serious injury", the FTM is used to obtain the VSL, based on some estimations of VSL for several countries. So, the first thing these researchers did was to convert the data from its original estimates to 2004 dollars (as is done in the value transfer method). Subsequently, the study assumes that the determination of VSL depends on the income level of the country concerned. This dependency relationship is reflected in the following regression:

$$log_n\,(VSL) = a + b * log_n(GDP/Capita)$$

Then, based on data collected by the study, they run the regression and obtain the following parameter values:

$$log_n\,(VSL) = 3.015 + 1.125 * log_n\left(\frac{GDP}{Capita}\right)$$

Using the parameters obtained, just replace the income per capita in the above equation to determine the VSL in the country where the study is conducted. For example, in the case of Mexico, replacing the value of GDP per capita in the regression, and thus would get the value of the natural logarithm of VSL.

[87] The results in the meta-analysis include an estimate of the profit function based on multiple estimates of relevant studies. The method can range from a ranking of prices, to complex regression.
[88] Abelson, P. (2008). Establishing a Monetary Value for Lives Saved: Issues and Controversies. Department of Finance and Deregulation: http://www.finance.gov.au/obpr/docs/Working-paper-2-Peter-Abelson.pdf

CHAPTER V

METHODOLOGIES TO QUANTIFY COSTS AND BENEFITS IN ECONOMIC REGULATION

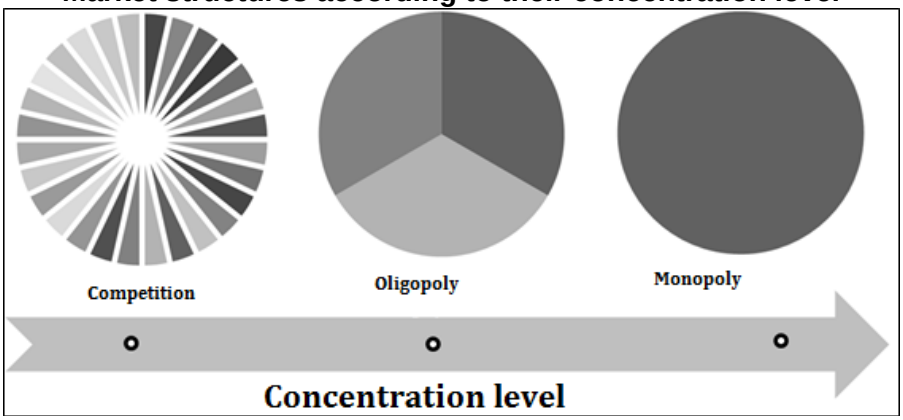
Chapter V. Methodologies to quantify costs and benefits in economic regulation

5. Economic Regulation

The primary objective of economic regulation is to correct the **competition failures**, which, as we already explained in the introduction, are a type of market failure that prevents the efficient allocation of economic resources, as they limit free competition of producers in the markets, which generates concentration.

This concentration of producers often results in the absence of competition, as it lacks incentives for this: **if there are few producers meeting all the demand in a market, this will create conditions for them to deliberately share out the demand and not to offer services with sufficient quality and at the lowest price**. This is why excessive concentration and the resulting lack of competition decrease the population welfare.

Market structures according to their concentration level



The extreme case of competition failure is the monopoly. Monopolies are market structures in which **there is only one producer** (monopolist) or **there are few producers colluded with each other**. Usually, the monopolists offer their products at high prices and they have the capacity to reduce discretionary the amount of goods or services offered.

Considering that there are no substitute goods for the one they offer, the monopolies force consumers to consume what they produce, so that these products are not often offered in the variety or quality that consumers require. That is, the monopolist has **market power**, which uses to increase its profits.

The **market power** is the capacity of some producer(s) to impose conditions that harm other participants of the market (including other producers), whether setting prices higher than those observed in competitive equilibrium, or reducing the quantity or quality of the goods offered in the market.[89]

However, there will be times when it is convenient to have only one supplier in the market, as the existence of two or more producers is not socially profitable. In such circumstances, it is said that there are natural monopoly conditions. Strictly speaking, a natural monopoly

[89] Landes, William; Posner, Richard. *Market power in antitrust cases*. Harvard Law Review. 1981.

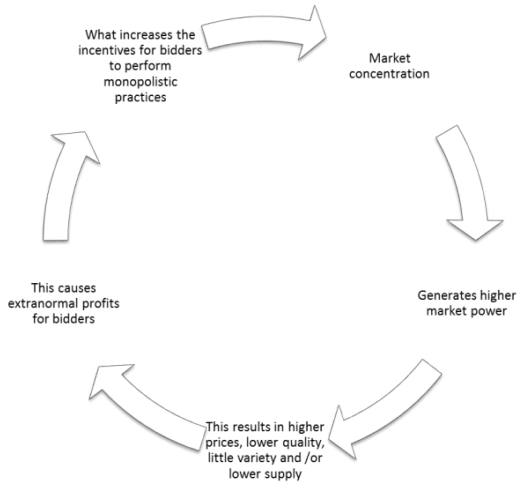
is a market structure in which, because of the nature of its costs, only one enterprise can satisfy the demand. This usually occurs in markets in which large capital investments must be made to enter the industry, which greatly reduces the incentives for other enterprises to join the market. Potable water service and electricity are examples of natural monopolies.

On the other hand, there are highly concentrated markets, even though they are not natural monopolies. This concentration can derive from producers' interactions who consciously try to increase their benefits. In other words, producers can use **monopolistic practices** in order to capture a share of the market, as they believe that their benefits would be less if there were more producers.

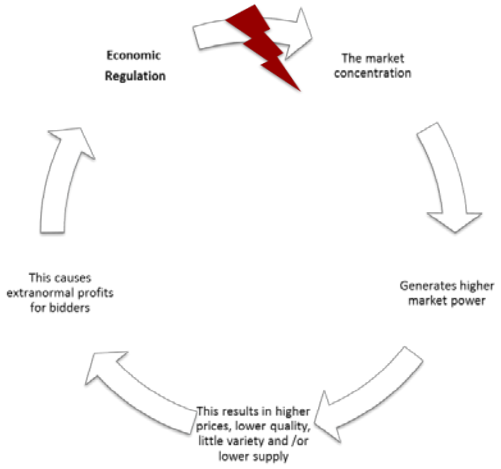
Monopolistic Practices	
These are actions or business decisions taken by one or more persons or enterprises which purpose is restricting the process of free competition, and protect or extend their market position, causing a detriment to market itself, to other companies and, finally, to consumers.	
Absolute monopolistic practices (AMP)	**Relative monopolistic practices (RMP)**
Agreements between competitors, which fix prices, restrict supply, fragment the market or coordinate their stance in tenders. These practices eliminate competition among colluded agents, which has serious implications for the welfare of the economy, given the possibility of imposing prices higher than those of a competitive market. Therefore, these prevent society from obtaining better prices and higher quality products.	They occur when there is an enterprise with market power and abusing of this position to: 1. Take other companies out of the market 2. Limit market entry 3. Establish exclusive advantages in favor of one or more persons
Source: Federal Economic Competition Commission, (CFCE)	

In this sense, the regulator must consider that the enterprises in the industry have economic incentives to restrict competition, as the more concentrated the market is, the greater the benefits for each of them. **Therefore, the regulator should encourage competition where feasible. One way to achieve this is by implementing economic regulation in order to reduce the market power of monopolistic participants, for example.**

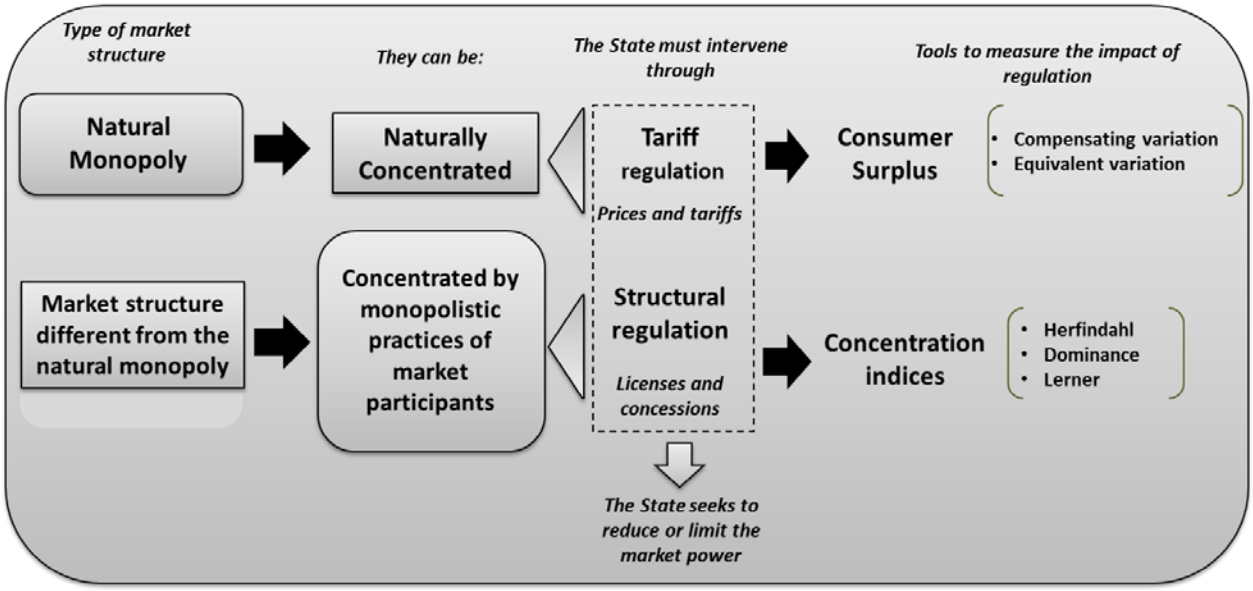
Vicious circle



Regulation breaks the vicious circle of the market concentration



Mainly, economic regulation has two approaches, the **tariff regulation** and the **structural regulation**.



- ***Tariff regulation*** mainly regulates the behavior of monopolies to limit their market power. Considering that the monopolist has strong incentives to produce a smaller quantity at a market price higher than the one that would be observed in a competitive market. The prices that should be observed in the market are set through tariff regulation, as well as the methodologies proposed to define them.

- ***Structural regulation*** changes the way in which the industry is constituted when designing mechanisms that facilitate the entry of more producers into the market. This type of regulation seeks to limit the capacity of producers already established to impose barriers to entry that prevent the inclusion of more participants in the industry or to encourage other producers to leave the market.

Both approaches of economic regulation generate costs and benefits. The costs do not only include implementation costs (including compliance costs), but also the income that producers do not get when their market power is reduced. On the other hand, benefits are the profits of consumers when obtaining better quality goods at a lower price. For example, regulation of interconnection rates in the telecommunications sector, which would be a cost to producers, prevents producers from getting excessive profits, which generates a benefit to consumers.

Once we identify the positive or negative effects of regulation on competition, they must be quantified and monetized. To this end, this chapter presents various methodologies such as consumer surplus, compensating variation method and equivalent variation to quantify the welfare cost which implies a variation in prices as a result of the implementation of a tariff regulation. Similarly, there are also the concentration indices and the Lerner index as useful tools to study the changes in the industry integration arising from the implementation of economic regulation.

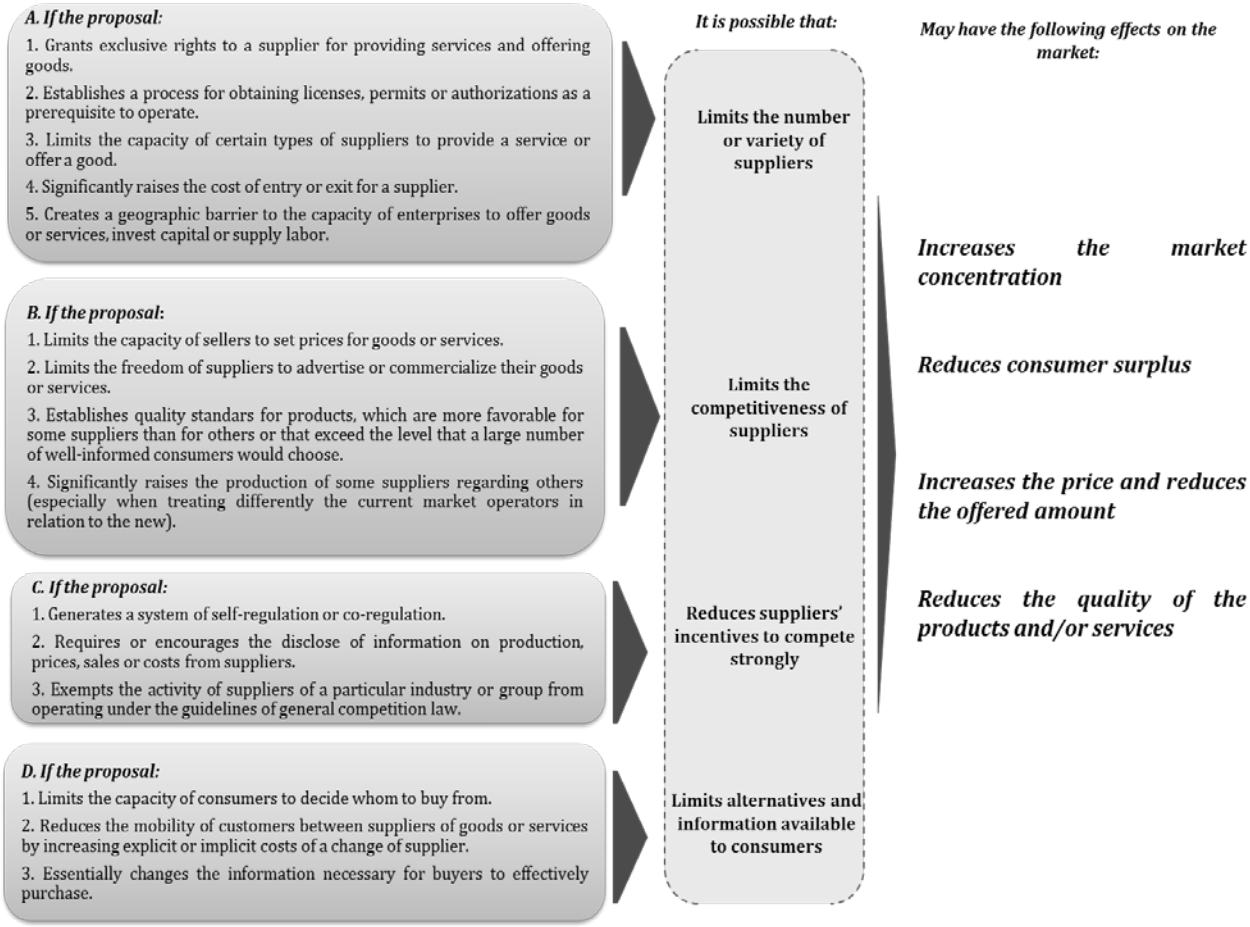
Adverse effects of competition caused by mistakes when regulating

Occasionally, regulators, eager to protect the public interest, establish rules that inadvertently restrict competition and generate market concentration. For example, a regulation establishing a standard of quality could change the market structure, as there could be few producers able to meet the set standards, so that those who do not meet the standard would have to close and leave the market. This would encourage the remaining producers to share out the market and increase their power in it.

In this sense, a useful tool to identify the effects on competition of a regulatory proposal is the competitive impact checklist of the OECD (*OECD's Competition Assessment Toolkit*), which is a series of questions that help detect regulations that may restrict competition by altering the structure of the market.

This review should be considered in the early stages of the regulation development, so that, if necessary, regulators can make further analysis of the measures they intend to issue and the effects they may generate on markets competition.

Checklist of competitive impact and possible effects



5.1 Tariff regulation

There will be markets in which only one enterprise can meet the whole demand, so it is neither convenient nor possible for more companies to enter and compete. Such is the case of industries that require large capital investments. As we already explained, in these circumstances the State must apply the tariff regulation in order to prevent the monopoly from using its market power and harm the welfare of participants.

Consumer surplus is one of the tools most used to estimate changes in social welfare, which is used by economists to quantify the benefits obtained by consumers after participating in an economic transaction. An alternative way to quantify the impact of a price change on consumers' welfare is using the concepts of compensating variation and equivalent variation.

5.1.1 Consumer surplus

The **consumer surplus** is the difference between the price the consumer is willing to pay and the price he actually pays for certain quantity of a good or service. Graphically, the consumer surplus is equal to the area bounded by the price paid and the inverse curve of the demand. The demand curve is determined by the willingness to pay of all those people who wish to consume the good, and who are able to do so. Therefore, when those who demand a good, pay indeed a lower price than that they are willing to pay, there is a gain in welfare.

Consider the following example. The following figure shows the demand curve for pizza (red line). On the y-axis we plotted the price, and the x-axis shows the quantity. We can see that, as the price decreases, there is greater demand for pizza. But when the price is equal to eight, there is no demand. If the price falls to three, then the demanded quantity is equal to seven. The green area shows the consumer surplus. This area defines the gains of those who ended up paying three pesos for each pizza, although they were willing to pay a higher price.

Graph: Consumer surplus

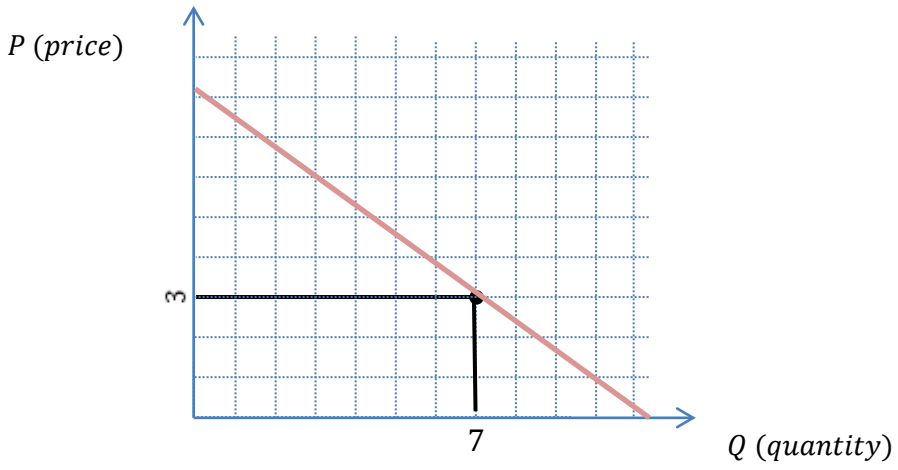


Figure: The green area represents the consumer surplus generated by the transaction. If the market price is 3 and the consumer will buy 7 units of the good; then the consumer surplus would be equal to 35/2.

The change in the consumer surplus allows determining a change in welfare generated by a change in prices. The lower the market price is, the greater the consumer surplus. On the contrary, the higher the price is, the lower the surplus. The following graph shows the way in which the surplus increases when the market price decreases.

Graph: Change in welfare

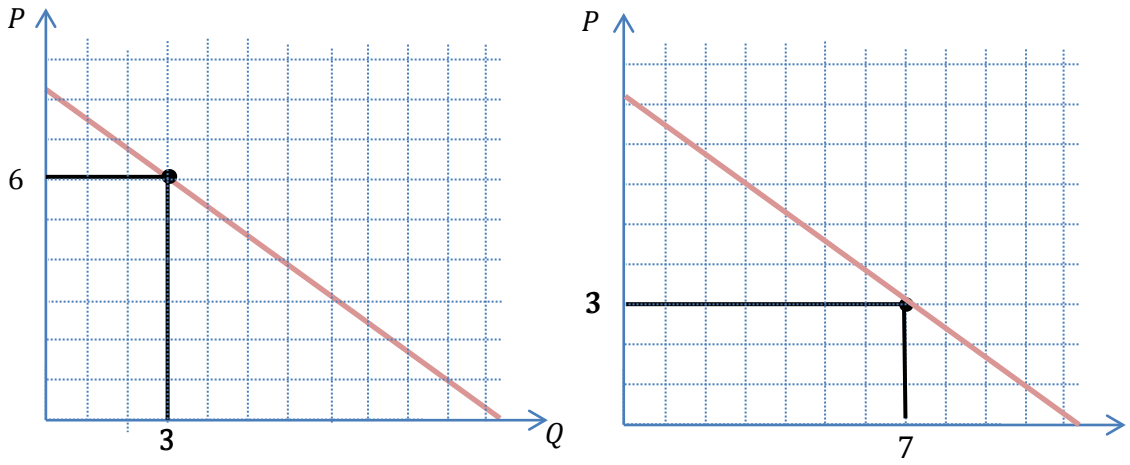


Figure: If a monopolist sets a price equal to 6, consumer surplus would be much lower than if setting a regulated price of 3. The difference between both surpluses allows us to estimate the change in welfare generated by the high prices of a monopoly. In this case, the consumer surplus would go from 3 units to 35/2, as a result of such decrease in the market price.

Similarly, we can define the **producer surplus** as the difference between the minimum price the producer is willing to charge and the price at which he sold the product. The producer surplus is bounded by the supply curve, which describes the quantity of the product offered in the market at a certain price. Contrary to the demand curve, the supply curve shows a positive relationship between price and quantity, since the higher the price, the greater the quantity of product that producers want to sell. Thus, at the breakeven point we can calculate the total benefit for society, which is the sum of the consumer surplus and the producer surplus, also called total surplus.

Graph: Social welfare

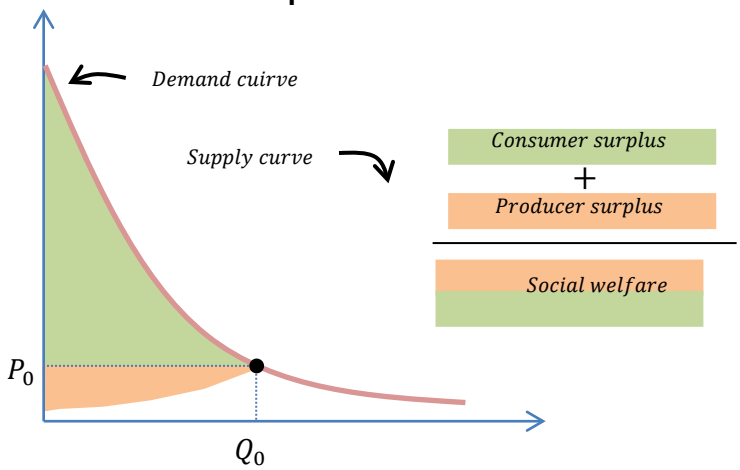


Figure: In equilibrium, total welfare is calculated by adding consumer surplus to producer surplus.

In consequence, any price above the market equilibrium will cause a decrease in total surplus, which will generate a loss in social welfare. In this case, the market price could be above the equilibrium price because of the market power exercised by the producer.

In order to quantify the impact of a regulation on social welfare, a useful approach is to quantify the change in the total surplus (increase or decrease), considering that the final purpose of an efficient policy is to maximize such surplus.

For example, a monopoly can increase the price by exercising its market power, which decreases consumer surplus and increases producer surplus at the same time. If tariff regulation in the market sets a price lower than the price of a monopoly, then the total surplus will increase, as the consumer surplus will have increased more than the producer surplus decrease. Therefore, the benefits and costs generated by a tariff scheme will be the gain of consumers and the producers' loss, respectively. Thus, we can use the measurement of the change in total surplus as a way to measure the impact of a tariff scheme.

5.1.2 Compensating variation

One way to quantify the impact of the change in consumer surplus is through the compensating variation. This concept captures the amount the consumer should pay (or receive), in terms of income, to keep the same utility as before the price change. This approach is called compensating variation because it represents the monetary compensation that a person must be given or taken from for this to have the same welfare.

For example, suppose we have an initial income, I, equal to one peso which we can only spend in two goods, $\mathrm{x}_1 \text{and } \mathrm{x}_2$. The prices of these goods are $\mathrm{p}_1 = 1$ and $\mathrm{p}_2 = 2$, respectively. This individual can only spend his income distributed between the consumption of both goods, that is:

$$1 = 1 \cdot \mathrm{x}_1 + 2 \cdot \mathrm{x}_2.$$

This equation is known as budget constraint, and it can be graphically represented by the straight line I:

Graph: Budget constraint

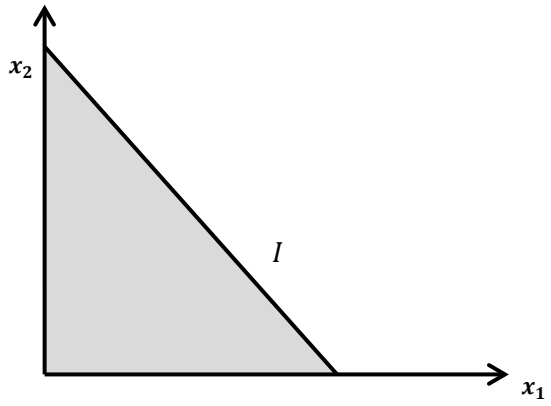


Figure: The area under the straight line $\boldsymbol{I}$ determines all possible combinations that consumer can obtain when $\boldsymbol{p_1 = 1}$, $\boldsymbol{p_2 = 2}$ and the income is **1.**

The gray area, including the edges, represents all possible ways in which the individual can acquire amounts of both goods. If we assume that the consumer will spend all his income, the amounts x_1 and x_2 will be above the inclined line defining the triangle.

Now, if the individual's income increases, from one to two pesos, the budget constraint will move to the right, because the chances to acquire more goods increased. This is graphically represented by the displacement of the line I upward and to the right.

Graph: Change in income

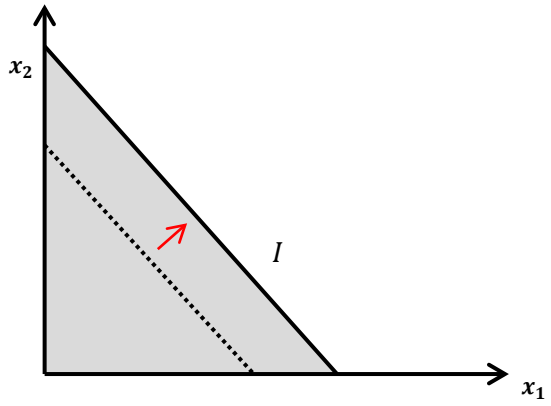


Figure: When the individual's income increases, the probability of purchase also increases and the line I moves upward.

When the price of any of the goods increases, the budget line will change the gradient. Suppose that the price of the first good decreases, then the individual will be able to acquire a greater quantity, regardless of what his decision to buy the other good. Graphically, this is represented with a spin of the straight line I.

Graph: Increase in price of good one

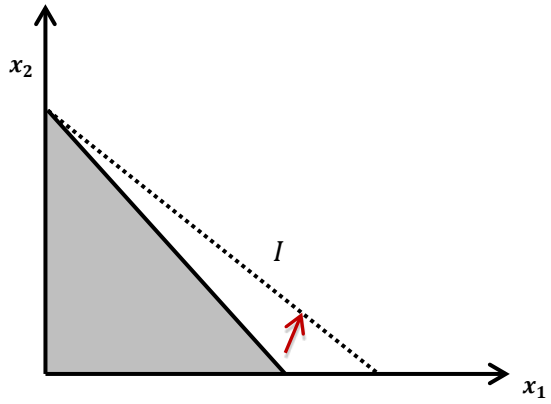


Figure: the slope of the line changes as a result of a change in the price. Note that, unlike the case in which income increases, the point in which the budget line intersects with the corresponding axis, at x_2, does not change.

At this point, it is convenient to define the concept of utility curve. The consumer will receive certain benefit or utility U_1 from consuming both goods. Graphically U_1 curve represents all possible combinations of good x_1 and x_2 of which the consumer obtains the same utility; this means that any combination $(\mathrm{x}_1, \mathrm{x}_2)$ in U_1 curve generates him the same welfare. In this sense, consumer is indifferent to any of the U_1 points; this is why this curve is known as **indifference curve.**[90]

Graph: Indifference curve

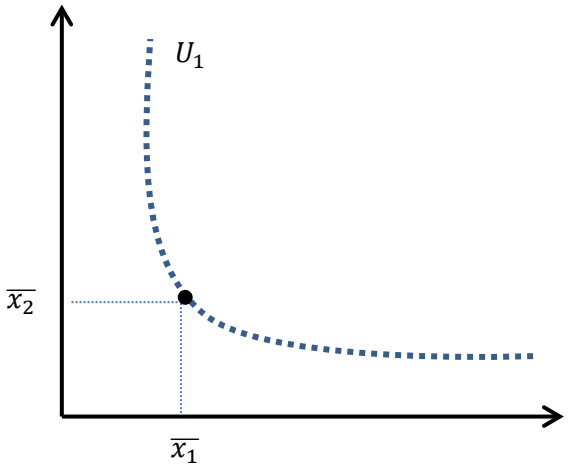


Figure: $\boldsymbol{U_1}$ represents the indifference curve when the combination $(\overline{\mathrm{x}_1}, \overline{\mathrm{x}_2})$ is consumed.

The following graph shows the different representations of the indifference curve, subject to budget constraint.

Graph: Indifference curve subject to budget constraint

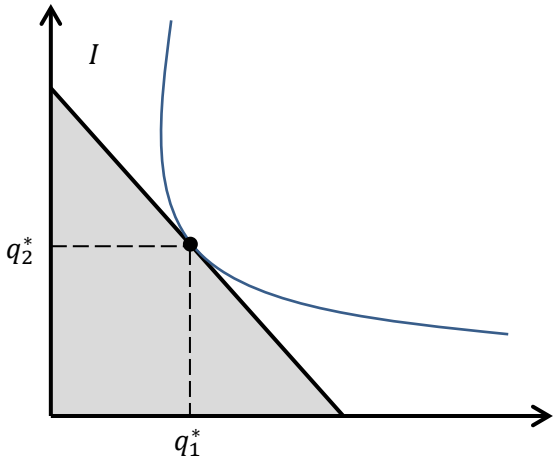


Figure: The point (q_1^*, q_2^*) represents the pair of quantities of consumption that is affordable and will generate the greatest possible utility to the consumer.

The point where the indifference curve and the budget constraint are tangent indicates the consumption basket that maximizes the utility. For any rational consumer, this point will

[90] The reader might wonder why we drew the indifference curve $\boldsymbol{U_1}$ in this way among many other possible ways. This fact is based on stylized assumptions that can be consulted in detail in any book of advanced microeconomics.

determine his consumption, as there is no other that gives him greater welfare, subject to his budget constraint. Therefore, when the income varies, the intersection will change, so his level of utility will do so as well.

Consider the following example. Suppose that the price of good one is reduced. This will cause a change in the quantity consumed and, therefore, a change in its level of utility, as shown in the following graph:

Graph: Change utility derived from prices increase

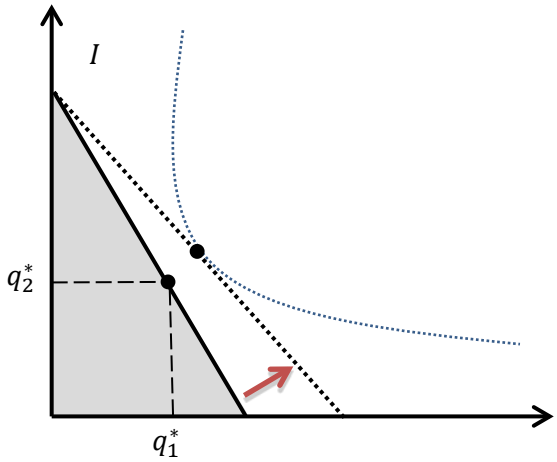


Figure: A change in price changes the purchasing power of individual. So its optimum allocation is no longer (q_1^*, q_2^*).

As there is a new budget constraint, another utility curve will intersect with this. Such curve is on the right of the previous one, which means that in view of the new prices, this consumer has improved his level of utility as he can consume more goods than before.

The compensating variation allows expressing, in monetary terms, how much the increase in utility is equivalent to. The compensating variation answers the question: how much money we have to "take" from consumer for him to have the same utility he had before the price reduction?

Graphically, in the following figure we can see that the new budget constraint intersects with the previous indifference curve when it moves in parallel due to a decreased level of income. The compensating variation measures the change in income required to reach the utility level before the price change. Therefore, this economic concept is useful to quantify and express, in monetary terms, the impact on the welfare generated by a change in prices.

Graph: Compensation in the income to the increase in prices

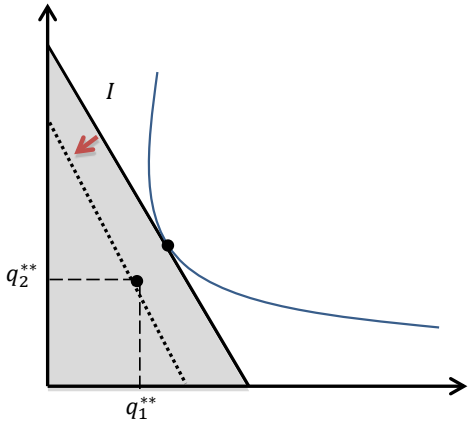


Figure: The positive effect of price change is equivalent to an increase in income when it reaches the same level of utility. The red arrow represents the compensating variation.

In practice, quantifying the compensating variation requires a complex econometric analysis to determine the changes in the demand for a good before changes in prices. However, in many cases it is used a compensating variation, in which it is assumed that the change in demand will be zero before a price change.[91] If we assume this, it is much easier to estimate the compensating variation; we just have to apply the following formula:

$$\mathrm{CV} = (\mathrm{P_a} - \mathrm{P_r}) * \mathrm{Q}$$

Where P_a is the market price before regulation, P_r is the resulting price after the regulation implementation, and Q is the amount consumed. $\mathrm{P_r}$ will be lower than $\mathrm{P_a}$ when we assume that the impact of regulation has reduced the price. Nevertheless, the opposite can happen, since social regulation can often increase market prices involuntarily as this has anticompetitive effects. Either way, this analysis is also useful in those cases.

For example, suppose we want to implement a regulatory policy in order to limit the market power of pharmaceutical companies selling insulin, needed for the diabetes treatment. Usually, the pharmaceutical market is a highly concentrated sector due to the high investment costs required to produce a new drug. In addition, demand for diabetes drugs is characterized for being highly inelastic, that is, the consumer does not reduce his consumption in view of a change in prices.

Because of this, the government decided to regulate the price of insulin by reducing it to half of what pharmaceutical firms had established. The social benefit potentially generated by this tariff policy is estimated through compensating variation. Suppose that the quantity exchanged in the market is 10 million, the initial price, before the regulation implementation, is $10 and the price cap is $5. Thus, the compensating variation is calculated by using the previous formula:

$$\mathrm{CV} = (\mathrm{P_a} - \mathrm{P_r}) * \mathrm{Q} = \ (10 - 5) * 10 \text{ million} = 50 \text{ million}$$

[91] In economic terms, if the demand for a good does not change substantially when prices of the same vary, it is said that the demand for the good is *inelastic*.

The compensating variation, or the increase in the consumer utility caused by the decrease in price, is 50 million. This increase in utility can be interpreted as the benefits of regulation. If we assume that the implementation of this policy requires compensating the pharmaceutical firms, so that the cost of implementing the price cap is 20 million. By applying a cost-benefit analysis, we obtain the following:

$$\text{CBA} = \text{Benefits measured by the compensating variation} - \text{Costs generated by regulation}$$

Substituting the figures previously estimated we obtain the following value:

$$\text{CBA} = 30 \text{ million pesos}$$

That is, the benefits obtained by the price cap are sufficient to cover the costs this generates or to compensate those who cover them.

5.1.3 Equivalent variation

An approach similar to compensating variation is the **equivalent variation**. Similarly to the application of compensating variation, the equivalent variation allows determining the advisability of eliminating the policy when quantifying benefits and determining if these exceed the costs.

The equivalent variation is the amount of income that the individual has to be given or taken from to reach the utility (same welfare, same indifference curve, same purchasing power) he will have after a change in prices (taking initial prices as reference). Thus, while in compensating variation we use new prices and the same level of utility (before the price increase), in equivalent variation we use initial prices and the utility level resulting from a change in prices. That is, the equivalent variation measures the maximum that the individual is willing to pay to avoid a change in prices.

Both, the compensating variation and the equivalent variation, seek to quantify the same concept from different points of view: the benefit (or harm) a consumer obtains as a result of a change in prices. In practice, these concepts are useful to understand the effect of a policy on the welfare of society; specially, if there are distributional effects.

5.2 Structural regulation

In practice, economic regulators should use empirical evidence, whenever possible to estimate the degree of market concentration. In this sense, structural regulation, which aims to eliminate those limitations that prevent the free entry of industry participants, uses the concentration indices as a measure. These indices summarize the market composition, so they are useful and widely used to describe and quantify the effects that a regulation can have on certain industry.

The concentration indices refer to the individual shares of each enterprise. Market share is defined as the portion of the demand satisfied by each producer; for example, if only one enterprise meets all the demand, its market share will be 100%, if there are two producers and they divide in equal parts the total market, then the share of each of them is 50%.

When talking about market concentration and market structure, it is convenient to define the relevant market concept. The relevant market includes not only the analyzed product,

but also incorporates its substitute goods (see the table below). That is why this concept is useful, because it allows the identification of goods that are substitutes or that can be consumed when the price of the good in question increases (a typical example of substitute goods are margarine and butter, or natural gas and oil).

Definition of relevant market

The relevant market is the one in which competition is developed and it is used to identify those products competing with each other. This concept has two dimensions: the product and the geographical dimension. The first means that the relevant market consists of one or several products supposed to be substitutes for each other; for example, to determine whether a credit card from a department store and a credit card from a bank are part of the same relevant market, there must be an increase in the price of the first (an increase in its Total Annual Cost) that makes the customers of this card to substitute this for the latter.

Also, in its geographical dimension, a relevant market is the physical space where these products are produced or sold, and where there is a possibility of replacing them with others. For example, the cement producers in Mexico City do not compete with those of Madrid or any other European city, considering the distance between the two markets, even if the good negotiated is exactly the same.

Therefore, in order to define a relevant market we must consider both dimensions. The most commonly used method to do so is the Hypothetical Monopoly Test (HMT). This test assumes the existence of a monopoly that controls the production of a group of goods in a specific geographic area. Then, the test asks whether the hypothetical monopolist can sustain a small and a significant increase in prices that is not transitory; if the answer is affirmative, then that market (defined as the group of goods in that geographic area) is the relevant market.

The HMT identifies whether the monopolist can maintain for one year a price increase of 5-10% higher than the current price in the geographic area in which this dominates. So, in case that this increase in prices makes consumers to choose substitute goods (so that the price increase will not produce extra profits), then it is necessary that these goods are included in the relevant market definition. This exercise is repeated until the increase in prices is sustainable.

As we will explain later, identifying substitute goods is essential to quantify the market power of suppliers. Technically, the market power is defined as the capacity of an enterprise to fix the price above the cost of producing an additional unit of the good they produce (marginal cost). This market power generates a cost in welfare to consumers as they acquire the products they need at higher prices.

An enterprise with market power can raise prices without losing customers along the way. Usually, in a competitive environment, prices are determined by the interaction of producers and consumers. If the price is too high, consumers will decide to refrain from consuming the good; this will cause a decrease in demand, and thus the price falls and returns to equilibrium. However, when the producer has market power, the price is above its social optimum level, as consumers will be unable to reduce prices because they cannot reduce their consumption, especially because the goods exchanged in this kind of markets does not have many substitutes.

The following figure shows that whatever price above the price of competitive equilibrium (P_0) generates a welfare loss. The extreme case is the monopoly equilibrium, where the enterprise maximizes its profits at the expense of consumers.

Graph: Social welfare loss

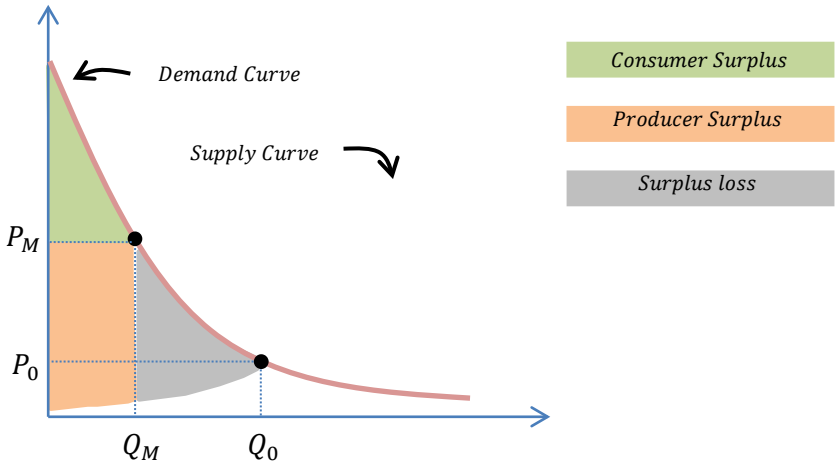


Figure: The equilibrium of market and monopoly. You can see that the monopoly equilibrium generates a welfare loss.

Therefore, in addition to estimating the changes in the industry as a result of an amendment to the regulation, the regulator should also measure the social impact of market power. With this purpose, first the regulator has to measure the market power, to do so, there are several procedures or methodologies in the studies, one of them is the Lerner Index. Then, quantifying the social impact only requires applying a formula, which will be discussed by the end of the chapter.

Concentration indices

Market concentration means that there are few producers or suppliers, and it is positively correlated with market power as it is much more likely that a few participants **collude** or **coordinate** to raise the price. For example, if there are only two suppliers in the market it is easier that these collude than they coordinate with thousands of producers who have significant incentives to break the agreement. This is that the probability of collusion among enterprises in the market is inversely proportional to the number of participants. And if there is collusion, there will be market power. For this reason, concentration indices that estimate the degree of concentration are often used to measure the level of market power indirectly.

5.2.1 Concentration ratio

The industrial organization theorists consider that the market behavior and, therefore its structure, depend greatly on larger companies rather than on the smallest. That is why some indices are more sensitive to the large enterprises' behavior. The concentration ratio is the ratio that only considers the m largest companies (for $m < n$), where n is the total number of enterprises in the industry. Each enterprise should be ordered from high to low, according to their share: $\alpha_1 \geq \cdots \geq \alpha_m \geq \cdots \geq \alpha_n$. The concentration ratio looks like this:

$$\mathrm{CR_m} \equiv \sum_{\mathrm{i}=1}^{\mathrm{m}} \alpha_{\mathrm{i}}$$

For example, we have a market with four enterprises, which shares are 30, 30, 20 and 20 percent. In this case, only considering two enterprises, the concentration ratio is:

$$\mathrm{CR}_2 \equiv 0.30 + 0.30 = 0.60$$

This means that the two largest companies control the 60% of the market.

The most used measures of this ratio are the CR_4 and the CR_8, that is, the ratio considering the four biggest companies, and the ratio considering the biggest eight. Thus, when this indicator is close to zero, this means that market conditions are close to perfect competition; while when this is close to one, the market is highly concentrated.

Rule of analysis: A recurrent criterion of this measure indicates that when CR_4 is between 0 and 0.5 there is a low market concentration, and when it is between 0.5 and 0.8 the market is controlled by an oligopoly.

For example, in the United Kingdom, the CR_5 index of construction industry is 0.05, which indicates a highly competitive environment; in contrast, gas distributors' ratio is 0.82, which means that this is a highly concentrated industry.

5.2.2 Herfindahl index

The Herfindahl Index (HHI) is equal to the sum of the square of the shares:

$$\mathrm{HHI} \equiv \left(\sum_{\mathrm{i}=1}^{\mathrm{n}} {\alpha_{\mathrm{i}}}^2\right) * 10{,}000$$

Where α_i is the market share of the enterprise i and n is the number of enterprises in the industry.

This index considers the relative shares of the enterprises in the market, so it weighs more the biggest enterprises than the smallest. In this way, this index is close to zero when the market is occupied by a large number of enterprises of equal size, and it reaches its peak of 10,000 points if the market is controlled by only one enterprise. This index increases as the number of enterprises decreases and as the disparity between them becomes larger.

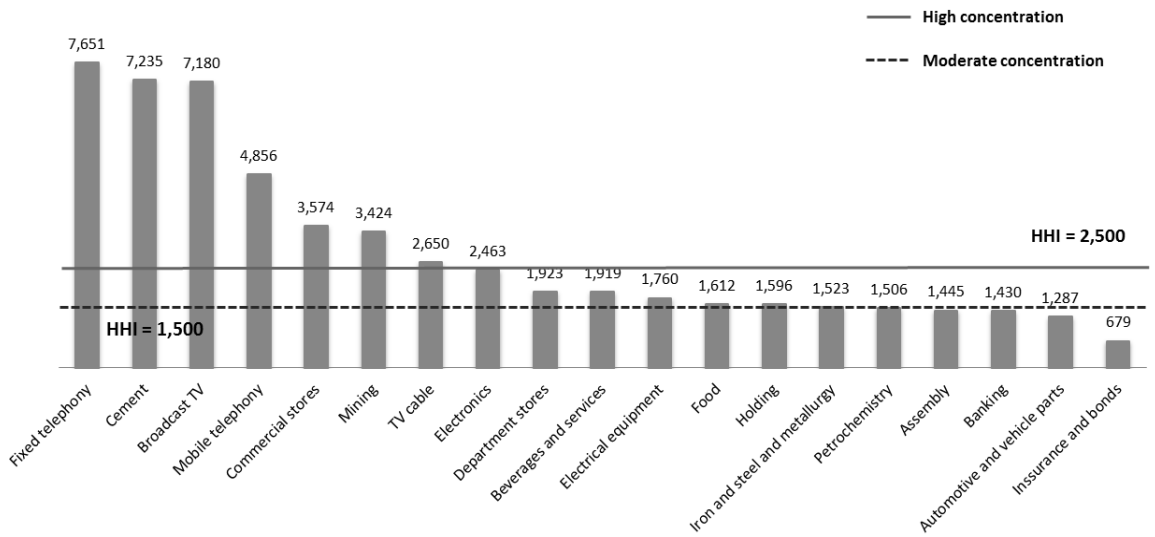
Rule of analysis: It is usually said that there is moderate concentration when this index is between 1,500 and 2,500 points, and there is a high concentration when the 2,500 points are exceeded. Thus, the Monopolies Division of the Department of Justice of the United States notes that in highly concentrated markets, an operation that increases this index by 200 points will increase the market power of dominant enterprises.

The Herfindahl index uses the square of the market shares to weight more to the larger companies and weight less to the smaller ones. Going back to the previous example, the HHI is equal to:

$$\mathrm{HHI} \equiv (0.30^2 + 0.30^2 + 0.20^2 + 0.20^2) * 10{,}000 = 2600$$

That is, a highly concentrated market, according to the criteria we just explained. The following graph shows the HHI of different industries in Mexico, where HHI of sectors such as fixed telephony, cement production; broadcast television, mobile telephony and mining are higher than 2,500 points, which means that they are extremely concentrated.

Graph: Herfindahl index in Mexico



Source: Association of Banks of Mexico, 2012.

5.2.3 Dominance index

According to its author, Dominance Index (DI) tries to correct the weaknesses presented by other concentration indices. Compared to the HHI, the DI captures better the competition improvements that can arise from a merger of small enterprises, which would lead to an increase in welfare even though there would be a decrease in production.[92] This index takes the following form:

$$\mathrm{DI} \equiv \left(\sum_{\mathrm{i}=1}^{\mathrm{n}} \mathrm{w_i} \left[\frac{\alpha_{\mathrm{i}}^2}{\sum_{\mathrm{k}} \alpha_{\mathrm{k}}^2} \right] \right) * 10{,}000$$

Again, α_i is the market share of enterprise i; α_k is the share of enterprise k and n is the number of enterprises in the industry. Also $\sum_{\mathrm{k}} \alpha_{\mathrm{k}}^2 = HHI$ and $\mathrm{w_i} = \left(\alpha_{\mathrm{i}}^2 / \mathrm{HHI}\right) * 10{,}000$. That is, the dominance index uses the Herfindahl index as input. This index also varies between 0 and 10,000, accordingly to a fragmented or monopolized market.

Specifically, when the number of enterprises decreases in a market, the HHI increases; in contrast, the dominance index can increase or decrease, depending on the size of the concentrated agents compared to the rest of the agents of the analyzed market. This index decreases when the size of the concentrated agents is relatively small compared to the rest of the agents in the market.

Considering the shares of the previous example, the ID is equal to:

$$\mathrm{DI} \equiv 2{,}870$$

[92] García Alba, Iduñate Pascual. *El índice de dominancia y el análisis de competencia de las líneas aéreas mexicanas*. Boletín Latinoamericano de Competencia.

Rule of analysis: In Mexico, according to the resolution issued in 1998[93] by the Federal Competition Commission (COFECO, in Spanish), it is considered that a concentration does not affect the free and open competition process if there is a decrease in the DI, or if its value is lower than 2,500 points.

Example of Herfindahl and Dominance indices

In 2002, the largest operating enterprise of rail transport in Mexico, Ferrocarril Mexicano or Ferromex, tried to merge with Ferrocarril del Sureste or Ferrosur, one of its main competitors. However, the antitrust authority blocked this operation as it considered it a violation of the Federal Law of Economic Competition (LFCE, in Spanish). The Federal Competition Commission (CFC, in Spanish) refused the merger as it considered that Ferromex-Ferrosur would control more than 67% of total concession roads against 26% of Transportación Ferroviaria Mexicana (TFM, in Spanish), the main competitor of Ferromex. Also, if this operation was carried out, Ferromex-Ferrosur would have no competition in some of the most important regions of the country, such as the Mexico City and Veracruz.

Since 1998, CFC established in a resolution the criteria used to evaluate the concentration in the relevant market. The criteria used are the Herfindahl Index and the Dominance Index. According to article four of this resolution, CFC will consider that a merger **is unlikely to threaten free and open competition** in the relevant market when the estimated result of concentration is equal to any of the following results:

1. The HHI increase is lower than 75 points;
2. The HHI value is lower than 2,000 points;
3. The value of the DI decreases;
4. The DI value is lower than 2,500 points.

Before the merger attempt, the indices of the rail transport industry were:

Table. Concentration indicators

Index	Value
Herfindahl	3698
Dominance index	6132
Source: COFEMER	

They considered the following market shares:

Table. Participant enterprises

Enterprise	Share
Ferromex	53%
Ferrosur	14%
TFM	26%
Compañía de Ferrocarriles Chiapas-Mayab, S.A. de C.V. (CHIAPAS-MAYAB)	3%
Línea Coahuila Durango, S.A. de C.V. (COAHUILA-DURANGO)	2%
Ferrocarril y Terminal del Valle de México, S. A. de C.V. (TFVM)	2%

[93] Resolution disclosing the method for calculating the existing indices to determine the degree of concentration in the relevant market and the criteria for their application. Federal Competition Commission. Official Journal of the Federation (1998).

Source: General Directorate of Railways and Multimodal Transport, SCT (2011), "Railway Yearbook."

If the merger between Ferromex and Ferrosur had been realized, the Ferromex-Ferrosur association share would have increased to 67%. In this case, the HHI and DI estimate results in the following:

Table. Estimates of concentration under merger

Index	Value
Herfindahl	5182
Dominance index	7674

Source: COFEMER

The HHI and the DI would have increased in 1484 and 1542 points respectively. Thus, considering both measures, the merger between Ferromex and Ferrosur would have violated CFC considerations as an operation that does not threat competition.

5.2.4 Lerner index

As we explained before, market concentration indicates how total production is distributed among the different participants in the industry, which measure are the concentration indices. Usually, an increase in these indices indicates a decrease in competition and an increase in the market power of participants. Though concentration and market power are two elements positively correlated, they are not equivalent.

That is why we require a specific measure to directly quantify the capacity of a producer to raise the prices above the marginal cost. One of the most used is the Lerner index, which formalizes the concept of market power as the location of the price above the marginal cost.

The Lerner index is calculated in the following way:

$$\text{Lerner} = \frac{\mathrm{p^m} - \mathrm{MCg}}{\mathrm{p^m}} = \frac{\mathrm{S}_i}{|\varepsilon_\mathrm{D}|}$$

Where $\mathrm{p^m}$ is the market price, MCg is the marginal cost of production, $\mathrm{S_i}$ is the share of the enterprise i and ε_D is the price elasticity of market demand.

As we can see in the previous expression, there are two options to estimate this index. **The first resorts to the direct use of the marginal cost of the enterprise to compare it with the market price.** This approach is complicated because the function of the marginal cost is a theoretical construction, rather than something we can obtain directly. In many cases, it is extremely difficult for large enterprises to estimate the cost of producing an additional unit. However, there are some exceptions, especially in relatively small enterprises producing a single product. When we can measure the marginal cost, the estimation of the Lerner index is direct.

The other alternative requires estimating the price elasticity of the market demand (ED).[94] In these cases, we obtain first the ε_D to adjust it later according to the share of

[94] For further reference, please consult Besanko, Dranove y Shanley, "*Economics of Strategy.*"

such enterprise in the industry. Elasticity is a sensitivity measure that measures the percentage change of the demanded quantity before a percentage change in the market price. The ε_D can be represented as follows:

$$\varepsilon_D = \frac{\%\ \text{Variation in demanded quantity}}{\%\ \text{Variation in price}} = \frac{\Delta Q_D / Q_D}{\Delta P / P}$$

The result obtained through the formula must be negative due the inverse relationship between the price and the quantity demanded.[95] For example, if the price of tortillas increases by 5% and, as a consequence of this increase, the quantity demanded changes by -3% (the demanded quantity for tortillas decreased), then $\varepsilon_D = \frac{-3\%}{5\%} = -0.6$. Therefore, in economic terms it is said that tortillas are an inelastic good, as a price increase of 5% does not change the quantity demanded in the same percentage.

The sensitivity of the demanded quantity to changes in the price of a good is not only determined by what happens within the market itself, but also depends on the number of substitutes that these products have outside the relevant market. Substitute goods are those that can replace the good when this is too expensive, so that its demand will also change the market price of the good in question. For example, if the price of coffee increases, we can substitute this for tea or milk, so it is reasonable that the price of the latter two will affect the demand of the first and, therefore, its price.

Thus, in markets where the good has many substitutes, the market power of the dominant firm is considerably less than when it comes to essential goods that have no close substitutes. In this way, **the monopoly may exercise its market power to a greater extent when demand does not react to changes in prices, that is, when demand is inelastic.**

As we can see in the Lerner index definition, the difference between the market price and the marginal cost will be greater as elasticity decreases. If we have an inelastic good, $\varepsilon_D < 1$, the difference between p^m and the marginal cost will be greater. For example, in the case of a perfectly inelastic good, $\varepsilon_D = 0$, the difference between p^m and the CMg will tend to be infinite. In contrast, when the price equals the marginal cost, the elasticity of demand will be close to infinity. This means that in the hypothetical case that there is a great number of competitors in the market or that there an equilibrium of perfect competition, then $\varepsilon_D \approx \infty$, that is, the price will be equal to the marginal cost.

[95] Law of Demand: The relationship between the quantity demanded and price is inverse, this is reflected in the negative slope of the demand curve, that is, the higher the price, *ceteris paribus* (keeping constant all the rest), the lower the quantity demanded and the lower the price, the higher the demanded quantity. Keep in mind that the price is always the independent variable.

Price elasticity of demand

The elasticity of demand function is relevant because it allows us to know the magnitude of the relationship between the demanded quantity and the price. For example, when the elasticity of demand is greater than one (inelastic demand), this means that the demanded quantity will increase at a higher rate than the price does, therefore, we say that demand is elastic. In contrast, when the elasticity is smaller than one, we say that the change in quantity is lower than the price.

Graph 2: Inelastic demand vs Elastic demand

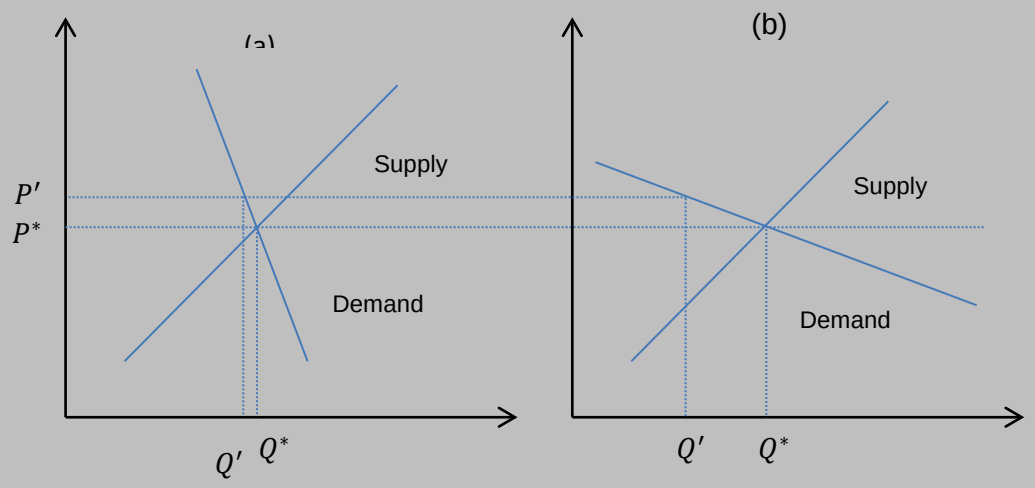


Figure: This graph shows the difference between the demand curve, relatively more inelastic (a), compared with a more elastic (b). The variation in rates is the same for both cases, while it is greater in quantities for

In the previous figure, in the graph on the left, we can see that we require a smaller decrease in the demanded quantity for the price to increase in the same magnitude as in Figure (b). In Figure (a), the demand curve is inelastic because the change in the demanded quantity is smaller than the change in price. The opposite happens in figure (b), since the decrease in the demanded quantity is far greater than the increase in price.

In the following table, we characterize the different types of demand according to their relation with the price:

Table: Characterization of the demand curve	
$\varepsilon_D = \mathbf{0}$	**Perfectly inelastic demand:** in view of percentage changes in the price, no matter the size, the demanded quantity will not change at all.
$-\mathbf{1} < \varepsilon_D < 0$	**Inelastic demand:** in response to a change in the price, the percentage change in demanded quantity will be lower than the percentage change in price.
$\varepsilon_D = -\mathbf{1}$	**Unitary demand:** the percentage change in demanded quantity will be the same percentage change as occurred in the price.
$-\infty < \varepsilon_D < -1$	**Elastic demand:** in response to percentage changes in price, the percentage change in the demanded quantity will be greater than the percentage change in price.
$\varepsilon_D = -\infty$	**Perfectly elastic demand:** in view of any percentage change in price, however minimal, the demanded quantity will change in a large magnitude.

Measure of welfare loss from the Lerner Index

It is important to remember that the purpose of market regulation is to reduce social losses that can potentially produce a rise in market prices. To do this, it is necessary for the regulator to keep in mind the concept of **relevant market size**, which is vital to quantify market power. This is due to the fact that the damage caused by the loss in competition

also depends on the size of the market. Thus, an enterprise that has the monopolistic power in a market of no more than a million dollars, does not represent the same cost to society than an enterprise with a Lerner index of 10% in a market of ten billions of dollars.

Market size is important because it allows setting the following rule: A regulator that seeks to maximize social welfare will only intervene when the costs implied by the reduction of competition are greater than the costs of implementing this regulation. In other words, the regulator should not allocate resources to those violations that do not pose a great threat.

To illustrate this, consider the following example. Suppose that the regulator has decided to intervene only in cases where the market power of certain enterprise causes a welfare loss greater than $15 million dollars. Thus, that is the threshold at which the authority decides that it is efficient to investigate the competition reduction. The following table shows the market share combinations of elasticity of market demand and market size required for the social welfare loss to be equal to fifteen million.

We calculated the welfare loss through the following expression:[96]

$$\text{Welfare loss} = \mathrm{S_i}^2 \mathrm{P} * \mathrm{Q}/2\varepsilon_{\mathrm{D}}$$

Where $\mathrm{S_i}$ is the share of the enterprise i, P is the market price, Q is the equilibrium exchanged quantity and ε_{D} is the elasticity of demand. From this formula, we can conclude that the welfare loss is directly proportional to the market size and to the share of enterprise i, while it is inversely proportional to the elasticity of demand.

In the following table we can see that the share is decreasing regarding the market size. For example, if we have a market size of $50 million dollars, it is necessary that the market share be of 55% for the market power of certain enterprise to cause a loss in welfare of 15 million. While in a market of 10 billion dollars, the share required is much smaller, only 4%. Therefore, in terms of impact on social welfare, both enterprises potentially generate the same loss.

Table: Variations of share in response to changes in elasticity and in market size

	Market size in millions of dollars					
ε^d	**$50**	**$100**	**$200**	**$500**	**$1,000**	**$10,000**
0.5	55%	39%	27%	17%	12%	4%
1	77%	55%	39%	24%	17%	5%
1.5	95%	67%	47%	30%	21%	7%
2	110%	77%	55%	35%	24%	8%

In this case, welfare loss is constant in 15 million dollars.

Source: Posner, Richard. Market power in antitrust cases, 1981.

Therefore, before seeking to set a limit for the market power an enterprise can have in a particular industry, the regulator must try to limit the loss in social welfare generated from such market power. Finally, before limiting the market power of a company in a particular industry, the regulator must reduce the social welfare loss that is generated by the market power; in other words, the regulator's intention will always be to reduce as possible the damage caused by the market power rather than its magnitude.

[96] For further reference, please consult R. Posner, "*The market power.*"

CHAPTER VI

FINAL CONSIDERATIONS OF THE REGULATORY IMPACT EVALUATION

Chapter VI. Final considerations of the Regulatory Impact Evaluation

6.1 Divulgation of the regulatory proposal

6.1.1 Final report

In the final report the conclusions on the impact evaluation are drawn, as well as a full and comprehensive description of the process. The final report should be a functional document for regulators to count on a documented and supported evaluation, as well as on elements to make the best decision and inform the community about the impact of the measure to be taken.

In the presentation of results we should emphasize the relevant aspects of the impact evaluation of the regulation; this includes comments on general aspects of the data collection, the definition of inferences, the choice of the methodology, the discounting of data, the definition of the planning horizon, among other elements. The regulator should consider the following for preparing the final report:

- ***Executive summary.*** The report should include an executive summary which mentions the most important aspects of the analysis, especially, how conclusions were reached.
- ***Simplicity.*** The final report should be written in an easy and concise language to communicate results; the implications of the regulatory proposal implementation, as well as the implications of not modifying at all the regulatory framework, should be explained in detail. Similarly, the report should address the different public policy alternatives considered in the process[97], so that decision makers and public in general, can easily understand it. We should favor the use of non-technical language easy to understand.
- ***Coherence.*** The way we present the results must be coherent with what we did in the impact evaluation.
- ***Format.*** It would be useful to present results in a concise format that introduces the final results and differentiates between monetized benefits and costs, costs quantified but not monetized, and those that were not quantified[98]. That is, the presentation of final results must be integrated according to:
    i. A separable list of monetized benefits and costs that show their type and temporality.
    ii. A list of the benefits and costs quantified, but not monetized, including their temporality.
    iii. A description of the benefits and costs that could not be quantified.
    iv. If necessary, identify or reference the data or studies on which the estimates of costs and benefits are based.

[97] EPA. (2010). "Chapter 11: Presentation of analysis and results". Guidelines for preparing economic analyses.
[98] Office of Management and Budget. (2003). "The Need for Analysis of Proposed Regulatory Actions".

Presentation of final results

Summary of costs and benefits generated by public policy alternatives							
Benefits Annual average since 2006; 12% disccount rate							
Type	Chosen option		Option A		Option B		Analysis limitations and other notes
	Units	$ Million	Units	$ Million	Units	$ Million	
Monetized							
Quantified but not monetized							
Non-quantified							
Total benefits							
Costs Annual average since 2006; 12% disccount rate							
Type	Chosen option		Option A		Option B		Analysis limitations and other notes
	$ Million		$ Million		$ Million		
Monetized							
Quantified but not monetized							
Non-quantified							
Total costs							
Expected impacts	Chosen option		Option A		Option B		Comments
Citizens							
Enterprises							
Salaries							
Growth							
Employment							
Environment							

Source: OMB (2003)

- ***Presentation of empirical evidence.*** The source of information and databases used should be clarified in the report. If possible, and if the information is not restricted, full information should be reproduced or made available to the public, so that the analysis can be eventually reproduced. It is also advisable to present the data accuracy, their reliability, representativeness, thoroughness and comparability. Even when information is available in several sources, we must explain why we chose one of them, instead of the others.

  The presentation of the models used should be done very carefully, making emphasis on the inferences used and the preference for one method instead of another. Providing transparency to the presentation of the methodology will help to clarify the process, and prevent the analysis from being seen as a "black box". Whenever is possible and necessary, the regulator should include a sensitivity analysis on the variables that could potentially affect the result of the evaluation.

- ***Transparency and public consultation.*** It is necessary to promote the dialogue with those interested in the regulation to be issued in order to strengthen the regulatory proposal, as this enriches the evaluation of the regulatory policy when considering important issues that the regulator might has put aside. Public consultation should be indicated in the report of results. Particularly, the final report should consider to address:

  - The main opinions of the stakeholders;
  - Areas of convergence and divergence of opinions;
  - Information on intergovernmental consultation;
  - How the proposal has been modified when taking into account the stakeholders opinions. Also, if the proposal has not been modified, it must be explained why critical opinions have not been taken into account.

Public consultation increases the credibility of regulatory authorities; it builds the confidence of society in the process of public policies development and encourages the government to perform properly in regard to the policy to be implemented.

It must be noted that, in Mexico, the final report could be equivalent to the Regulatory Impact Assessment (RIA).

6.1.2 Considerations in the implementation of regulation

Political and economic factors are the main factors that may limit or condition the proper design and implementation of the regulation.

Political dimension. Although the process of impact evaluation of regulation can conclude that a public policy alternative solves best certain problem, without the political support necessary for its implementation this proposal will not get very far. In other words, the effectiveness of the regulation implementation depends largely on the political commitment that supports it. This means that the proper design of the regulatory policy should consider, among other aspects, the support and political commitment behind the proposed regulation. The importance of taking into account the political dimension in the process of impact evaluation is that if there is a political sector that does not support the implementation of the proposed policy, then its implementation is unlikely, even if the process fully justifies the implementation. Shapiro (2006) notes that, based on the political support achieved by the regulation, different scenarios are generated that will define whether the regulation is accepted or not.

Thus, mechanisms such as transparency and effective accountability are key elements contributing to align incentives between the political considerations and the result of the impact evaluation. In particular, public consultation is a tool that ensures such elements, as it promotes the identification of the groups interested in the regulation and in the impact evaluation process, which generates a source of political support[99].

Economic dimension. It is also essential to consider the economic dimension. Broadly, the economic dimension refers to the budget constraint existing on the choice of the method to be used. Frequently, the cost of using certain methodology can be very high or the resources to apply it are not sufficient. As a consequence, the complexity and magnitude of the analysis we try to make will be subject to this restriction. So, during the impact evaluation we must consider the economic effects resulting from the implementation of a regulation.

6.1.3 Monitoring of the regulation

The monitoring is a continuous process that involves collecting data on the implementation of the regulation and the indicators that evaluate its performance and the achievement of its objectives. The monitoring should help to ensure that the regulation is implemented as planned and it may help to assess the quality, efficiency and effectiveness of regulations. The monitoring should consider the following elements:

[99] OCDE. (2008) "Building an Institutional Framework for Regulatory Impact Analysis (RIA): Guidance for Policy Makers." Regulatory Policy Division, Directorate for Public Governance and Territorial Development.

Table. Elements to be considered when monitoring and evaluating

Elements	Description
Results	Obtained from continuous data collection
Indicators	Obtained from results
Data source	Source and location of information: surveys, collection, meetings with stakeholders
Data Frequency	Frequency of data availability
Analysis and report	Frequency of analysis, methods of analysis and responsibility for reporting the monitoring and evaluation
Resources	Estimation of the resources required to monitor and evaluate the activities
Purpose	Why the report is made, what is its purpose, who will receive the information

Source: World Bank (2010)

6.1.4 Ex post evaluation of regulation

The ex post evaluation process refers to the evaluation of the current regulatory framework (regulatory stock) in order to determine its effectiveness, efficiency and the advantage of keeping it in force. Particularly, ex post evaluations can be used:

- To give explanations on the investment made
- To diagnose what does not work in the regulation and how to fix it
- As a learning process to improve future efforts when making regulations.

6.2 Main elements of the policy of regulatory quality

As a conclusion of this guide, we present basic concepts that may be considered in the development of the regulatory improvement policy. This idea seeks to coordinate all the government efforts to improve the regulatory quality, assuming that the impact evaluation process is an essential tool for achieving it, and, for this to be effective, it involves other elements of political and institutional kind.

As we mentioned in Chapter 1, regulatory quality refers to the effectiveness and efficiency of the government action. Effectiveness refers to the regulation effectiveness to address the problem, while efficiency is understood as the appropriate and diligent use of public resources. Considering that the regulation generates compliance costs to businesses, in addition to the costs that its implementation and verification generates to the government, it must be ensured that taken action truly generates the maximum possible benefits.

The implementation of a policy of regulatory quality does not only mean to improve the regulation proposals, but also refers to the continuous review of the regulations stock, that is, the regulation performance must be monitored and evaluated ex post.

The policy of regulatory quality requires the cooperation and participation of various government agencies. In order to obtain consistent results in the long term, the policy of regulatory quality should be established through a legal instrument in which a permanent commitment of authorities consolidates towards the regulation improvement. This ensures that, regardless of the fact that the government is in charge, the regulation improvement is a duty to be performed, being a State policy rather than a policy of only one government

It can also be helpful to count on **institutions responsible for implementing the policy of regulation improvement**. In this sense, the creation of oversight agencies (oversight bodies), which have a clear mandate, powers, counterbalances and institutional shield should be considered to help guarantee and promote good regulation. Finally, it is important to count on tools that promote and ensure good regulation.

6.2.1 Explicit policy of regulatory improvement

An explicit policy of regulatory improvement refers to the intention of a State to systematically review its regulatory framework in order to improve it. Furthermore, it also refers to the commitments assumed by governments, at the highest level and permanently, to have a quality regulation. For a regulatory improvement policy to be explicit it must: a) be contained in a law, agreement or decree, b) have specific and clear objectives, and c) be based on principles of regulatory quality.

The objective of a policy of regulatory improvement is to ensure that the regulation works effectively, that it is fully justified, of good quality and suitable for its purpose. It also helps policy makers to make informed decisions about what to regulate, whom to regulate and how to do so.

6.2.2 Institutions to manage the regulatory reform

Just as the high level political support, we also need the different institutions responsible for making regulations to support the policy of regulatory quality[100]. In this sense, the existence of strong institutions that show the political commitment of the government is one of the factors that promote regulatory quality.

Institutions refer to all government agencies responsible for regulating, the body responsible for reviewing the regulation and the rules established to implement and manage the regulatory reform. In short, institutions are the instruments that give structure, establish counterbalances, restrict agents and reduce uncertainty in political, economic and social interaction.[101]

Key institutions to manage the policy of regulatory improvement are the bodies responsible for monitoring the compliance with precepts that the policy of regulatory quality dictates. These supervisory institutions (oversight bodies) prevent the issuance of inefficient regulations and allow correcting those that are not being effective in meeting the needs of society. They are also responsible for keeping order in the strategy, avoiding the duplication of functions. They also advise and support the cultural change of the way to implement regulation.[102]

The function of the supervisory or oversight bodies is to coordinate and oversee the policy of regulatory quality.

That is why these bodies should be granted with powers to question the regulation and its amendments, so that they can review and/or eliminate a regulation that does not meet the minimum quality requirements. Moreover, these agencies may be responsible for keeping

[100] OCDE. (2008) "Building an Institutional Framework for Regulatory Impact Analysis (RIA): Guidance for Policy Makers." Regulatory Policy Division, Directorate for Public Governance and Territorial Development.
[101] Douglass North Institutions, *The Journal of Economic Perspectives* (Winter,1991)
[102] OECD, *Oversight Bodies for Regulatory Reform*, (February, 2007).

order in the policy implementation, avoiding duplication of functions, and advising on the best way to implement the regulation.

To sum up, the presence of an oversight bodyshould be considered, as it can be helpful in minimizing the possibility of occurrence of government failures; in addition, it is useful in the implementation of the regulatory quality policy.

Finally, it is important to note that the design and implementation of politics and processes of regulatory improvement and regulatory reform are relatively new. Such politics and processes are aimed to establish and continuously improve the procedures to elaborate and review the regulatory process. In this sense, governments may opt to create their own Regulatory Management Systems through the design of institutional arrangements, according to each national context. For instance, in Mexico, the Federal Commission of Regulatory Improvement (COFEMER) is the responsible agency of the Mexican Government for administering the Regulatory Improvement process, which applies to all federal agencies, except for those involved in national security, taxation, land and labor justice and public prosecution issues. The legal mandate of COFEMER is to promote transparency in the development and implementation of regulations and that they generate more benefits than costs with the maximum benefit to society.

For more details about the institutional design of the Regulatory Improvement within APEC economies, the following table lists the responsible agencies of each country and their respective website.

Institutions responsible for the regulatory impact evaluation in APEC economies		
Country	**Name of the oversight body**	**Website**
Australia	Office of Best Practice Regulation (OBPR)	http://www.qca.org.au/obpr/
Canada	Advisory Committee on Paperwork Burden Reduction (ACPBR) Centre of Regulatory Expertise (CORE)	http://www.reducingpaperburden.gc.ca/eic/site/pbri-iafp.nsf/eng/Home http://www.tbs-sct.gc.ca/tbs-sct/organization-organisation/ras-sar-eng.asp
South Korea	Regulatory Reform Committee (RRC)	http://www.rrc.go.kr
United States	Office of Information and Regulatory Affairs (OIRA)	http://www.whitehouse.gov/omb/inforeg_default
Japan	Council for the Promotion of Regulatory Reform (CPRR)	http://www8.cao.go.jp/kisei/en/
Mexico	Federal Regulatory Improvement Commission (COFEMER)	http://www.cofemer.gob.mx
New Zealand	Treasury Regulatory Impact Analysis Team (TRIAT)	http://www.treasury.govt.nz/economy/regulation/regulatoryimpactanalysis

Source: COFEMER

Moreover, regulatory agencies with enough institutional strength that allows them to monitor public policies in the long term are necessary. Within regulatory agencies there are those of sectorial (focused on one single sector, such as those focusing only on natural gas or electricity) and transverse type (those serving several sectors at the same time). It must be noted that transverse regulatory agencies have the advantage that they are less susceptible to regulatory capture in the standards preparation and/or supervision process, as they are addressed to all economic sectors.

Regulatory agencies are organizations directly involved in the development of standards and they are often responsible for their monitoring and enforcement.[103] These institutions may have very different areas of action, encompassed in economic and social areas. Regulatory agencies can be classified into four types:

- **Government departments**: are agencies that are part of the central government, they do not have an independent legal status and report directly to a minister.
- **Ministerial agencies**: are agencies close to central government, they may have an autonomous budget and independent management, these agencies may be subject to different legal frameworks and they are subject to ministerial intervention.
- **Independent advisory bodies**: are agencies with the power to advise the government and other agents on specific regulations.
- **Independent regulatory agencies**: are agencies that regulate specific aspects of the industry. These institutions usually have administrative autonomy and their budget often depends on the Ministry.[104]

On the other hand, it must be considered that institutions are not only bodies, but also the rules that govern the regulatory framework review. These rules are provisions that outline and define the tools used in the policy of regulatory quality.

Some institutions recommended to manage the regulatory improvement policy are: (i) the obligation to count on formal training programs on regulatory improvement skills for public servants responsible for developing regulatory proposals, or reviewing them, (ii) the State's obligation to seek coherence in public policies to include competition and openness criteria in the markets in the early stages of the development of regulation, and (iii) the implementation of the regulatory improvement policy at the subnational level.

6.2.3 Tools for implementing the regulatory reform

The tools are the instruments used to implement the regulatory quality policy. These are built by the aforementioned institutions, which outline their duties. Regulatory tools support the regulatory improvement process. Some examples are the regulatory impact analysis, the consideration of regulatory alternatives and the administrative simplification.[105]

Tools for implementing the regulatory reform
- Transparency in communication and access to regulations and to regulatory proposals
- Formal processes of public consultation
- Analysis of regulation alternatives and justification of regulatory actions
- Ex-ante systematic review of regulation through a regulatory impact analysis that identifies and quantifies costs and benefits of the new regulation
- Systematic review of the regulatory stock
- Software systems that facilitate the interaction of entrepreneurs and citizens with government
- Projects to facilitate the granting of licenses, permits and one-stop-shops
- Measurement of administrative burdens

The impact analysis is an essential element of the impact evaluation process, which allows distinguishing between different policy options to obtain the one that best solves the

[103] David Levu-Faur, *Regulation and regulatory governance*, The Federmann School of Public Policy & Government. The Hebrew University (February, 2010).
[104] OECD, *Regulatory Policy and Governance*, OECD Publishing (2011).
[105] OECD, *Regulatory Policy and Governance*, OECD Publishing (2011).

problem. The impact analysis is subject to the needs and capacities of each country; hence some economies choose to establish thresholds for determining the regulatory proposals to be submitted to review. United States and Mexico use different criteria, which depend on the available resources, or on the need for in-depth analysis of a particular problem because of the magnitude of the impact this generates.

In the **United States** the Office of Management and Budget (OMB), through the Office of Information and Regulatory Affairs (OIRA), is responsible for reviewing all significant regulatory action (draft) before its publication. According to the Executive Order 12866, all regulatory agencies must prepare a Regulatory Impact Analysis (RIA) for each project regulatory that OIRA determines as economically significant.

The economically significant regulatory proposals are those that may have an annual effect equal to or greater than $100 million dollars, or those that adversely affect the economy or a sector of this, productivity, competition, employment, environment, public health or safety, or state, local or tribal governments or communities in a significant way.

From all the regulations presented to OMB, review by OIRA, between 10 and 15% are considered as economically significant, which are treated differently, as they require a more in-depth study that includes an sensitivity analysis and the greatest possible quantification of adverse impacts and benefits resulting from the proposed regulation.

In **Mexico**, the Federal Commission for Regulatory Improvement (COFEMER) is the body responsible for reviewing all regulatory action (draft) before its publication in the Official Gazette of the Federation. Before making a Regulatory Impact Assessment (RIA), regulatory agencies must fill in a questionnaire called "Regulatory Impact Calculator," which is a software tool consisting of ten questions related to processes, activities, stages of the business cycle, consumers and economy sectors.

The purpose of the calculator is to differentiate between a moderate impact draft project and one of high impact, which will help to prioritize the regulations and, in the case of high impact draft projects, to analyze them in-depth. In addition, once the impact is differentiated, Mexico includes two checklists in the RIA software system, one about impact on competition and other about risk analysis, which allows identifying the regulatory proposals that directly affect competition in the markets and those that require a risk analysis. The latter are not mutually exclusive, so a project may require both analyzes.

Of all the regulations with cost of compliance reviewed by COFEMER, between 10% and 12% of these are considered as high Impact regulations, approximately.

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Summaries

Summary of the process of regulatory impact evaluation	
1	**Identification and definition of the problem**
	▪ Define the nature and extent of the problem ▪ Clearly identify the affected parties ▪ Establish the causes of the problem ▪ Include an statistical analysis and/or empirical evidence that shows the magnitude of the problem ▪ Identify the international evidence ▪ Identify the target population
2	**Clear definition of the regulation objective**
	▪ Define quantifiable objectives sufficiently precise and concrete ▪ Establish objectives coherent with the problem and its cause
3	**Establishment of different regulatory and non-regulatory alternatives**
	▪ Develop a baseline scenario ▪ Identify different policy options, distinguishing between regulatory and non-regulatory options; comparing always with the baseline scenario
4	**Analysis and quantification of the impact of the public policy alternatives**
	▪ Identify the direct and indirect impacts, whether economic, social or environmental ▪ Quantify and monetize the impacts of each alternative by using the most appropriate methods and methodologies ▪ Evaluate the impacts of each alternative vs. the baseline scenario ▪ Consider the risks and uncertainties of each alternative
5	**Comparison of the different alternatives and choice of the one that best solves the problem**
	▪ Compare the net benefits of each alternative and choose the one that generates greater benefits to society ▪ In the case of non-quantifiable evaluations, weigh the positive and negative impacts of each option and choose the one with best net impacts, always considering the objective of the public policy.
6	**Implementation of the regulation**
	▪ Prepare an implementation plan for the regulation ▪ Consider making public the regulation to the regulated ▪ Provide the regulated with technical and administrative advice on the regulation and its implications ▪ Train the government staff on the new regulation, estimate the resources needed for the implementation
7	**Outline of the regulation assessment**
	▪ Identify and/or design indicators related to the different regulatory objectives, which will allow the regulator to evaluate the performance of sush alternatives
8	**Access to regulation and public consultation**
	▪ Provide free and unrestricted access to regulation ▪ Collect feedback from stakeholders through different channels ▪ Define the consultation period for individuals and the most appropriate time to do it ▪ If necessary, establish criteria to hold the consultation ▪ If necessary, include the feedback of individuals in the regulatory proposal

Cost Effectiveness Analysis	
Advantages	Easy and feasible alternative to implement in case of not having enough inputs to monetarily quantify both, costs and benefits.
	It is a tool that helps to decide when information is scarce.
	It is a good decision tool when the regulatory proposal is of low impact, and/or the available time is limited.
	It can be used as a complement of the Cost-Benefit Analysis; mainly when evaluating regulatory actions within a regulation alternative
	It is easy to interpret.
Disadvantages	Comparison between alternatives is only based on the less costly.
	It does not consider the impact evaluation within the regulation proposals.
	It considers the same unit of measure for all the alternatives.
	Through the CEA we can hardly identify the costs for those involved and thus make proposals for improving the regulation intended to issue
	When unifying the measurement to be used as benefit for all the alternatives, the analysis leaves out other benefits that may be linked to the regulation proposal.
Cost-Benefit Analysis	
Advantages	It allows a more complete comparison when quantifying costs and benefits monetarily. Its implementation is recommended for regulations of medium or high impact.
	It is possible to identify and count the impacts of the proposals for the different parameters involved.
	It clearly determines which the most beneficial alternative for society is. Allowing the consideration of the direct, indirect and intangible costs and benefits.
	It is possible to identify the impact in each step of the CBA, besides having the possibility of incorporating macroeconomic effects into the analysis
	Easy to interpret.
Disadvantages	It requires a lot of information to make the monetary quantification.
	It takes considerable time to obtain the benefits.
	Its technical complex.
	It does not usually consider the interaction between the different impacts.
	It requires a considerable number of inferences.
	It tends to be subjective if criteria are not defined since the beginning.
Multi-criteria decision analysis	
Advantages	It allows comparing heterogeneous alternatives in a more complete form than in the CBA. Its implementation is recommended for high impact regulations.
	Capable to simplify situations and/or complex alternatives.
	It includes lots of tools and these cover a wide range of approaches. Studies distinguish about 40 ways of implementing the MCA.
	The decision criteria involve qualitative and quantitative information.
	It provides different ways to break down a complex decision.
	It is an option that is more adapted to reality.
Disadvantages	It requires lots of information or a solid database to organize and validate the methodologies.
	Its implementation is difficult.
	It can be considered as a subjective tool.
	Most of the times the values of the weightings are not clear and respond to the evaluator judgments.
	It requires technical knowledge to make the analysis.
	Its interpretation is not as simple as the CBA and the CEA.

Contingent Valuation (CMV)

Objective	***Assign economic value to goods which are not assigned.***
When is this used?	When you want to know the valuation of assets that are not assigned a value in the market and you can hardly get that value indirectly. It is usually used for environmental assessments.
Considerations on the necessary data	**Lift data through surveys**. Once data are available, it is possible to make its estimate by simple statistical techniques. For accuracy econometric models can be used dichotomous or MCO.
Advantages	Application flexibility. The results are easy to analyze and describe. It is one of the most widely used methods in the evaluation of environmental policies.
Disadvantages	There may be skepticism of the veracity of the surveys If the survey design is not adequate, it is an instrument that can yield highly skewed values. There is no way of testing the validity of the results, so that uncertainty leads to biases between observed and actual valuation.
Type of regulation this evaluates	Social

Hedonic Prices (HPM)

Objective	***Assign economic value to an intangible usually feature a private good***
When is this used?	When you need to get the value of a feature of any good and that it does not have a direct market value. Its use is common in environmental applications, labor market and human health.
Considerations on the necessary data	Sample Data sorted on features and price of the private good.
Advantages	Quantify the value of features that affect the price of any good.It is easy to conceptualize and to apply. Generally obtaining data is simple. It is a method that can be applied in various areas as long as what you want to evaluate is the feature that has some good, and that this holds good market value.
Disadvantages	It requires a large amount of data. Application and interpretation is relatively complex and requires extensive statistical knowledge. It assumes perfect information The estimates depend heavily on the perception of consumer. Does not take into account the non-use values.
Type of regulation this evaluates	Social

Travel Cost

Objective	Assign economic value through expenses incurred by individuals for the enjoyment of it.
When is this used?	When you want to know the value of certain services and natural resources, as well as archaeological sites.
Considerations on the necessary data	Data from the input and transportation costs mainly incurred by individuals.
Advantages	Easy interpretation and quantification. Data are usually available. Requires relatively simple statistical techniques for estimation. Incorporates the cost incurred by individuals as a proxy of the value that they assign to certain good. Uses real data from the behavior of the participants. Widely used method in the evaluation of natural areas.
Disadvantages	The determination and measurement of the time spent to enjoy the good being valued can be a problem during the trip if time spent is used for another activity. To estimate the demand curve has to be a big difference between the distances traveled by what travel expenses are affected significantly. The travel cost method is quite limited in scope.
Type of regulation this evaluates	Social

Defense Expenditures (DEM)

Objective	***Assign economic value to goods which are not assigned.***
When is this used?	When trying to assign a monetary value to the change in the quantity of a good that causes a negative externality for individuals
Considerations on the necessary data	Identify the external factor that causes damage and from this determine the market value of the property or of the actions used by individuals to mitigate the damage. The population impacted by the good.
Advantages	Assign a monetary value increases. It is easy to interpret. Can be used to quantify the value of any damage from the actions or expenses that individuals incur.
Disadvantages	Typically underestimates the benefits of regulation because it does not capture the value of the "dis-utility" associated with any disease The identification of both the population of targeted spending target and reduce the harm it is sometimes difficult to separate.
Type of regulation this evaluates	Social

Cost of Illness (COI)

Objective	***Assign economic value to goods which are not assigned.***
When is this used?	When we need to calculate the willingness to pay of an individual to prevent, reduce or facing an illness.
Considerations on the necessary data	Identify all costs associated with various diseases. Identify wage statistics to quantify the opportunity cost.
Advantages	Its application is simple. The necessary data is generally available. Reveals the willingness to pay of consumers for health services.
Disadvantages	It does not capture the value of the discomfort of being sick. Difficult to quantify intangible costs related to the disease.
Type of regulation this evaluates	Social

Benefit Transfer (BTM)

Objective	***Assign economic value to goods which are not assigned***
When is this used?	When you need the value of a good for which there is no established market and does not have the resources for a large-scale study.
Considerations on the necessary data	Get the values of studies of the regulation, to equate economic values, adjusted for inflation and get the willingness to pay..
Advantages	It is a lower cost alternative to a large-scale study. Its implementation is relatively simple.
Disadvantages	Only works under certain assumptions. Populations affected by the valuation of the property without market value should be very similar. Depends on other original studies.
Type of regulation this evaluates	Social

Human Capital Method (HCM)

Objective	***Assign economic value to goods which are not assigned***
When is this used?	When you need to know the value of life by calculating lost wages.
Considerations on the necessary data	It is necessary to obtain the projection and discount of wages. Identify the target population.
Advantages	Necessary data is easy to obtain. The estimate is simple through projections.
Disadvantages	For certain age groups (infants) calculation is complicated because wages are not known. Could be considered unfair due to the range of income that is used to calculate it..
Type of regulation this evaluates	Social

Value of Statistical Life (VSL)

Objective	***Assign an economic value to human life***
When is this used?	When you want to measure the value of life from the maximum amount of money that people are willing to pay to reduce the risk of death.
Considerations on the necessary data	Get the likelihood of a fatality or death and the amount the individual is willing to pay to reduce the probability.
Advantages	It is one of the most used methods. Reveals the willingness to pay or accept risk. You can use estimates derived from other studies. The estimation resulting from the analysis may be subsequently adjusted for inflation.
Disadvantages	The results of the analysis are controversial because it assigns a price on human life. Results are variable depending on the approach used. It may be an expensive method of applying.
Type of regulation this evaluates	Social

Years of Quality-Adjusted Life (QALY)

Objective	***Assign an economic value to the quality of human life***
When is this used?	When it is required to know the time increments a positive health status derived from an improvement in regulation.
Considerations on the necessary data	Make groups of health states and assign values, Obtain the duration of the health states.
Advantages	Establishes a framework to assess the benefits of an intervention. Provides a measure of the benefits of a program in the extent and quality of life. Can be used to compare the effectiveness of various interventions on the same problem.
Disadvantages	The value used for the quality may be questionable. It may underestimate the effects of any medical condition
Type of regulation this evaluates	Social

Adjusted Life Years Disability (DALY)

Objective	***Assign an economic value to the quality and extension of human life***
When is this used?	When required to analyze the effects of disability and premature death arising from any health risk.
Considerations on the necessary data	Identification of the target population. Obtain the parameters on the modulation factor age weighting, the social discount rate, age of death, age weighting and the standard life expectancy at a given age.
Advantages	Establishes a relationship between the current situation and the ideal situation from a health standard life expectancy. Use units of time as measured by segments of the population.
Disadvantages	It can get to overestimate the life of the economically active population on the population of early and advanced age. Provides only a single result to various health costs caused by disease.
Type of regulation this evaluates	Social

Herfindal Index (HHI); Dominance Index (DI)

Objective	***Analyze the state of a market***
When is this used?	When we want to know how concentrate is a market. Specifically, it seeks to know what proportion of the industry belongs to the chosen enterprises
Considerations on the necessary data	Get the shares of the enterprises that are considered the most important in the industry. These can be determined by taking into account: sales statistics, number of customers, quantity produced and infrastructure.
Advantages	Easy to implement. Give greater relevance on enterprises whose concentration is higher ID: Solve problems of the Herfindal Index. In particular, it better captures competition improvements that can arise from a merger of small businesses that would lead to an increase in welfare even though there would be a reduction in production.
Disadvantages	There are direct measures of the concentration of a market. Results are variable depending on the approach used. You can lose sight of the competition in different markets but whose products are substitutes. Usually do not take into account the presence of foreign competitors what could decrease the values of these indices. They do not reflect the behavior of the enterprise in terms of its ability to raise prices.
Type of regulation this evaluates	Economic

Lerner Index

Objective	Analyze the state of a market
When is this used?	When we want to know the market power of an enterprise, or the market power in view of a possible merger of enterprises.
Considerations on the necessary data	It is necessary to make econometric estimates of the change in the demand in view of changes in the price of the good, whether to estimate the market or the enterprise demand to be analyzed. It is necessary to know the share of the enterprise in question within the industry.
Advantages	It directly measures the market power It is a measure that appropriately reflects the welfare within the market, as it involves the elasticity of demand. It allows reflecting the ability of the enterprise to set prices above the marginal cost.
Disadvantages	Difficult to calculate. It is an static measure, it does not include dynamic effects as technological change, innovation and “learning by doing.” It assumes that the price deviation regarding the marginal cost results from improvements in terms of economies of scale.
Type of regulation this evaluates	Economic

Compensatory and Equivalent Variation

Objective	Analyze the social welfare and its changes
When are they used?	When we want to know the change in social welfare derived from a regulatory policy, whether caused by the impacts of enterprises behavior or by the impact a regulation could have on a too restrictive regulation.
Considerations on the necessary data	It is necessary to make estimates of the changes in prices, as well as of the changes in the quantity demanded by consumers. In a more technical way, the analysis can be done through compensated demand (Hicksian) and the estimated prices, through econometric regressions.
Advantages	These are more appropriate measures for the direct calculation of the change in welfare (Hausman, 1981). They use budget constraint as essential input, as well as different prices.
Disadvantages	They do not consider the redistributive effects
Type of regulation these evaluate	Economic