What does Mexico gain when there is competition?

Economic benefit from eight interventions of COFECE

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The Federal Economic Competition Commission conducts and manages that academics and experts in matters of economic competition elaborate ex post assessments to emblematic cases to quantify the impact of competition policy in Mexico. The foregoing, based on article 12, sections XXIII and XXIX, of the Federal Economic Competition Law; and articles 22, section V, and 41, sections IV and X, of the Organic Statute of the Federal Economic Competition Commission.

The present document must not be understood as an official interpretation of the Federal Economic Competition (COFECE) regarding the Federal Economic Competition Law, nor it can be used to bind COFECE by any means. COFECE invokes its power to enforce the regulatory provisions in matters of economic competition without regard to the present document.

EXPLANATORY NOTE

With the objective of promoting competition and free market access, the Federal Economic Competition Commission (COFECE or Commission) publishes this document based on article 12, sections XXIII and XXIX, of the Federal Economic Competition Law, as well as articles 22, section V, and 41, sections IV and X, of the Organic Statute of the Commission.

The works that comprise this book were elaborated by researchers and academics of national and foreign institutions following the *Methodology for the elaboration of ex post assessments of the interventions of COFECE*.[1] Prior to its publication, each assessment undergoes a review process by other specialists in matters of economic competition, including staff from COFECE which conducts the policy interventions assessed here. Likewise, the results are presented by the authors of the Competition Policy Assessment Working Group and before the Commissioners.

The information and results provided in the studies do not constitute official positions of interpretations from COFECE with respect to the Federal Economic Competition Law (LFCE) or regarding the enforcement of competition policy. The Commission does not guarantee the precision of the data included or used in the assessments. This document cannot be used to bind the Commission by any motive. COFECE invokes its power to enforce the regulatory provisions in matters of economic competition without regard to the present document.

1. The methodology is available, in Spanish, at: https://www.cofece.mx/cofece/images/informes/metodologia_ev_expost_cofece.pdf

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PRESENTATION

In accordance with article 28 of the Political Constitution of the United Mexican States, COFECE is the authority in charge of promoting, protecting, and guaranteeing free market access and economic competition, as well as to preventing, investigating, and combating monopolies, monopolistic practices, concentrations and other restrictions to the efficient functioning of the markets.

To achieve this mandate, the Commission conducts investigations to identify and, if it is the case, sanction those conducts that impede the efficient functioning of the markets. It also prevents the concentrations and market structures that facilitate or encourage the conduction of these practices.

As a result of these interventions, the markets may observe effects such as price reductions, improvements in the quality, entrance of new competitors, savings in public finances or the prevention of market structures with effects opposite to the previously listed. The identification and measurement of these effects is a complex task since a great quantity of factors intervene which hinder the construction and identification of counterfactual scenarios.

For this reason, COFECE promotes that its interventions are evaluated, through ex post assessments, by academics and experts in matters of competition once the markets have incorporated their effects. This contributes to improving the quality of future interventions and, simultaneously, generates results that can be disseminated.

In the present book eight assessments conducted on interventions in several markets by COFECE and its predecessor, the Federal Competition Commission (CFC) are presented. The first two were conducted by the General Directorate of Planning and Evaluation and the remaining six by renowned specialists in the matter.

Competition Policy Assessment Working Group

ABBREVIATIONS AND ACRONYMS

A ▸ **AFAC –** Federal Civil Aviation Agency
AICM – Mexico City International Airport
AIDS – Almost Ideal Demand Systems
AM – Metropolitan Area
ARIMA – Autoregressive Integrated Moving Average

B ▸ **BTS –** Bureau of Transportation Statistic

C ▸ **CANACAR –** National Chamber of Freight Land Transport
CANIFARMA – National Chamber of the Pharmaceutical Industry
CARSO – Grupo Carso S.A de C.V.
CEN – National Executive Council
CFC – Federal Competition Commission
CF-CHM – Chiapas-Mayab Railway Company S.A de C.V.
CIDE – Center for Research and Teaching in Economics
CINEMARK – Cinemark de México S.A de C.V
CINEMEX – Grupo Cinemex S.A de C.V
CNIAA – National Chamber of the Sugar and Alcohol Industries
COFECE – Federal Economic Competition Commission
COFEMER – Federal Regulatory Improvement Commission
CONADESUCA – National Committee for the Sustainable Development of Sugarcane
CONDUMEX – Grupo Condumex S.A de C.V.
CPAC – Fuel Adjustment Charge
CPI – Competition Policy International

D ▸ **DED –** Difference in Differences
DENUE – National Statistical Directory of Economic Units
DF – Federal District
DOF – Federal Official Gazette
DOJ – United States Department of Justice

E ▸

ECD – Behavior Performance Structure
EDC – Ethylene Dichloride
EEF – Factory Efficiency
Estimador DiD – Difference in Differences Estimator

F ▸

FERROMEX – Ferrocarril Mexicano S.A de C.V.
FERROSUR – Ferrosur S.A de C.V.
FERROVALLE – Ferrocarril Terminal del Valle de México
FIT – Ferrocarril del Istmo de Tehuantepec

G ▸

GAN – Grupo Acerero del Norte
GDP – Gross Domestic Product
GFM – Grupo Ferroviario Mexicano
GMM – Generalized Method of Moments
MIP – Input Output Matrix
GUPPI – Gross Upward Pricing Pressure Index

I ▸

IATA – International Air Transportation Association
ID – Dominance Index
IFT – Federal Telecommunications Institute
IGAE – Global Index of Economic Activity
IHH – Herfindahl-Hirschman Index
IMSS – Mexican Institute of Social Security
INEGI – National Institute of Statistics and Geography
INPC – National Consumer Price Index
INPP – National Producer Price Index
ITAM – Autonomous Technological Institute of Mexico
ITF – Infraestructura y Transportes Ferroviarios S.A DE C.V.
ITM – Infraestructura y Transportes de México S.A de C.V.

K ▸

KCSI – Kansas City Southern Lines Industries
KCSM – Kansas City Southern Mexico S.A de C.V.

L ▸

LFCE – Federal Economic Competition Law

LIML – Limited Information Maximum Likelihood Method

Líneas Ferroviarias – Líneas Ferroviarias de México S.A de C.V.

LRSF – Regulatory Law of the Railway Service

N ▸

NAICS – North American Industry Classification System

O ▸

OECD – Organization for Economic Cooperation and Development

OFT – Office for Fair Trading

OLS – Ordinary Least Squares

P ▸

PEMEX – Petróleos Mexicanos

PIRCE – Interdisciplinary Program on Regulation and Economic Competition

PROFECO – Office of the Federal Prosecutor for the Consumer

PVC – Polyvinyl chloride

S ▸

SCT – Ministry of Communications and Transport

SIAVI – Internet Tariff Information System

SIN – National Researchers System

SINCA INBURSA – Sinca Inbursa S.A de C.V. Sociedad de Inversión de Capitales

SNIIM – National System of Market Information and Integration

T ▸

TFM – Transportación Ferroviaria Mexicana

TMM – Transportación Marítima Mexicana

TRIBASA – Triturados Mexicanos

U ▸

USA/United States – United States of America

 # ▸

2SLS – Two-Stage Least Squares

CONTENT

ASSESSMENT CONCLUDED IN 2016

1. Concentration in the chemical industry in Mexico

1.1. Introduction

The assessments of public policies are important as they allow to determine whether an institution provides benefits to the society with its actions. Moreover, ex post assessments conducted over individual cases clarify the effect of specific decisions. Thus, the more information that is available about the impact on consumers of concrete policy decisions in delimited markets, the better-informed public actors are to deal with situations involving similar decisions.

This work document presents the ex-post assessment of a concentration in the chemical industry in Mexico. The involved companies are *Mexichem* and *Cydsa-Polycid*, which overlap in the markets of polyvinyl chloride resins (PVC) in suspension, emulsion PVC resins, PVC pipes, PVC fittings and joints, and high-density polyethylene pipes.[1] However, the analysis focused on the market of PVC resin suspension/mass, since it was the one that posed greater risks to competition with the conclusion of the transaction.

Mexichem is a Mexican public society that controls companies with activities in the elaboration and commercialization of chemical and petrochemical products. In 2008 it notified to the competition authority its

1. Polyvinyl chloride (PVC) is a thermoplastic synthetic material made from polymerized vinyl chloride. It is used in a wide variety of manufactured products, including waterproof clothing, garden hoses, phonograph records and floor tiles. The material in its flexible form is used in hoses, insulation, shoes, clothing, etc.; in its rigid form it is used for molded articles. Appendix 1 presents a brief description of the PVC production process.

intention to acquire three companies with activities both in the production of PVC resins and in the production and commercialization of piping and fittings of the same material.

Of the three operations, two were confined to the market for the production and commercialization of PVC pipes and fittings.[2] The former CFC considered that in one of these the acquisition did not represent a threat to the competition conditions in the market, thus it authorized the concentration.[3]

However, the second operation consisted in the acquisition of *Plasticos Rex*, an important participant in the market, thus the competition authority denied its approval by considering that it would grant *Mexichem* with a very high market participation in a market where there would not be competitors with the sufficient volume of operation to discipline the behavior of the company that would be formed. In this sense, conditions that would facilitate the increase of prices to consumers would be generated along with incentives for the anti-competitive displacement of the rest of the producers, in an environment of high entry barriers and in which the imports from the United States of America (USA or United States) of PVC resin, an essential input for the fabrication of piping, were limited due to the validity of a countervailing duty.

Finally, the third operation consisted in the acquisition of *Cydsa*, a company with activities mainly in the market for the production and commercialization of PVC resin both in suspension and emulsion. Said resin is the main input for the fabrication of any PVC element, being the suspension its most used presentation in the fabrication of industrial applications.

Mexichem and *Cydsa* were the only two suppliers in the market of the elaboration and sale of PVC resin in suspension, thus the authorization of the concentration would have originated the creation of a monopoly. The Federal Competition Commission also identified high entry barriers, accented by the difficulty that the possible competitors of *Mexichem* would face to acquire the vinyl chloride monomer, the main input for the

2. The related files to which these operations refer to are: i) CNT-091-2008, ii) CNT-093-2008 and CNT-088- 2009, the resolutions are available, in Spanish, at: https://www.cofece.mx/cofece/index.php/resoluciones-y-opiniones

3. From September 2013, the competition authority in Mexico became an autonomous body named Federal Economic Competition Commission (COFECE)m, extinguishing the former Federal Competition Commission (CFC).

elaboration of the resin. Thus, the purchase of *Cydsa* was not authorized.

In 2009, the parties requested again the authorization of the CFC arguing a change in the circumstances due to the elimination of the countervailing duty applied to the imports of suspension PVC resins. In this sense, the Commission reviewed the operation again and identified the following changes in the analyzed market:

- The elimination of the countervailing duties generated a rising trend in the imports of PVC resin from the USA, becoming a new source of competition in the Mexican market and modifying one of the conditions which have backed the original denial of the Commission towards the concentration of *Mexichem* and Policyd.
- The new configuration of the market, with the incorporation of producers from the USA, is characterized by the presence of important competitors, even when higher market participations than those that the concentration between *Mexichem* and *Cydsa* would exhibit. However, the Commission also recognized that the full integration into a broader market would be gradual and would be consolidated only if the absence of barriers to trade remained.

Due to the foregoing, the CFC resolved to authorize this last request under certain conditions that, specifically, would protect the competition conditions in the market of PVC pipes.

To conduct the assessment presented in the document, a structural simulation of the Stackelberg leader-follower duopoly model is used. Market prices, produced quantities and the elasticity of the demand of the market are used to calibrate the parameters of the model. Afterwards, a change in the structure of the market using the calibrated parameters is simulated.

It is important to mention that a key input to calibrate the parameters of the model is the market price elasticity of the demand. Since it is not known ex ante, it is necessary to estimate it. To this end, an instrumental variables approach is used to estimate the price elasticity of the demand for the PVC suspension/mass resin market.

Once the prices that would have predominated in the counterfactual scenario have been simulated, the impact of the actions of the Commission over the consumer surplus is estimated. Summarizing, these are the steps followed before reaching final conclusions:

1. The price elasticity of the demand of the market is estimated using instrumental variables;
2. Market prices and quantities that would have predominated in a counterfactual scenario are simulated using the Stackelberg model;
3. The simulated prices and quantities are used to calculate the impact of a specific action of the Commission with respect to the concentration.

Also, an event study was conducted to evaluate the impact of the concentration on the stock prices of both companies. According to Beverly (2007), if stock prices reflect the underlying value of assets, their variations will adequately capture changes in the profitability of the companies. This allows us to interpret the market's valuation of the firm in terms of the perceived effects of the concentration on competition (See Appendix 2).

The research work is organized as follows: Section I.2 presents a brief review of the PVC market in Mexico, Section I.3 describes the main events of the concentration between *Mexichem* and *Cydsa*; Section I.4 shows the details of the Stackelberg model used to explain the concentration and its consequences in the market; Section I.5 presents the empirical strategy to estimate the elasticity of the market, to calibrate the parameters of the demand function and the marginal cost, as well as the changes in the simulated market prices and quantities; Section I.6 shows our calculations of the impact of the decisions of the competition authority in the consumer surplus and welfare; and finally, Section I.7 presents the conclusions.

The results suggest that both decisions of the CFC were favorable for consumers. The first intervention avoided damages in the consumer welfare for approximately 7.3 million dollars, as a result of avoiding the concentration that would have created a monopoly. The second intervention allowed an increase the consumer welfare for approximately 10.1 million dollars by promoting the elimination of antidumping fees that created barriers to entry for potential foreign competitors.

1.2. The PVC market in Mexico

Within the North American Industry Classification System (NAICS 2007), the inputs for the manufacture of PVC resins are included in the *"3251 Basic Chemical Manufacturing"* branch which belongs to the subsector that comprises the chemical industry, while the production of PVC resin is registered in the *"3252 Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing"* branch of the same subsector. In accordance with the 2009 Economic Census, the productive activities considered by both branches are conducted by 13.7% of the economic units that operate the chemical industry. Likewise, they represent the 25.1% of the labor occupation and generate 50% of the added value of the chemical industry. General data of the diverse branches that comprise the chemical industry are presented in Table 1.1.

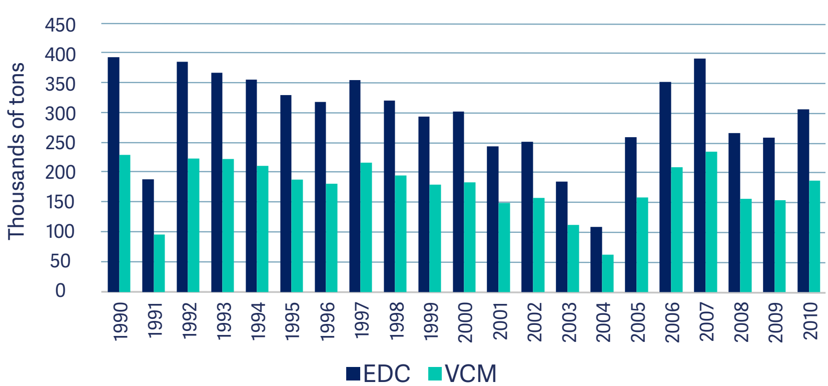
One of the inputs to produce PVC is ethylene. In Mexico, the petrochemical branch of *Petróleos Mexicanos* (PEMEX, per its acronym in Spanish) is the most important producer of ethylene. Since it is not a basic petrochemical, this input can also be processed, stored, distributed, and sold by companies of the private sector. As part of the strategy of PEMEX to encourage productive chains associated with hydrocarbons, it takes advantage of its infrastructure and produces both ethylene dichloride (EDC) and vinyl chloride monomer (VCM). The recent path of the production of EDC and VCM conducted by PEMEX is showed in Figure 1.1. The VCM/EDC ratio exhibited by PEMEX's production shows a stable path for the 1990-2010 period, which is similar to the molecular weight ratio of each compound, suggesting that PEMEX assigns the totality of EDC that it produces to the generation of VCM.

Table 1.1. The chemical industry in Mexico, 2008

4 digits NAICS	BRANCH	Economic Units*1	Occupations*	Added Value*
		(1)	(2)	(3)
3251	Basic Chemical Manufacturing	11.2	19.4	44
3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	2.5	5.7	5.9
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	5.7	3.8	3.1
3254	Pharmaceutical and Medicine Manufacturing	14.6	34.7	27.2
3255	Paint, Coating and Adhesive Manufacturing	11.7	8.3	4.1
3256	Soap, Cleaning Compound and Toilet Preparation Manufacturing	30.2	19.7	12.5
3259	Other Chemical Product and Preparation Manufacturing productos químicos	24.2	8.3	3.3

Source: INEGI. Economic Census 2009
Notes: *As a percentage of the total of the chemical industry.
1. An economic unit operates as a basic element for the statistical representation of the economic activity. A same company may have several economic units, differentiated by localization, production volume, size, etc.

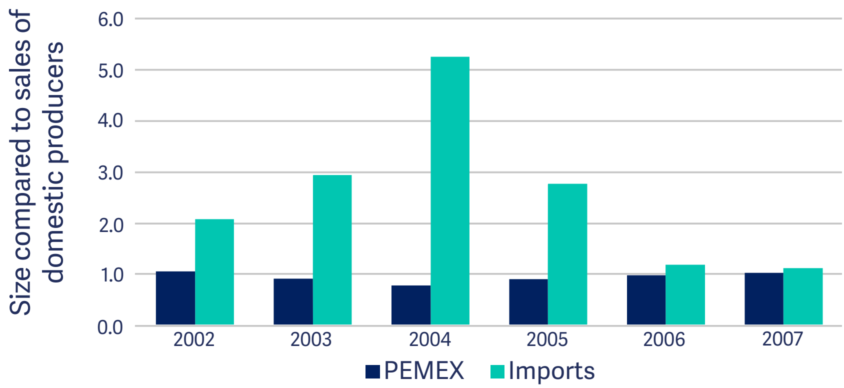
Figure 1.1. Production of EDC and VCM of PEMEX, 1990-2010



Source: PEMEX.

In this sense and given that PEMEX does not participate in the production of PVC resin, all the VCM that it generates is destined for two uses: commercialization in the domestic market or exports. As Figure 1.2 shows, the production of VCM conducted by PEMEX between 2002 and 2007 was practically directed at the internal market, becoming in some years into the only local producer. On the other side, the requirements of the domestic producers of PVC resin were complemented with a substantial quantity of imports of VCM. In the 2002-2007 period these imports averaged 2.6 times the volume of sales reached by domestic producers.

Figure 1.2. Production VCM by PEMEX and Total Net Imports of VCM, 2002-2007



Source: PEMEX e INEGI.

Towards mid-2008, PVC resins were manufactured in Mexico by subsidiary companies of two conglomerates of the chemical industry: *Mexichem* S.A.B. de C.V. and *Cydsa* S.A.B. de C.V. Both *Mexichem* and *Cydsa* are companies with important subsidiaries in the chemical industry, including the manufacture of PVC resin as well as PVC piping and other applications for the construction industry. Particularly, *Mexichem* also participates in investments and associations in other stages of the PVC production chain, for example acting as a provider of inorganic inputs to produce VCM that is conducted by PEMEX.

Mexichem and *Cydsa* only produce PVC resin with the polymerization techniques through suspension and emulsion. In 2008, the production of PVC in suspension represented 92.6% of the total domestic production, while the remaining 4.7% was for PVC in emulsion. It is important to mention that, during this time, the requirements of the local producers of PVC applications could hardly be covered by imports. This is due to the fact that the imports of suspension/emulsion PVC had an important tax burden (shown in Table 1.2) and to a specific tariff to the imports from the United States which was in force until 2009.[4]

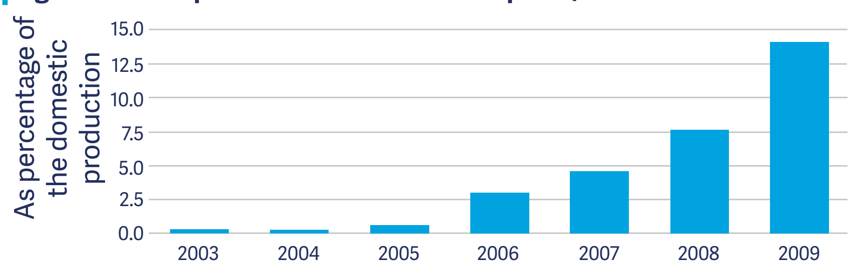
Table 1.2. Tariffs applied to the imports of suspension/emulsion PVC

Period	Import Tariff
April 1 2002 – December 30 2004	13%
December 31 2004 – September 29 2006	10%
September 30 2006 – November 23 2012	7%
November 24 2012 – December 31 2013	5%
January 1 2014	3%

Source: Ministry of Economy. Internet Tariff Information System.

Consequently, most of the domestic producers of PVC applications acquired PVC resin from the subsidiaries of *Mexichem* or *Cydsa* and competed with other branches of the same conglomerate that also participate in the market for the manufacture of PVC applications. Figure 1.3 shows that, as restrictions to foreign trade were decreased between 2003 and 2009, the imports of PVC resin/suspension steadily grew.

Figure 1.3. Suspension/emulsion PVC imports, 2003-2009



Source: Ministry of Economy. SIAVI, Internet Tariff Information System.

4. The tariff applied to the emulsion/suspension PVC imports from the United States was applied from August 1995 to August 2009. The tax rate was fixed as follows:
12.5% for the imports of Vista Chemical Co.,
18.9% for the imports of Shintech Inc., and
34.6% for the imports of Occidental Chemical Co., and the rest of the American companies.

1.3. The concentration between *Mexichem* and *Cydsa*

On September 18, 2008, *Mexichem* and *Cydsa* notified the CFC their intention to concentrate. The transaction involved the purchase by *Mexichem* of the totality of shares of *Polycid* and *Plasticos Rex*. A brief description of the parties involved in the concentration at that time is presented:

- *Mexichem* had the control, directly or through its subsidiaries, of companies in the chemical, petrochemical and of PVC pipes and fittings industries.
- *Amanco*, subsidiary of *Mexichem*, was a Mexican company that produced and sold PVC fittings and pipes, mainly for the construction industry.
- *Cydsa* was a holding company that controlled companies in the chemical, textiles and plastics industries.
- *Polycid* was a Mexican company that produced and sold suspension and emulsion PVC resins, property of *Cydsa*.
- *Plasticos Rex* was a manufacturer of pipes and fittings located in Mexico City, which was acquired by *Cydsa* in 1981.

The economic analysis developed by the CFC identified that *Mexichem* and *Cydsa* had overlapping interests in the following markets: PVC suspension/mass resin; PVC emulsion resin; PVC pipes; PVC fittings and high-density polyethylene pipes. This analysis established that the merger raised the most serious risk to competition in the PVC suspension/mass resin market. Additionally, PVC suspension/mass resin is an essential input for the PVC pipes and fittings industry, so the proposed merger could also have had adverse downstream effects.

When the concentration was first notified to the competition authority, *Mexichem* and *Polycid* were the only two producers of PVC suspension/mass resin in the Mexican market. Access to the PVC suspension/mass resin was restricted to Mexican companies due to the existence of countervailing duties.[5] Under this market conditions, both the Herfindahl-Hirschman Index (HHI) and the Dominance Index (DI) would have reached

5. The countervailing duties that protected the Mexican producers of PVC resin suspension/mass entered into force on June 5, 1991, through a publication in the Federal Official Gazette regarding the resolution of the administrative file Rev. 18/8 of the International Commercial Practices Unit (UPCI per its acronym in Spanish), of the Ministry of Economy.

10,000 points, indicating the complete monopoly in the market, if the concentration would have been approved.[6, 7, 8] The rest of the markets in which the closing of the transaction would have increased the level of concentration beyond the limit established by the competition authority were the market of PVC pipes and the market of PVC fittings.

On May 19, 2009, the CFC resolved to not authorize the merger of *Mexichem* and *Cydsa* in the markets of pipes and fittings that included the purchase of *Plasticos Rex* and its subsidiary, *Amanco*, by *Mexichem*. The possibility of conducting this operation was denied by the competition authority, since it would have raised a high degree of concentration in the market of PVC pipes and fittings of the same material, and there were big entry barriers in the relevant market.

Even more important, the merger would have consolidated the vertical integration between the PVC resins and PVC pipes industries. This would have generated incentives for *Mexichem* to incur in practices against competition by restricting free access to the rivals of *Amanco* in the market of PVC resin. The possible vertical restraints would be the vertical price fixing, exclusivity agreements, refusal to supply and service requirements.

A week after, on May 26, 2009, the CFC also denied the authorization to finalize the merger between *Mexichem* and *Polycid*. The arguments presented by the Commission were that the merger would have resulted in the creation of a monopoly in a market where entry barriers are high

6. The HHI is a measure of the concentration of the market, commonly used by competition authorities and is defined by the formula $IHH=\Sigma_{i=1}^{N} s_i^2$, where s is the market share of company i in a market where N competitors companies exist.
7. The *DI* is another measure for the concentration in a market used in Mexico, defined by the formula:

$$ID = \left[\frac{\Sigma_{i=1}^{N} s_i^4}{IHH^2} \right] \bullet 1000$$

where s is the participation of the company i in a market in which there are N competing companies and IHH is the Herfindahl-Hirschman Index. What this index tries to show is that there can be cases in which the two smallest agents concentrate and, although the *HHI* suggests a greater concentration of the market, it could be that the concentrated agent diminishes the dominance of another agent with a greater market share.
8. The CFC used two indexes when analyzing concentrations: the *HHI* and the *DI*. The Mexican competition authority considers that a concentration has low probabilities of threatening competition in the following cases: i) the concentration results in an increase of the *HHI* in less than 7.5 pints, ii) the value of the *HHI* after the concentration is less than 2000 points, iii) the value of the *DI* decreases and iv) the value of the *DI* after the concentration is less than 2,500 points.

due to the difficulty to access to VCM in the local market, the high requirements for the initial investment for a new competitor, the difficulty to use the specialized infrastructure in other economic activities, and the prolonged time required between the installation of a new plant and the effective entry into the market. The negative impact in the transformative industry of the PVC resin in pipes and accessories was also considered by the competition authority in its denial to authorize the merger.

Mexichem and *Cydsa* decided to challenge the decisions before the Federal Competition Commission. On July 1 and 9, 2009, *Mexichem* filed an appeal on the decision referring to the acquisition by *Mexichem* of the companies *Polycid* and *Plasticos Rex*, respectively. The companies presented evidence that they had requested the Ministry of Economy the review of the import tariffs, and that this request was parallelly supported by the CFC. Both companies argued that once the import tariffs were eliminated, the Mexican consumers would be able to buy PVC suspension/mass resins from North American producers under competitive prices. The companies argued that under these new conditions the concentration would not pose any threat to competition.

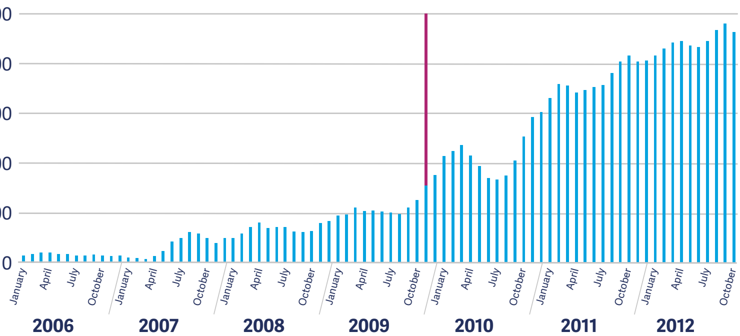
Approximately three months after the companies appealed the decision, on September 30, 2009, the elimination of the import tariffs for PVC suspension/mass resins was made official, through its publication in the Federal Official Gazette. The CFC considered that it was too soon to ensure that the elimination of the tariffs was enough to avoid the possible threats to competition posed by the operation. According to the Commission, it was necessary to observe how the reference markets reacted. Thus, on October 1, 2009, the Mexican competition authority confirmed its previous decisions regarding the merger between *Mexichem* and *Cydsa*.[9]

On December 17, 2009, two and a half months after the elimination of the import tariffs, *Mexichem* and *Cydsa* notified the Federal Competition Commission their renovated intentions to concentrate. The companies presented data from the market so that the Commission could conduct an analysis under the new conditions, that is, after the elimination of the tariffs. With the elimination of the commercial tariffs, the monthly import volumes of PVC suspension/mass resin began to increase (see

9. More information regarding this decision is available to the public under file numbers RA-27-2009 and RA-28-2009 in the website of the Federal Economic Competition Commission (COFECE): http://www.cofece.mx/index.php/resoluciones-y-opiniones.

Figure 1.4). Consequently, in the first year after the tariffs were eliminated the relation of imported resin regarding the national apparent consumption increased from 6.3% to 16.1%.[10]

Figure 1.4. Volume of imports of PVC Resin Suspension/Mass (Tons per month)



Source: Ministry of Economy. SIAVI Internet Tariff Information System.
Note: Five-month moving average.

The last arguments allowed the Federal Competition Commission to consider a relevant market different to the one foreseen in its last resolution, under which the concentration had to be analyzed. With these new conditions, the authorization of the concentration would have given rise to a HHI of 1,857.5 and a DI of 2,776.5, as it can be observed in Table 1.3. These values of the indexes, according to the parameters established by the Federal Competition Commission, indicated that the concentration has few probabilities of hindering competition in the relevant market.

Table 1.3. Concentration Indexes in the NAFTA PVC Resin Suspension/Mass Market

	Before the Concentration	After the concentration	Variation
	(1)	(2)	(2)
HHI	1,837.7	1,857.5	19.7
DI	2,831.7	2,776.5	-55.1

Source: Files of the CFC related with the concentration.
Notes: It can be observed that if the concentration is analyzed in the framework of the US-Mexico market the merger does pose any threat to competition in accordance with the thresholds established by the Mexican competition authority. The competition authority of Mexico considers that a concentration has a low probability of harming competition in the following cases: i) that the concentration results in an increase of the HHI index of less than 75 points, ii) that the value of the HHI after the merger is less than 2000 points, iii) the value of the DI decreases and iv) the value of the DI after the merger is less than 2500 points.

10. National Apparent Consumption is defined as national production + imports - exports.

On August 18, 2010, the Federal Competition Commission authorized the merger with the condition that *Mexichem* did not acquired the PVC pipes plant of *Plasticos Rex* located in *Poncitlán*, Jalisco. This measure was intended to avoid an excessive concentration in the market of PVC pipes.[11]

1.4. The model

To model the structure of the market of PVC suspension/mass resin before the concentration, a Stackelberg duopoly game was used. In this model the existence of two firms is supposed —leader and follower—, which sell homogeneous goods, compete in quantities and decide on their production levels sequentially; that is, the leader decides first and the follower makes its choice afterwards. However, although the leader decides first, it does so based on what it assumes is the "best answer" of the follower; that is, it uses all that is known as backwards induction. Once each firm has decided what quantity to offer, the break-even price is established through the demand and supply mechanism of the market.

The leader company usually has at least one of the following characteristics: the biggest installed capacity in the market, control over one or several essential inputs, or has the most advanced technology. These advantages allow the leader company to have a greater market share and stay ahead of its competitors.

Additionally, the follower company has information regarding the strategy of the leader, since it can observe it in the market, which allows both companies to hold a leader and follower interaction, instead of behaving as Cournot's duopoly model would describe. Also, given than the Stackelberg model assumes that the selection of strategies by the competing companies is conducted sequentially, there is a possibility that the follower company punishes the leader in case that the latter deviates from the equilibrium of the game.

In consideration of the previous description, the model is shown below in the stages of pre-concentration and post-concentration and the parameters are calibrated.

11. Additional information on this decision of the CFC is available to the public under file CNT-088-2009 on the Commission's website http://www.cofece.mx/index.php/resoluciones-y-opiniones.

1.4.1. Pre-Concentration Model

A linear inverse demand function is assumed in the market as follows:

$$P \bullet (q_l + q_f) = a - b \bullet (q_l + q_f) \tag{1}$$

Where q_l and q_f are the levels of production for the leader and follower companies, respectively. At the same time a and b are linear parameters that will be estimated later. Now, the problem of the follower is analyzed. The profit function, Π, that the follower company, f, has to maximize is:

$$\pi_f = (a - b(q_l + q_f)) \bullet q_f - c_f \bullet q_f \tag{2}$$

Where c_f represents the marginal cost of the follower company. Thus, the problems faced by the follower is:

$$\max_{q_f} \pi_f (q_l , q_f) = (a - b (q_l + q_f)) \bullet q_f - c_f \bullet q_f \tag{3}$$

The first-order condition (FOC) of the previous maximization problem is:

$$\frac{\partial \pi_f}{\partial q_f} = \frac{\partial(a - b (q_l + q_f))}{\partial q_f} \bullet q_f + a - b \bullet (q_l + q_f) - c_f = 0 \tag{4}$$

Simplifying *(3)* the following expression is obtained:

$$-2b \bullet q_f + a - b \bullet q_l - c_f = 0 \tag{5}$$

Solving for q_f from *(5)* the optimal quantity for the follower company as a function of its own marginal cost and the level of production of the leader company:

$$q_f = \frac{a - b \bullet q_l - c_f}{2 \bullet b} \tag{6}$$

Once the leader knows the alternative scenarios faced by the follower, it maximizes its gains. The profit function of the leader is described in the following equation:

$$\pi_l = (a - b(q_l + q_f(q_l))) \bullet q_l - c_l \bullet q_l \tag{7}$$

Where c_f represents the marginal cost of the leader. Substituting *(6)* in *(7)*, and simplifying the expression, the following is obtained:

$$\pi_l = \frac{(a - b \bullet q_l - cf)}{2} \bullet q_l - c_l \bullet q_l \tag{8}$$

Therefore, the maximization problem faced by the leader is:

$$max\ \pi_l = \frac{(a - b \cdot q_l - c_f)}{2} \cdot q_l - c_l \cdot q_l \tag{9}$$

The FOCs of the maximization problem described in *(9)* is:

$$\frac{\partial \pi_l}{\partial q_l} = \frac{(a - 2bq_l - c_f)}{2} - c_l = 0 \tag{10}$$

Isolating the quantity produced by the leader in *(10)* the following is obtained:

$$q_l = \frac{a - 2 \bullet c_l + c_f}{2 \bullet b} \tag{11}$$

Therefore, by substituting *(11)* into *(6)* we obtain that the follower chooses the quantity:

$$q_f = \frac{a - b\left(\dfrac{-2 \bullet c_l + c_f}{2 \bullet b}\right) - c_f}{2 \bullet b} \tag{12}$$

Simplifying the common terms, we obtain the final production level for the follower as a function of its own and the leader's marginal cost:

$$q_f = \frac{a - 2 \bullet c_l + 3 \bullet c_f}{4 \bullet b} \tag{13}$$

From *(11)* and *(13)* it can be observed that the differences in the quantities offered in the market by the companies depend on their own marginal costs and from the ones of the rival, and from the structural advantage that allows the leader company to decide before its competitor.

1.4.2. Post-Concentration Model

In the post-concentration stage, the industry may be described as a monopoly with two plants. Under these conditions, the concentrated company has to maximize its profit by setting the production levels of both plants:

$$\max_{q_l,\, q_f} \pi_l\,(q_l, q_f) + \pi_f\,(q_l, q_f) =$$

$$\max_{q_l,\, q_f} (P \bullet (q_l + q_f) - c_l) \bullet q_l + (P \bullet (q_l + q_f) - c_f) \bullet q_f \tag{14}$$

An important decision at this stage of the model is what will the marginal cost of the concentrated company be, assuming that initially there are relevant differences between both companies. A possible scenario is that the less efficient company has a very high marginal cost with respect to the more efficient one; if this is the case, the less efficient company will be closed if it does not reduce the gap in a determined time.

A second scenario is that the less efficient company accelerates its learning curve and learns from the leader, so that its marginal cost converges to the lowest in a reasonable period. In fact, the second scenario is the one most widely accepted by the industrial organization literature for concentrations (Salant, Switzer and Reynolds, 1983).

In accordance with the previous assumption, in the post-concentration stage it is considered that the lowest marginal cost prevails and that the level of production matters only at the level of monopolistic company, and not at the plant level. Now, given that $q_f + q_l = Q$, can be expressed *(14)* in the following way:

$$\max_{q_l, q_f} (P \bullet (q_l + q_f) - c_l) \bullet (q_l + q_f) = \max_{Q} (P(Q) - c) \bullet Q \qquad (15)$$

By deriving the FOCs the following is obtained:

$$P(Q) + P'(Q) \bullet Q \qquad (16)$$

Substituting the inverse demand function *(1)* in *(16)*, an expression that is related with the demand parameters, the level of production and the marginal cost is obtained:

$$a - 2 \bullet b \bullet Q = c \qquad (17)$$

Isolating Q from the previous equation, the level of production of the monopolistic company is identified:

$$Q = \frac{a - c}{2 \bullet b} \qquad (18)$$

In a similar way, using *(1)*, *(16)*, and *(18)* the market equilibrium price is obtained:

$$P = \frac{a + c}{2} \qquad (19)$$

1.4.3. Calibration of the parameters

To run the structural simulation model, it is necessary to calibrate the two parameters contained in the linear inverse demand function. Starting from *(1)*, we know that:

$$P = a - b \bullet Q \tag{20}$$

Calculating the derivative with respect to Q on both sides of *(20)*, and using the definition of price elasticity:

$$\eta = \left(\frac{\partial Q}{\partial P} \right) \bullet \left(\frac{P}{Q} \right)$$

It can be determined that:

$$b = \frac{1}{\eta} \bullet \frac{P}{Q} \tag{21}$$

This expression includes only observed variables and the elasticity. Once the parameter b is obtained, it is easy to identify the parameter a through *(20)*, in the following way:

$$a = P - b \bullet Q \tag{22}$$

This expression, again, only includes observed variables, which allows its calibration.

1.4.4. Estimation of the marginal cost

The FOCs at which each company maximizes its profit by choosing its level of production can be expressed in general terms as follows:

$$P \bullet (q_l + q_f) - c_j + \frac{\partial P \bullet (q_l + q_f)}{\partial q_j} \bullet q_j = 0 \tag{23}$$

Where c_j is the marginal cost of the company $j = l, f$; and each company decides its production level sequentially, thus an increase in its own production raised the total production of the market in the same amount (conjectural variation):

$$\frac{\partial P \bullet (q_l + q_f)}{\partial q_j} = \frac{\partial P \bullet (q_l + q_f)}{\partial Q} \tag{24}$$

Substituting *(24)* in *(23)* and adding some terms without altering the equation, the following is obtained:

$$\frac{P - c_j}{P} = \frac{s_j}{-\eta} \tag{25}$$

Where $s_j = q_j / Q$ is the market share of the company j. Isolating the marginal cost in *(24)*, the following expression of the marginal cost of company j is reached:

$$c_j = P \bullet (1 + \frac{s_j}{\eta}) \tag{26}$$

This result is consistent with what it is observed in the reality, given that the market share is inversely related to the marginal cost, when considering the negative sign of the elasticity, which must be negative for all normal goods. Also, when isolating s_j from *(26)*, it can be identified that the difference in the market shares is mainly due to the own marginal cost and the market elasticity.

$$s_j = \eta \bullet (\frac{c_j}{P} - 1) \tag{27}$$

However, when the good is relatively inelastic, it will generate that in the market structures where there are large differences in marginal costs, these translate into relatively small differences in market shares. This can be explained because the demand has little response to price changes resulting from differences in efficiency.

1.5. Empirical strategy and structural simulation

This section presents the information used to analyze the PVC suspension/mass resin market. It then describes the specification and econometric techniques used to estimate the price elasticity of market demand and the procedure for the structural simulation.

1.5.1. Data

Data include 70 monthly observations, from December 2003 to September 2009, of the volume of national sales of PVC suspension/mass resin; the sale price in the market of PVC suspension/mass resin; the subindex of plastic pipes of the National Producer Price Index; the value of the national apparent consumption of PVC pipes and the purchase price of VCM to which *Mexichem* buys.

The observations cover a span of almost 6 years of market data, which far more that what is usually available for an economic analysis in a competition case. The number of observations allow to estimate robust results that capture the variations in quantities caused by price variations.

1.5.2. Specification and estimation

A log-log specification was used to estimate the price elasticity of market demand:

$$ln\, Q_t = \alpha + \eta \bullet ln\, P_t + \gamma \bullet ln\, PC_t + \beta \bullet ln\, PPI_t + \varepsilon_t \tag{28}$$

where:

- Q_t is the total volume of the national sales of PVC suspension/mass resin;
- P_t is the sale price in the market in dollars for a ton of PVC suspension/mass resin;

PPI_t is the sub index of plastic pipes in the National Producer Price Index;

PC_t is the national apparent consumption of PVC pipes in thousands of dollars, and

ε_t is the error term[12]

The coefficient of interest is η, which is an estimate of the price elasticity of the demand of the market. To estimate the parameter of interest, instrumental variables are used since P_t is endogenous.[13]

As instrumental variable of the market price of PVC suspension/mass resin, the purchase price of VCM at which *Mexichem* buys is used.[14] The instrument was tested for the assumption of relevance, thus the statistical F of the first stage of 31.09 confirms that the price of VCM is not a weak instrument, because it is relevant to explain variations in the price of PVC suspension/mass resins.

In respect to the exogeneity requirement, it is known that it cannot be statistically proved. Although, as explained in Section1, the main input to produce PVC suspension/mass resin is VCM. Therefore, the most important determinant of the changes in the endogenous variable (the price of the PVC suspension/mass resin) is the instrument (the price of VCM). In addition, the instrument has no visible effects on the dependent variable (exchanged quantity of PVC suspension/mass resin) except through its price. Additionally, the dependent variable has no inverse effect on the instrument since the market for VCM is much larger than that for PVC suspension/mass resin, and the former has more competition than the latter.

Table 1.4 presents the results for the estimation of the elasticity. Two estimation methods were used: Ordinary Least Squares (OLS) and Two-Stage Least Squares (2SLS). In addition, regressions were performed

12. In order to find any source of multicollinearity, a Variance Inflation Factor (VIF) test was conducted, which includes the value of *Tolerance*. For all regressors, the VIF value was below 10 and the value of Tolerance above 0.1, both sets of results reject the hypothesis of the presence of multicollinearity in the specification of the model.

13. A *Hausman* test was perfomed and it does no yield evidence against endogeneity of the price of PVC suspension/mass resin, since its statistical *t* was 3.04.

14. Vinyl chloride monomer is the most important input in the production of PVC suspension/mass resin.

using the Generalized Method of Moments (GMM) and Limited Information Maximum Likelihood (LIML) method, however the last two are not shown since they yield results very similar to those of the 2SLS model. These last three methods, unlike OLS, control for endogeneity in the empirical model described above.

Table 1.4. Estimators of Market Price Elasticity of Demand using OLS and Instrumental Variables

Dependent Variable: Log of Quantity Demanded		
Variable	**OLS**	**2SLS**
Price Log	**0.0189**	**-0.5896 ****
	(-0.1436)	(-0.2826)
Log of Apparent Consumption of PVC PIPES pipes	**0.3840 *****	**0.8485 *****
	(-0.1371)	(-0.2260)
Log of PPI Plastic pipes	**-0.1727 ****	**-0.2502 ****
	(-0.0873)	(-0.1012)
Constant	**6.8251 *****	**6.6010 *****
	(-0.7622)	(-0.5478)
Observations	**70**	**70**
R^2	**0.2620**	**0.0613**

Notes:
1. The two estimation methods shown in the table are Ordinary Least Squares (OLS) and Two-Stage Least Squares (2SLS).
2. The instrumented variable is Log of Price, the instrument: Log of Price of VCM.
3. Coefficients are reported in the first row of each variable and standard errors are reported in the second row in parentheses.
4. Significance is reported by marking with an asterisk the coefficient using the following p-values: *** p<0.01, ** p<0.05, * p<0.1.

The coefficient obtained from the OLS estimation turned out not to be statistically significant, a possible justification being the endogeneity of the causal relation between price and quantity. The 2SLS model produces consistent results since the estimated coefficient (-0.5896) has the correct sign (negative for a normal good) and is statistically significant at 95% confidence level. This result also makes economic sense– it is expected to be relatively inelastic because the PVC suspension/mass resin is an essential input for many manufactured products and there are no substitutes.

Based on the result of the price elasticity of demand of PVC suspension/mass resin, and knowing the equilibrium price and quantities pre-concentration for both companies, the parameters of the aggregated demand can be calibrated from *(21)* and *(22)*, and the marginal cost for each company can be calculated through *(26)*.

1.6. Estimation of the impact on the consumer welfare of the PVC market

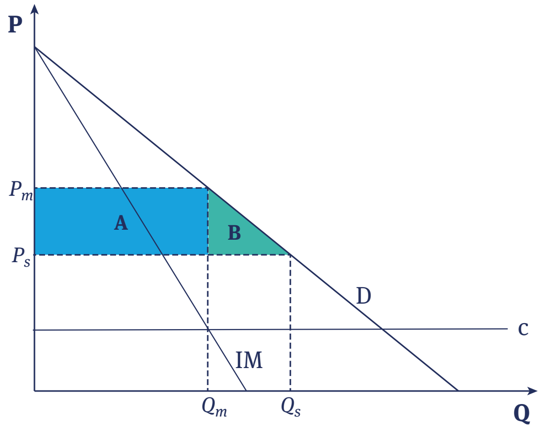
In the context of the Stackelberg duopoly model, when the market is in equilibrium, the market quantity (Q_s) is determined by the marginal revenue (IM) and the marginal cost (c) of the companies. Each of these will not produce an additional unit if their revenue is less than the cost of producing it. The market price in the Stackelber model (P_s) is determined by the market equilibrium mechanism.

Similarly, a monopolist company sets its quantity where IM and c are equal. The price that the monopolist sets (P_m) is higher than the Stackelberg price $(P_m > P_s)$. This difference is because the monopolist will take into consideration the effect on the price of producing each extra unit, whereas under the Stackelberg model scheme, the decision of the leader company is based on the expected output of its rival.

In Figure 1.5, two areas capture the loss in consumer surplus as a result of an increase in the price and a reduction in the quantity demanded are identified. The first is created by the increase in the price from P_s to P_m, which is the rectangle that captures the transfer from consumer surplus to the producer surplus (Area A).

In addition, the deadweight loss (area B) is a reduction in the consumer surplus as a consequence of the increase in price and a contraction of the quantity exchanged. Some competition authorities identify the impact on consumer welfare only as the transfer from consumer surplus to producer surplus, while other authorities consider only the sunk efficiency loss. For our purposes we consider both as consumer welfare losses.

Figure 1.5. Graphical identification of consumer welfare loss



Note: The transfer from consumer surplus to producer surplus corresponds to area A, while the deadweight loss corresponds to area B. Both are considered as consumer welfare losses, generated as a consequence of a structural change in the market, from a Stackelberg market to a monopoly, this increases the price of P_s to P_m and decreases the demanded quantity from Q_s to Q_m.

An important step prior to calculating the impact on consumer welfare is to determine what the marginal cost of the new monopolists, either the one from *Mexichem* or the one of *Polycid*, will be. In this case, we decided to be conservative and use the lowest marginal cost, which would imply that, in each period, the acquired plant will produce as efficiently as the acquirer. This will also yield conservative results on the impact on consumer welfare, since the concentrated company will have incentives to sustain higher production than the one it would choose if it had higher costs.

With the simulation model it was estimated that if the concentration was authorized, then there would only be a monopoly producer with two factories in production, the new price would be 32.26% higher and the new commercialized quantity 21.38% lower (see Table 1.5). Therefore, the total consumer welfare loss would be approximately 7.3 million dollars.[15] Similarly, the upper bound estimate of the avoided consumer welfare loss, using the marginal cost of *Polycid* is of 9.4 million dollars.

15. Across the document, we refer to current 2009 U.S. dollars.

Table 1.5. Simulated Variation in the Market Price, Quantity and Consumer Welfare due to a Concentration

	Price	Quantity	Consumer Welfare	
			Lower Bound	Upper Bound
	(%)	(%)	(current dollars)	
Variation	36.26	-21.38	7.3 million	9.4 million

Source: Own calculations
Notes: All variations were obtained from the structural simulation model described in section 4. Variations in Price and Quantity are presented as percentages and the variation consumer welfare is presented in current 2009 U.S. dollars.

Additionally, the analysis included another comparison. It involves the simulated scenario compared with the data observed after the import tariffs were eliminated and the concentration was authorized by the CFC. As it can be seen in Table 1.6, the price in the simulated scenario fell 29.42%, while the quantity demanded grew 83.46%. The comparison of results is consistent with the theory that from the moment in which the elimination of tariffs allowed new producers to enter the market, which increases competition and leads to lower prices. These calculations reveal a gain in the consumer welfare close to 10.1 million dollars, and following the same procedure, we estimate the upper bound of the welfare gain in 12.8 million dollars.

Table 1.6. Simulated Variation in Market Price, Quantity and Consumer Welfare due to the Elimination of Antidumping Duties

	Price	Quantity	Consumer Welfare	
			Lower Bound	Upper Bound
	(%)	(%)	(current dollars)	
Variation	-29.42	83.46	10.1 million	12.8 million

Source: Own calculations
Notes: All variations were obtained from the structural simulation model described in section 4. Variations in Price and Quantity are presented as percentages and the variation consumer welfare is presented in current 2009 U.S. dollars.

An important variable to consider when assessing the impact of the interventions of the competition authority is the duration of the anticompetitive practice. According to Davies (2013), most competition authorities use one to two years for the duration of the anticompetitive effects of a concentration, except for the Directorate-General for Competition of the European Union, which uses a range between two and seven years. For this point, we decided to use a conservative approach and limit the duration to just one year.

It is important to mention that some assumptions were used to generate conservative estimates and approximate a lower bound of the potential outcomes of the interventions of the CFC. First, only the potential effects for one year were considered, while some competition authorities use ranges between two and seven years. Secondly, the marginal cost used for the structural simulation is the lowest among the possibilities, leading to smaller changes in prices and quantities. Finally, the analysis does not consider potential dynamic effects of the anticompetitive conducts that may have arisen as other competitors prepared to enter the market when the import tariffs were eliminated.

1.7. Conclusions

A demand function of the PVC suspension/mass resin was estimated using instrumental variables and a logarithmic specification with two different methods (OLS and 2SLS). A database of 70 observations was used for the estimation, which allowed the market to be analyzed for almost six years and made estimates robust. The results yielded a price elasticity of -0.5896, which is consistent with economic theory, since it shows that it is a normal and relatively inelastic good, due to the lack of substitute goods.

The Stackelberg model, the basis of the analysis, proved to be a good approximation of the market, due to the applicability of the assumptions included in the model regarding the production levels and the costs of the analyzed companies. Thus, the results produced by the model confirm that the goods are homogenous, there is a leader and a follower competing in quantities–based on the absence of product differentiation, and their marginal costs are relatively similar.

According to the results of the structural simulation, the decision to block the concentration in 2009, prior to the elimination of the import tariffs, prevented a loss in consumer welfare of at least 7.3 million dollars. Evidence also suggests that the elimination of the import tariffs on PVC suspension/mass resin facilitated the entry of other competitors into the market. This pushed prices down in way that the demand increased and, as consequence, consumer welfare increased.

Results vary depending on the model and the specification that is used. Also, the construction and estimation of the counterfactual is based on particular assumptions in order to reflect the own conditions of the analyzed market, so it is to be expected that the comparison with different counterfactuals may generate different results.

The estimated results are conservative. They are based on assumptions that include the lowest marginal cost for the concentrated companies, the shortest duration of the anticompetitive effects of the concentration and a linear demand function that generates a relatively stable price elasticity. Thus, the results can be interpreted as the lower bound of the market harm prevented with the intervention of the CFC.

Finally, this study contributes with the Mexican economic literature by being an ex-post assessment of competition policy. Assessment policy in Mexico is often focused on social policy and its success in reducing poverty. In some cases, analyzes have been conducted to capture the effect of industrial policy on specific sectors in determined periods.

This exercise also disseminates the application of the industrial organization techniques of the competition authority of Mexico and the specialized academic community, in order to analyze and evaluate competition policy. This type of studies will refine the procedures used and will provide more solid conclusions about the relevance of promoting and strengthening competition as an efficient instrument to increase consumer welfare and promote economic development.

1.8. Bibliography

Angrist, J. D., Imbens, G. D., & Rubin, D. B. (1996). Identification of casual effects using instrumental variables. Journal of the American Statistical Association, 91, 444-455.

Beverley, L. (2007). Stock Market Event Studies and Competition Commission Inquiries. Retrieved from SSRN: https://ssrn.com/abstract=1114114

Brown, S. J., & Warner, J. B. (1985). Using daily stock returns: The case of event studies. Journal of Financial Economics, 14, 3-31.

Cameron, A., & Trivedi, P. K. (2005). Microeconomics: methods and applications. Cambridge University Press.

Campbell, J. Y., Lo, A. W., & Mackinlay, A. (1997). The Econometrics of Financial Markets (1st ed.). Princeton University Press.

Cox, A. J., & Portes, J. (1998). Mergers in Regulated Industries: The Uses and Abuses of Event Studies. Journal of Regulatory Economics, 14, 281-304.

Crook, P., Froeb, L., Tschantz, S., & Werden, G. J. (1997). Properties of Computed Post-Merger Equilibria. Nashville, Tennessee: Draft Vanderbilt University.

Davies, S. (2013). Assessment of the impact of competition authorities' activities. OCDE, Competition Committee.

Davis, P., & Garcés, E. (2009). Quantitative Techniques for Competition and Antitrust Analysis (1st ed.). Princeton University Press.

Farrell, J., & Shapiro, C. (1990). Horizontal Mergers: an Equilibrium Analysis. American Economic Review, 80, 107-127.

Hausman, J., Leonard, G., & Zona, J. (1994). Competitive analysis with differentiated products. Annales d'Economie et de Statistique, 34, 159-180.

Heckman, J. J., & Vytlacil, E. (2005). Structural equations, treatment effects, and econometric policy evaluation. Econometrica, 73, 669-738.

Ivaldi, M., & Verboven, F. (2005). Quantifying the effects from horizontal mergers in European competition policy. International Journal of Industrial Organization, 23, 669-691.

Ivaldi, M., Jullien, B., Rey, P., Seabright, P., & Tirole, J. (2003). The economics of horizontal mergers: unilateral and coordinated effects. Report for DG Competition, European Commission.

Kokkoris, I. (2007). A practical application of events studies in merger assessment: successes and failures. European Competition Journal, 3(1), 65-99.

Angrist, J. D., & Krueger, A. B. (2001). Instrumental variables and the search for identification: from supply and demand to natural experiments. Journal of Economic Perspectives, 15(4), 69-86.

Levitan, R., & Shubik, M. (1972). Price duopoly and capacity constraints. International Economic Review, 13(1), 111-122.

Lundmark, R., & Nilsson, M. (2003). What Do Economic Simulation Tell Us? Recent Mergers in the Iron Ore Industry. Resources Policy, 29, 111-118.

MacKinlay, A. (1997). Event Studies in Economics and Finance. Journal of Economic Literature, 35, 13-39.

McAfee, R., & Williams, M. (1988). Can event studies detect anticompetitive mergers? Economics Letters, 28, 199-203.

McAfee, R., & Williams, M. (1992). Horizontal Mergers and Antitrust Policy. The Journal of Industrial Economics, 40(2), 181-187.

McCabe, M. J. (2002). Journal pricing and mergers: a portfolio approach. American Economic Review, 259-269.

Novshek, W. (1985). On the existence of Cournot equilibrium. Review of Economic Studies, 52, 85-98.

Office of Fair Trading (2007). Consumer savings from merger control. Merger simulation for impact estimation. OFT.

Office of Fair Trading (2010). A guide to OFT's Impact Estimation Methods. OFT.

Peltzman, S. (1977). The gains and losses from industrial concentration. Journal of Law and Economics, 20, 229-263.

Salant, S. W., Switzer, S., & Reynolds, R. J. (1983). Losses from horizontal merger the effects of an exogenous change in industry structure on Cournot-Nash equilibrium. Quarterly Journal of Economics, 98, 185-199.

Scheffman, D. T., & Coleman, M. (2003). Quantitative analyses of potential competitive effects of a merger. George Mason Law Review, 12(2), 319-369.

Werden, G. (1991). Horizontal mergers: comment. American Economic Review, 81, 1002-1006.

Werden, G. (1997). Simulating the effects of differentiated products mergers: a practitioners' guide. In J. Caswell, & R. Cotterill, Strategy and Policy in the Food System: Emerging Issues. Proceedings of NE-165 Conference, Washington, DC.

Werden, G. J., & Froeb , L. M. (1993). Correlation, causality and all that jazz: the inherent shortcomings of price tests for antitrust market delineation. Review of Industrial Organization, 8, 329-353.

Werden, G., & Froeb, L. (1993). The effects of mergers in differentiated product industries: structural merger policy and the logit model. Journal of Law, Economics & Organization, 10, 407-426.

Werden, G., & Froeb, L. (2005). Unilateral competitive effects of horizontal mergers: theory and application through merger simulation. In P. Buccirosi, Handbook of Antitrust Economics. Cambridge, MA: MIT Press.

APPENDIX 1.
CHARACTERISTICS OF THE PVC PRODUCTION CHAIN

The precursor compound to produce PVC is VCM. The latter may be produced through three different processes: ethylene-based (associated with oil), acetylene-based (associated with carbon) and under a mixed process using both techniques.

The ethylene-based process uses, in the presence of a catalyst, the application of chlorine to the ethylene to create EDC, which is transformed in VCM after distillation of the product obtained by thermal decomposition (pyrolysis) of EDC.[16] In order to use the main by-product (hydrogen chloride) in the further generation of EDC, a sub-process that uses ethylene in an oxychlorination reaction allows the total depletion of inputs and complete recycling of by-products.[17]

As for the acetylene-based process, calcium carbide acts as a raw feedstock, producing acetylene and calcium hydroxide when it reacts to water (hydrolysis). Subsequently, the reaction of the acetylene with the hydrogen chloride, in the presence of a catalyst, produces VCM. However, the very high energy requirement that must be applied to produce acetylene and the risks associated to its use and handling, on the one hand, and the ever-widening access to the petroleum products market, on the other, have reduced the use of this method in the recent decades.[18]

The third method, which is less widely used, combines the two techniques described above in a way that takes advantage of all inputs and by-products are used in an integrated production chain that exploits both ethylene and acetylene. Based on the widespread availability of petroleum derivatives as well as the environmental concerns associated with the coal mining, the use of ethylene-based processes to produce VCM has extended to the Americas, Europe and some regions of the Middle East.

16. Event though the current nomenclature names the compound as 1, 2-dichloroethane, this old name is still commonly used in the industry.

17. Oxychlorination is a proceed through which hydrocarbons are chlorinated using hydrogen chloride (HCl) and oxygen (O_2). This process is preferred industrially due to lower relative price of the hydrogen chloride in comparison with pure chlorine.

18. In China this is the predominant method of production because the high availability of coal and limestone makes its exploitation substantially cheaper and makes the use of acetylene in VCM production economically more profitable. Until 2012, China was the most important producer of PVC in the world.

On the other hand, to produce PVC resin, VCM is polymerized using any of the following methods: a) suspension, b) emulsion, c) bulk, and d) in solution. Currently, given the main uses of the PVC resin, the suspension method has prevailed as the most popular one for the polymerization of VCM. With the purpose of exemplifying the global trend observed in the last decades (with the exception of China), Table 1.A1 presents shares of PVC production by process and by polymerization technique in Europe.

Table 1.A1. Production of PVC in Europe during 2009*

Process	Participation
Ethylene-based	98%
Acetylene-based	2%
Polymerization method	
Suspension	90%
Emulsion	10%

Source: "PVC production profitability", Deloitte Touché Tohmatsu Limited. Reino Unido. 2010. p.3.
Note: * Total of 9,150,000 Tons.

Through suspension polymerization, VCM is stirred in a liquid phase, such as the mixture of water with suspension agents, so that polymer spheres are formed. Through this method a resin is obtained that the industry calls S-PVC. Emulsion and mass polymerization are alternatives to manufacture finer grades of resin required for specialized applications. This type of resin is called paste and is referred to in the industry as P-PVC. Finally, VCM can be dispersed in a non-reactive solvent through solution polymerization. This polymerization technique is used primarily in manufacturing applications where the presence of specific characteristics of a solvent are desired in the final PVC product.

The most intensive use of PVC is in the construction industry, mainly in the manufacture of plumbing structures, moldings and PVC sheet applications. Additionally, PVC products are used intensively in the electrical industry for cable isolation, and there are even vinyl applications in the footwear and apparel industries. Asia, Europe and North America accounted for more than 90% of the global production of PVC in 2009, being China the greatest producer. Table 1.A2 presents the installed and produced capacity of PVC during 2009 in the main regions of the world.

Table 1.A2. Global Production of PVC by region during 2009

Region	Participation in the Total Capacity*	Participation in the Total Production**
China	37%	26%
Asia (without China)	20%	25%
Europe	19%	21%
North America	17%	20%
Latin America	3%	4%
Middle East	3%	2%
Rest of the World	1%	2%

Source: "PVC markets of Europe and South-East Asia: analysis of profitability and production cost", Deloitte Touché Tohmatsu Limited. United Kingdom. 2010. p.13
Notes: * Total of 47,972,000 Tons
** Total of 29, 924,000 Tons.

Based on the information described above on PVC production processes, and given the extensive use of the ethylene-based process for the production of PVC resin in the world (Mexico included), the following analysis is focused on resin production associated with ethylene-based VCM. The three stages of the integrated production system of PVC resin can be identified as follows: i) acquisition of ethylene and exploitation of sodium chloride to obtain chlorine, ii) production of EDC/VCM, and iii) production of PVC resin by polymerization. Important participants in the production of PVC have links between the three stages of the process through the configuration of investments and associations with companies established at each stage. Focusing in the last two stages (transformation processes), the approximate requirement of inputs to produce a ton of PVC through a process based in the transformation of ethylene is presented in Table 1.A3.

Table 1.A3. Inputs for the production of a ton of PVC

Input	Use (%) (1)	Quantity (2)
Ethylene	100%	460 kg
Chlorine	100%	585 kg
Oxygen	100%	139 kg
Vape	-	925 kg
Energy consumption	-	290 kWh
Water for cooling	-	152.3 m^3

Fuente: "PVC markets of Europe and South-East Asia: analysis of profitability and production cost", Deloitte Touché Tohmatsu Limited. United Kingdom. 2010. p.5.

For industrial use, PVC is mainly classified in three categories: common resin, paste resin and specialty PVC. Paste resin in particular, is highly valued for its physical characteristics and as an input for the manufacture of various applications. As a sample of the large number of industries that use PVC resin as a production input, those listed in the Table 1.A4 can be pointed out.

Table 1.A4. Applications in the PVC industry

Classification	Application
Common resin	Rigid and heat resistant coating for cables, pipes and molds, mold-injected products, electronic components, food packaging
Paste resin	Rigid molds for toys and tubing, chemical foams, wall and floor coverings and insulation, synthetic leathers
Of specialty	Adhesives

Source: "La Industria Química en México 2011", INEGI. México. 2011. p.85.

APPPENDIX 2.
STUDY OF EVENTS

The impact of some important events related with the concentration on the prices of the shares of *Mexichem* and *Cydsa* was analyzed. As shown in Table 1.A5, the events examined include the notification of the concentration to the CFC, the resolutions of the CFC with respect to the transaction and the elimination of import tariffs.

The market model is used to estimate the counterfactual return, i.e., the return that would have been obtained if the event had not happened. The market model is a statistical model that relates the return of any financial instrument with the return on the market portfolio (MacKinlay, 1997). The assumption of this model is that asset returns are jointly, normal, multivariate and identically distributed over time. This model is described next:

$$R_{it} = \alpha + \beta \bullet R_{mt} + \varepsilon_{it} \qquad (a1)$$

Where R_{it} and R_{mt} are the returns in period t of the instrument and of the market portfolio, respectively; α_i is the intercept; β_i is the coefficient of the regression of OLS that related the instrument i with the portfolio of the market; and ε_{it} is a term of error with zero mean and $\sigma^2_{\varepsilon i}$ *variance*.

In this study R_{it} represents the performance of the shares of *Mexichem* or from *Cydsa* in day t. R_{mt} is represented by the Prices and Quotations Index of the Mexican Stock Exchange. The return of the interest instrument is calculated as follows:

$$R_{it} = lnP_{it} - lnP_{it-1} \qquad (a2)$$

Where P_{it} is the price of the share of the interest instrument i in a t day. The return of the market portfolio is calculated analogously.

Following Campbell et al. (1997), a 120-day estimation window is used to estimate α_i and β_i from equation *(a1)*. A splice of the trading days used to estimate these parameters with the trading days comprising the window of each even was avoided. This window covers 20 days prior to the event and 20 days after, which results in an event window of 41 days.

Once the parameters were estimated, the returns of the interest instrument were predicted across the duration of the window of each event. This allows us to calculate the abnormal returns of the instrument (AR_{it}) by means of the difference between the returns observed (AR_{it}) and the ones predicted $(\alpha_i + \beta_i AR_{it})$, as follows:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \qquad (a3)$$

Next, all the abnormal returns across the window of the events were added, thus obtaining the cumulative abnormal returns:

$$CAR_i = \Sigma^{T}_{t=1} AR_{it} \qquad (a4)$$

The statistical significance of the abnormal results is determined with a statistical *t*. The null hypothesis is that the abnormal returns are equal to zero. The statistical *t* is calculated as follows:

$$t = CAR_i / \sigma_i \qquad (a5)$$

Where σ_i is the standard error in the abnormal returns during the estimation period. When the statistical *t* is greater than 2.57, the event is significative to 5%; and when it is greater than 1.64 it is significative to 10%.

Our results for the relevant events are summarized in Table 1.A.5. Of all events, only two obtained a significative effect in the prices of the shares of *Mexichem*. As it can be observed in column 1, the decision to not authorize the purchase of *Plasticos Rex* by *Mexichem* is associated with a loss in the value of the share of around 15% during the window of the event. For the other part, the authorization of the concentration in August 2010, is associated with an increase of 4% in the price of the shares of *Mexichem*, during the window of this event. Neither of the events had a statistically significative impact in the price of the shares of *Cydsa*.

Table 1.A5. Abnormal Cumulative Returns

Event	Date	Abnormal Cumulative Returns	
		Mexichem	Cydsa
		(1)	(2)
Mexichem and *Cydsa* notify their intention to concentrate to the CFC	18/09/2008	**0.1918** (1.1003)	**0.1019** (0.4296)
CFC denies the authorization to acquire Plásticos Rex	19/05/2009	**-0.1479 **** (-2.2973)	**-0.0346** (-0.3106)
CFC denies the authorization to acquire *Polycid*	26/05/2009	**-0.1044** (-1.5941)	**-0.0357** (-0.3440)
Mexichem and *Cydsa* file a RA for the purchase of *Polycid*	01/07/2009	**-0.0377** (-0.7420)	**0.0719** (0.6342)
Mexichem and *Cydsa* file a RA for the purchase of Plásticos Rex	09/07/2009	**-0.0287** (-0.6707)	**0.0541** (0.4374)
The PVC Suspension/Mass import tariff is eliminated	30/09/2009	**-0.0418** (-1.0221)	**0.0181** (0.3769)
CFC ratifies its previous decision regarding the purchase of *Polycid* and Plásticos Rex	01/10/2009	**-0.0496** (-1.1859)	**0.0334** (0.7052)
Mexichem and *Cydsa* notify to the CFC their new intentions to concentrate	17/12/2009	**-0.0234** (-0.5762)	**-0.0014** (-0.0155)
The concentration is authorized subject to conditions	18/08/2010	**0.0442 **** (1.9716)	**-0.0506** (-0.3801)

*** p<0.01, ** p<0.05, * p<0.1
Notes: The value of t statistic is presented in parentheses.

ASSESSMENT CONCLUDED IN 2015

2. Estimation of the benefits obtained for the sanction of a cartel in public procurement of the IMSS in Mexico

2.1. Introduction

According to the LFCE, absolute monopolistic practices are contracts, agreements, arrangements, or combinations between competing economic agents, whose object or effect is to, among others, establish, agree or coordinate bids or the abstention in tenders, contests or auctions.[19]

A cartel is one of the forms of absolute monopolistic practices and it is defined as an organization formed through an agreement between economic agents that compete in a same market to control the production and distribution of a good or a service, in way that they can manipulate its prices to obtain greater rents than those that could be obtained in the absence of said collusive agreement. Thus, collusion of competing agents to fix prices of the products they offer is a form of cartel.

By nature of their composition, cartels eliminate or lessen competition in a given market. Their members can do so by setting higher prices, the restriction of the available supply, the division of the demand and the allocation of its benefits among themselves. With this, the members of the cartel can reach greater benefits than those that they would obtain under competition, since resources would be allocated inefficiently, in

19. During the period that comprises this study, that is, from 2003 to 2010, this definition of absolute monopolistic practices was in force in article 90, section IV, of the Federal Economic Competition Law published in the Federal Official Gazette (DOF) On December 24, 1992, that has its last reform published in the DOF on April 9, 2012. Currently, this definition is in force in article 53, section IV, of the LFCE published in the DOF on May 23, 2014.

detriment of the consumers. The LFCE sanctions this type of practices to promote the most efficient functioning of the markets and increase consumers' welfare.

This work quantifies the benefits obtained by the sanction of a cartel that coordinated bids in tenders for the supply of medicines to the biggest medical services provider in Mexico. For this, it assesses the impact of the intervention of the CFC in the market of medical inputs acquired by the Mexican Institute of Social Security (IMSS per its acronym in Spanish) through public procurement.[20,21]

This type of assessments provides a better understanding about the consequences of the resolutions made by the authority regarding the structure and dynamic of the intervened markets, as well as the scope of the benefits obtained by consumers for the enforcement of the law to favor economic competition. The results contribute to the promotion of regulation public policies and to further study best practices and techniques to conduct ex post assessments of impact in specific markets.

This study estimates the impact in the welfare of consumers that was obtained as a result from the intervention of the CFC to diagnose the tendering processes of the IMSS and, afterwards, sanction a cartel of pharmaceutical companies. These companies conducted agreements to fix the prices of medical inputs acquired by the IMSS through public tenders, affecting to a greater extent Mexicans who used their public health services.[22]

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20. This is an ex post assessment. Ex post assessments estimate the impact that the elimination of an anticompetitive practice, or its prevention, had on the prices and quantities that are observed in a market and, consequently, on the welfare of consumers. This measurement is made on the equilibrium conditions of the market after the intervention of the competition authority; so, it is necessary to wait for the market to internalize the information entailed by the intervention, and the behavior of its participants to reflect the new conditions.

21. Since September 10, 2013, the competition authority of Mexico is an autonomous body called Federal Economic Competition Commission (COFECE). This body replaces the former CFC.

22. In 2006, year in which the changes to the bidding rules proposed by the CFC took place, the potential and registered beneficiary population of the IMSS consisted of approximately 46.6 million people. In 2013, this population reached 59.5 million. Potential beneficiaries are those family members of entitled beneficiaries who have not been registered to the IMSS, generally because they only register in the event of an accident.

The IMSS is one of the Mexican public institutions that allocates most resources to the acquisition of inputs to conduct its operation.[23] In 2010, it allocated more than 49 billion Mexican pesos to the acquisition of goods, services and infrastructure.[24] Most of these acquisitions correspond to medicines and medical supplies, which particularly represents a strong incentive for pharmaceutical companies to strive to increase their profit margin and even share those profits through the formation of illegal schemes, such as a cartel.[25]

In August 2006, the CFC initiated an ex officio investigation for the alleged existence of anticompetitive conducts in tenders to acquire human insulin, as well as serums and solutions conducted by the IMSS. The investigation concluded in January 2010 with the imposition of a sanction to six companies that colluded between 2003 and 2005 to supply these medicines.

To calculate the impact that the intervention of the CFC had over the contracting conditions of the IMSS, a difference-in-difference (DiD) estimator is used in the analysis of the prices of medicines purchased between 2003 and 2007. This estimator adjusts the difference that results from comparing the states before and after an intervention, with the difference between the before and after of a group with comparable characteristics except for the non-exposure to the intervention. This corrected comparison results in an objective measurement of the impact of the intervention.

In total, the price sample considers 143 medical keys of purchased products, of which 20 keys correspond to medicines provided by the sanctioned companies: 18 from the group of serums and solutions and two from the insulin group.[26] To identify the comparison group, the keys whose prices shared a similar behavior to that of investigated keys were excluded from the sample under the following criteria:

23. Petróleos Mexicanos, the Federal Electricity Commission and the IMSS are the three entities that allocate most resources to public procurement.

24. The IMSS allocated approximately 49.7 billion Mexican pesos for the acquisition of goods, services and infrastructure in 2010.

25. Of all the goods purchased, 44% are therapeutic goods, either medicines or medical supplies.

26. A product key is a specific medicine or supply in a particular presentation. That is, the same drug in a different presentation or dosage is classified as a different product key.

i. the entry of an aggressive competitor whose lower bids broke a previous (possibly collusive) behavior;
ii. a high average contraction observed in the level of prices after the entry of the competitor;
iii. a significative increase in average price volatility accompanying their respective reduction;
iv. the presence of any of the investigated companies among the competitors of the tender, and
v. the existence of repeated patterns in the price series that could indicate a rotation of the winners among the competitors.

Thus, the refined comparison group, which is used to contrast the price dynamic of the keys under investigation, includes 123 keys of medicines and supplies purchased by the IMSS.

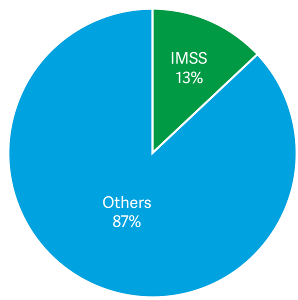
The results of the study suggest that the intervention of the CFC led to a decrease in the purchase prices of serum and other solutions through public tenders of more than 2.9% and of approximately 57.6% in the case of human insulin. Likewise, it was found that 11 purchasing units consistently paid higher prices compared to the most efficient unit during the period in which the practice took place. The highest overprice paid by contracting units reached a level of up to 17.8% in the case of serums and solutions, and of up to 76.3% in the case of insulin.

This document has the following structure: Section 2.2 describes the market of purchases through public tenders of the IMSS. Section 2.3 details the case of the cartel investigated by the CFC and whose members were sanctioned in 2006. Section 2.4 presents a description of the data analyzed, the identification strategy used in the empirical analysis and the results found. Section 2.5 identifies the impact over consumer welfare as a consequence of the intervention of the CFC. Finally, Section 2.6 presents the conclusions and final considerations.

2.2. IMSS acquisitions through public tenders

The IMSS is a public institution dedicated to the provision of health and social security services to its beneficiary population. In this regard, it is the largest provider of health services in Mexico and Latin America, providing service to almost 55 million people.[27] In 2011, the budget exercised by the IMSS represented approximately 13% of the total budget of the Federal Government (See Figure 2.1).

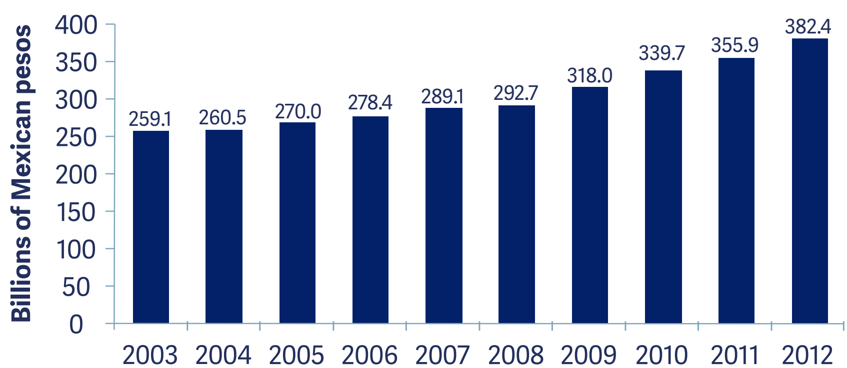
Figure 2.1. Relation of the Budget of the IMSS with the Federal Budget, 2011



Source: Budget of Expenditures of the Federation for the 2011 Fiscal Year: http://dof.gob.mx/nota_detalle.php?codigo=5169843&fecha=07/12/2010

Given the importance of the IMSS in the provision of public health services, its budget has shown a growing trend over the last years (See Figure 2.2).

Figure 2.2. Annual Budget of the IMSS, 2003-2012

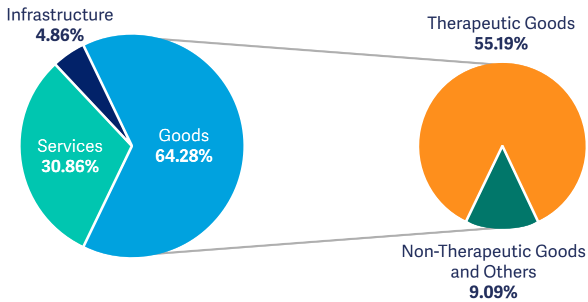


Note: Constant prices, 2010 base.
Source: First Government Report, 2012-2013. Statistical Annex. http://www.presidencia.gob.mx/informe/

27. More details on the statistical information of the IMSS can be found in: http://www.imss.gob.mx/conoce-al-imss/informes-estadisticas.

During 2011, on a typical day at the IMSS 47 thousand medical consultations, 4 thousand surgeries, one thousand and 270 childbirth services and 5 thousand hemodialysis sessions were performed, just to mention some of the most representative services. In order to meet the demand of its services, the IMSS spent more than 64.3 billion Mexican pesos that year. Of this amount, 64.28% was dedicated to the acquisition of goods, 30.86% to the contracting of services and 4.86% to the construction of medical infrastructure. Of the total expenditure on goods, 85.86% corresponded to therapeutic goods, 7.4% to non-therapeutic goods, and 6.7% to others. (See Figure2.3).

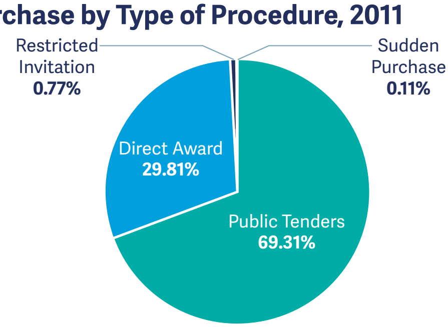
Figure 2.3. Purchases by Type of Acquisition, 2011



Source: IMSS procurement portal: http://compras.imss.gob.mx

Based on the procurement regulations of the Federal Government, the IMSS has three main procedures to conduct its acquisitions: public tender, direct award, and restricted invitation. The proportion of purchases made through public tenders represents around 69.31% of the total (See Figure 2-4).

Figure 2.4. Purchase by Type of Procedure, 2011



Source: IMSS procurement portal: http://compras.imss.gob.mx

For the acquisition of medicines through public tenders conducted between 2003 and 2005, the IMSS conducted first-price auctions with sealed bids. In the absence of collusion, in this type of auction each bidder makes an offer without knowing the bids from the others, and the bid with the lowest price wins the contract and supplies the medicines at the offered price. Under these conditions, each bidder faces a trade-off between the price it offers and its chances of winning the auction. That is, the bidder can offer a lower price with the purpose of increasing its probability of winning the contract, but it would cause a reduction of its rents; or bid a higher price to maximize its profits, although that strategy would reduce its probability of winning the tender. However, the odds of winning in the auction can be manipulated when the bidders coordinate their bids, as they can offer prices that increase their profits and, at the same time, secure the results of the contest. With these incentives, it is common for bidding companies to follow a strategy that allows them to agree on what price will win in each auction, to designate on a rotating basis the winner bidder for each tender and share their profits among competitors participating in these procedures.

In August 2006, after identifying indications of collusive behavior, the CFC initiated an investigation in the market of medicines purchased by the IMSS. In particular, the CFC identified two groups of medical compounds for which there were indications of sustained high prices due to a collusion in the tenders. The first group covered five types of solutions that are administered intravenously. The classification incorporates: i) injectable water, ii) 0.9% sodium chloride injectable solutions in five different sizes, iii) combined sodium chloride and glucose solutions, iv) six different presentations of 5% and 10% glucose solutions and, finally v) Hartmann's solutions in three presentations.

The second group of medical compounds that was investigated comprises keys related with human insulin in two presentations. Human insulin is a hormone involved in the utilization of nutrients to supply cells with the glucose needed in the metabolic processes of energy synthesis and utilization. All presentations of both groups are detailed in Tables 2.A1 and 2.A2 of the Appendix.

The CFC found the following conditions in the IMSS procurement scheme that favored collusion:

1. Homogeneous goods: The goods subject to the investigation are generic substances, which made it easier for competing companies to reach an agreement on their price as these produced prefect substitutes.
2. Entry barriers: Only domestic companies were allowed to participate in public tenders, unless the foreign participant was from a country with which Mexico had a free trade agreement or provided elements to purchasing unit to reliably assume a reduction of more than 15% of the reference price. Additionally, drug importers were required to have a production plant in Mexico. During the period in which the collusive agreement took place, there was a maximum of ten pharmaceutical companies in Mexico producing human insulin, as well as serums and other solutions.
3. High reference prices: The reference prices published by the IMSS were much higher than market prices, which allowed companies to raise their bid price and extract the IMSS reserve price.
4. Fragmented market: Due to a procurement decentralization policy, between 2003 and 2006, 52 different units of the IMSS in the country held tenders for the purchase of medicines. This purchase system facilitated collusion among suppliers, who organized to fix their bids and share the profits obtained.
5. Shared contracts: The rules allowed awarding a contract to two or three companies when their tender prices were similar.
6. Exchange of information: Companies could verify if any of the participants followed any strategy that deviated from the collusion agreement through two mechanisms: First, through the purchase of bidding information allowed by the Federal Law of Transparency and Access to Public Governmental Information. Second, the companies that participated in the tenders of the investigated keys were also members of the National Chamber of the Pharmaceutical Industry (CANIFARMA, per its acronym in Spanish), which held periodical meetings in which information regarding the behavior of the participants could be exchanged.

7. Repeated Games: Between 2003 and 2005 the IMSS conducted more than 130 public tenders in which the sanctioned agents participated (See Table 2.A.3 of the Appendix). This high frequency, combined with a small group of competitors, favored the rotation of bid winners, and allowed for timely punishment of participants that deviated from the agreement, since the announcement of the winner of each tender allowed the participants to identify those that unilaterally broke their alliance.

The CFC determined that the described conditions allowed the existence of an agreement between Cryopharma, Eli Lilly, Pisa and Probiomed to fix the prices of human insulin. In the case of serum and other solutions, the companies identified were Baxter, Fresenius and Pisa. The quantities sold to the IMSS through tenders, as well as the market share of each company, are presented in Tables 2.A4 and 2.A5 of the Appendix, respectively. Likewise, the annual average prices of the medical compounds investigated are presented in Table 2.A6 of the Appendix.

2.3. The case

The first precedent of a sanction imposed by the CFC on companies for agreeing prices in public tenders of the IMSS dates back to April 17, 2002, when fines were imposed to several companies for collusion in the provision of radiographic materials. As a consequence, on April 30, 2002, the Commission issued recommendations to improve the procurement processes of the IMSS and prevent future practices against competition.

In 2005, the IMSS made modifications to its bidding rules that became effective as of the first day of the following year, which marks the beginning of the treatment of the empirical evaluation of this study. Thus, in 2006, the IMSS initiated a centralized procurement process to obtain a better control of the tendering processes and to incorporate the recommendations of the CFC. These modifications led to the entry of new competitors as of January of that same year.

In order to follow up the implementation of the previous recommendations, on May 19, 2006, the CFC requested information from the IMSS to review the updated procurement scheme. After reviewing the information provided by the IMSS, on August 15, 2006, the CFC initiated an ex officio investigation for the alleged existence of a cartel in the procurement processes of 20 keys of medical products.

The analysis focused on public tenders made between 2003 and 2007 for the purchase of two groups of medical compounds: human insulin as well as serum and other solutions. The information gathered during the investigation included evidence that some companies coordinated their bids to increase the price of the products they supplied to the IMSS.[28]

The bids from the pharmaceuticals were identical in several cases. Also, the bidders took turns winning and losing in each auction and distributed their sales in similar percentages. The Commission also observed that the market shares and the prices remained stable until 2006, when the entry of new participants dissolved the collusion agreement.

In the case of human insulin, the entry in 2006 of DIMESA and SAVI caused a drastic reduction of prices. Subsequently, the beginning of the process for the consolidation of the purchases by the IMSS, from the second semester of 2006, reduced the number and frequency of purchases, making it more complex to maintain the collusive agreement.

Likewise, the CFC found that the companies maintained constant communication during the procurement processes, since telephone calls between employees of the pharmaceutical companies were discovered in the days prior to the acquisition processes, a situation that supports the coordination of their bids.

Based in the foregoing, on January 28, 2010, the Commission fined six pharmaceutical companies, as well as eight individuals acting on behalf of their employers. The sanctions reached a total of 151.7 million Mexican pesos. The sanctioned pharmaceuticals and individuals filed several appeals against this determination. However, after analyzing all of their complaints and arguments, on June 10, 2010, the Commission confirmed its original resolution (See Figure 2.5).

28. For a more detailed analysis of the case, in particular, of the identification of collusive conducts, see Estrada and Vazquez (2013).

Figure 2.5. Timetable of the Case, 2002-2010

2002	• April 17: The CFC fined several companies for bid rigging in IMSS public tenders released for the acquisition of radiographic material. • April 30: The Commission issued recommendations to the IMSS to improve competition conditions in its procurement processes through public tenders.
...	
2005	• The IMSS modified its biddings rules, which were applied as of the beginning of the following year.
2006	• The modifications to the rules led to the entry of new competitors to the market of human insulin and of serums and other solutions (initiation of the treatment). • The IMSS began a centralized procurement process. • August 15: The CFC began its ex officio investigation.
2007	• The IMSS continued with the centralized procurement process.
...	
2010	• January 28: The CFC sanctioned six pharmaceutical companies for the existence of a cartel. • June 10: The Commission confirmed its original resolution.

*Source:*CFC

Empirical Assessment

The reduction in prices observed after the entry of new competitors in a specific market is not sufficient to indicate that the second condition is the fundamental cause of the occurrence of the first condition. It is important to take into account that prices could have declined for a variety of reasons, even if no competitor would have entered the market. In this sense, the impact assessment requires tools that allow to identify the extent to which the intervention of the CFC contributed to the access of new participants and to the change of the observed prices.

The impact (δ) of an intervention (I) on prices (P) can be expressed as the difference between the observed level of prices with the intervention (i.e. when $I=1$) and the level of prices without the intervention (i.e. when $I=0$). In other words, an observation in the same point in time must be compared, but in a different state of nature, thus:

$$\delta = (P \mid I=1) - (P \mid I=0) \qquad (1)$$

The equation *(1)* the parameter δ captures the difference between two price levels in a market, which would be exactly the same in the absence of the intervention of the Commission.

However, it is not possible to measure the price level in two different states of the nature at the same time. In a given moment, the decisions over prices could have, or not, been affected by the intervention. However, although prices cannot be observed simultaneously in these two different states, one of them can be estimated as "what would have been observed in the absence of the intervention". In conducting an impact assessment, the first term of the equation *(1)*, called the outcome under the treatment, can be observed. However, the second term of the equation cannot be directly observed, so the estimation of a counterfactual that supports the objective estimation of the parameter δ is required (Morgan and Winship, 2007).

In order to find a counterfactual, it is necessary to identify a group of observations in the market affected by the intervention (the treatment group) and another that is not affected by the intervention and that is comparable to the treatment group in the absence of the intervention (the comparison group). This means that the observations of the comparison and treatment groups, on average, have similar characteristics and, thus, the same reaction when affected by an intervention (or treatment) can be expected from both of them. For both groups to be comparable after the application of the treatment to one of them, it is important that neither of them is exposed to other interventions during the time of the assessment (Khandker, Koolwal and Samad, 2010).

2.3.1. The difference-in-difference estimator

The DiD estimator calculates the difference among the results obtained in a sample that is affected by a treatment (for example, the intervention of the CFC) and the results observed in a sample that is not affected by this intervention (the comparison group). This methodology has been used to assess, for example, the impact of a merger between bookstores over the prices of the books they offered to their customers and the effect of a merger in the market for the commercialization of videogames in the United Kingdon (Aguzzoni, et al. 2013), among other cases.

The DiD estimator corrects for the bias that exists in two methods of estimating differences: i) the "before and after" contrast, which compares the results obtained over time, and ii) the "with and without" comparison between two units of a population, which compares observations that have been subjected to an intervention with others that have not been influenced by the treatment.

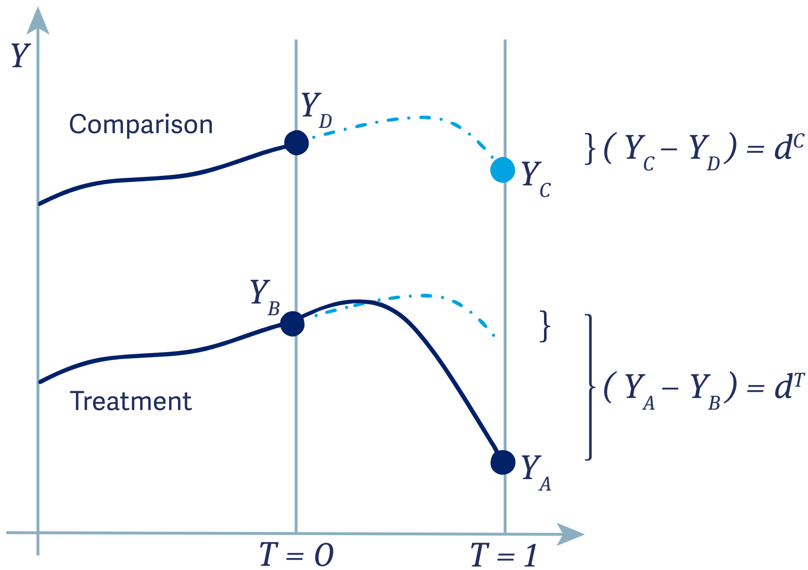
A before and after comparison aims to distinguish the impact of an intervention by comparing the final condition of an observation against its pre-treatment state (Card and Krueger, 1994). For this estimate to be valid, it is necessary to assume that in the absence of the treatment the initial state of the observation would not have changed. However, several factors can alter the initial conditions of the analyzed subjects throughout the time, and even inertial dynamics rarely leave the initial state of an observation unchanged (Cook and Tauchen, 1982).

On the other hand, when comparing a state subject to an intervention against one that it is not affected by the intervention ("with and without" estimation), there is not enough information to determine whether the difference between the results comes from the treatment or from other systematic variables or differences that could exist between the groups (Holland, 1986 and Moffit, 1991).

The DiD estimator combines the "before and after" and "with and without" methods to control for non-treatment factors that may affect the observations and thus produce an unbiased estimate (Angrist and Pischke, 2009). On the one hand, it controls for elements that may affect both the treatment and comparison group over time, since the effect is on average the same for both groups, and, on the other hand, it identifies differences between these groups to estimate the impact of the treatment.

Figure 2.6 illustrates the DiD method. In the first place, the difference between the initial and final state of the observations that received the treatment is observed, given by $(Y_A - Y_B) = dT$. Next, the changes undergone by the observations in the comparison group are identified, which are exactly the same that the treatment group would have suffered in the absence of the intervention, which are given by $(Y_C - Y_D) = d^C$. Finally, the impact of the intervention is obtained by subtracting the changes caused by exogenous factors from the effect observed in the treatment group over time, and it's given by $d^T - d^C = \delta$.

Figure 2.6. The DiD Estimator



Source: CFC

Even though a DiD estimator allows to consider the differences between the treatment and comparison groups that are constant over time, it does not control for differences that vary over time. That is, the DiD estimator attributes any post-treatment differences in the behavior of the two groups to the intervention. If any other factor that influences these in a different way is present, then the DiD estimator would be biased. Thus, it is necessary to verify the validity of the comparison group.

To find the effect of the intervention of the CFC on the prices of the medicines investigated using of DiD estimators, the following econometric specification is used:

$$P^i_t = \alpha^i + \beta \bullet W^i + \gamma \bullet V_t + \delta \bullet W^i \bullet V_t + \theta \bullet X^i_t + e_t \qquad (2)$$

con i = 1, ..., 52 y t=1,2

Where:

- P^i indicates the purchase price of a medicine at the medical unit of acquisitions i on period t. In turn,
- W_i is a dichotomous variable that identifies with a value of one the acquisitions of the IMSS which were subject to the intervention of the CFC and the rest with a value of zero.
- V_t is a dichotomous variable that assigns a value of one to the purchases in the period after the intervention of the CFC and zero to rest of them.
- X^i is a control variable that contains the size of each acquisition in the unit i during period t in terms of the quantity of medicines purchased, and
- e_t represents a stochastic disturbance.

The direction and the magnitude of the parameters to be estimated α^i, $\beta, \gamma, \delta, \theta$ depend on the specific effect of each variable on P^i. All variables contain information both from the treatment and comparison group.

The parameter of interest (δ) estimates the effect of the interaction between the dichotomous variables "with and without" (W^i) and " before and after"(V_t) over the purchase prices of medicines. This parameter corresponds to the difference between the expected values of the purchase price in the treatment and comparison groups. That is, δ is the estimator of the impact of the intervention of the CFC over the prices used in the acquisition of medicines (See Table 2.1).

Table 2.1. Expected values for equation 2 by group

4 digit NAICS	Treatment Group	Comparison Group
After the intervention (a)	$E[P] = \alpha + \beta + \gamma + \delta + \theta$	$E[P] = \alpha + \gamma + \theta$
Before the intervention (b)	$E[P] = \alpha + \beta + \theta$	$E[P] = \alpha + \theta$
Difference between (a) and (b)	$E[P] = \gamma + \delta$	$E[P] = \gamma$
Difference in Difference (DiD)	$E[P] = \delta$	

In the impact assessment of the intervention of the CFC, the treatment on the behavior of the agents is considered to correspond to the beginning of the reforms to the procurement scheme, in January 2006.

The data used for the empirical analysis are described below. Subsequently, the results of the DiD estimation are presented for the two groups of investigated medical compounds and for each purchasing unit of the IMSS.

2.3.2. Data

To estimate equation *(2)*, a dataset containing information regarding 11,931 acquisitions made by the IMSS through 52 medical units that issued public tenders distributed in the national territory between 2003 and 2007 is used. For each acquisition observed, the purchase price, the unit and the period in which the transaction was conducted, the quantity of medicines requested and the medical key to which these belong are known. In total, the information covers 143 medical keys that include generic medicines, serums, solutions, and general use medicines. Consumable medical supplies, such as disposable instruments are not included (See Table 2.2).

Table 2.2. Classification of the analyzed keys

Medical Group	Number of keys
Group 1: "Dermatological"	7 keys
Group 2: "Anti-flu and analgesics"	8 keys
Group 3: "Antibiotics"	19 keys
Group 4: "Contraceptive and hormonals"	3 keys
Group 5: "Cardiovascular"	10 keys
Group 6: "Expectorants and decongestants"	4 keys
Group 7: "Gastrointestinal"	6 keys
Group 8: "Nutritional"	1 key
Group 9: "Other medicines"	85 keys
Total	**143 keys**

Source: IMSS.

Information on quantities supplied per key and contracted prices are known for each observation. In the event that there was more than one winner in a tender, the proportions awarded to each winner are also known, as well as their respective prices.

Observed prices were converted to constant prices of 2005 based on the component corresponding to medicines in the Index of Consumer Prices made by the National Institute of Statistics and Geography (INEGI per its acronym in Spanish). In addition, to make estimates in this study, an index built with information with real prices that uses 2005 as based year was used.

As of 2006, new competitors presented in tenders for the acquisition of human insulin and for serums and solutions, which allowed, compared to the previous year, to reduce their prices drastically and increase the variance of bids submitted by the participants in the auctions. The medical components analyzed by the CFC belong to Group 9, whose average price was the one that showed the greatest reduction (22 units in an index of real prices) between the 2003-2005 and 2006-2007 periods (See Table 2.3).

Table 2.3. Descriptive Statistic of the Observed Prices (Real Index, 2005 Base)

	Average		Standard Deviation		Min / Max	
	2003-2005	2006-2007	2003-2005	2006-2007	2003-2005	2006-2007
Group 1	105.7	94.6	14.5	11.4	65.9 / 152.9	46.7 / 136.7
Group 2	105.8	90.9	26.6	138.7	59.1 / 448.0	36.7 / 1,986.6
Group 3	105.4	84.8	16.0	12.5	59.4 / 298.7	31.6 / 176.3
Group 4	105.3	86.2	12.1	11.6	83.5 / 158.7	56.0 / 97.5
Group 5	107.0	92.9	20.8	12.8	52.6 / 208.9	57.3 / 177.4
Group 6	104.6	89.3	10.3	11.4	76.4 / 181.2	47.0 / 101.9
Group 7	105.4	89.7	16.5	19.5	61.5 / 187.7	32.0 / 180.1
Group 8	104.1	93.0	6.4	3.9	80.5 / 113.4	85.4 / 96.7
Group 9	106.2	84.2	24.9	19.6	11.2 / 491.2	17.1 / 353.0

Source: IMSS

Harrington (2004), Abrantez-Metz (2006) and Bolotova (2008) argue that markets that move from a cartel structure to a competitive market typically experience entry of competitors, a decrease in price and increases in the variability of the prices from the period of competition with respect to the period of collusion.

The empirical evaluation model of this study assumes, by construction, that the observed tenders in the comparison group did not change from a situation of cartel presence to one of open competition. Therefore, this group only comprises keys for which the following conditions are met: i) prices did not show a reduction higher than the minimum observed in the treatment group between the 2003-2005 and 2006-2007 periods; ii) the variance of their prices did not suffer an increase higher that the minimum observed in the treatment group between the same periods;

iii) there was no entry of new competitors in the bids for their acquisition during the second study period; iv) no repeated patterns of price bids were presented and v) they did not involve the participation of any of the agents investigated by the CFC.

In particular, the third condition isolates those tenders that could have been affected by the intervention of the CFC. That is, the consequences of the intervention could have generated greater competition not only for the purchase of insulin, serums and other solutions, but also for the acquisition of other medicines. Consequently, in order to eliminate a possible contamination of the impact estimator related with this effect, the comparison group only included observations that do not present an increase in the number of competitors.

Additionally, the last two conditions verify the absence of the indications of collusion identified in the tenders of the treatment group within the comparison group. This suggests that in these acquisitions there was no cartel to agree the prices offered and distribute its profits across time. Thus, the comparison group is formed by 123 keys that obey the five criteria previously described.

Of the 143 keys analyzed in total, two are associated with human insulin (each key corresponds to a presentation of different volume) and 18 refer to serum and other solutions (dextrose, saline solution, mixture of both and Hartmann solutions) in different presentations. Since 2006, the tenders that included these 20 keys (the group that received the treatment) incorporated new competitors with aggressive bids, which resulted in a reduction of the award prices of 14.7%, in average, between the 2003-2005 and 2006-2007 periods. On the other hand, in the tenders of the remaining 123 keys (comparison group), an average reduction of the prices of 7.1% was registered in the same periods.

During the first period analyzed, the treatment and comparison groups had a downward trajectory in their prices. For serum and other solutions, the contractions in their real average price in 2003-2004 and 2004-2005 were of 15.7 and 4.3%, respectively, while for human insulin were of 3.3 and 14.6%. In the case of the comparison group, the reductions of the real average price during these periods were of 3.2 and 4.1%.

The average price of serum and other solutions fell sharply in 2006, the year in which the intervention of the CFC took place. Likewise, the number of medical units that issued tenders to acquire these solutions substantially increased until 2005, and afterwards a reduction which accented in 2006 began (See Table 2.4).

Table 2.4. Real Prices of Serum and Solutions, 2003-2007

Year	Average Price	Min. Price	Max. Price.	Medical Units
2003	18.02	16.78	21.26	22
2004	15.16	8.45	18.15	30
2005	14.54	12.55	20.63	45
2006	9.32	7.71	11.56	42
2007	7.71	6.59	10.69	10

Note: Constant prices of 2010.
Source: IMSS

In human insulin purchases, a more drastic reduction in prices is observed. The average price fell 83.6% from 2003 and 2007, while the number of medical units that issued tenders for its acquisition went from 23 in 2003 to 44 in 2005 and, subsequently, fell to 10 units in 2007 (See Table 2.5).

Table 2.5. Real Prices of Human Insulin, 2003-2007

Year	Average Price	Min. Price	Max. Price	Medical Units
2003	212.43	165.32	216.16	23
2004	205.47	204.85	218.40	27
2005	175.39	129.64	179.49	44
2006	66.87	43.88	78.43	32
2007	33.81	30.70	49.22	10

Note: Constant prices of 2010.
Source:IMSS

Results of the estimations

In equation *(2)*, α^i represents the average price of medical compounds purchased by unit i, which is positive for any value of i. β represents the effect of the intervention of the CFC on the price of the medical compounds without controlling for other factors of change, while γ captures the change on average in prices between 2003-2005 and 2006-2007, which can be attributed to various causes exogenous to the model. Finally, δ (the DiD parameter) represents the impact of the intervention of the CFC on prices of the sanctioned markets compared to those in markets that were not intervened. Thus, the DiD estimator captures the average change in the price index of the treatment group that is due solely to the intervention, since it controls for other factors that could have altered this index when taking into account the information contained in the comparison group. δ is expected to be negative, which would suggest the existence of gains in consumer welfare.

Due to the characteristics of the data, the estimation is performed using panel data techniques. The specification proposed in equation *(2)* allows for the existence of heterogeneity among units, but restricts it to the constant of the relation of the variable. In particular, the model considers Fixed Effects (FE) that allow to estimate different intercepts for each medical unit, which are captured in the α^i vector, but the estimators associated with the independent variables are restricted to be equal among all units.[29] The inclusion of fixed effects per medical unit allows to control the estimation for the different particular characteristics of each unit that could have had some incidence over the acquisition prices of medicines. For example, a unit may be located in a geographical region associated to high transportation costs due to the low availability of access roads in comparison to another unit, which would pressure the price offer up in the former unit.

Additionally, the intra-group correlation is allowed in the estimation of standard deviations of the parameters. That is, it is assumed that the observations are independent between the groups of observations, but not necessarily within same (for several example, see Wooldridge 2002). The groups of observations are defined by their correspondence with each medical unit that released a tender.

Serums and solutions

Table 2.6 shows the results of the estimation of equation *(2)* for the case of serum and other solutions in the treatment group. Column I presents the results of the estimation without including fixed effects, while in column II these are part of the model. The fixed effects corresponding to the estimation of column II for the 45 medical units of the sample are reported in Table 2.A8 of the Appendix.

29. This estimation is known as Least Squares with Dummy Variables (LSDV). One way to understand fixed effects estimation is to note that removing the group-level averages of the dependent variable from each side of the equation eliminated these effects. This type of estimation has been used for diverse impact assessments (See Aguzzoni, et al. 2011 and 2013).

Table 2.6. Results of the Estimation for Serum and Solutions

Dependent Variable: *Real Prices Index*		
Variable	**(I)**	**(II)**
DiD Interaction (δ)	**-2.928** ***	**-3.028** **
	(0.860)	(1.358)
Intervention of the CFC (β)	**-1.361** ***	**-1.356** ***
	(0.458)	(0.812)
Post-intervention Period (γ)	**-14.551** ***	**-14.406** ***
	(0.495)	(1.348)
Quantity (θ)	**3.88e-07**	**2.54e-07**
	(1.52e-06)	(1.2e-06)
Average of Fixed Prices ($\bar{\alpha}^i$)		**105.082** ***
		(0.524)
Constant	**103.962** ***	
	(1.065)	
Fixed Effects by Unit	**NO**	**SI**
Observtions	**10,834**	**10,834**
R^2	**0.4213**	**0.4207**

Notes:
1. The standard deviations of the estimators are shown under these in parentheses.
2. *, ** and *** demonstrate statistical significance levels under 90, 95 and 99% respectively

The results show that the estimator of interest is almost identical in both estimations, but the statistical significance of some fixed effects suggest that there is some heterogeneity among average purchase prices of medical units. The estimated parameter δ of column II indicates that, controlling for the exogenous changes in the market, captured in the comparison group, the intervention of the CFC caused a reduction in the average purchase price of serum and other solutions of approximately 2.9%. This effect over prices is statistically significative to 95%.[30]

The estimator associated with the quantity of medicines purchased (θ) is close to zero and not significant. The above indicates that the volume of medical compounds purchased in each tender did not have an effect over the purchase price, suggesting the presence of a flawed strategy in the procurement processes, which did not allow the aligning of incentives for competition.

30. The percentage effect of the intervention on the real price index is obtained by diving the estimator δ by the average price of the medical compound.

Human insulin

Table 2.7 shows the results of the estimation of equation *(2)* for the case of human insulin also using a 2005 base price index. In the same way as was conducted for serum and other solutions, column I presents the estimation results without fixed effects, while column II includes them. The fixed effects corresponding to the estimation of column II for the 44 medical units of the sample are reported in Table 2.A9 of the Appendix.

Table 2.7. Results of the Estimation for Human Insulin

Dependent Variable: *Real Prices Index*		
Variable	**(I)**	**(II)**
DiD Interaction (δ)	**-60.778** ***	**-60.745** ***
	(2.220)	(2.254)
Intervention of the CFC (β)	**0.7422**	**0.8951**
	(1.221)	(0.989)
Post-intervention period (γ)	**-15.328** ***	**-15.142** ***
	(0.572)	(1.428)
Quantity (θ)	**2.66e-07**	**9.11e-08**
	(1.78e-06)	(1.30e-06)
Average of Fixed Effects ($\bar{\alpha}^i$)		**105.353** ***
		(0.479)
Constant	**104.937** ***	
	(0.955)	
Fixed effects by Medical Unit	**NO**	**SI**
Observations	**8,426**	**8,426**
R^2	**0.663**	**0.663**

Notes: 1 The standard deviations of the estimators are shown under these in parentheses.
2 *, ** and *** demonstrate statistical significance levels under 90, 95 and 99% respectively.

Also in these results, the estimator of interest is almost identical in both estimations and the statistical significance of some fixed effects reflects the existence of heterogeneity among average purchase prices of the medical units. On the other hand, the DiD parameter in column II shows that, controlling for the information contained in the comparison group, the intervention of the CFC caused a statistically significative reduction in the average purchase price of human insulin of approximately 57.6%, an effect vastly greater than that found in the case of serum and other solutions.

The estimators associated with the quantity of medicines purchased do not have a significant effect either, which also suggests an absence of incentives to maintain competition in the tenders of this medicines.

Heterogeneous Effects by Medical Units

In addition to the results found on the effects on the price level of serum and other solutions, as well as human insulin, the impact of the intervention of the CFC can be classified by its magnitude on the average purchase prices that each of the medical units that released tenders had. The DiD estimator in Table 2.6 indicates that in the case of serum and other solutions, the intervention of the CFC caused a reduction of approximately 2.9% of its purchase price on average for all units. Table 2.A10 of the Appendix shows the classification of the impact of this intervention by its magnitude for each unit. In 27 units of the sample, the treatment had a statistically significative impact. In a dozen of them, the impact on price was in the positive range of less than 2.5% while in other twelve, price reductions of between 1.1 and 18.8% were estimated.

In the case of human insulin, the estimated parameter δ of Table 2.7 indicates that the treatment caused a reduction in the average price of approximately 57.6% across all medical units. Table 2.A11, which classifies this effect by its magnitude in each unit, shows that in 25 of them the intervention caused a statistically significative reduction of the average purchase price of between 44 and 76%. In 16 of these units, reductions were over 55%.

2.4. Impact on consumer welfare

Table 2.8 shows that between 2003 and 2005 the IMSS acquired 31 million 479 thousand units of serums and solutions on average in the year, while the average price per unit during the same period was of 15.9 Mexican pesos. The foregoing results in a total average expense per year of approximately 500.9 million Mexican pesos in this medicine.

Table 2.8. Procurement of Serums and Solutions, 2003-2005

Year	Quantity (Thousands of units)	Average Price (Mexican Pesos)
2003	33,514.20	18.02
2004	36,465.30	15.13
2005	24,458.40	14.20
Average 2003-2005	**31,479.30**	**15.91**

Notes: Constant prices of 2010.
Source: IMSS

Based on the estimations of the previous chapter, in the absence of collusion, the IMSS would have paid approximately 2.9% lower prices, on average, for the purchase of serum and other solutions. This would have translated into an average price of around 15.45 Mexican pesos per unit, so that the total expenditure in this medicine would have been of almost 486 million Mexican pesos on average per year, assuming that the same quantity of these medical compounds would have been purchased. Therefore, the estimate of the damage caused by the existence of the cartel in the market of serum and other solutions between 2003 and 2005 is of approximately 43.5 million Mexican pesos.

Table 2.9 shows that during the period prior to the intervention (2003-2005), the IMSS purchased an average of 1,695.8 thousand units of human insulin per year, and the average price of these was of 197.7 Mexican pesos. Thus, the IMSS spent yearly, in average, 335.6 million Mexican pesos in the purchase of human insulin.

Table 2.9. Procurement of Human Insulin, 2003-2005

Year	Quantity (Thousands of units)	Average Price (Mexican Pesos)
2003	2,303.90	212.43
2004	1,320.60	205.47
2005	1,462.80	175.39
Average 2003-2005	**1,695.77**	**197.76**

Notes: Constant prices of 2010
Source: IMSS

The estimates in the previous chapter indicate that for human insulin, in the absence of collusion, the IMSS would have paid a price approximately 57.6% lower than the one it actually paid, thus the price that would have prevailed in this case would have been of around 83.9 Mexican pesos per unit. Therefore, the expenditure on human insulin would have been, on average, close to 141.7 million Mexican pesos per year, assuming also that the same quantity of medicines that was acquired during those years would have been purchased. With this, the damage caused to the IMSS due to the presence of a cartel in the market of insulin represents approximately 579.2 million Mexican pesos during the 2003-2005 period. The sum of the damages in the markets intervened by the CFC ascends to an amount of 622.7 million Mexican pesos.

It is important to bear in mind that this estimate of the damage in the markets is conservative and it could be considered within an lower range, since i) the impacts are not identified year by year, but only on an average of the period prior to the intervention of the CFC, ii) the calculation previously presented does not takes into account any opportunity cost associated with the expenditure of resources allocated to overpricing in the procurement of medical compounds, a condition that could significantly increase the magnitude of the damage to the consumer and iii) it does not take into account the possible modification of strategies of some companies to abandon collusive agreements in markets different to those intervened by the CFC, to avoid a possible sanction.

However, even the most conservative estimate is important for the public provision of the services of the IMSS. Between 2003 and 2005 the average annual expenditure in goods of this institution was of 23.3 billion Mexican pesos, an amount clearly higher than the estimated damage in these markets. Nevertheless, a better allocation of resources in the procurement processes would help the IMSS to recognize other sources of savings within its administrative branch. Likewise, a saving of 622.7 million Mexican pesos for avoiding the payment of overprices in the purchase of medicines, would have allowed the IMSS to acquire 47 tomography units, 727 ambulances or 2168 incubators. Also, it would have allowed to build 5 clinics with 10 medical offices each.

2.5. Conclusions

For this study a difference-in-differences estimation was used which is a standard methodology for assessing changes in the outcomes observed between two periods, controlling for the characteristics present in a comparison group. This approach, unlike Least Ordinary Squares, allows to take into account a trend that captures the changes that took place independently to the intervention of the authority.

The estimates of this study show that price reductions are not only due to the intervention of the CFC, but also due to factors such as market price fluctuations and the changes in the regulatory framework of the public tenders of the IMSS; mainly, the liberation of the permits for the import of acquired pharmaceutical products.

The estimated damage identified rises to at least 622.7 million Mexican pesos. This figure represents an amount of resources that could have been used for the acquisition (under competitive circumstances) of approximately 292% more human insulin purchased annually or 128% of serum and other solutions necessary for a regular year. With this quantity of savings, the IMSS could have purchased 47 tomography units, 727 ambulances or 2168 incubators or have built 5 clinics with 10 medical offices each.

The study has some limitations, which mainly refer to: i) the identification strategy of the impact, ii) the definition of the treatment periods and threshold, and iii) the inclusion of the different control variables in the specification of the model.

For the specification of most models that require a counterfactual, their validity is subject to controversial criteria. In this particular case, the treatment and comparison groups were selected based on the existence of a previous work of the CFC which identified the members of the cartel, as well as the supplied products that were not suspicious of having a collusion agreement. A review of a broader set of medical products and suppliers could influence in the results shown in this study.

Another fundamental characteristic of the analysis is related to the definition of the time threshold at which it is considered that the CFC has conducted its intervention. Considering different definitions over the initiation and the end of the treatment significatively affect the results.

Three control variables were used for the specification of the empirical model: i) the quantity of medical supplies purchased by each unit, ii) price indexes of medicines and medical supplies acquired through similar tendering processes (contained in the comparison group) and iii) the fixed effects for each purchasing unit. The lack of significance of the first variable, which contains information about the quantity of products purchased in each tender, calls into question the effectiveness of the auctions conducted and the impact of this mechanism on the acquisition price of medical supplies, since, under competition conditions, the purchase of large quantities of medicines should have allowed competing agents to offer lower prices in the contests in which they participated.

It is also important to note that the estimated results are conservative. The specification of the empirical model allows the calculation of the effects over the average price by period, not by year. The estimation of the damage does not take into consideration year-to-year price dynamics to update with inflation and the discount rate of projects of the IMSS. In that sense, the results shown in the previous section are a lower bound of the damage avoided in the subsequent three years for the intervention of the CFC in the market. Additionally, an identification strategy built through segmented sections to identify effects per year could be considered.

Finally, this work contributes to recent economic literature regarding public procurement in Mexico. The competition authority of Mexico, along with the OECD and organizations working to improve the efficiency of public spending and promote competition, has dedicated an important part of its work to the analysis and dissemination of better practices in public procurement.

Through this work the Commission seeks to contribute to two fundamental questions: i) highlight the importance of competition to reduce the cost overruns faced by public organizations, that are ultimately covered by taxpayers and which diminish their institutional capacities to achieve government goals regarding high importance topics, such as public health, and ii) support the construction of a better regulatory framework for public procurement.

2.6. Bibliography

Abrantes-Metz, R. M., Froeb, L. F., Geweke, J., & Taylor, C. T. (2006). A variance screen for collusion. International Journal of Industrial Organization, 24(3), 467-486.

Aguzzoni, L., Argentesi, E., Buccirossi, P., Ciari, L., Duso, T., & Tognoni, M. (2011). The Ex-post Evaluation of Two Merger Decisions. Reporte para la UK Competition Commission.

Aguzzoni, L., Argentesi, E., Ciari, L., Duso, T., & Tognoni, M. (2012). Ex Post Merger Evaluation in the UK Retail Market for Books. The Journal of Industrial Economics, 170-200.

Aguzzoni, L., Argentesi, E., Ciari, L., Duso, T., Tognoni, M., & Vitale, C. (2013). They Played the Merger Game: A Retrospective Analysis in the UK Videogames Market. Deutsches Institut für Wirtschaftsforschung.

Angrist, J. D., & Pischke, J.-S. (2009). Mostly Harmless Econometrics: An Empiricist's Companion. Princeton University Press.

Ashenfelter, O. C., & Hosken, D. (2010). The Effect of Mergers on Consumer Prices: Evidence from Five Mergers on the Enforcement Margin. Journal of Law and Economics, 417-466. doi:10.3386/w13859

Bolotova, Y., Connor, J. M., & Miller, D. J. (2008). The impact of collusion on price behavior: Empirical results from two recent cases. International Journal of Industrial Organization, 26(6), 1290-1307.

Cameron, A., & Trivedi, P. K. (2005). Microeconomics: methods and applications. Cambridge University Press.

Card, D., & Krueger, A. B. (1993). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. American Economic Review, 84(4), 772-793.

Cook, P. J., & Tauchen, G. (1982). The Effect of Liquior Taxes on Heavy Drinking. Bell Journal of Economics, 13, 379-390.

Davis, P., & Garcés, E. (2009). Quantitative Techniques for Competition and Antitrust Analysis (1st ed.). Princeton University Press.

Duflo, E. (2001). Schooling and Labor Markets Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment. American Economic Review, 91(4), 795-813.

Estrada, E., & Vazquez, S. (2013). Bid rigging in public procurement of generic drugs in Mexico. Competition Policy International Journal, 9(1), 100-122.

Harrington, J. E. (2004). Cartel pricing dynamics in the presence of an antitrust authority. The Rand Journal of Economics, 651-673.

Harrington, J. E. (2004). Post-Cartel Pricing during Litigation. The Journal of Industrial Economics, 52(4), 517-533.

Harrington, J. E. (2015). Thoughts on why certain markets are more susceptible to collusion and some policy suggestions for dealing with them. OECD.

Hayashi, F. (2000). Econometrics. New Jersey, Princeton: Princeton University Press.

Holland, P. W. (1986). Statistics and causal inference. Journal of American Statistical Association, 81, 945-960.

IMSS (2011). Informe de Labores 2010-2011 y programa de actividades. Mexico, D. F. Retrieved from https://www.imss.gob.mx/sites/all/statics/pdf/ informes/2011/2011_InformeLabores2010-2011.pdf

IMSS. (n.d.). Estadísticas sobre adquisiciones. Retrieved from: http://compras.imss. gob.mx/

IMSS. (n.d.). Memoria estadística 2011. Retrieved from: http://www.imss.gob.mx/ conoce-al-imss/memoria-estadistica-2011

Khandker, S. R., Koolwal, G. B., & Samad, H. A. (2010). Handbook on impact evaluation. The World Bank.

Lechner, M. (2011). The estimation of causal effects by difference-in-difference methods. University of St. Gallen.

Levenstein, M. C., & Suslow, V. Y. (2006). What determines cartel success? Journal of Economic Literature, 44(1), 43-95.

Miller, N. H. (2009). Strategic leniency and cartel enforcement. The American Economic Review, 99(3), 750-768.

Moffitt, R. (1991). Program Evaluation with Nonexperimental Data. Evaluation Review, 15(3), 291-314.

Morgan, S., & Winship, C. (2007). Counterfactuals and Causal Inference (1st ed.). Cambridge University Press.

Simon, J. L. (1966). The Price Elasticity of Liquor in the U.S. and a Simple Method of Determination. Econometrica, 34, 193-205.

Verboven, F., & Van Dijk, T. (2009). Cartel damages claims and the passing-on defense. The Journal of Industrial Economics, 57(3), 457-491.

Wooldridge, J. M. (2002). Econometric analysis of cross section and panel data. The MIT Press.

APPENDIX

Table 2.A1. Group I: Serums and solutions

Key	Name
3675	Injectable water
Sodium chloride	
3608	Injectable solution 0.9%, 250 ml
3609	Injectable solution 0.9%, 500 ml
3610	Injectable solution 0.9%, 1000 ml
3626	Injectable solution 0.9%, 50 ml
2627	Injectable solution 0.9%, 100 ml
Sodium chloride and glucose	
3611	Injectable Solution, 250 ml
3612	Injectable Solution, 500 ml
3613	Injectable Solution, 1000 ml
Glucose	
3601	Injectable Solution 5%, 250 ml
3603	Injectable Solution 5%, 1000 ml
3604	Injectable Solution 10%, 500 ml
3605	Injectable Solution 10%, 1000 ml
3624	Injectable Solution 5%, 50 ml
3525	Injectable Solution 5%, 100 ml
Hartmann Solution	
3614	Injectable Solution, 250 ml
3615	Injectable Solution, 500 ml
3616	Injectable Solution, 1000 ml

Source: CFC.

Table 2.A2. Group II: Human Insulin

Key	Name
1050	Intermediate-reacting insulin
1051	Regular and fast-acting insulin

Source: CFC.

Table 2.A3. Total of tenders conducted by investigated key, 2003-2007

Key	2003-2005	2006-2007	Total
1050	134	47	181
1051	128	39	167
3601	127	28	155
3603	125	29	154
3604	125	26	151
3605	112	22	134
3608	128	33	161
3609	121	34	155
3610	126	35	161
3611	49	10	59
3612	114	38	152
3613	129	37	166
3614	109	26	135
3615	122	36	158
3616	126	38	164
3624	106	26	132
3625	42	14	56
3626	118	34	152
3627	56	17	73
3675	124	32	156

Source: CFC, with data from the IMSS.

Table 2.A4. Quantities Sold and Market Shares Group II (Human Insulin), 2003-2006

Company	Quantity Sold (Millions of Pesos)	Market Share (%)
Eli Lilly	263.516	28.54%
Cryopharma	256.058	27.74%
Pisa	182.721	19.72%
Probiomed	164.076	17.81%
Savi	31.075	3.35%
DIMESA	12.43	1.31%
Equimed	6.215	0.67%
Others	7.458	0.87%
Total	**923.549**	**100.00%**

Source: IMSS.

Table 2.A5. Quantities Sold and Market Shares Group I (Serum and solutions), 2003-2006

Company	Quantity Sold (Millions of Pesos)	Market Share (%)
Baxter	538.219	31.91%
Fresenius	518.331	30.73%
Pisa	503.415	29.86%
DIMESA	67.122	3.96%
CF Medical	43.505	2.57%
Hi-Tec	6.215	0.34%
Abbott	4.972	0.30%
Artimedica	2.486	0.11%
Antibióticos	2.486	0.11%
Jayor	1.243	0.06%
Salveo	1.243	0.06%
Total	**1689.237**	**100.00%**

Source: IMSS.

Table 2.A6. Average Annual Prices per Investigated Medical Compound (Mexican Pesos)

Key	2003	2004	2005	2006	2007
1050	155.14	155.67	152.57	55.07	32.55
1051	155.36	156.12	152.83	54.60	31.16
3601	9.28	9.45	9.39	8.66	7.06
3603	14.49	14.79	14.75	13.54	11.28
3604	12.40	12.57	12.67	11.65	8.24
3605	14.55	14.83	14.86	13.55	11.05
3608	9.26	9.45	9.38	8.73	5.82
3609	12.37	12.60	12.60	11.68	9.38
3610	14.41	14.69	14.72	13.53	8.46
3611	11.23	12.40	12.14	10.32	
3612	12.37	12.70	12.62	11.82	9.80
3613	14.50	14.79	14.78	13.60	11.20
3614	9.29	9.48	9.39	8.81	7.22
3615	12.40	12.64	12.63	11.74	6.28
3616	14.51	14.86	14.77	13.67	10.93
3624	6.23	6.48	6.66	6.11	5.15
3625	7.43	8.15	8.50	7.53	5.08
3626	6.21	6.59	6.66	6.04	4.96
3627	7.61	8.24	8.25	7.45	5.08
3675	9.56	9.74	9.59	9.02	6.86

Source: CFC, with data from the IMSS.

Table 2.A7. Fixed Effects by Unit for Serum and Solutions

Medical Unit	Fixed Effect	Medical Unit	Fixed Effect
Aguascalientes	**3.262 ***** (0.325)	N. L.	**11.002 *** (5.748)
Baja California	**3.770 **** (1.550)	N. L. Esp Gineco (UMAE)	**-9.38 ***** (4.401)
Baja California Sur	**1.541 **** (0.590)	N. L. Esp (UMAE)	**5.225 *** (4.205)
Campeche	**1.634** (4.237)	Nayarit	**0.949** (5.245)
Chiapas	**-.9205 ***** (0.125)	Oaxaca	**5.805 *** (2.267)
Chihuahua	**-7.626 **** (2.323)	Puebla	**-7.214 ***** (3.441)
Coahuila	**1.244 **** (0.547)	Querétaro	**0.264** (5.127)
Colima	**6.787 *** (3.451)	Quintana Roo	**-5.653 ***** (2.420)
D. F. 1	**-11.753 ***** (6.629)	Raza Esp (UMAE)	**-0.9668** (4.275)
D. F. 2	**-1.538** (4.587)	S XXI Esp (UMAE)	**1.244** (4.847)
D. F. 3	**-.9505** (4.615)	S XXI Pediatría (UMAE)	**0.6479** (4.201)
D. F. 4	**-.0413** (4.237)	San Luis Potosí	**1.45 **** (.407)
D. F. 4 Gin-Obs (UMAE)	**-1.189** (7.012)	Sinaloa	**5.233 *** (2.22)
Durango	**-.9205 **** (0.257)	Sonora	**-0.1706 ***** (4.302)
Guanajuato	**-2.741** (4.332)	Sonora Esp. (UMAE)	**-3.5** (1.637)
Guerrero	**3.471 **** (1.239)	Tabasco	**4.896 **** (2.217)
Hidalgo	**1.425** (5.266)	Tamaulipas	**-11.923 ***** (4.412)
Jalisco	**3.682 **** (1.230)	Tlaxcala	**-5.653** (6.42)
Lomas V Trauma (UMAE)	**-1.481** (-1.481)	Veracruz Norte	**-3.878 **** (1.155)
Mag Sal Trauma (UMAE)	**-1.541** (4.190)	Veracruz Sur	**3.471 *** (1.239)
México Oriente	**-1.475** (4.261)	Yucatán	**-9.7149 **** (4.385)
México Poniente	**-1.179 **** (.369)	Zacatecas	**1.348** (4.260)
Michoacán	**-4.002 ***** (1.449)		

Source: CFC, with data from the IMSS.

Table 2.A8. Fixed Effects by Unit for Serum and Solutions

Medical Unit	Fixed Effect	Medical Unit	Fixed Effect
Aguascalientes	**52.893** *** (19.078)	N. L. Esp Gineco (UMAE)	**31.459** *** (19.98)
Baja California	**58.176** ** (19.037)	N. L. Esp (UMAE)	**57.009** * (19.44)
Baja California Sur	**32.03** ** (26.807)	Nayarit	**60.877** (19.02)
Campeche	**53.252** (18.995)	Oaxaca	**59.775** * (19.024)
Chiapas	**49.452** *** (19.015)	Puebla	**36.406** *** (21.925)
Chihuahua	**50.793** ** (30.272)	Querétaro	**53.806** (23.223)
Coahuila	**57.979** ** (18.990)	Quintana Roo	**43.742** *** (26.446)
Colima	**52.893** * (31.925)	Raza Esp (UMAE)	**43.742** (29.008)
D. F. 1	**37.396** *** (19.062)	S XXI Esp (UMAE)	**29.485** (18.993)
D. F. 2	**36.764** (39.058)	S XXI Pediatría (UMAE)	**52.893** (19.078)
D. F. 3	**36.228** (21.925)	San Luis Potosí	**60.877** ** (19.02)
D. F. 4	**32.03** (19.032)	Sinaloa	**57.389** * (19.443)
D. F. 4 Gin-Obs (UMAE)	**43.801** (19.16)	Sonora	**51.18** (18.998)
Durango	**47.929** ** (19.142)	Sonora Esp. (UMAE)	**51.611** *** (19.016)
Guanajuato	**26.534** (18.988)	Tabasco	**31.889** ** (19.103)
Guerrero	**53.806** ** (23.223)	Tamaulipas	**56.763** *** (19.013)
Hidalgo	**37.178** (22.062)	Tlaxcala	**35.201** (23.249)
Jalisco	**51.357** ** (19.432)	Veracruz Norte	**56.104** ** (18.991)
Lomas V Trauma (UMAE)	**47.485** (19.132)	Veracruz Sur	**56.18** * (19.39)
México Oriente	**30.459** (20.272)	Yucatán	**48.446** ** (19.156)
México Poniente	**28.139** ** (19.149)	Zacatecas	**33.164** (19.058)
Michoacán	**51.292** *** (18.988)		
N. L.	**64.447** * (19.078)		

Source: CFC, with data from the IMSS.

Table 2.A9. Impact of the Intervention of the CFC over the Acquisition Price Index of Serums and Other Solutions by Medical Unit

Medical Unit	Impact	Medical Unit	Impact
Aguascalientes	2.46%	N. L.	11.77%
Baja California	1.80%	N. L. Esp Gineco (UMAE)	-8.19%
Baja California Sur	1.19%	N. L. Esp (UMAE)	2.14%
Campeche	1.85%	Oaxaca	1.16%
Chiapas	-3.88%	Puebla	-8.48%
Chihuahua	-5.85%	Quintana Roo	-8.99%
Coahuila	1.83%	San Luis Potosí	2.13%
Colima	1.88%	Sonora Esp. (UMAE)	-8.46%
D. F. 1	-17.88%	Tabasco	1.63%
Durango	-5.35%	Tamaulipas	-18.81%
Guerrero	1.93%	Veracruz Norte	-8.15%
Jalisco	6.57%	Veracruz Sur	1.20%
México Poniente	-1.99%	Yucatán	-1.18%

Note: Each estimation of the impact of the intervention of the CFC over the acquisition Price of serum and other solutions is based on DiD estimators with at least 10% of statistical significance.
Source: CFC with IMSS data.

Table 2.A10. Impact of the Intervention of the CFC over the Acquisition Price Index of Human Insulin by Medical Unit

Medical unit	Impact	Medical unit	Impact
Aguascalientes	-52.59%	N. L. Esp (UMAE)	-61.69%
Baja California	-58.23%	Nayarit	-61.02%
Campeche	-56.23%	Oaxaca	-51.01%
Chiapas	-44.97%	Querétaro	-56.20%
Coahuila	-58.91%	San Luis Potosí	-76.35%
D. F. 1	-47.87%	Sinaloa	-59.67%
D. F. 4 Gin-Obs (UMAE)	-43.74%	Sonora	-56.37%
Durango	-46.00%	Sonora Esp. (UMAE)	-58.81%
Guerrero	-55.80%	Tamaulipas	-54.31%
Jalisco	-67.51%	Veracruz Norte	-57.92%
Lomas V Trauma (UMAE)	-49.11%	Veracruz Sur	-56.15%
Michoacán	-73.74%	Yucatán	-46.17%
N. L.	-71.51%		

Note: Each estimation of the impact of the intervention of the CFC over the acquisition Price of serum and other solutions is based on DiD estimators with at least 10% of statistical significance.
Source: CFC with IMSS data.

ASSESSMENT CONCLUDED IN 2015

3. Assessment of the impact of a collusive practice in the Mexican land freight transportation market

Andrés Aradillas López

3.1. Introduction

This document studies the empirical evidence and the measurement of the impact of the anticompetitive practice observed in the sector of land freight transport in Mexico between 2008 and 2010. This anticompetitive practice revolved around the so-called Fuel Adjustment Charge (CPAC, per its acronym in Spanish) through which the National Land Freight Transport Chamber (CANACAR, per its acronym in Spanish) and its members colluded to transfer fuel price increases directly to their customers. This analysis will be based solely on price behavior, due to data availability. The objectives of the study are:

i. To establish whether there is statistical evidence of a structural change in the evolution of the price index of the land transport sector during the period of the anticompetitive practice in relation to the period during which such practice did not exist.

ii. To isolate and quantify the impact of the anticompetitive practice on the price index of the land transport sector. This will be done through an anticompetitive price markup measure.

iii. To propose and estimate impact measurements of the welfare impact derived from the anticompetitive practice.

iv. To study the explanatory power of the CPAC as a predictor of the anticompetitive price markup index.

Each one of the previous points will be analyzed in individual sections of this document. From now on, we will refer to the period of the anticompetitive practice as the "collusive period" and to the period when said practice was not observed as the "non-collusive period".

3.2. The case[31]

On November 13, 2008, the CFC received a complaint against CANACAR and its decision-making body, the National Executive Council (CEN), for the probable commission of absolute monopolistic practices.[32,33] The alleged conduct consisted in the fact that the CANACAR's CEN agreed to issue to its affiliates a recommendation to pass on to their clients the increases applied by the Federal Government to the price of fuels through the so-called "Fuel Adjustment Charge (CPAC, per its initials in Spanish)".

As part of the conduct, CANACAR disseminated and followed up on the application of the CPAC by publishing the agreement on its website and on a specially constructed webpage so that members would comply with the recommendation. This agreement prevented companies from deciding, on an individual basis, whether to transfer the price increase to the users of their services or to absorb it totally or partially according to their cost structure, as occurs under competitive conditions.

On June 3, 2010, the Board of Commissioners decided that it was proven the realization of the absolute monopolistic practice, foreseen in article 9, section I of the LFCE, consisting in the execution of contracts, agreements, arrangements or combinations among competitors with the purpose of raising, agreeing or manipulating the sale price of the freight land transport services in Mexican territory. The Board of Commissioners of the CFC ordered the suspension of the practice and fined those involved with nearly 31 million pesos.

31. File number DE-153-2008. Available in Spanish at: http://www.cfc.gob.mx:8080/cfcresoluciones/docs/Asuntos%20Juridicos/V76/9/1765469.pdf

32. The CFC was terminated on September 11, 2013, to be replaced by the Federal Economic Competition Commission (COFECE).

33. CANACAR is the main association of cargo carriers at the national level, in 2008, they had around 4 thousand 500 affiliated companies. At the time of the investigation, five affiliated companies had representatives at the CEN.

The sanctioned economic agents filed an Appeal for Reconsideration against the resolution issued on June 3, 2010.[34] In view of this procedure, the Board of Commissioners of the CFC considered that the complaints filed by the appellants were unfounded and ineffective, ratifying on October 21, 2010 previous resolutions.

3.3. Econometric analysis of structural change

The first part of the analysis focuses on determining whether there is evidence of a structural change in the evolution and behavior of the land transport price index if we compare the collusion period against the non-collusion period. In general, the shift towards a collusive regime should manifest itself in the data through a structural change. Before describing the model used in this section, the following related variables are defined in Table 3.1:

Table 3.1. Definition of included variables

$Y_t =$	National Producer Price Index (INPP per its acronym in Spanish) (base June 2012=100, monthly). Generic prices indexes for the national market. General Freight Land Transport (1461).
$X_{t lub} =$	NPPI (base Junio 2012=100, monthly). Generic price indexes for the national markets: Lubricant Oils (1242).
$X_{t llan} =$	NPPI (base June 2012=100, monthly). Generic price indexes for the national market: Pneumatic tires for automobiles and vans0 (1319).
$X_{t refac} =$	NPPI (Base June2012=100, monthly). Generic price indexes for the national market: Other parts and automotive spare parts (1438).
$X_{t dies} =$	NPPI (Base June2012=100, monthly). Generic price indexes for the national market: Diesel (1237).
$Z_t =$	Vector of indicator variables for each yearly quarter.

Source: INEGI
Note: The gathered data encompass the period: January 2004-October 2014.

The econometric analysis will be based on price behavior due to data availability and sample size. Economic activity variables in the land transport sector (included in INEGI's National Transportation Surveys) have an annual frequency. Given the monthly frequency of the price data and the fact that the analysis revolves around price changes, the annual frequency variables had very little predictive power and were therefore

34. File RA-085-2010 and accumulated. Available in Spanish at: http://www.cofece.mx:8080/cfcresoluciones/Docs/Asuntos%20Juridicos/V38/1/1363160.pdf

excluded from the study. More disaggregated information (at the company or city level) was also not found. However, as the results show, the price analysis is sufficient to identify a clear anticompetitive pattern and to establish a genuine measure of welfare impact and make estimates of that impact.

3.3.1. Collusive period

The sample used covers the period: January 2004 — October 2014. Hereafter, the collusion period is from September 2008 to July 2010. Therefore, the period recognized as collusive conduct in Technical Fact Sheet of COFECE is expanded by one month.[35] This is done because the anticompetitive effects on price changes would still be reflected in July 2010. The rest of the sample will hereafter be referred to as the "non-collusive period". We will denote:

$$\tau^{c}\{t: 09/2008 \leq t \leq 06/2010\},\ \tau^{n,c}\{t: t \leq 08/2008 \text{ ó } t \geq 07/2010\}$$

τ^{c} refers to the period of collusive conduct, while $\tau^{n,c}$ refers to the period of non-collusive conduct.

3.3.2. Econometric model

Let us group together the following price series:

$$Xt = (X_t^{lub}, X_t^{llan}, X_t^{refac}, X_t^{dies})$$

Due to the natural presence of a time trend in the price series, the econometric model used is based on the study of price changes. Let us define:

$$\Delta Y_t = Y_t - Y_{t-1},\ \ \Delta X_t = X_t - X_{t-1}$$

As Figure 3.1 suggests, taking first differences eliminates the time trend of the price series of land transport and produces a time series with stationary characteristics, a requirement for the theoretical validity of our econometric analysis (see Hamilton, 1994, Chapter 15).

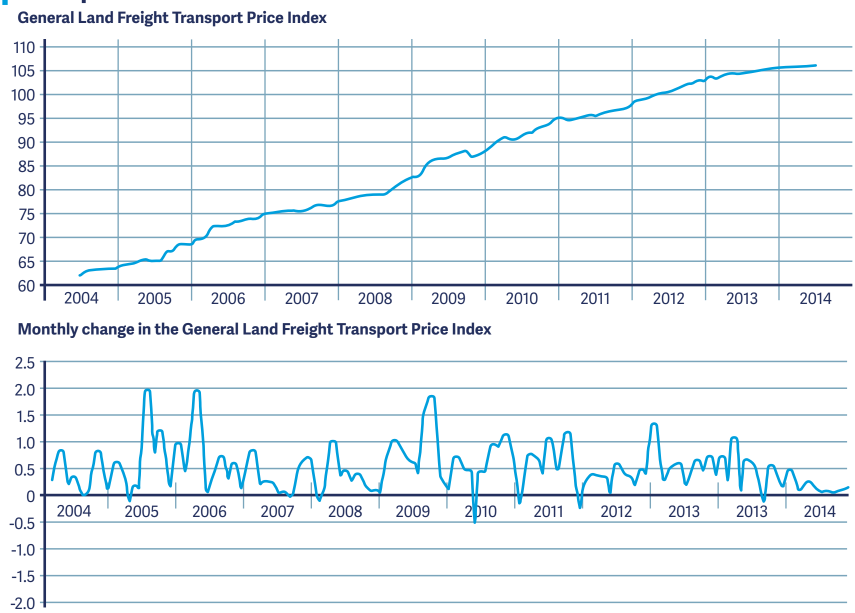
35. The resolution of COFECE is dated June 2010, which would mark the end of the conduct. However, its impact on the monthly price change would still be reflected in July 2010.

Our analysis is based on the following model:[36]

$$\Delta Y_t = \Delta X'_t \beta_1 + Z'_t \beta_2 + \varepsilon_t \qquad (1)$$

β_1 y β_2 are coefficient vectors (with four elements each) to be estimated. By focusing the econometric analysis on the change in prices, the presence of a time trend is eliminated and at the same time the potential problem of estimating a "spurious regression" is prevented (see Hamilton, 1994, Section 18.3).

Figure 3.1. Level and monthly change in the General Land Freight Transport Sector Price Index



Source: Prepared by the author, with data from INEGI.

36. This model is identical to a specification where an intercept is included and only three out of four indicator variables are included in Z_t. Including an intercept in addition to all the variables in Z_t would result —as is well known— in a perfect multicollinearity, making it impossible to estimate the model's parameters.

The prices in X_t include the most relevant observable components to explain the price dynamics of the land transport sector. The inclusion of the quarterly indicator variables Z_t helps to control for seasonal factors that explain the price variation.[37]

3.3.3. Econometric test of structural change

The method focuses on the so-called "Chow Test" (Chow, 1960), perhaps the most popular and well-known method for performing statistical tests of structural change. Assuming the model described in Equation (1), a change in the value of the coefficients $\beta 1$ and/or $\beta 2$ in the collusive period compared to the non-collusive period is what is referred to as a structural change. Specifically, our objective is to analyze whether the original model (1) can be generalized as follows:

$$\Delta Y_t = \begin{cases} \Delta X'_t \beta_1^{nc} + Z'_t \beta_2^{nc} + \varepsilon_t & \text{when } t \in \tau^{nc} \quad \text{(non-collusive period)} \\ \Delta X'_t \beta_1^{c} + Z'_t \beta_2^{c} + \varepsilon_t & \text{when } t \in \tau^{c} \quad \text{(collusive period)} \end{cases} \qquad (2)$$

Structural change is said to occur if $\beta_1^{nc} \neq \beta_2^{nc}$ or $\beta_2^{nc} \neq \beta_2^{c}$. Otherwise such change is discarded. The Chow test consists of the following steps:

1. Estimate the model *(1)* by least squares for the sample as a whole, denoting the estimators as $(\hat{\beta}_1, \hat{\beta}_2)$ and the corresponding sum of squared errors as:

$$RSS = \sum_{t=1}^{T} (\Delta Y_t - (\Delta X'_t \hat{\beta}_1 + Z'_t \hat{\beta}_2))^2$$

2. Estimate model *(1)* by least squares for the non-collusive period, denoting the estimators as $(\hat{\beta}_1^{nc}, \hat{\beta}_2^{nc})$ and the corresponding sum of squared errors as:

$$RSS^{nc} = \sum_{t \in \tau^{nc}} (\Delta Y_t - (\Delta X'_t \hat{\beta}_1^{nc} + Z'_t \hat{\beta}_2^{nc}))^2$$

37. The conclusions of the econometric analysis presented in this document were kept intact by using monthly rather than quarterly indicator variables.

3. Estimate model *(1)* by least squares for the collusive period, denoting the estimators as $(\hat{\beta}_1^c, \hat{\beta}_2^c)$ and the corresponding sum of squared errors as:

$$RSS^c = \sum_{t \in \tau^c} (\Delta Y_t - (\Delta X'_t \hat{\beta}_1^c + Z'_t \hat{\beta}_2^c))^2$$

4. Construct the Chow statistic:

$$Chow = \frac{(RSS - (RSS^{nc} + RSS^c)) / k}{(RSS^{nc} + RSS^c) / (T_c + T_{nc} - 2k)}$$

Where:

- k is the number of parameters to estimate (in this case, eight),
- T_c is the number of observations in the collusive period (in this case, 23), and
- T_{nc} is the number of observations in the non-collusive period (in this case, 106).

Under the null hypothesis that there is no structural change, the Chow statistic is approximately distributed as a random variable F with $k=8$ degrees of freedom in the numerator and $T_c+T_{nc}-2k=113$ degrees of freedom in the numerator. The hypothesis of no structural change is rejected if $Chow>F(1\text{-}\alpha;8,113)$ where α is the chosen significance level and $F(1\text{-}\alpha;8,113)$ refers to the corresponding critical value for a distribution $F_{8,113}$. For example, if the significance level is 5%, the hypothesis of no structural change is rejected if $Chow>2.02$. The results in our case are included in Table 3.2.

Table 3.2. Results of the structural change test.

Chow Statistic	Critical value (A=5%)	Value p of the test
2.2576	2.0215	0.0281

Source: Own estimates.

Derived from the results in Table 3.2, it can be affirmed with a certainty greater than 95% that there was a structural change between the collusive and non-collusive periods. The p-value indicates that this certainty is approximately 98%.

Having empirically evidenced the presence of a structural difference in the data between the collusive and non-collusive periods, the following section proposes a markup index to measure the price impact of anti-competitive behavior.

3.4. Analysis of the price markup in land transport derived from the collusive behavior

The most natural way to measure the impact of any anticompetitive practice on prices is through a counterfactual analysis that consists of estimating the price behavior in the absence of the anticompetitive practice, and contrasting it against the observed behavior of the price (see Whinston (2006, Chapter 2)). For this purpose, we resort to the model estimated in the previous section. As previously done, let us define $(\hat{\beta}_1^{nc}, \hat{\beta}_2^{nc})$ as the least squares estimators of model *(1)* during the non-collusive period. Hereafter we will define:

$\underline{t}^c$ = *Beginning of the collusive period (September 2008)*

$\overline{t}^c$ = *End of the collusive period (July 2010)*

Likewise, let us define:

$$\hat{\Delta} Y_t^{nc} = \Delta X'_t \hat{\beta}_1^{nc} + Z'_t \hat{\beta}_2^{nc},$$
$$\hat{Y}_{\underline{t}^c}^{nc} = Y_{\underline{t}^c-1} + Y_{\underline{t}^c}^{nc} \qquad (3)$$
$$\hat{Y}_{\underline{t}}^{nc} = \hat{Y}_{\underline{t}-1}^{nc} + \hat{Y}_{\underline{t}}^{nc}, \text{ for } \underline{t}^c + 1 \leq t \leq \overline{t}^c$$

$\hat{Y}_{\underline{t}}^{nc}$, defined in Equation *(3)*, represents the auto-transport price predicted by our model in the absence of collusion. In particular, for each period $t \in \tau^c$ (during the collusive period), $Y_t - \hat{Y}_{\underline{t}}^{nc}$ measures (estimates) the counterfactual difference in prices in the absence of collusion.

3.4.1. Definition of the markup

Our measure of the impact of the collusive conduct on land transport prices is as follows:

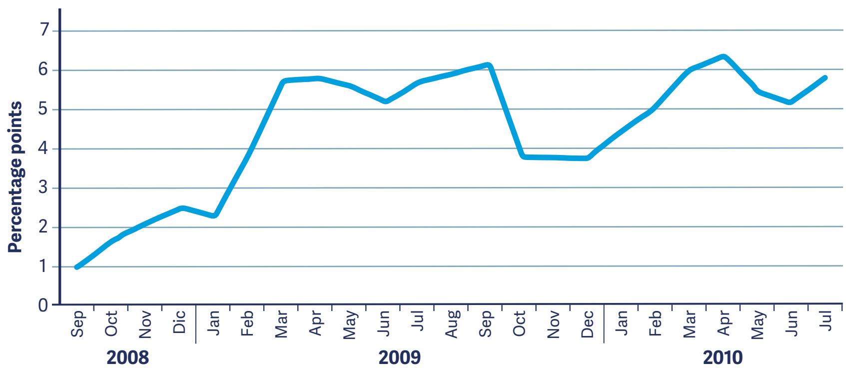
$$\hat{M}_t = \frac{Y_t - Y_t^{nc}}{\hat{Y}_t^{nc}} \qquad (4)$$

Henceforth we will refer to this index as the "markup", which should be interpreted as the percentage deviation between the expected price in the absence of collusion and the price observed in the data. In the absence of collusive behavior, such a difference would be approximately insignificant (in a statistical sense). A measure similar to *(4)* is analyzed, for example, in Block, Nold, and Sidak (1981).

3.4.2. Evolution of the markup during the collusion period

As it can be seen in Figure 3.2, the estimated markup $\hat{M}_t$ had a positive sign during the entire collusion period, which is consistent with what we would expect to observe as a result of an anticompetitive practice.

Figure 3.2. Evolución del markup estimado ($\hat{M}_t$).



Source: Own elaboration.

Table 3.3 summarizes the main statistical characteristics of the $\hat{M}_t$. markup. From our results, the following derives:

I. The freight land transport price index observed in the data was systematically higher than we would have expected to observe in the absence of collusion.

II. This difference is statistically significant, with a resulting markup that was, on average, approximately 5% and with a 95% probability it could have been as high as 7.67%.

3.5. Measurement of the welfare impact of the anticompetitive practice

The nature of the available data prevents us from estimating a demand function (see, for example, Oum, Waters and Yong, 1992 and Berry, Levinsohn and Pakes, 1995) and using consumer surplus as a measure of welfare loss (see, for example, Davis and Garcés, 2010, Chapters 1, 8 and 10, or Whinston, 2007).

Table 3.3. Characteristics of the markup distribution (In percentage points)

Average	4.56%
Standard deviation	1.58%
Minimum	1.12%
Median	5.18%
75vo percentile	5.73%
90vo percentile	6.04%
Maximum	6.45%
95% confidence interval	[1.45% , 7.67%]

Source: Own elaboration.

However, our data allow us to identify, estimate and quantify the impact of the collusion on price inflation in the land transport sector. It is clear that inflation is a factor that affects the economy and the welfare of companies and individuals (see Aiyagari, Braun and Eckstein, 1998). Therefore, isolating and estimating the impact of the collusive behavior on inflation in the land transport sector is a relevant measure of welfare impact. As previously done, the first and last period of collusion are defined as:

$\underline{t}^c = \textit{September, 2008} \qquad \overline{t}^c = \textit{July, 2010}$

Let us define:

$$\Pi^c = \left(\frac{12}{24}\right)\left[\frac{\hat{Y}_{\underline{t}^c-1} - Y_{\underline{t}^c-1}}{Y_{\underline{t}^c-1}}\right]$$

$$\hat{\Pi}^{nc} = \left(\frac{12}{24}\right)\left[\frac{\hat{Y}^{nc}_{\underline{t}^c} - Y_{\underline{t}^c-1}}{Y_{\underline{t}^c-1}}\right]$$

Π^c represents the (annualized) inflation observed in the data between August 2008 and July 2010. $\hat{\Pi}^{nc}$ represents the inflation that would have been expected in the absence of the collusive behavior. The welfare impact measure is as follows:

$$\hat{W}^c = Y + \hat{\Pi}^{nc} \tag{5}$$

We can identify $\hat{W}^c$ as an estimator of the inflationary increase derived from the collusive behavior. In addition to presenting the estimated value of $\hat{W}^c$, we are interested in constructing a confidence interval to have a more precise idea of the range of the impact of the collusive conduct on welfare. To this end, an estimator of the variance of $\hat{W}^c$ is needed. To derive the asymptotic variance of $\hat{W}^c$ one can invoke the "Delta Method" (see Hayashi, 2000, Chapter 2) in econometrics. Let us define:

$$U_t = (\Delta X'_t, Z'_t)'$$

Conditional on the values of prices (X_t, Y_t) observed during the collusive period, an estimator of $Var(\hat{W}^c)$ can be constructed as follows:

$$V\hat{a}r(\hat{W}^c) = \left[\sum_{t=\underline{t}^c}^{\bar{t}^c} \frac{U'_t}{Y_{\underline{t}^c-1}}\right] V\hat{a}r(\hat{\beta}^{nc}) \left[\sum_{t=\underline{t}^c}^{\bar{t}^c} \frac{U_t}{Y_{\underline{t}^c-1}}\right]$$

Where $V\hat{a}r(\hat{\beta}^{nc})$ is the variance-covariance matrix estimator of $\hat{\beta}^{nc}$. In this case, the variance estimator $V\hat{a}r(\hat{\beta}^{nc})$ is constructed following the Newey-West method (Newey and West (1987)) which allows for autocorrelation and heteroscedasticity in the residuals of Equation *(1)*.[38] Using these results, a 95% confidence interval for $\hat{W}^c$ is constructed as follows:

$$\left[\hat{W}^c - 1.96\sqrt{\hat{Var}(\hat{W}^c)}\,,\ \hat{W}^c + 1.96\sqrt{\hat{Var}(\hat{W}^c)}\right] \tag{5}$$

The results are included in Table 3.4.

Table 3.4. Estimated inflationary impact of collusive conduct (In percentage points of inflation)

Observed value Π^c	Estimated Value $\hat{\Pi}^{nc}$	Inflationary increase $\hat{W}^c = Y + \hat{\Pi}^{nc}$	95% confidence interval for $\hat{W}^c$
7.25%	4.05%	3.20%	[0.23% , 6.31%]

Source: Own estimates

The following conclusions derive from the results:

i. The observed inflation was 3.2 percentage points higher than would have been expected in the absence of collusion. This is equivalent to a difference of 79%.

ii. The inflationary impact of said conduct is statistically significant with a 95% of certainty.

3.5.1. Evolution of annual inflation: comparison of observed and counterfactual behavior without collusion

To complement the analysis and to have a more complete idea of the inflationary impact of the anticompetitive behavior, a comparison of the behavior of the annual inflation observed against the one that would have been expected in the absence of collusion is presented. Let us define:

$$\pi_t^c = \frac{Yt - Y_{t-12}}{Y_{t-12}} \qquad \pi_t = \frac{\hat{Y}t - \hat{Y}_{t-12}}{\hat{Y}_{t-12}}$$

π_t represents the annual inflation observed in the period (month) t, while π_t represents the inflation that would have been expected in the absence of collusion. Figure 3.3 makes a comparison between the two quantities.

38. By constructing this estimator, third order autocorrelation between the residuals of Equation *(1)* is allowed.

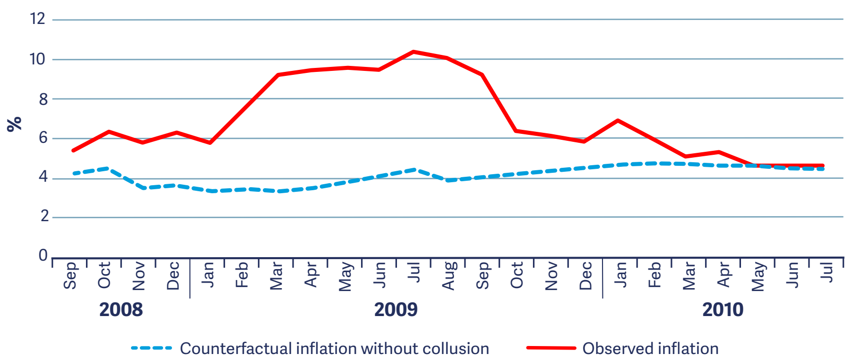
The following stems from what is observed in said figure:

i. The observed inflation in freight land transport prices remained systematically above the expected inflation without collusion during the entire period where the anticompetitive practice took place.

ii. This discrepancy started from the beginning of the collusive period, exacerbating towards the second half of 2009 and decreasing steadily towards the end of the collusive period, when the resolution of COFECE was approaching.

iii. The estimated counterfactual difference during 2009 was, on average, 4.34 percentage points of inflation, reaching an estimated 6.17 points in August 2009 (just one year after the beginning of the anticompetitive practice).

Figure 3.3. Observed and counterfactual inflation without collusion.



Source: Own elaboration.

3.5.2. An economic estimation of the harm

A comparison of the revenue from the provision of services in the land transport sector during the collusive period, against the counterfactual revenue that would have been generated in the absence of collusion would provide an approximation of the direct economic impact of the anticompetitive practice.[39] With respect to this type of information, the most reliable and consistent source are the Annual Transport Surveys published by INEGI. These surveys include annual accumulated figu-

39. Some of the indirect impacts in other sectors of the economy that may result from anticompetitive practices in the land freight transport industry on other sectors will be discussed below.

res of Revenues from the Supply of Goods and Services of Land Freight Transport (both, general and specialized). This will be the revenue concept we will work with in this section, and we will denote it as ING_A, where A refers to year 'A'. To have an idea of the economic magnitude of this economic activity, in 2012 (the most recent year for which figures are available), this sector's revenues equaled to $ING_A = 124.3$ thousand million Mexican pesos. The available income figures have the disadvantage of being annual accumulated (monthly figures are not available). However, if we assume that the actual volume of activity remains approximately constant throughout each year, the counterfactual revenue in the absence of collusion can be approximated as follows:

$$ING_A^{nc} = \left(\frac{\Sigma_{t \in A} Y_t^{nc}}{\Sigma_{t \in A} Y_t} \right) ING_A$$

Where, as previously defined, Y_t^{nc} refers to the counterfactual price index in the absence of collusion. In this manner, the cumulative counterfactual revenue during year 'A' can be estimated as:

$$\hat{ING}_A^{nc} = \left(\frac{\Sigma_{t \in A} \hat{Y}_t^{nc}}{\Sigma_{t \in A} Y_t} \right) ING_A$$

Where $\hat{Y}_t^{nc}$ is estimated according to Equation 3 during the collusive period (September 2008 to July 2010) and $\hat{Y}_t^{nc}$ corresponds to Y_t during the rest of the sample. The monetary measure of anticompetitive impact to be analyzed in this section is:

$$\begin{array}{ll} \hat{M}_A = ING_A - \hat{ING}_A^{nc} & \textit{(annual amount), for } A = 2008, 2009, 2010. \\ \hat{M} = \hat{M}_{2008} - M_{2009} - M_{2010} & \textit{(amount accumulated during the collusive period).} \end{array} \qquad (6)$$

In addition to estimating $\hat{M}_A$ and $\hat{M}$ it is convenient to construct confidence intervals for these measurements. For this it is necessary to have an estimator of the corresponding variances. As previously done for $\hat{W}^c$, we will resort to the so-called "Delta method". Once again, let us define:

$U_t = (\Delta X'_t, Z'_t)'$

As was previously defined, $t^c = September, 2008$ and $t^c = July, 2010$ denote the initial and final dates of the anticompetitive period in our study. The variances of $\hat{M}_A$ and $\hat{M}$ can be estimated in the following manner:

$$Va\hat{r}(\hat{M}_A) = \left(\frac{ING_A}{\Sigma_{r\in A} Y_r}\right)^2 \left(\sum_{\substack{t\le t_c\\ t\in a}}^{t\le \bar{t}c} \sum_{s=t_c}^{tc} U'_s\right) Va\hat{r}(\hat{\beta}^{nc}) \left(\sum_{\substack{t\le t_c\\ t\in a}}^{t\le \bar{t}c} \sum_{s=t_c}^{tc} U_s\right)$$

$$Va\hat{r}(\hat{M}) = \left(\sum_{A=\underline{2008}_c}^{2010} \left(\frac{ING_A}{\Sigma_{r\in a} Y_r}\right) \sum_{\substack{t\le t_c\\ t\in a}}^{t\le \bar{t}c} \sum_{s=t_c}^{tc} U'_s\right) Va\hat{r}(\hat{\beta}^{nc}) \left(\sum_{A=\underline{2008}_c}^{2010} \left(\frac{ING_A}{\Sigma_{r\in a} Y_r}\right) \sum_{\substack{t\le t_c\\ t\in a}}^{t\le \bar{t}c} \sum_{s=t_c}^{tc} U_s\right)$$

On this basis, confidence intervals with 95% statistical certainty are constructed simply as follows:

$$\left[\hat{M}_A - 1.96\sqrt{Va\hat{r}(\hat{M}_A)}\ ,\ \hat{M}_A + 1.96\sqrt{Va\hat{r}(\hat{M}_A)}\ \right]$$

$$\left[\hat{M} - 1.96\sqrt{Va\hat{r}(\hat{M})}\ \ ,\ \hat{M} + 1.96\sqrt{Va\hat{r}(\hat{M})}\ \right]$$

The results are included in Tables 3.5 and 3.6.

Table 3.5. Estimated Economic Impact (billions of Mexican pesos)

Period	Estimated Amount	95% confidence interval
2008	0.696	[0.218 , 1.175]
2009	5.186	[4.442 , 5.933]
2010	3.548	[3.205 , 3.891]
2008-2010	9.432	[8.197 , 10.667]

Source: Own estimates.

Table 3.6. Estimated Economic Impact (as percentage of total revenues)

Period	Estimated Amount	95% confidence interval
2008	0.643%	[0.201% , 1.085%]
2009	4.617%	[3.952% , 5.282%]
2010	3.050%	[2.755% , 3.345%]
2008-2010	2.798%	[2.432% , 3.165%]

Source: Own estimates.

The results in Tables 3.5 and 3.6 show the following:

i. It is confirmed that the greatest impact of the anticompetitive conduct was recorded in 2009 since, unlike 2008 and 2010, said conduct was recorded throughout 2009. The estimated amount of damage during 2009 was 5.2 billion Mexican pesos and the results indicate that, with 95% certainty that this amount rose to at least 4.4 thousand million Mexican pesos.

ii. The estimated impact represents a relatively minor proportion (around 3%) of the income for the provision of the service in the land freight transport sector. However, the magnitude of the economic activity in this sector translates into accumulated damages of around 9 billion Mexican pesos. With 95% certainty, the results indicate that this amount rose to at least 8.2 billion Mexican pesos.[40]

The measurement herein presented is an approximation of the direct impact of the anticompetitive conduct as it focuses exclusively on the land freight transport sector. The importance of freight land transport as a link between different sectors and regions of the national economy suggests that the macroeconomic impact is much greater. A discussion of this impact is included in the following section.

3.5.3. Impact on other sectors of the economy

Freight land transport is an important cost component in many sectors of the economy, thus anticompetitive practices in this sector have repercussions that extend to many branches of economic activity. Therefore, the figures presented above should be considered as a lower bound, a very conservative estimate of the damage sustained in the economy by

40. Even if it is conservatively assumed that only 10% of the sample in the survey participated in the anticompetitive practice, the amount of the estimated damage would be in the order of one billion Mexican pesos.

the anticompetitive practice studied here. The data available for this study preclude an exact quantification of the damages in other sectors of economic activity; however, previous studies that are largely applicable to the Mexican economy can be used to get an approximate idea of the impact of the land transport sector on costs and prices of the Mexican economy. We will focus specifically on the food sector for two main reasons:

i. The behavior of food prices is essential for the welfare of families in vulnerable conditions.
ii. Due to its perishable nature, the food sector is particularly vulnerable to variations in land transport costs.

In this regard, the World Bank (Schwartz, Guasch, Wilmsmeier and Stokenberga, 2009) prepared a working paper to study the impact of transport costs on food prices in Latin America and the Caribbean. The main conclusions of this study can be summarized as follows:

i. Logistics costs in Latin America and the Caribbean constitute between 16% and 26% of the Gross Domestic Product (GDP) and between 18% and 32% of the total value of primary products. Transportation costs in the region constitute a major proportion of said logistics expenses.
ii. Increases in transport costs translate into increases in food prices for the final consumer in a proportional order of magnitude ranging between 15% and 25% (i.e., for each percentage point increase in transportation costs, final food prices for the consumer increase between 0.15% and 0.25%).
iii. Fluctuations in transport costs are the main cause for the recent volatility observed in food prices in the region.

In Table 3.4 the impact of the anticompetitive conduct on the inflation of the freight land transport price index between September 2008 and July 2010 is analyzed. During this period, the cumulative inflation measured through the National Consumer Price Index for Food, Beverages and Tobacco was 10.54%. Extrapolating the elasticities estimated by the World Bank and combining these figures with our results in Table 3.4, we estimate that, holding other factors constant, food price inflation in the absence of the anti-competitive practice in land transport would have been in the range of 8.45% and 9.29% instead of the observed level of

10.54%. Given the proportion of Mexican families in vulnerable economic situations, this inflationary impact has considerable social costs.

3.6. CPAC as Markup predictor

At the center of the anticompetitive practice during the collusion period is the Fuel Adjustment Charge (CPAC, per its initials in Spanish) through which CANACAR and its members colluded to transfer fuel price increases directly to their customers. This section studies the statistical relationship between the markup $\hat{M}_t$ and the CPAC. Given that the collusive practice revolved around the latter, CPAC would be expected to have predictive power to explain the markup $\hat{M}_t$.

The first obstacle we faced is the lack of information about the CPAC during the collusive period (September 2008 to July 2010). Included in the Technical Fact Sheet of COFECE for the CANACAR case are public data on the CPAC until April 2009.[41] For this reason, the first step in our analysis is to project the CPAC until July 2010. This projection was constructed based on the following econometric autoregressive model:

$$CPAC_t = \gamma_0 + \gamma_1 \bullet CPACt\text{-}1 + \gamma_2 \bullet CPACt\text{-}2 + v_t$$

The inclusion of the intercept γ_0 helps to capture time trends of the CPAC. The coefficients γ_1 and γ_2 capture the dynamic characteristics of this series. The parameters of this autoregressive model were estimated using available CPAC data, and for periods after April 2009 we project this charge using:

$$C\hat{PAC}_t = \begin{cases} CPACt \text{ for } t \leq \text{april } 2009 \\ \gamma_0 + \gamma_1 \bullet CPACt\text{-}1 + \gamma_2 \bullet CPACt\text{-}2 \text{ for } t\text{=mayo } 2009 \\ \gamma_0 + \gamma_1 \bullet C\hat{PA}Ct\text{-}1 + \gamma_2 \bullet CPACt\text{-}2 \text{ for } t\text{=june } 2009 \\ \gamma_0 + \gamma_1 \bullet C\hat{PA}Ct\text{-}1 + \gamma_2 \bullet C\hat{PA}Ct\text{-}2 \text{ for } t\geq\text{july } 2009 \end{cases}$$

Our objective is to study the statistical relationship between the markup $\hat{M}_t$ and CPAC. Given that the latter has a time trend factor (captured by the coefficient $\hat{\gamma}_0$), it is necessary to remove any time trend in $\hat{M}_t$ to

41. Said information comes directly from the CANACAR's internet page, where the CPAC was published monthly for its members.

remove the risk of a "spurious regression" (Hamilton (1994, Section 18.3)). For this purpose, the following regression is estimated first:

$$\hat{M}_t = \delta_0 + \delta_1 t + \eta_t$$

and we use

$$\bar{M}_t = \hat{M}_t - [\delta_0 + \hat{\delta}_1 t]$$

$\bar{M}_t$ eliminates the time trend in the markup $\hat{M}_t$. Finally, we estimate the following regression for the collusive period:

$$\bar{M}_t = 0 + \theta_1 CP\hat{A}C_t + \theta_2 CP\hat{A}C^2{}_t + \theta CP\hat{A}C^3{}_t + \varepsilon_t \tag{7}$$

The coefficient of determination (R^2 or "R-squared") of regression *(7)* was 0.66. It follows that, through model *(7)*, the variation in CPAC explains 66% of the variation in the markup during the collusive period. This finding is consistent with the fundamental role of CPAC as an instrument of collusion.

3.7. Conclusions

We found empirical evidence of a statistically significant change in the dynamic pricing structure in the land freight transport sector during the collusive period (September 2008 to July 2010) compared to the non-collusive period.

Our index measure of the price impact of the observed anticompetitive practice was a markup $\hat{M}_t$ constructed as the percentage difference between the observed land transport price index in the data and the price index that we would have expected in the absence of collusion.

The estimated markup $\hat{M}_t$ had a positive sign during the entire collusion period, demonstrating that the land freight transport price index observed in the data was systematically higher than we would have expected in the absence of the anticompetitive practice. This difference was statistically significant, with an average value of approximately 5% which, with 95% certainty, could reach levels close to 8%.

As a welfare impact measure, we used the comparison between the inflation rate in the land transport sector observed during the period of the anticompetitive practice and the inflation rate that would have been expected in the absence of such practice. Specifically, the inflation rate (annualized) between September 2008 and July 2010 was analyzed. The analysis revealed that this difference was statistically significant, with an estimated value of 3.2 percentage points of annualized inflation. We also compared the evolution of the annual inflation rate for each month in that period and found an inflationary impact of the anticompetitive practice in each of the months during that period, reaching a maximum level of six percentage points of annualized inflation in August 2009. Applying this inflationary differential to the income figures for the provision of services in the land transport sector, it was estimated that the difference in monetary terms during the collusive period was of the order of 9 billion Mexican pesos, an amount that represents the accumulated economic harm of the analyzed practice.

The previous figures are an estimate of the direct impact of the anticompetitive practice. Indirect costs reverberate throughout the sectors of economic activity that require land freight transport as an intermediate input. The food sector deserves particular attention due to the perishable nature of its products and its impact on the welfare of families. Extrapolating from World Bank studies and combining them with our findings, it was estimated that, holding other factors constant, consumer price inflation in food during the period of September 2008 to July 2010 would have been in the range of 8.45% and 9.29% in the absence of the anticompetitive practice. However, the observed inflation was 10.54%. The proportion of Mexican families in vulnerable economic situations makes this an economic impact with enormous social and welfare implications.

Finally, we estimate that the Fuel Adjustment Charge (CPAC) explains approximately 66% of the variation in the markup $\hat{M}_t$ during the collusive period. This is consistent with the determination of COFECE that the anticompetitive practice revolved around the CPAC as the instrument of collusion.

3.8. Bibliography

Aiyagari, S. R., Braun, R., & Eckstein, Z. (1998). Transaction services, inflation, and welfare. Journal of Political Economy, 106, 1274-1301.

Berry, S., Levinsohn, J., & Pakes, A. (1995). Automobile prices in market equilibrium. Econometrica, 89, 841-890. doi: https://doi.org/10.2307/2171802

Block, M. K., Nold, F. C., & Sidak, J. G. (1981). The deterrent effect of antitrust enforcement. Journal of Political Economy, 89, 429-445.

Chow, G. C. (1960). Tests of equality between sets of coefficients in two linear regressions. Econometrica, 28(1), 591-605.

Davis, P., & Garcés, E. (2009). Quantitative Techniques for Competition and Antitrust Analysis (1st ed.). Princeton University Press.

Hamilton, J. D. (2000). Time series analysis. Princeton University Press.

Hayashi, F. (2000). Econometrics. New Jersey, Princeton: Princeton University Press.

Newey, W. K., & West., K. D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica, 53(3), 703-708.

Oum, T. H., Waters, W. G., & Yon, J.-S. (1992). Concepts of price elasticities of transport demand and recent empirical estimates: An interpretative survey. Journal of Transport Economics and Policy, 26, 139-154.

Schwartz, J., Guasch, J. L., Wilmsmeier, G., & Stokenberga, A. (2009). Logistics, transport and food prices in lac: Policy guidance for improving efficiency and reducing costs. Sustainable Development Occasional Papers Series(2), 1-38.

Whinston, M. (2006). Lectures on Antitrust Economics. MIT Press.

Whinston, M. D. (2007). "Antitrust policy toward horizontal mergers.". In M. Armstrong, & R. H. Porter, Handbook of industrial organization 3 (pp. 2369- 2440).

ASSESSMENT CONCLUDED IN 2016

4. Assessment of the impact on consumer welfare derived from the sanction to cartels in the chicken market

Pablo A. Peña

4.1. Introduction

The extinct Federal Competition Commission determined the existence of a price-fixing collusion (an absolute monopolistic practice) in the commercialization of chicken in three regions of the country between 2005 and 2010.[42]

A price-fixing agreement was identified between *Bachoco*, *San Antonio*, *Pilgrim's*, *Tyson* and *PQRO* in the Federal District and the Metropolitan Area (DF and AM, per its acronym in Spanish). The agreement had a cumulative duration of 44 days between 2008 and 2009 and affected sales in poultry stores and public markets.

In Córdoba, Orizaba and Veracruz/Boca del Río, in the state of Veracruz, it was determined that the companies *Neria*, *Marver*, *Agroindustrias*, *Aca*, *San Antonio* and *Bachoco* conducted an agreement to fix prices. The practice lasted a total of 52 days between 2005 and 2009 and affected the sale in poultry stores and public markets.

In Cancún and Chetumal, Quintana Roo, it was determined that there was an agreement to fix prices between *Crío* and *Bachoco*, and also between *Oxtankah* in Chetumal. The agreement in Cancún lasted seven days and in Chetumal lasted 258 days, both during 2010.

42. The Federal Competition Commission was replaced by the current Federal Economic Competition Commission. The files corresponding to the cases analyzed are: IO-005-2009-IA, IO-005-2009-IB, IO-005-2009-II, and IO-005- 2009-III.

The competition authority determined the duration of the practices based on physical evidence. In the case of the agreements in Córdoba, Orizaba, Veracruz/Boca del Río and DF and AM, the beginning and conclusion of the collusive agreement were determined based on the duration of publications with chicken offers in the media. In the practice carried out in Cancún, the duration was determined based on a price agreement that was filed before the offices of the Office of the Federal Prosecutor for the Consumer (PROFECO) in Quintana Roo. For the agreement entered in Chetumal, the duration was established based on the minutes of the meetings held to coordinate the price fixing.

The size and relative importance of the participants in the price fixing agreements differ from case to case. Some of the participants are local distributors and others have a national presence. Their annual sales range between 40 and 18,211 million Mexican pesos.

This document presents an ex-post assessment of the impact of price fixing on consumers. It was commissioned by the Federal Economic Competition Commission (COFECE) and seeks to measure the impact on consumers using the information collected by the CFC in its proceedings and complementing that information with data on chicken prices from two sources: PROFECO and the National System of Information and Market Integration (SNIIM) of the Ministry of Economy.

The methodological approach used measures the impact of price fixing on consumer welfare despite not having estimates of the price elasticity of demand for chicken in the relevant markets.[43] That approach focuses on discarding elasticity values using economic theory.

The impact estimates are reported as the interval that results from considering the ranges of price elasticity that are feasible and compatible with the theory. It is difficult to imagine reasons why the true value of the price elasticity of demand in the relevant market does not lie in the range considered.

43. Estimates of price elasticity in the literature refer to national markets and sometimes include egg or other poultry along with chicken.

4.2. Conceptual framework

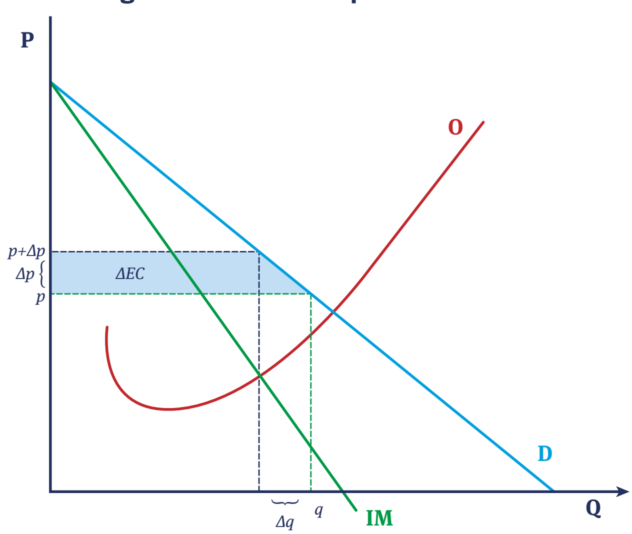
The impact of a price-fixing collusion can be measured as the change in consumer surplus. Given a change in price from p to $p + \Delta p$, the change in consumer surplus, denoted by ΔEC, is calculated as:

$$\Delta EC = g \bullet d\left(1 + \frac{\Delta q}{2q}\right)\frac{\Delta p}{p}$$

$$= g \bullet d\left(1 + \frac{1}{2} \bullet \frac{\Delta p}{p} \bullet \varepsilon\right)\frac{\Delta p}{p} \qquad (1)$$

Where g is the daily expenditure before the price increase, and d is the number of days the increase took effect, q is the quantity demanded before the price increase, and Δq is the change in quantity derived from the higher price. The price elasticity of demand for chicken in the relevant market is ε. The elasticity is the crucial parameter for determining the impact of collusion. If ε is "very large" in absolute value, the impact could be practically zero (see Figure 4.1).

Figure 4.1. Change in consumer surplus due to a collusion in prices



Based on economic theory, we can derive a "feasible" range for the value of the price elasticity. First, the elasticity cannot be positive.[44] Second, given the price increases derived from the collusion, values of price elasticity that are "too" large (in absolute value) would imply that under collusion the quantity exchanged would be zero.

The feasible range for price elasticity in the relevant market is given by:

$$-\frac{p}{\Delta p} \leq \varepsilon \leq 0 \qquad (2)$$

As an example, expression *(2)* indicates that if the price increase in collusion is of 20%, then the price elasticity must be located between -5 and 0. If it was less than -5, the quantity exchanged would be negative.

Economic theory in combination with some additional data allows us to further narrow the elasticity values. It is possible to use estimates of price elasticity in other markets to determine a lower bound that is greater than zero in absolute value.

Relevant markets are geographically bounded. Price fixing derived from collusion is limited to periods of less than a calendar year —most are limited to a few days a year. In several cases the relevant market is reduced to a subset of the distribution channels.

For the above reasons, economic theory would predict that the price elasticity in the relevant markets is higher in absolute value than the national level elasticity for all sales channels and for longer price increases. Consequently, we can use the national-level estimates of the price elasticity of demand for chicken as lower bounds (in absolute value) for the relevant price elasticity for the assessment. For that purpose, we could even use elasticities for other countries and different periods

Table 4.1 presents different estimates of the price elasticity of demand for chicken. Most are calculated using "almost ideal demand systems" (AIDS) or the Rotterdam method. The variation in point estimates across countries and periods is notable. This variation is probably due to differences in the share of chicken in spending —in turn explained by differences in income, preferences or prices. The methods used in these

44. For greater details see Jehle and Reny (2001), p. 54.

estimates are structural. They identify the price elasticity of different expenditure items through the share of each item in total expenditure, sometimes with cross-sectional data. They do not identify price elasticity by analyzing exogenous changes in prices and therefore their source of identification is not clear.[45]

Table 4.1. Estimates of price elasticity of demand for chicken, nationwide estimates

Study	Country	Analyzed period	Estimation
Chalfant, Gray y White (1991)	Canada	1960-88	-0.72 a -0.91
Capps Oral et al. (1994)	Korea Japan Taipei	1960-88	-0.37 a -0.47 -0.12 a -0.45 -0.15 a -0.28
Chalfant (1987)	USA	1947-87	-0.51
Chalfant (1987)	USA	1947-87	-0.51
Dahlgran (1989)	USA	1950-85	-0.60 a -0.86
Moschini and Meilke (1989)	USA	1967-87	-0.10
Eales and Unnevehr (1993)	USA	1962-89	-0.16 a -0.23
Andreyeva, Long and Brownell (2010)	EE.UU.	1938-07	-0.16 a -2.72
Lin (2012)	EE.UU.	2012	-0.37
Gallet (2012)	EE.UU.[a]		-0.71 a -0.74
Mehta (2003)	India	2002	-0.69
Hayes, Wahl and Williams (1990)	Japón	1965-86	-0.42 a -0.59
Chern et al. (2003)	Japón[a]	2003	-0.66 a -1.08
Golan, Perloff and Shen (2001)	México	1999	-0.40 a -0.64
Erdil (2003)	México	1961-99	-0.22
	OCDE		-0.05 a -0.66
Fernández (2007)	México	1999-05	-0.73 a -0.75

Note: a. Includes meat from other birds.

The lowest estimate for Mexico (in absolute value) is -0.22. The elasticity estimated for Mexico by Erdil (2003) is based on an AIDS system for agricultural products in 25 OECD member countries. The study uses data from the Food and Agriculture Organization of the United Nations for the period 1961 to 1999. The study estimates elasticities for various agricultural products in OECD member countries. The price elasticity of demand for chicken estimated by Erdil (2003) provides a lower bound (in absolute value) for the relevant price elasticity. In addition, few studies for other countries provide lower magnitude estimates.

45. "Natural experiments" (e.g., changes in supply resulting from weather conditions) and "policy experiments" (e.g., changes in excise taxes) are examples of clear sources of identification.

We can also set an upper bound (in absolute value) lower than that expressed in *(2)*. To do so, we first define a "participation constraint": as a result of price fixing, collusion participants cannot have lower profits than in the absence of such behavior.[46]

There are "too large" values of the price elasticity of demand that are not compatible with the participation constraint. To show this, suppose that in the absence of collusion the margin per unit for producers considering colluding is π, p is the pre-collusion price and $0 < \pi < p$. If we define Π as the total profits of the colluding participants (i.e., the margin per unit multiplied by the total units sold), the change in producers' profits resulting from a price increase equal to Δp is:

$$\begin{aligned}\frac{\Delta\Pi}{\Pi} &= \left(1+\frac{\Delta q}{q}\right)\left(1+\frac{\Delta\pi}{\pi}\right)-1\\ &= \left(1+\frac{\Delta q}{q}\bullet\varepsilon\right)\left(1+\frac{\Delta p}{\pi}\right)-1 \qquad (3)\end{aligned}$$

We can therefore define $\varepsilon^\star$ as the threshold for the price elasticity such that the percentage change in profits is positive. The threshold elasticity $\varepsilon^\star$ can be calculated by equaling the right-hand side of expression *(3)* to zero and clearing:

$$\begin{aligned}\varepsilon^\star &= \left(\frac{\pi}{\pi+\Delta p}-1\right)\frac{p}{\Delta p}\\ &= \frac{p}{\pi+\Delta p} \qquad (4)\end{aligned}$$

46. The participation constraint serves to verify that the value of the price elasticity is in a range such that price fixing generates a net benefit for those who participate in it. It does not necessarily mean that the colluding agents must operate as a monopoly. The participation constraint is not informative of how a collusion operates. It only tells us whether, given costs and price elasticity, if it is possible to have higher joint profits by increasing the price

Expression *(4)* indicates that, given the pre-collusion price p and the collusion-derived increment Δp, a higher pre-collusion margin per unit π, implies a threshold elasticity closer to zero (lower in absolute value). Intuitively, a higher pre-collusion margin per unit implies sacrificing more profit for each unit of lost sales. Therefore, consumer sensitivity has to be lower to make the price increase profitable.

With information on pre- and post-collusion prices, and with assumptions about the margin per unit we can establish an upper bound for the absolute value of the price elasticity, i.e. we can calculate the threshold elasticity ε^*.

In combination, the threshold elasticity and the estimates for Mexico define a range of elasticities "compatible" with theory and the evidence. That range is given by the price elasticity of -0.22 estimated by Erdil (2003) and by the threshold elasticity calculated with a "small" but positive unit margin.[47]

The compatible range for the relevant elasticity is defined as follows:

$$-\frac{p}{\pi + \Delta p} \leq \varepsilon \leq -0.2 \qquad (5)$$

By comparing expressions *(2)* and *(5)* it can be seen that the compatible range is totally contained in the feasible range —the latter is wider.

An additional challenge is to determine the average daily expenditure in the relevant market in the absence of collusion, denoted by g. As described below, the available expenditure measurements are based on annual data. Consequently, those measures mix in the same calendar year periods in which there was collusion with periods in which there was no collusion. To solve this challenge, we use price elasticity to calculate daily expenditure in the absence of collusion based on the total annual expenditure in the relevant market, denoted by G:

47. We propose to use the estimate in Erdil (2003) not because we consider it to be more reliable than the rest but simply because, for Mexico, it is the estimate closest to zero, and therefore allows us to consider a wider range of values.

$$g = \frac{G}{d\left(1+\varepsilon\frac{\Delta p}{p}\right)\left(1+\frac{\Delta p}{p}\right)+(365-d)} \quad (6)$$

Where d is the number of days that the practice lasted in the calendar year. For the cases in 2008, a year length of 366 days was used because it was a leap year. Expression *(6)* imposes consistency in the calculations. If the expenditure is not adjusted to incorporate the reaction of consumers in the pricing periods, the relevant price elasticity is implicitly assumed to be unitary, and the use of another elasticity for subsequent calculations would be inconsistent.

4.3. Description of the data

In principle, the information collected in the investigation provides the necessary data to calculate the change in consumer surplus by applying formulas *(1)* to *(6)*. Table 4.2 shows the values of the variables used for each of the cases.

Table 4.2. Baseline data from the case

Case	Annual expenditure in the relevant market (million Mexican pesos)[1]	Days of the collussion	Pre-collusion prices (Mexican pesos per kg)	Price increase resulting from collusion
	G	d	p	Δp
Cancún 2010	143.2	7	29.17	5.83
Chetumal 2010	63.2	285	28.19	6.81
Veracruz 2005	71.3	10	12.50	2.50
Córdoba 2005	7.5	9	10.00	2.00
Veracruz 2007	80.6	7	11.67	2.33
Córdoba 2007	11.2	7	11.67	2.33
Orizaba 2007	1.7	7	11.67	2.33
Veracruz 2008	113.1	14	15.00	3.00
Córdoba 2008	12.7	14	15.00	3.00
Orizaba 2009	15.7	12	16.67	3.33
Córdoba 2009	14.7	12	16.67	3.33
DF and AM 2008	5,012.5	20	16.62	5.38
DF and AM 2009	5,012.5	24	16.62	5.38

The investigation calculated the expenditure in the relevant markets by prorating the chicken sales at state or national level of the participants of the collusion in accordance with the population of each city. In the cases of DF and AM and the state of Veracruz, the percentage corresponding to poultry stores and public markets was also inferred using the 2010 National Survey of Household Income and Expenditure -in those cases other sales channels were excluded.

In the cases of DF and AM and Veracruz, the duration of the practice and the collusion prices $(p + \Delta p)$ come from the publications in the media used by the participants in the collusion. In the cases of Cancún and Chetumal, they come from the minutes of the meetings between the participants in the collusion.

The information collected in the investigation does not include direct evidence of prices in the absence of collusion (p) or increases (Δp). For the DF and AM, the price in the absence of collusion was estimated using data on revenue per kilogram sold. In Chetumal, information from the declarations of those involved in the collusion was used. In the rest of the cases, values were assumed such that the agreement resulted in a 20% increase in price.[48]

In the case files there is no information available to indicate the margin per unit sold for the participants of the collusion prior to fixing prices (π). In the absence of such information, we can assume different scenarios covering the extreme cases.

Table 4.3 shows the threshold elasticities calculated according to equation *(4)* and the data in Table 4.2, also using five-unit margin assumptions: 0.01p, 0.25p, 0.50p, 0.75p and 0.99p.

48. According to the "Technical Criteria for the Imposition of Fines in Antitrust Matters" of the CFC, 20% is a conservative measure for the overcharge that is usually observed in cases of absolute monopolistic practices for successful cartels. These criteria were in force when the CFC issued the resolutions.

Table 4.3. Threshold elasticity under different unit margin scenarios

Case	Pre-collusion unit margin (fraction of consumer price)				
	0.01p	0.25p	0.50p	0.75p	0.99p
Cancún 2010	-4.77	-2.22	-1.43	-1.05	-0.84
Chetumal 2010	-3.97	-2.03	-1.35	-1.01	-0.81
Veracruz 2005	-4.76	-2.22	-1.43	-1.05	-0.84
Córdoba 2005	-4.76	-2.22	-1.43	-1.05	-0.84
Veracruz 2007	-4.77	-2.22	-1.43	-1.05	-0.84
Córdoba 2007	-4.77	-2.22	-1.43	-1.05	-0.84
Orizaba 2007	-4.77	-2.22	-1.43	-1.05	-0.84
Veracruz 2008	-4.76	-2.22	-1.43	-1.05	-0.84
Córdoba 2008	-4.76	-2.22	-1.43	-1.05	-0.84
Orizaba 2009	-4.77	-2.22	-1.43	-1.05	-0.84
Córdoba 2009	-4.77	-2.22	-1.43	-1.05	-0.84
DF and AM 2008	-3.00	-1.74	-1.21	-0.93	-0.76
DF and AM 2009	-3.00	-1.74	-1.21	-0.93	-0.76

In addition to the information gathered during the investigation, we have price data from PROFECO (consumer) and SNIIM (distribution center). These data show apparent differences with the data in the file. Table 4.4 shows a comparison of PROFECO, SNIIM, and collusion prices according to the information in the file. It should be noted that the data from PROFECO include some sales channels different from those considered in the authority's files, and for that reason are not entirely comparable.

PROFECO's prices were calculated as simple averages for the states in which the cities involved in the cases are located and for the year in which the collusions occurred. For DF and MA we considered the price per kilogram of chicken leg only in Mexico City. For the rest of the cases, we consider the price per kilogram of whole chicken in the corresponding state. SNIIM prices are reported for 15 distribution centers. None of these distribution centers are located south of Mexico City. For that reason, for all cases we use the average price in the distribution centers located in Mexico City. In the cases of DF and AM, we considered the average price of leg and thigh. In the other cases we consider the price of the whole chicken.

Table 4.4. Consumer prices, in distribution center and of collusion

Case	Consumer price	Price at distribution centers	Collusion price
	PROFECO	SNIIM	$p+\Delta p$
Cancún 2010	28.22	21.96	35.00
Chetumal 2010	28.22	21.96	35.00
Veracruz 2005	18.61	16.93	15.00
Córdoba 2005	18.61	16.93	12.00
Veracruz 2007	20.32	17.89	14.00
Córdoba 2007	20.32	17.89	14.00
Orizaba 2007	20.32	17.89	14.00
Veracruz 2008	23.96	17.73	18.00
Córdoba 2008	23.96	17.73	18.00
Orizaba 2009	27.75	20.19	20.00
Córdoba 2009	27.75	20.19	20.00
DF and AM 2008	24.75	22.42	22.00
DF and AM 2009	28.37	24.66	22.00

There are several points to note in Table 4.4. First, PROFECO prices are higher than SNIIM prices, which is to be expected because the former are consumer prices, and the latter are distribution center prices. Second, except for Cancún and Chetumal, PROFECO prices exceed collusion prices. Third, except for Cancún, Chetumal, Veracruz (2008) and Cordoba (2008), prices at distribution centers exceed collusion prices. In other words, the prices taken from the advertisements obtained during the investigation are lower than the average prices in the Mexico City distribution centers.

If we take as valid the price differences shown in Table 4.4, price fixing appears to have been effective only in Cancún and Chetumal —consumer and distribution center prices are clearly lower than the collusive price. In the other cases it appears that the collusion may not have affected consumer prices upwards. Although this information is not definitive, it casts doubt on the effectiveness of the collusive agreements. However, it is important to note that absolute monopolistic practices are investigated per se, and not only for their effects on the market.[49]

49. According to Article 53 of the Federal Economic Competition law, absolute monopolistic practices are considered unlawful and consist of contracts, agreements, or arrangements amongst competing economic agents to manipulate prices and production, allocate markets and/or, coordinate bids in tenders. These practices are prosecuted per se with the proof of the purpose of effect due to the harm they generate in consumer welfare.

4.4. Results

Given the differences in prices in Table 4.4, we now present two measures of the impact of price fixing on consumer welfare. For the first measure we assume that the data gathered during the investigation and presented in Table 4.2 are correct and based on them we calculate the change in consumer surplus.

For the second measurement we use the information in Table 4.4 and only consider cases where the collusion price is higher than consumer prices and in distribution centers. This filter leaves us with only the cases of Cancún and Chetumal.

Figure 4.2 shows the results of the first measurement (taking prices from the file information). Each case is presented separately. On the vertical axis is the reduction in consumer surplus in Mexican pesos. On the horizontal axis is the price elasticity. The range is defined by the negative values of the elasticity for which the quantity exchanged would be greater than zero after the price increase. The "compatible" range is bounded at the bottom by the threshold elasticity assuming a margin per unit of 0.01p bounded at the top by a value of -0.22, which comes from Erdil's (2003) study for Mexico in the period 1961-99.

In twelve of the thirteen cases the impact on consumers is higher for elasticities with a lower absolute value. The exception is Chetumal. This apparent anomaly (a higher magnitude price elasticity paired with a higher loss in consumer surplus) is due to the duration of the collusion (285 days in Chetumal and less than 25 days in the other twelve cases).

The duration modifies the relationship between elasticity and impact because the calculations take as fixed the prices with and without collusion as well as the annual expenditure. The latter must be prorated between periods with collusion and periods without collusion. Given the prices, the adjustment variable in the calculations is the quantity exchanged. This implies that, for the same case, the trapezoids describing the loss in consumer surplus under different elasticities have the same height (Δp) but different bases. Higher elasticities (in absolute value) result in higher bases of the trapezoids. Also, the longer the duration of the practice, the larger the base of the trapezoid. This can be shown by noting that the pre-collusion exchanged quantity is g/p and g is defined according to equation *(6)*.

Figure 4.2. Impact on consumers (weights lost) for different values of price elasticity.

Table 4.5 presents a summary of Figure 4.2. Using the highest elasticity (in absolute value) of the compatible range, the sum of the reduction in consumer surplus amounts to 132.2 million Mexican pesos. When considering the elasticity value of -0.22, it amounts to 198.4 million Mexican pesos. Since in the case of Chetumal 2010 the relationship between the elasticity and the change in surplus is the opposite of the rest of the cases, the range for the total change in consumer surplus is wider and goes from 118.4 (sum of minima) to 212.3 million pesos (sum of maxima). In other words, considering the data in Table 4.2, the price fixing had a negative impact on consumers of at least 118.4 million Mexican pesos, and could have been as much as 212.3 million Mexican pesos.

Table 4.5. Change in consumer surplus

	Elasticity	Impact (thousand of Mexican pesos)	Elasticity	Impact (thousand of Mexican pesos)
Cancún 2010	-4.77	293	-0.22	535
Chetumal 2010	-3.97	24,034	-0.22	10,199
Veracruz 2005	-4.76	210	-0.22	380
Córdoba 2005	-4.76	20	-0.22	36
Veracruz 2007	-4.77	165	-0.22	301
Córdoba 2007	-4.77	23	-0.22	42
Orizaba 2007	-4.77	4	-0.22	6
Veracruz 2008	-4.76	470	-0.22	841
Córdoba 2008	-4.76	53	-0.22	95
Orizaba 2009	-4.77	56	-0.22	101
Córdoba 2009	-4.77	52	-0.22	94
DF y AM 2008	-3.00	48,190	-0.22	84,450
DF y AM 2009	-3.00	58,647	-0.22	101,362
Total[a]		**132,216**		**198,443**

a. The sum of maximums amounts to 212,277 thousand Mexican pesos, while the sum of minimums amounts to 118,382 thousand Mexican pesos.

Table 4.6 presents the results for the Cancún and Chetumal cases taking as non-colluding prices the consumer prices according to PROFECO in Table 4.4 (the graphical version of the results is omitted as they are very similar to those in Table 4.2). Since we use different pre-collusion prices, the threshold elasticity changes slightly with respect to Table 4.5 (although we still assume a unit margin equal to 0.01 of the consumer price). With the higher elasticity, the sum of the change in surplus is 24.2 million Mexican pesos, while with the -0.22 elasticity it amounts to 10.8

million Mexican pesos. The total loss in consumer surplus lies between 10.5 (sum of minima) and 24.5 million Mexican pesos (sum of maxima).

Table 4.6. Change in consumer surplus using additional price information

	Elasticity	Impact (thousand of Mexican pesos)	Elasticity	Impact (thousand of Mexican pesos)
Cancún 2010	-4.00	349	-0.22	640
Chetumal 2010	-4.00	23,892	-0.22	10,151
Total		**24,242**		**10,791**

To put the results in perspective, we can express them as the additional household spending that the price fixing would have generated if (instead of being limited to a few days) it had lasted for a year. Assuming a per capita chicken consumption of 25 kilograms (Salazar et al. 2005), a household of four, and an average price per kilogram of 15 Mexican pesos, the price fixing would have resulted in an increase of between 158 and 468 Mexican pesos in annual household expenditures.[50]

4.5. Conclusions

Despite not having estimates of price elasticity in the relevant markets, it is possible to approximate with reasonable assumptions the impact of price fixing on consumers, from the point of view of economic theory. Our results imply a clear impact in the Cancún and Chetumal cases of at least 10.5 million Mexican pesos and up to 24.5 million Mexican pesos. In the other cases it is not clear whether the collusive prices documented during the investigation implied an increase relative to prices in the absence of collusion.

Based on the price changes used by the competition authority, the impact on consumer welfare is at least 118.4 million Mexican pesos and up to 212.3 million Mexican pesos.

50. Using the notation of equation (1), the figure was calculated as: $[\Delta EC/(g\times d)]\times 25\times 4\times 15$. We consider the minimum and maximum values resulting from doing the calculation for each case.

The calculations presented have several areas of opportunity. They could be improved if there was more information on chicken consumption by locality and by period of the year, and if more granular information on prices in the relevant channels was available -e.g., poultry stores and public markets. In addition, the range of price elasticities considered could be further narrowed with information on pre-collusion unit margins. However, it is not foreseeable to obtain such information.

4.6. Bibliography

Andreyeva, T., Long, M. W., & Brownell, K. D. (2010). The Impact of Food Prices on Consumption: A Systematic Review of Research on the Price Elasticity of Demand for Food. American Journal of Public Health, 216-222.

Capps, O., Tsai, R., Kirby, R., & Williams, G. W. (1994). A Comparison of Demands for Meat Products in the Pacific Rim Region. Journal of Agricultural and Resource Economic, 210-224.

Chalfant, J. A. (1987). A Globally Flexible, Almost Ideal Demand System. Journal of Business & Economic Statistics, 233-242.

Chalfant, J. A., Gray, R. S., & White, K. J. (1991). Evaluating Prior Beliefs in a Demand System: The Case of Meat Demand in Canada. American Journal of Agricultural Economics, 476-490.

& Tokoyama, Y. (2003). Analysis of food consumption behavior by Japanese households. FAO - ESA.

Dahlgran, R. A. (1986). Is U.S. Meat Demand In Equilibrium? In R. C. Buse, The Economics of Meat Demand: Proceedings of the Conference on the Economics of Meat Demand (pp. 187-200). Wisconsin.

Eales, J. S., & Unnevehr, L. J. (1993). Simultaneity and Structural Change in U.S. Meat Demand. American Journal of Agricultural Economics, 259-268.

Erdil, E. (2003). Demand systems for agricultural products in OECD countries. The Middle East Technical University.

Fernández, A. M. (2007). Estimación de sistemas de demanda de carne. [Estimates of meat demand systems] Undergraduate Thesis. Instituto Tecnológico Autónomo de México.

Gallet, C. A. (2012). A Meta-Analysis of the Price Elasticity of Meat: Evidence of Regional Differences. Business and Economic Research, 14-25.

Golan, A., Perloff, J. M., & Shen, E. Z. (2001). Estimating a demand system with nonnegativity constraints: Mexican meat demand. Review of Economics and Statistics, 541-550.

Hayes, D. J., Wahl, T. I., & Will, G. W. (1990). Testing restrictions on a model of Japanese meat demand. American Journal of Agricultural Economics, 556-566.

Jehle, G. A., & Reny, P. J. (2001). Advanced Microeconomic Theory.

Lin, B.-H. (2012). Food Demand Analysis. Economic Research Service, USDA.

Mehta, R., Narrod, C. A., & Tiongco, M. M. (2003). A case of Indian poultry sector. In C. L. Delgado, C. A. Narrod, & M. M. Tiongco, Livestock industrialization, trade and social-health-environment impacts in developing countries: a case of Indian poultry sector. FAO, Corporate Document Repository.

Moschini, G., & Meilke, K. D. (1989). Modeling the pattern of structural change in US meat demand. American journal of agricultural economics, 253-261.

Salazar, A., Mohanty, S., & Malaga, J. (2005). 2025 vision for Mexican chicken consumption. International Journal of Poultry Science, 292-295.

ASSESSMENT CONCLUDED IN 2017

5. Ex post assessment of a merger in the public service market for rail freight transport in Mexico

Jorge Omar Moreno Trevino

5.1. Introduction

The present study examines the empirical evidence for the ex post measurement of the impact on various market performance indicators caused by the change in the concentration in suppliers observed in the public rail freight transport service in Mexico between 2000 and 2016, particularly considering November 2005 as the relevant date to measure this change.

The market performance indicators studied in the present document include the size and usage of the network, concentration in access and usage of the network, relevant fees at the national and company level, indicators of industry market margins, as well as welfare costs derived from the pricing practices observed in this industry.

The ex post impact effects on the different performance indicators potentially derive from the reconfiguration in the organization of the suppliers participating in the relevant market, particularly as a result of the events derived from: i) the acquisition of "Ferrosur S.A. de C.V." (FERROSUR), a company originally indirectly controlled by "Grupo Carso", by "Infraestructura y Transportes Ferroviarios, S.A. DE C.V." (ITF) and Líneas Ferroviarias de México, S.A. de C.V. (Líneas Ferroviarias), to centralize its administration in "Infraestructura y Transportes de México, S.A. de C.V." (ITM), a company indirectly controlled by "Grupo México"; and ii) the subsequent sale of shares of "ITM" by "Grupo México" to "Grupo Carso" in order to consolidate "ITM" as a participant with potential preponderance in the freight railroad transportation service market.

The higher concentration of suppliers in the market derived from the above financial actions reduced the level of competition within the industry and potentially could have led to the following adverse effects: 1) higher effective prices to the demander of the service provided by the railroad network, and 2) restriction and lower access to the network as well as a reduction in the growth of the service. These effects could have indirectly affected the efficiency and productivity level of those industries that demand and require this input, through production costs.

Due to the nature of the railway industry as a provider of a transport service integrated into the production process of other economic sectors, its analysis must be differentiated from a final good or service, whose demand is directly linked to consumer welfare. That is, the effects of the railway industry may indirectly affect the supply of intermediate goods and services, and successively the prices of final goods and services available to the consumer. Given the above, this study develops a methodology that is appropriate to the availability of information and that considers only the direct impacts of the railway industry on the other productive sectors, and therefore, said impacts are indicators of minimum expected effects on welfare, since the overcharge in each economic sector that uses the transport service would induce second-order impacts depending on the final demand in each industry.

The analysis proposed in this document follows the industrial organization approach defined under the classic analysis of "structure-behavior-performance" (SCP hereinafter)[51], that is, part of first defining the study market, the fundamental conditions of the market, the characteristics of competitors offering and consumers demanding the relevant product or service, the behavior of the participants in terms of market strategies, the analysis of some key market performance indicators derived from the behavior of the participants, to conclude with the relevant policy recommendations.

In this case, the study of these dimensions aims to identify the "**before**" and "**after**" of the operations linked to the highest concentration of suppliers, and, whenever possible, to propose a **counterfactual scenario** with the available information showing the main levels in perfor-

51. See Cabral (2000) and Church and Ware (2000) for more information on the use of this approach.

mance indicators that would have prevailed in the absence of such reorganization and concentration of participants, given the conditions and trends of the market studied. However, as we will observe in later sections of this document, a fundamental component of the market structure (initial condition for the analysis of this approach) is determined by the strong government regulation of the entry of new concessionaires into the market.[52] This allows to identify the original sources of market power, and the potential channels to increase the competitiveness of the market using different public policy tools, beyond the corrective ones in performance.

In the case of Mexico, given the series of financial operations carried out in November 2005 and which resulted in a reconfiguration of the structure through the participants, and a greater concentration in the number of suppliers within the market in the rail freight industry, the following particular objectives are identified for the present study:

i. To establish whether there is statistical evidence of a structural change in the evolution of the structure of concentration in the provision of the public rail freight service.
ii. To identify the relevant prices (fees) of the public rail freight service in Mexico and analyze whether the concentration had an impact on their levels and evolution.
iii. To propose and estimate market performance metrics complementary to the price, to incorporate the characteristics of "economies of scope" and "network economy", associated with this service. That is, to study the cost dynamics of the sector, integrating the potential gains or losses of efficiency derived from the greater concentration of suppliers in the market under analysis.
iv. To isolate and quantify the impact of the increased concentration on the rail sector price index once the cost effect is eliminated. This will be done through an approximate average markup in prices, using absolute price metrics and prices relative to other inputs.

52. For example, Cabral (2000) points out that according to the regulatory policy approach of the "Chicago School" school of thought, the causality between the structure and the action of government goes in the opposite direction to that typically established in the traditional study: that is, strong regulation can create conditions conducive to companies acquiring market power to the detriment of the consumer (see Chapter 1, Pag. 10).

v. To propose and estimate measures of the impact on welfare derived from the higher concentration observed after the operations mentioned above; in particular seeking to identify the impact on costs and competitiveness of the industry.

Each of the above points will be analyzed considering the available evidence on the pre-concentration and post-concentration conditions, estimating the effect value corresponding to the market performance indicator and welfare according to the corresponding statistical or econometric method.

This document comprises six sections including this introduction. The second section describes the elements of the market and the particular characteristics of the rail freight transport sector in Mexico. The third section describes the components of the case study, in particular the nature of the operations that resulted in a higher concentration of suppliers in the market to study. The fourth section presents the methodology of impact analysis, as well as the empirical limitations faced by a study of this type given the requirements of desirable information and the nature of the existing information. The fifth section constructs the relevant impact hypotheses and estimates the effects of the greater concentration in four areas: use of the railway network, prices charged for the service, implicit costs of the rail freight sector, and finally indicators associated with the competitiveness of the companies analyzed. The sixth section concludes the investigation and presents some recommendations to improve the conditions of competition of the industry given the background and conditions of the environment in which this service operates.

5.2. Elements of the railway freight transport industry in Mexico

5.2.1. The analyzed market

This first section defines the three dimensions to be considered in the definition of the market analyzed in this study: the specific description of the product or service analyzed, the geographical dimension of analysis, and the temporality to be studied.

Product or Service: The public service of rail freight transport, defined as that which is provided on railways intended for the carriage of goods, including the service of dragging third-party vehicles, can be developed by linking localities on the line of each railway or its lines can serve as transit routes to other railways. The market is interrelated through the different service providers, which forms an integral system with several interconnection points, origin and destination routes that are part of the national railway network.

Geographical Dimension: National, considering the coverage and available infrastructure networks of the railway network throughout the country, as well as the access and intensity of use of the same.

Temporality: The period between 2000 and 2016 will be considered, depending on access to relevant information and data in each section. In particular, a natural partition is made into two periods: the period prior to the concentration (pre-concentration, this is before November 2005, or before the year 2006 if the information accessed is annual), and after the concentration (post-concentration, December 2005, or January 2006, inclusive of that date to the most current data available).

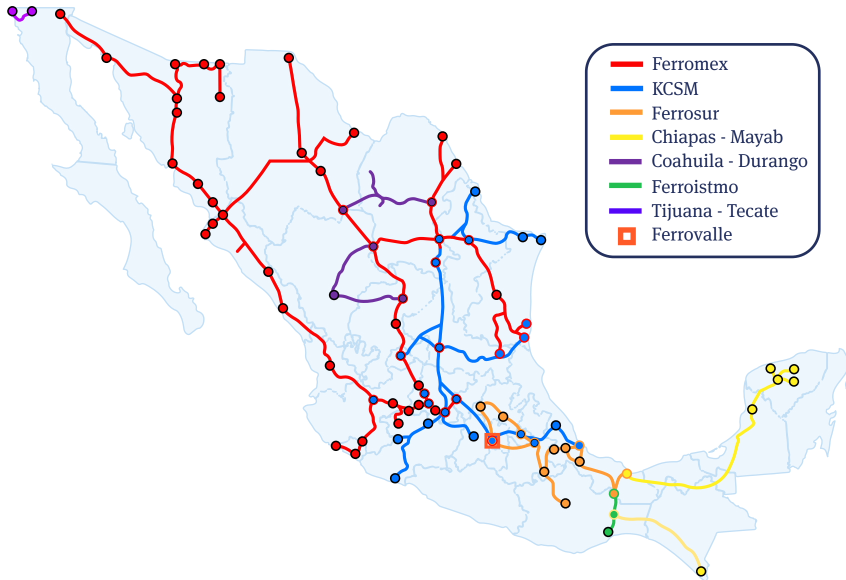
5.2.2. Elements and infrastructure of the railway network in Mexico

The infrastructure base on which the railway transport service is provided is made up of the railroad tracks of the network distributed in the different routes operated throughout the national territory.

According to recent data from COFEMER (2015), the length of the railway tracks in the country has not had significant changes in the last fourteen years: while in 2000 there were 26,655 kilometers (km) of railway tracks built, by 2014 the figure amounts to 26,727 km of which 20,722 km (77.5%) correspond to main and secondary tracks, 4,449.9 km, (16.6%) to auxiliary tracks (yards and slopes) and, finally, 1,555.1 km (5.8%) to private tracks. Following this information, of the total of 26,727 registered kilometers of railways built in 2014, 17,197 km (64.34%) correspond to concessioned main and secondary tracks, of which 47.22% (8,121 km) are concessioned to Ferrocarril Mexicano S.A. de C.V. (FERROMEX), 24.72% (4,251 km) to Kansas City Southern México S.A. de C.V. (KCSM), 10.10% (1,737 km) to Ferrosur, S.A. de C.V. (FERROSUR) and 9.01% (1,550 km) to Compañía de Ferrocarriles Chiapas-Mayab, S.A. de C.V. (CF-CHM). (See Figure 5.1).

This means that FERROMEX and FERROSUR jointly operate 57.32% (9,858 km) of the total primary and secondary railway lines under concession in the country.

Figure 5.1. Length of railway tracks and distribution of routes in Mexico, 2016



Source: PROMÉXICO (2016) and Secretaría de Comunicaciones y Transportes [Ministry of Communications and Transport] (2015).

On the other hand, in Mexico, 55% of the volume of cargo and 81% of its value was moved by motor transport in 2016, while the railway only transported 12.6% of the cargo and 6% of its value. As an international reference, in the United States the distribution of cargo has a share of 49% for ports, 34% for motor transport and 16% for rail.

5.2.3. Regulatory law, tender, and current concessions

In Mexico, the Regulatory Law of the Railway Service (LRSF) in force since 1995[53], establishes that the general communication routes remain under the control of the federation, in order to guarantee the sovereignty of the country and the control of the State over the railways. Concessions must be granted through public tender, for a term not to exceed 50 years, and may be extended. At the end of them, the railways return to the patrimony of the Nation to be reassigned in a new bidding process.

53. The latest reform to this law was published in the Official Gazette of the Federation (DOF) on November 6, 2020.

Likewise, the companies participating in the market must be Mexican legal entities, although foreign investment is allowed for up to 49%, or higher after a favorable resolution of the National Foreign Investment Commission.

Thus, to facilitate the bidding process for routes, in September 1995 the National Railways of Mexico were separated into five regional units that would be managed independently from the operational, accounting, budgetary and financial point of view. Thus, the following entities were created: the Northeast Railway, the North Pacific Railway, the Southeast Railway, the Chihuahua to the Pacific Railway and the Terminal Railway of the Valley of Mexico.

According to a study prepared by Gorostiza (2011)[54], in Mexico the history and sequence of railway concessions to these entities took place as follows:

- **Kansas City Southern Mexico Railroad (KCSM)** On August 6, 1996, the call for the concession of the Northeast Railroad was published in the DOF. Initially there were several interested parties. Finally, only three of them remained: the first formed by ICA, Union Pacific and SBC International Railways; the second, Grupo México, through its subsidiary *Grupo Ferroviario Mexicano* (GFM); and the third adopted the name *Transportación Ferroviaria Mexicana* (TFM), integrated by *Transportación Marítima Mexicana* (TMM), along with the U.S. railroad *Kansas City Southern Lines Industries* (KCSI). On December 2, 1996, the concession to provide freight transport was awarded to the latter group. *Transportación Ferroviaria Mexicana* (TFM) began operations on June 26, 1997, as a private company. After two years of negotiations, on April 1, 2005, and with the authorization of the Federal Competition Commission and the National Foreign Investment Commission, KCSI acquired all the shares of TFM, changing its corporate name to *Kansas City Southern Mexico* (KCSM), as it is currently called.
- **Ferrocarril Mexicano (FERROMEX)** To participate in the tender for the North Pacific Railway, the company *Grupo Ferroviario Mexicano* (GFM), whose majority shareholder was *Grupo México*, and two minority part-

54. Gorostiza, Francisco J. (2011). "Renaissance of Mexican rail freights: balance of privatization to the year 20120". Study for the Mexican Association of Railways. September 2011.

ners, ICA and the North American railroad Union Pacific (UP), were integrated. The presentation of technical and economic proposals was on 19 June 1997. There was a second interested group, made up of Tribasa, Itisa and Railtex, which decided to leave the contest. After verifying that it complied with the requirements established in the bases and that its proposal exceeded the amount set by the Secretariat of Communications and Transportation (SCT), the tender was awarded to the aforementioned GFM. In that same year, ICA sold its shareholding to UP. *Ferrocarril Mexicano*, known as FERROMEX, began operating as a private company on February 19, 1998.

- **Ferrocarril del Sureste (FERROSUR)** The *Ferrocarril del Sureste* was the last of the trunk lines offered in a tender to the private sector. On February 18, 1998, the call and the respective rules were published. Finally, after the withdrawal of ICA, two interested parties remained: the first, a group composed of the *Grupo Acerero del Norte* (GAN), *Industrias Peñoles* and the Illinois Central Corporation, owner and operator of railroads in the USA; and the second, the Mexican company *Triturados Mexicanos* (TRIBASA). The railway concession was awarded on 30 June 1998 to TRIBASA. On December 18 of that year it began its operations under the name of FERROSUR. The call included as part of the business the short track Coatzacoalcos-Mérida, which was then called "*Ferrocarril del Mayab*", whose exploitation and operation could be waived, and in practice was waived by the winner of the tender. At the end of 1999, *Grupo Carso* acquired the rights to that concession and in November 2005 *Grupo México* obtained 75% of FERROSUR's shareholding. The formal merger of the latter railway with FERROMEX was not in principle authorized by the CFC. However, the two railways operated efficiently through operational coordination agreements[55]. In February 2011, *Grupo México* and KCSM signed an agreement on additional rights of way and trawling for various sections in the states of Puebla and Tlaxcala, as well as the infrastructure of the port of Veracruz, all in exchange for the acceptance of the aforementioned merger.

55. On March 25, 2011, the First Collegiate Court in Administrative Matters of the Capital of the Republic, decided to dismiss the appeal for review filed by the now defunct CFC against the judgment of the plenary session of the Federal Court of Fiscal and Administrative Justice, in favor of the operation, so that the matter of unification between FERROMEX and FERROSUR must be understood as definitively approved.

- **Ferrocarril Terminal del Valle de México (FERROVALLE)**, In the tender for the three regional trunk railways, the obligation was established to deliver to each of the winners, the ownership of 25% of the capital stock of FERROVALLE for the joint provision of train reception and formation services, as well as classification, collection and delivery of cars, in an area of high traffic density and complex operation. Its facilities included the intermodal yard of Pantaco. On April 30, 1998, the company was formally handed over to TFM and FERROMEX, pending the tender for the Southeastern Railway. The remaining 25% of the shares were reserved for the Suburban Passenger Railway that was contemplated to be part of the Mexico-Queretaro's electrified double track. To date, this last shareholding remains in the hands of the Federal Government.
- **Isthmus of Tehuantepec Railway (FIT)**. The Isthmus of Tehuantepec Railway was an exception in the model for opening Mexican railroads to the private sector. In consultation with the deputies and senators of the Republic, it was warned about the political and social risks involved in leaving this project to private agents, due to its strategic nature and the possible dangers to sovereignty, if foreign investment is allowed. For this reason, it was decided to convert the railway into a state-owned company, responsible for the track and its maintenance, as well as the control of the dispatch of the trains. Private concessionaires of other companies, through rights of way, would have access to provide cargo and passenger services on the route. With the authorization of the Ministry of Finance and Public Credit, on October 19, 1999, the company *Ferrocarril del Istmo de Tehuantepec, S.A. de C.V.* was established.

Finally, with respect to the current regulations on fees and prices of the service, the LRSF establishes that the deregulation process allows for freedom in the establishment of fees by the concessionaire companies, and only if COFECE determines that effective competition conditions do not exist, the SCT may establish specific regulation for the sector.

5.3. Elements of the case study by higher concentration

According to File CNT-132-2005 and Technical Sheet CNT-132-2005 attached to this file, the following economic agents linked to the market analyzed in this study and to the operations that gave rise to the highest concentration in the railway market are described:

1. *Grupo México, S.A. de C.V. (Grupo México):* Indirect controller of the acquiring company. It is a Mexican company that controls shares of companies engaged in the exploration, exploitation and processing of metallic and non-metallic minerals, coal mining, as well as the multimodal freight railway service.
2. *Infraestructura y Transportes de México, S.A. de C.V. (ITM):* Controller of the acquiring company. Mexican company whose corporate purpose is to promote, build, organize, exploit, acquire and take participation in the capital stock or equity of all types of commercial or civil companies, associations or enterprises.
3. *Infraestructura y Transportes Ferroviarios, S.A. DE C.V. (ITF):* Acquirer. Mexican company whose corporate purpose is to promote, build, operate, organize and manage Mexican companies or companies of any other nationality, whose purpose may be the provision of rail freight, passenger, multimodal and auxiliary services, among others.
4. *Líneas Ferroviarias de México, S.A. de C.V. (Líneas Ferroviarias):* Acquirer. Mexican company controlling shares of companies dedicated to the provision of transportation services on general communication routes.
5. *Ferrocarril Mexicano, S.A. de C.V. (FERROMEX):* Subsidiary of the acquiring company. Mexican company engaged in providing the multimodal railway freight service and ancillary services, as well as any activity that directly supports and is related to said object, including any activity that is complementary to railway transportation services.
6. *Grupo Carso, S.A. de C.V. (CARSO):* Controller of the selling companies. Mexican holding company of a group of companies, whose main activities are developed in the following industries: tobacco; mining and metallurgy; hotels; in the operation of specialized personal computer, department, gift and record stores; restaurants and pastry shops; manufacture and sale of bread and pastries; public freight transport service; production and sale of products derived from copper and its alloys; production and sale of ingots, sheet, foil and other aluminum products; production of electric conductor cables; production and sale of ceramic coatings and administration of shopping centers.

7. *Sinca Inbursa, S.A. de C.V., Sociedad de Inversión de Capitales (SINCA INBURSA):* Seller. Mexican company dedicated to investing in shares and securities issued by Mexican corporations that require long-term resources.
8. *Grupo CONDUMEX, S.A. de C.V. (CONDUMEX):* Seller. Mexican company controller of shares of companies engaged in the manufacture and marketing of products for the markets of the telecommunications, automotive, energy and construction industries; it also participates in the metallurgical mining and rail freight transportation industry.
9. *FERROSUR, S.A. de C.V. (FERROSUR):* Acquired. Mexican company whose main activity is the provision of the public freight and multimodal rail service, as well as any complementary activity of this service.

During November 2005, two financial operations were carried out that radically modified the structure of bidders in the market of the public rail transport service in Mexico, which are described below:

Operation 1:

On 24 November 2005, ITF notified the operation consisting of the acquisition by ITF and *Líneas Ferroviarias* of 100% of the shares representative of the capital stock of Ferrosur, which were owned by CONDUMEX and SINCA INBURSA (ref. exp. CNT-132-2005). On 25 November 2005, ITF's legal representative submitted a supplementary letter informing the CFC that the notified transaction was closed on 25 November 2005.[56] (See Figure 5.2).

Operation 2:

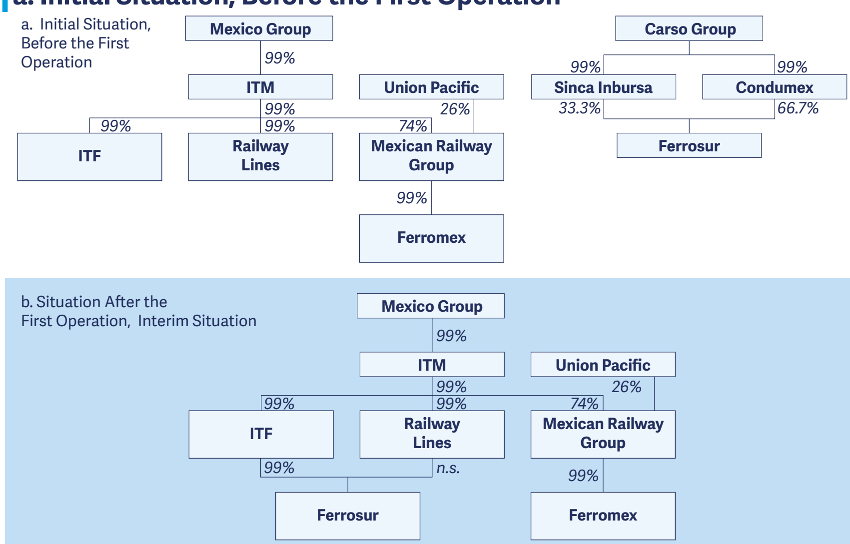
On November 25, 2005, ITM notified the operation consisting of the acquisition by Grupo Carso and SINCA INBURSA of up to 25% of the representative shares of the capital stock (ref. exp. CNT-134-2005). Also, hours after having notified, the legal representative of ITM submitted a supplementary letter in which he informed the CFC that he had closed the notified operation. (See Figure 5.3).

56. The notified transaction updated section I of Article 20 of the abrogated LFCE, since the amount of the operation was 3,260 million pesos, an amount greater than 12 million times the general minimum wage in force for the Federal District in 2005, equivalent to 561.6 million pesos.

On 13 December 2005, ITM and ITF were notified of agreements informing them that the merger notifications in dossiers CNT-132-2005 and CNT-134-2005 constituted a succession of acts, and it was therefore ordered that the files be joined (ref. CNT-132-2005 and cumulative) and were required to appoint a common representative.

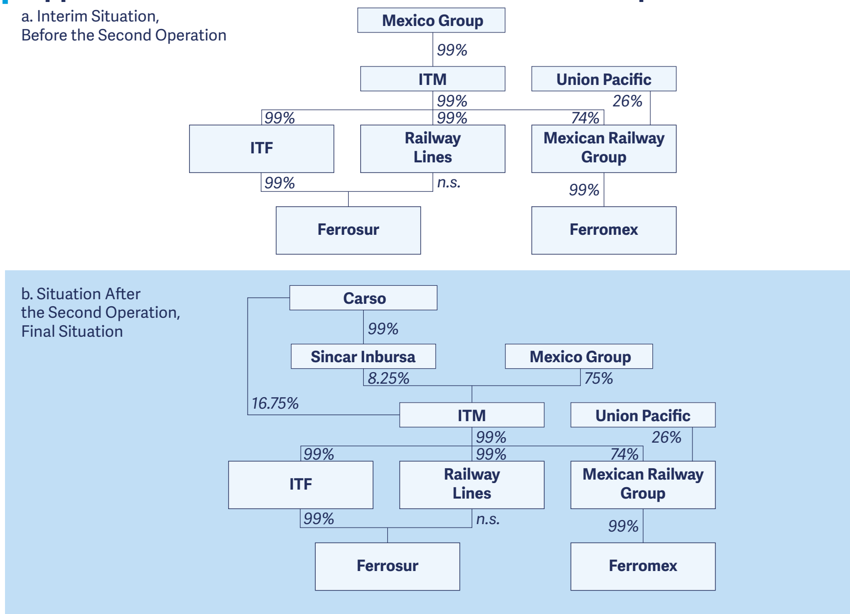
In order to meet the objectives of the study, the following sections analyze the behavior of the following market indicators: absolute prices of the service, service prices relative to other transport inputs, indirect transmission at costs and productivity of the companies that demand the service, as well as in the size, growth, and concentration of use, access points and routes of the railway network. Finally, to measure the impact on the aggregate real sector, growth in costs is estimated for the entire economy derived from the higher margin of the railway sector, and the distribution of this load among the different productive sectors that demand the railway freight service.

Figure 5.2. Evidence on First Operation of Concentration of Bidders
a. Initial Situation, Before the First Operation



Source: CFC, 2005. Technical Data Sheet CNT-132-2005.

Figure 5.3. Evidence of the Second Concentration Operation of Suppliers a. *Interim* Situation, Before the Second Operation



Source: FC, 2005. Technical Data Sheet CNT-132-2005.

5.4. Methodological framework

Efficiency considerations and industrial organization

The case of the railway freight industry requires a potentially differentiated analysis from that of other industries whose production is concentrated in the provision of final goods, and where market demand is a function solely of the final buyer of the good or service analyzed.

This differentiation is mainly due to the following factors: 1) the freight railway service is an intermediate input of production potentially anchored to the efficiency and productivity of other industries and economic sectors of the country, 2) the geographical dimension of the relevant market is national and extends throughout the network, therefore it is not possible to differentiate it by zones since, given the concessions, these constitute regional monopolies by definition, 3) there are natural access and entry barriers to the sector, particularly due to the high operating costs, the operating rules of the concessions that limit the number of bidding participants, long licenses, state ownership of railway lines, and 4) due to the nature of freight railway service, there are potentially economies in scope (decreasing average costs in providing services across multiple sectors) and network economics (decreasing average costs in number of routes and access to them).

Therefore, it is important to differentiate three concepts that will be fundamental in this impact study of the greater concentration in the number of suppliers in the railway freight transport sector: **efficiency** of the industry, **competitiveness** of the industry and the existence of **effective competition** in the industry.

The structure of an industry is **efficient** to the extent that the organization of its participants, the investment in technology, and the coordination of productive processes make it possible to carry out product supply activities at the lowest possible cost to society; that is, each unit produced is achieved with the combination of inputs that would be technologically preferred by society at the lowest opportunity cost in terms of its alternative uses.

On the other hand, Shy (1995) defines the **competitive behavior** of a seller or buyer (hereinafter agent) if this assumes or believes that the market price is given and the actions of this agent do not influence the market price. The author established that the competitive behavior is independent of other market conditions, such as the number of suppliers and demanders, and concentrates solely on the use of prices as a signal to integrate information into their decisions.

In this case, at the extreme limit of a competitive market structure are the market conditions associated with the perfect competition model of an industry, among which, following the analysis of Carlton and Perloff (2000), the following assumptions of that market structure are distinguished:

i. Relatively homogeneous product offered by all sellers.
ii. Perfect information about the benefits and utilities that all participants receive from owning each product or service offered.
iii. A large number of participants, both in market supply and demand, all willing to sell and buy at the same market price given for everyone.
iv. There are no transaction costs in addition to the price.

v. There are no market externalities, that is, there are no costs or benefits that are not reflected in the market price. In other words, there are no scale or networks effects on the production and consumption of the good.

vi. There are no barriers to entry or exit from the market, therefore there is free access to complementary and substitute inputs and products.

vii. Perfect severability of the product or service offered.

This, together with well-defined physical property rights and intellectual property, perfect mobility of factors between industrial sectors, and the assumption that supplier companies maximize their net income from production costs and consumers have demands that come from a process of rational optimization of their consumption patterns, constitute the basis of behavior under perfect competition. As a result of this behavior, we have that consumers and producers are price takers, that is, the only market price contains all the information they need to decide their consumption and production strategies, and each of them cannot unilaterally affect the market price for its own benefit. In addition, under perfect competition all participating firms sell the products they offer at the marginal cost of production, i.e., no firm operating in the market presents extraordinary benefits to production costs.

According to Clark's (1940) classical approach, an industry rarely presents conditions where competition is perfect, and he proposed the alternative definition of effective competition in an industry. Currently, the definition proposed by Sheperd (2000) and more recently Jiménez Espriú (2016)[57] establish at least the following conditions necessary to evaluate effective competition:

1. There are a number of demanders and suppliers in the market to be studied large enough (at least 5), which prevents them from coordinating in their decisions to achieve better buying and selling conditions.

57. See: Jiménez Espriú, Javier. (2011) "Las concenciones en materia de telecomunicaciones" [Concessions in matters of telecommunications] Consulted at: https://archivos.juridicas.unam.mx/www/bjv/libros/7/3043/6.pdf.

2. There is no dominant company. According to empirical studies derived from the Structure-Conduct-Performance paradigm, this is equivalent to having between 40% (Stigler, 1947) and 60% (Williamson, 1972) of market share (see Jiménez Espriú, 2016).
3. There is no significant cost of entry or exit into the market, both for suppliers and demanders of the product or service.
4. The product or service offered by the sellers is primarily homogeneous and similar.
5. Therefore, each and every one of its participants, suppliers and demanders, are small enough not to unilaterally affect the price of the product or service provided for their own benefit.

That is, in economics and industrial organization, competitiveness refers exclusively to the lack of capacity of an economic agent to strategically determine unilaterally the final price in the market under study and has nothing to do with other supply conditions.[58]

A second model of industrial organization is oligopoly. This exists when there are few companies selling a similar product but, unlike the competitive case, these companies can raise their prices without losing the total of their consumers, this ability of the company to unilaterally modify its price is called "market power". In this model there are barriers to entry that hinder new companies from entering the market.

The last main model within the economy is monopoly. In this, there is only one company that is the only seller of a product without substitutes, for this reason, the company has a stronger market power than in the oligopoly. In the monopoly there are also barriers to entry that prevent free entry to the market, but prices are set above the marginal cost of production, generating potential efficiency losses.[59]

In this way, after analyzing the different previous models, the analysis question arises: In which model is the railway sector industry? The answer is that despite the homogeneity of the product offered (freight

58. According to the World Economic Forum (2010), in other industrial and business contexts, the concept of competitiveness refers to the ability to generate the highest satisfaction of consumers setting a price or the ability to offer a lower price once a certain quality standard has been set. In this way, it is assumed that the most competitive companies will be able to assume greater market share at the expense of less competitive companies, if there are no deficiencies that prevent it either in national or international markets.
59. An exception is the case of monopoly with perfect discrimination, see Carlton and Perloff (2000), Chapter 4 for a more extensive explanation on the subject.

transport), but due to the presence of companies representing a high percentage of the relevant market, the high natural entry barriers for this industry, the lack of competitors, and the high cost of changing rail transport for an alternative such as motor or air transport there is evidence to rule out that in the railway transport industry there is effective competition in the sense described by traditional models.

However, hypothetically the railway sector could achieve an economic efficiency with lower costs and their respective translation into production levels together with balanced fees that benefit society as a whole, remembering that few companies do not mean that there is a lack of competition. Thus, efficiency gains due to a reduction in production cost in the rail freight transport service must be accompanied by lower prices.

In this way, the metrics to be studied in this study will refer to the net gains and losses associated with the greater concentration of suppliers, which operate in a market environment where there is no effective competition.

5.4.1. The freight transport railway industry as an intermediate input

The market of the freight transport railway industry differs from that of a final consumer good essentially in that it constitutes a production input, and therefore its market demand depends on the productivity and importance of the service in the other industries.

Therefore, this section briefly presents the market fundamentals of the freight transport railway industry when this is a factor of production.

Suppose that a production industry $k \in \{1,2,...,K\}$ has such a technology that to produce Yk units of product requires "J" inputs $x_j \in \{x_1,...,x_J\}$ therefore, according to neoclassical economic theory its production function is:

$$Y_k = F_k\,(x_{k,1}\,,...,\,x_{k,J}) \tag{1}$$

Under the assumption that industry $k \in \{1,2,...,K\}$ is competitive, i.e., it cannot unilaterally affect the prices and fees at which it contracts each unit x_j of its factors of production $w_j \in \{w_1,...,w_J\}$, for a given level of production of that industry, say Y°_k, the industry chooses the combination of inputs that minimizes its production costs, giving rise to its minimum cost function $c_k(Y^{\circ}_k,w1,...,wJ)$ and the demand of conditional factors in production and prices of the inputs $x^d\ (Y^{\circ},w,...,w)$.This constitutes the system of Hicksian demand functions and the corresponding efficient cost function of the industry.

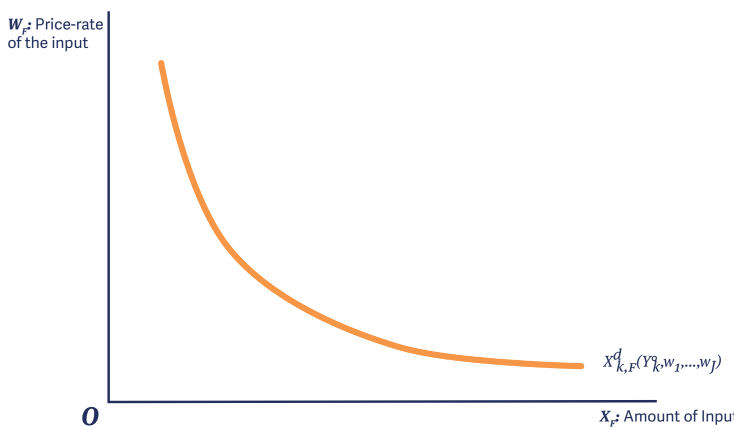
$$c_k(Y^{\circ}_k,w_1,...,w_J)=\sum_{j=1}^{J} w_j x^d_{kj}(Y^{\circ}_k,w_1,...,w_J) \quad (2)$$

$$\begin{array}{l} x^d_{k,1}\ (Y^{\circ}_k,w_1,...,w_J) \\ x^d_{k,2}\ (Y^{\circ}_k,w_1,...,w_J) \\ ... \\ x^d_{k,3}\ (Y^{\circ}_k,w_1,...,w_J) \end{array} \quad (3)$$

Let us define the factor "$x_{k,F}$" as the demand for the input "railway freight transport" and therefore "w_F" is the fee or unit price faced by the industry $k\in\{1,2,...,K\}$ associated with contracting each unit of the input in the relevant market.

When the industry $k\in\{1,2,...,K\}$ faces constant or decreasing returns of scale in production, the demand for each input, in particular the demand of one industry k per service in the freight railway industry, is given by the real value of the marginal product that it generates, and presents a negative slope like any market demand (see Figure 5.4).

Figure 5.4. Conditional demand of the factor of production "railway transport" for an industry "k" in the relevant market



Source: Based on Varian (1992), Nicholson (2004) and Tirole (1988).

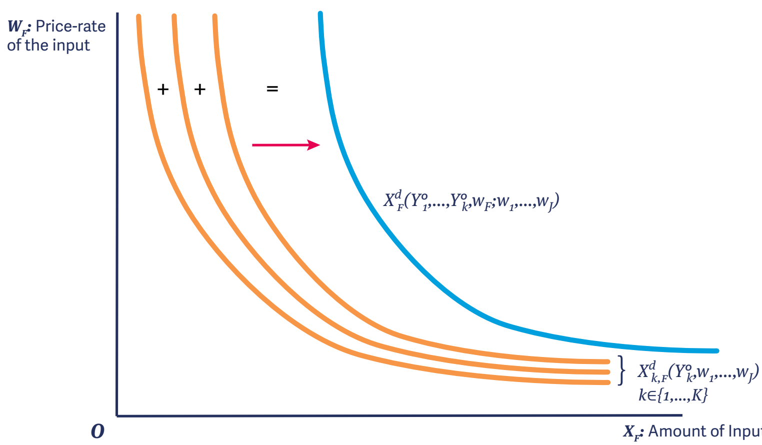
However, the functional form of demand for the production input will depend on the capacity of industry $k \in \{1,2,\dots,K\}$ to replace the rail transport input.

Finally, the aggregate demand for railway freight transport service of the whole economy for railway freight service $x^d_F\,(Y^o_1,\dots,Y^o_K, w_F, w_1,\dots,w_J)$ is the sum of all the individual demands of each individual industry that requires this service, and allows to know the aggregate productivity of the railway input, and the willingness to pay given the needs of the whole economic system for the service:

$$x^d_F\,(Y^o_1,\dots,\, Y^o_K, w_F, w_1,\dots,w_J) = \sum_{k=1}^{K} x^d_{k,F}\ (Y^o_K, w_F, w_1,\dots,w_K) \tag{4}$$

Therefore, the relevant demand is represented by the horizontal sum of all individual demandsand would be conceptually defined by Figure 5.5.

Figure 5.5. Conditional demand of the factor of production "railway transport" for the entire economy in the relevant market



Source: Based on Varian (1992), Nicholson (2004) and Tirole (1988).

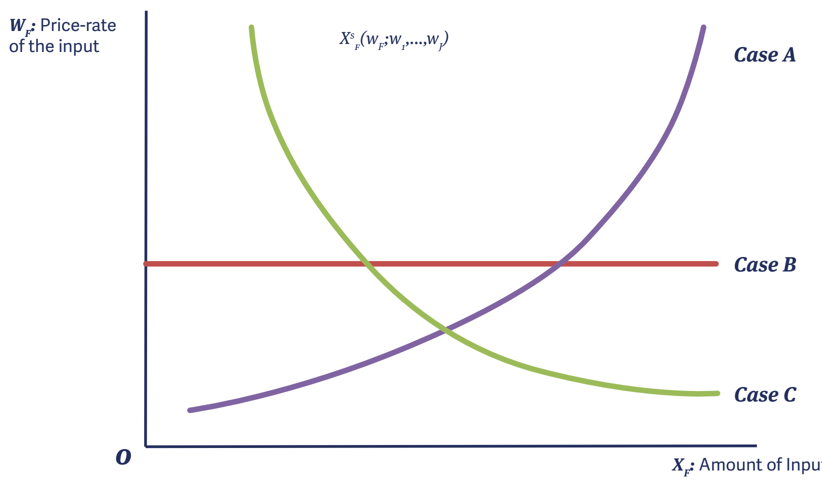
When, on the other hand, the supply of the freight transport service is analyzed, this depends on the railway industry as the provider of that service and also on the technology associated with the production of this input $X_F = F_F(x_1,\dots,x_J)$, of the price it receives when selling on the relevant market wF, and of the prices of inputs required for the production of the rail service offered $w_j \in \{w_1,\dots,w_J\}$; that is, the offer is a function $X^5_F\,(w_F; w_1,\dots,w_J)$.

In this case, if the railway industry behaves competitively while contracting the inputs required for its operation, the supply function $X^5_F(w_F;w_1,...,w_J)$ is identified by the marginal cost of industry production, i.e.:

$$X^5_F(w_F;w_1,...,w_J) = \frac{\partial}{\partial X^5_F} C(w_F;w_1,...,w_J) \tag{5}$$

Thus, analytically we have that the competitive supply curve of the industry will depend on whether we assume decreasing, constant, or increasing returns at scale, that is, whether the marginal production costs of the industry are increasing, constant, or decreasing corresponding to each case (see Figure 5.6).

Figure 5.6. Competitive supply of the factor of production "railway transport" in the relevant input market*/



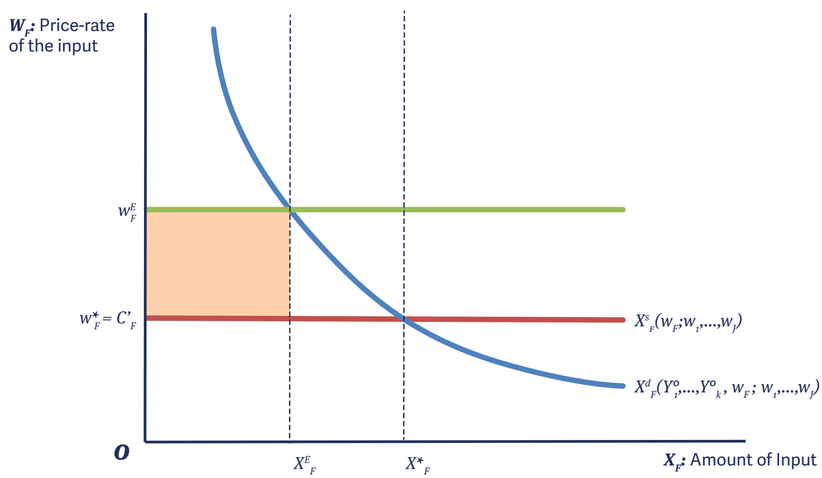
Notes: */ The competitive supply of the industry will depend on whether the associated production costs have diminishing returns at scale (Case A, in "purple"), constant at scale (Case B, in "red") or decreasing at scale (Case C, in "green").
Source: Based on Varian (1992), Nicholson (2004) and Tirole (1988).

A prototypical equilibrium to exemplify the interaction of competitive market forces, and then to obtain elements for analysis is to assume that demand has a negative slope (input demanding industries with constant or decreasing returns to scale) and that the railway industry has constant returns to scale (constant marginal cost).

In this case, the competitive balance of the industry is represented by a price $w^*_F = \frac{\partial}{\partial w^{S}_F} C_F(X_F, w_1, \ldots, w_J) = C'_F$ and by the quantity of service demanded and provided F^*_x defined in Figure 4.2.4.

However, if the railway industry were not competitive as a supplier, it could unilaterally determine the price or fee at which it provides the service to the industries that demand and require rail freights; this means that the effective price that the offeror charges for the service is higher than the marginal cost of production of the service, that is: $WE > C'$ (Figure 5.7).

Figure 5.7. Comparison of equilibria in the railway freight market under a competitive industry and a non-competitive industry, and loss of welfare due to overpricing*/



Notes: */ The surcharge charged depends on the bidder's own objectives, such as increasing revenues, higher profits, or financing industrial activities, among others.
Source: Based on Varian (1992), Nicholson (2004) and Tirole (1988).

Under this non-competitive scenario, the production, supply, and therefore quantity demanded of input equilibrium would be lower $xEF<x^*F$, and there would be a social cost of the practice away from the competitive industry model. This social cost, represented by the region $[o, xEF] \bullet [wEF,]$ is quantifiable in monetary terms and constitutes in an input market the metric equivalent to the loss in welfare associated with the consumer surplus traditionally measured in other industries where the consumer product or service is a final good.

Thus, the potential gains in efficiency of integrating few competitors and reducing production costs must be linked to the prices of the service they offer, and to the potential indirect effects they have on the rest of the economic system by affecting the production costs of other sectors and industries.

5.4.2. Impact analysis: difference, double difference, and counterfactual

The analytical framework proposed in this study is based on the premise of a structural change in the market, particularly derived from the financial operations that reorganized the railway services market by concentrating the number of suppliers. This change constitutes an instrument of analysis that allows to statistically verify whether the performance of the freight railway sector was modified by the reconfiguration of participants.

Given the increasing access to information in the form of databases at the consumer level, recent studies on market concentration impact analysis suggest the need to construct counterfactual metrics that allow the precise identification of the contribution of the potential practices of suppliers on performance indicators such as absolute and relative prices, and also to analyze the levels of economic activity in that market in objective terms such as production and growth (Hosken, et al. 2015).

However, the construction of counterfactuals and quasi-placebos in these studies is restricted to retail products and services with high frequency of records in purchasing data, which take advantage of product homogeneity and local information in different geographic locations to identify equivalent relevant markets and construct their metrics.

Due to the nature of the market for railway freight transport services, in particular the high entry costs and characteristics of network economies of the railway market, the present methodology recovers the original spirit of creating counterfactual scenarios not by comparing with other markets, but by integrating elements specific to the activities of the market analyzed including, but not limited to: absolute prices of the service, relative prices of the service, route supply, network usage intensity, as well as metrics of competitiveness and welfare for other industries that require this input (World Bank, 2015).

In principle, the reduction in the number of participants may induce incentives to collusive practices (Tirole, 1995); however, when the product or service offered presents characteristics of economies subject to network externalities, prices and costs should consider a way to internalize the high entry costs and the incentives associated with optimal growth of the network which internalize the social and operating costs of the network. Therefore, the prices of a product or service subject to network economies could be higher in the short term than the marginal cost of operation, without necessarily representing an anti-competitive practice.

Let us define Y_t as an economic performance variable that we are interested in studying, measured at a specific point in time $t \in \{1,...,T\}$. In this case, the total temporality considered in the study is defined by the period covered in the observations made for the group of relevant performance variables, describing the following set of historical observations.

$$\{Y_t\}_{t \in T} = \{Y_1,...,Y_T\} \tag{6}$$

Let us partition this analysis time into two periods defined by an event that occurring in period $s \in \{1,2,...,s,...,T\text{-}1,T\}$, where in our case it is 2005, the year in which the operations previously described in this document are reported.[60]

In our case, the observations are divided into the period before highest concentration operations $(t<s)$ and those observations after the moment of the operations described in the second section of this document $(t \geq s)$. Let us define an indicative variable to denote this period as $D_t=1$ for the post-concentration period $(t \geq s)$ and $D_t=0$ for the period before the concentration $(t<s)$.

The objective of the study is to quantify whether there is a statistically significant change in the expected market performance of conditional Y_t on the observed concentration D_t, i.e. "before" and "after" practice carried out, that is:

$$\Delta E[Y_t|D_t]=E[Y_t|D_t=1]-E[Y_t|D_t=0] \tag{7}$$

60. See Figure 5.2 and Figure 5.3 in Section 5.3 of the document.

In this case, the effect on the performance variable $\Delta E[Y_t|D_t]$ is defined as the average expected change in the market, conditional on the concentration, defined by the variable D_t. In this first conditional metric, it is stated that the average effect is simply the difference in the behavior before and after the observed concentration, without any additional control associated with the environment that could affect said performance.

However, there are other attributes of the economic environment that could modify market performance in addition to the change in concentration, and that could be integrated into the study to control and identify the pure effect of such concentration, filtering by these other factors, such as growth in demand for services, general inflation in costs, or exchange rate volatility.

Let us define $\{X_t\}_{t\in T}$ to the set of other important variables for the study of the market during the same period, complementary to the performance variables, and that help us identify other effects exogenous to the relevant market. The objective of the impact analysis is to quantify the following effect on performance, conditional on the highest concentration, and controlling this effect by other environmental variables:

$$\Delta E[Y_t|\,X_t,D_t]=E[Y_t|\,X_t,D_t=1]-E[Y_t|\,X_t,D_t=0] \tag{8}$$

Since in principle, the variables $\{X_t\}_{t\in T}$ that measure macroeconomic or other market performance are exogenous to the operation of this market and are not affected by concentration, it is possible to assume that:

$$Cov\,(X_t,D_t)=0 \tag{9}$$

This statistical condition between the observed variables exogenous to the market and the time at which FERROMEX and FERROSUR notified the concentration allow to identify more precisely the effect studied.

Finally, let us define for the same study period a set of variables $\{\varepsilon_t\}_{t\in}$ that could affect the performance variable, but it is not possible to measure or quantify directly.[61] These variables can either innovate or negatively affect market performance and introduce noise to the impact estimate of interest. Therefore, the potential concentration effect must integrate a model on the variables that are not observed, to also control for their contributions to the observed changes, defining the final effect as:

$$\Delta E[Y_t| X_t,\varepsilon_t,D_t]=E[Y_t| X_t,\varepsilon_t,D_t=1]-E[Y_t| X_t,\varepsilon_t,D_t=0] \qquad (9)$$

The ex-post impact study will consider, where the information allows it to, the analysis of treatment effects and may integrate linear specifications and time series studies to estimate the expected impact ex post in each of the previous models, discarding those that are statistically irrelevant to the objectives of the study.

5.4.3. Scope and limitations of this study

The objective of evaluating performance and competitiveness indicators of the freight railway sector of this work ideally requires a very broad set of indicators at the company level and at the industry level, which allow capturing information before and after the concentration in indicators such as quantities of service offered, fees, operating costs, investment, quality of infrastructure, among others. These indicators, ideally, should be highly periodic (monthly for example) and cover a wide time spectrum for before and after concentration, and also capture other elements of the economic environment such as real and business cycles both national and international.

However, this ideal set of variables is difficult to obtain from public sources of information, and in many cases, the methodologies of the periodicity of publication of these data make it difficult to create a consistent basis for many periods (months, quarters, semesters, years) or it is impossible to reconstruct a complete series of variables that integrate information for before and after the concentration.

For example, the requirements of data periodicity in a regression analysis are increasing in temporal information the more controls on independent variables try to be integrated, apart from the problems of the

61. In traditional econometrics they are called "errors" of the model, but also in the literature of time series they admit the definition of "innovations", and possess statistical properties that determine the relevant estimation method.

method such as endogeneity, collinearity, and autocorrelation, to mention the classic problems of the model (see Greene, 2010).

Faced with the above challenge, the present work represents an effort to build compatible databases and efficiently use the combination of limited information in market indicators with the power of economic theory of enterprise and industrial organization.

In this case, the limitation of access to compatible data series in the time scope of periodicity is the most important restriction of the work. However, each statistical method used the econometric technique best suited to each particular constraint to estimate the results presented, controlling in the largest of the cases for aggregate scope effects, common to the railway sector and all aggregate economic activity. Finally, in the case where access to data is extremely limited, the estimated results should be considered first-order approximations of the effects associated with the concentration, which serve as a guide to the pre- and post-concentration conditions without necessarily representing a causal effect in the strict sense of the term.

5.5. Ex-post analysis of higher concentration of suppliers in the market

The present analysis considers the movements in 4 sets of market variables: quantities offered in the market, service fees, implicit costs of the sector, and consequently the market margin (*markup*) and its impact on welfare, measured as the productivity of the aggregate economy.

5.5.1. Databases

Although, the ideal database to study the impacts on welfare would involve having periodic information for each company, before and after the concentration, this information does not exist for the case of Mexico.

In particular, there is recent information about the performance of companies and fees in the railway freight industry; however, access to historical, consistent and complete information on variables associated with the structure of the industry prior to the highest concentration is scarce and its historical structure is incomplete. In the best of the cases studied, there is information in digital formats that do not allow its direct statistical analysis, but it is possible by individual capture to reconstruct some important indicators of access to the network.

Therefore, the first step was to transfer the largest amount of printed and electronic consistent information from the different public sources, to a format that would allow its homologation over time, and also its subsequent use for performance estimates and corresponding statistical tests. In this case, the databases used in the study include:

1. Railway Statistical Yearbooks from 1997 to 2014, obtained from the General Directorate of Fees, Rail and Multimodal Transport of the SCT. This base provides the characteristics of the services provided at the company level, however, in many cases it is incomplete for some routes and participating companies.
2. Producer price indexes and price indexes of generic products at the sector, subsector, and branch level for all recent years, obtained from INEGI.
3. Information from INEGI on Generic Product Price Indexes; specifically, the series: Air passenger transport, Air freight transport, Railway freight transport, Maritime cargo transport, General cargo transport. Information from producer price indices was also used in the series of: Transport and communications, Railway transport and Railway freight transport.
4. Review of data from ITF-OECD on the development of the rail freight in Mexico, report of the International Transport Forum.
5. The website in charge of collecting information on the railway sector of the United States (Association of American Railroads, AAR) was consulted: https://www.aar.org/newsandevents/Press-Releases/Pages/2012-01-11-Railroad-Facts.aspxhttps://www.aar.org/newsandevents/Press-Releases/Pages/2012-01-11-Railroad-Facts.aspx
6. This website was used to be able to have a sub-sample of the fees of Mexican companies in past years (2001 to 2004, and 2010): https://web.archive.org/web/20010419021819/http://www.sct.gob.mx/tarifas/ferrocarriles/index.htm.
7. On the website of the SCT, the current fees (in force as of September 2016) of Mexican companies were obtained. http://sct.gob.mx/transporte-y-medicina-preventiva/transporte-rail-and-multimodal/freight-rail-fees/http://sct.gob.mx/transporte-y-medicina-preventiva/transporte-ferroviario-y-multimodal/tarifas-ferro

8. For maps and current routes of the railway network, the following website was consulted: http://mim.promexico.gob.mx/swb/mim/Infraestructura.
9. To estimate costs and technological factors associated with production in the country, the Input-Output Matrices (IPM) were consulted at the subsector level, and at the branch level of the NAICS, for the years 2003, 2008, and 2012. This allows us to know the technological conditions of the railway industry and its importance in the rest of the economy at three times: before the concentration (IPM 2003), shortly after it occurred (IPM 2008), and time after the concentration (IPM 2012). This makes it possible to measure efficiency gains derived from the reorganization of productive inputs in this and other industries in the country.

The history of the railway sector in Mexico was investigated using as a reference the work carried out by the Mexican Association of Railways (AMF), where they present the sector before the tender of the railway sector, the bidding process and the higher concentration observed in November 2005.

In the statistical reports of the SCT in the General Directorate of Fees, Rail and Multimodal Transport, information was found about: the length of the main track, evolution of the motor force, cargo equipment, transport equipment, evolution of the workforce, productivity of personnel, fuel consumption in the Mexican railway system, fuel efficiency in the Mexican railway system, cargo transported by by-product, products transported on each route, cargo sent by railway company, foreign trade cargo traffic and passenger traffic.

From these yearbooks, HHI concentration indexes were constructed on the proportion transported by each company of the Mexican railway system, of the total net tons transported, loaded cars and tons-kilometer. In the same way, these data were used to calculate the concentration indices of the route kilometers and the concession routes to each company.

On the other hand, based on the producer price index of INEGI for the different inputs and economic sectors, the costs and fees of the railway freight transport service were analyzed and estimated, integrating a labor cost index (labor productivity) and a capital cost index (based on the funding rate of commercial paper).

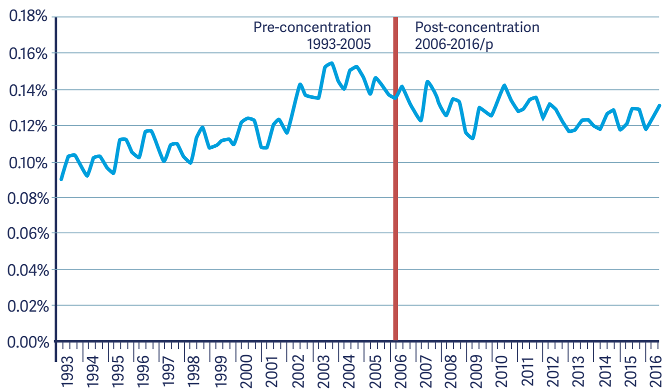
For the international analysis, Thompson's report (2013) for the International Transport Forum was consulted, in which he shows the development of the freight transport railway in Mexico, and from these data it was possible to reconstruct rates of Mexico compared to the United States and Canada from 2000 to 2012.

5.5.2. Macro-performance of the railway sector in the national economy

In the present study, the databases that relatively have more temporality and length of analysis to analyze the real activity of the sector are those associated with production and participation in the product of the rail freight sector, captured in the National Accounts of the INEGI.

The share of railway service as a proportion of GDP in the country is relatively small, but has increased slightly in recent years by going from from 0.0902 to 0.1304 percent of the value of GDP during the 1993-2016 period (Figure 5.8).

Figure 5.8. Direct market share of the railway sector in the national production (Value of railway industry production as % of the national GDP)



Source: Own estimates based on INEGI (2016).

The relative share estimates particularly reflect that, since the concentration in suppliers between FERROMEX and FERROSUR, the freight railway sector (identified with the "482" sector according to the SCIAN 2014) has reduced its growth relative to the dynamics of the total economy, and therefore, its share of aggregate production contracted from 0.1538% in 2003 to the current observed levels of around 0.13%.

A first exercise to evaluate pre- and post-concentration performance is to estimate the quarterly growth rates of national and railway productions at constant 2016 values.

In this case, despite the evidence that both the output of the economy and the railway production do not possess a significant change in their patterns before and after concentration, statistical evidence shows that the value of railway freight transport production ex post concentration grows slightly below what the aggregate economy does.

That is, after 2006 the railway industry grew at a higher rate relative to the economy compared to its previous dynamics of concentration (Table 5.1). This fact is consistent with the relative growth in the share of the railway sector in the total economy between 1993 and 2005, which subsequently stagnated and slightly declined from 2006 onwards.

As a second exercise, from the data it is possible to estimate the sensitivity of output in the freight rail industry to changes in the aggregate output of the economy. This type of elasticity shows the reaction capacity of the aggregate railway industry to adapt to the needs of Mexico's productive sector.

Table 5.1. Comparison of Average Quarterly Growth in Total GDP and Railway GDP, Mexico 1993-2016/p (Quarterly growth in GDP at 2016 prices) 1/ 2/

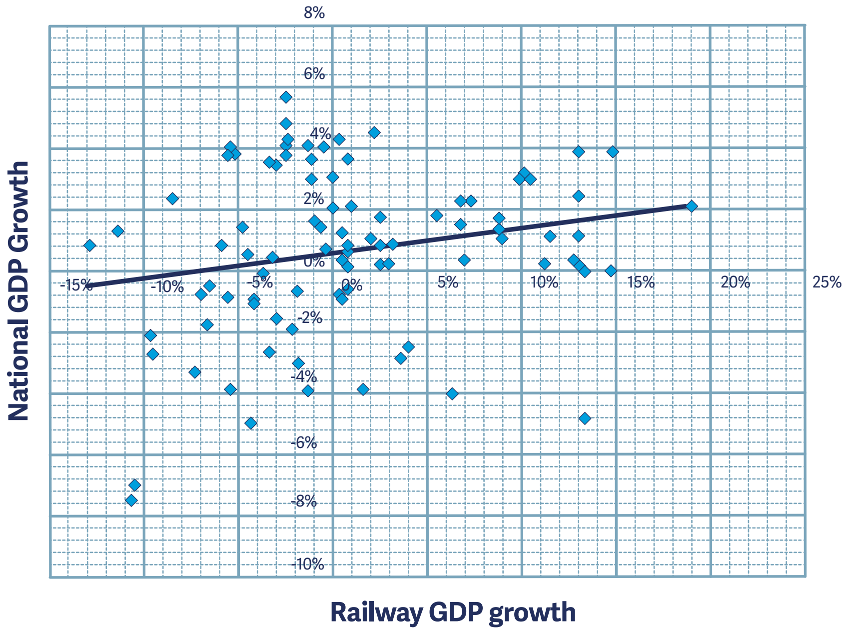
Period	Period average	Total GDP	Railway GDP	Difference
Pre-Concentration	1993-2005	**0.0071** 0.0254	**0.0151** 0.0716	**0.0080** 0.0117
Post-Concentration	2006-2016/p	**0.0051** 0.0289	**0.0041** 0.0667	**-0.0010** 0.0112
Ex post GDP difference		**-0.0020** 0.0056	**-0.0111** 0.0145	**-0.0091[c]** 0.0024

Notes: Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
Preliminary figures: p/ As of 2016/02
1/ Because the highest concentration of suppliers was carried out in November 2005, it is considered as a relevant period for the study of the beginning of effects on and including the year 2006.
2/ Relevant standard deviation in italic typography.
Source: Own estimates based on INEGI National Accounts (2016).

Given that the time series of GDP values in constant pesos for the different sectors and subsectors are not stationary[62], for this exercise, we proceeded directly to analyze the first differences in the logarithms of the series of aggregate GDP values and for the railway sector, i.e., the growth rates of each of the production aggregates.

Figure 5.9 shows that there is a weak positive correlation between GDP growth rates across the economy and the GDP of the rail sector.

Figure 5.9. GDP growth rate in the Railway Industry vs. National GDP (Quarterly Growth Rate, Mexico:1993-2016)



Source: Own estimates based on INEGI (2016).

Considering as relevant variables of the model the growth in the railway sector, the growth in the GDP of the whole economy, and controlling for the effect of the concentration and the potential seasonal effects linked to each quarter, we found that for the estimated models, the elasticity of the growth rate of the railway sector's output to a change in the growth

62. That is, each series has a unit root. The pertinent tests of statistical significance were carried out with the Phillips-Perron statistic, integrating trend, different lags, and displacements, finding in all cases statistical evidence to "not reject" the unit root hypothesis in the levels and logarithms of the relevant series. Therefore, we proceeded to work directly with the first difference of the logarithms, i.e., the growth rate of each relevant sector.

rate of GDP is statistically significant in all estimates of the empirical models implemented. This elasticity is in the range of 0.5610 and 0.7280, with the latter value corresponding to the most complete model that integrates the potential effect of the change in regime associated with the higher concentration of suppliers.

It is observed that in the simple model, the elasticity growth of the railway sector does not respond statistically to the change in the concentration of suppliers but depends on the growth of the economy in general; moreover, this growth in the sector presents statistically significant cycles that accelerate performance in the second quarter, and reduce it in the fourth quarter of each year.

Table 5.2. Estimation of the growth elasticity of railway production, Mexico 1993-2016/p
(Quarterly growth in national GDP and railway sector's GDP at 2016 prices) 1/ 2/

	Event Model Specifications			
	(1)	**(2)**	**(3)**	**(4)**
National GDP	**0.5610[b]** (2.03)	**0.5460[a]** (1.96)	**0.7360[a]** (2.65)	**0.7280[c]** (2.64)
Indicative: 1=Post Concentration		**-0.0093** (-0.62)		**-0.0103** (-1.17)
Second Trimester (=1)			**0.1090[c]** (6.60)	**0.1070[c]** (6.54)
Third Trimester (=1)			**0.0109** (0.74)	**0.0091** (0.62)
Fourth Trimester (=1)			**-0.0379[a]** (-1.82)	**-0.0397[c]** (-1.92)
Constant	**0.00307** (0.40)	**0.00747** (0.73)	**-0.0169** (-1.48)	**-0.0107** (-0.89)
Observations	93	93	93	93
R-square	0.0430	0.0430	0.6550	0.6600
Adjusted R-square	0.0330	0.0330	0.6400	0.6400

Notes: Own estimates using INEGI (2016).
1/ Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
2/ Calculated "Z" statistics enclosed in "( )"
3/ Econometric models estimated using the Generalized Least Squares method.

In this way, the conclusion of this first section is that growth in the railway sector is due to the growth in demand for its service, driven by the aggregate economy, and that for the fullest model, the growth elasticity is 0.7280 percentage points, i.e., the sector is relatively inelastic with respect to the requirements of the productive sector in general.

In the final sections of this paper, the estimates of the coefficients identified in the model (4) will constitute an important component in the analytical implications in terms of social and efficiency costs associated with the higher concentration of bidders in the relevant market.

5.5.3. Scope, size, network usage and market concentration.

When analyzing the size of the network and its distribution over time, it can be seen that neither the structure of the route allocation by concession nor the number of routes under concession per company has not changed much in recent years (Table 5.3). In this aggregate dimension of market operation, it's not concentrated, under the conventional criteria of market concentration. Likewise, when reviewing the proportion of the total kilometers of concessioned routes by company, it is found that the market has not grown and that it is highly concentrated around the four main participants: FERROMEX, FERROSUR, KCSM, and CFCHM, and when considering the concentration of the first two companies, their share is approximately 58 percent of the total kilometers under concession.

In this case, 3 of the 8 railway companies currently operating have 82.04% of the concessioned tracks, which shows signs of lack of competitiveness in this market using conventional metrics.

Table 5.3. Number of railway concessioned routes by company (Mexico 2002-2014, Pre-concentration and Post-concentration)

Company / Year	Pre-concentration				Post-concentration								
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
FERROMEX	3	3	3	3	3	3	3	3	3	3	3	3	3
FERROSUR	1	1	1	2	2	2	2	2	2	2	2	2	2
TFM 2/	1	1	1	1	NT	NT	NT	NT	NT	NT	NT	NT	NT
KCSM 3/	NT	NT	NT	NT	1	1	1	1	1	1	1	1	1
FTVM	1	1	1	1	1	1	1	1	1	1	1	1	1
L COAH-DGO	1	1	1	1	1	1	1	1	1	1	1	1	1
CF CHIA-MAY	1	1	1	1	1	1	1	1	1	1	1	1	1
FIT	1	1	1	1	1	1	1	-	1	1	1	1	1
ADMICARGA	1	1	1	1	1	1	1	1	1	1	1	1	1
TOTAL	**10**	**10**	**10**	**11**	**11**	**11**	**11**	**10**	**11**	**11**	**11**	**11**	**11**

Notes: 1/ Since the highest concentration is recorded in November 2005, it's assumed that it's effective from 2006.
2/ Ceases operations after 2005 and is acquired by KCSM.
3/ KCSM acquires the TFM line and begins operations.
NA. There is no information available to the company in the document consulted.
nt. It does not transport or does not operate in the market during that period.
Sources: Own elaboration with data obtained from "Railway Statistical Yearbook", General Directorate of Multimodal Railway Transport: SCT (2002-2014).

To analyze the level of concentration of the kilometers of concessioned route corresponding to each company over time, the Herfindahl-Hirschman[63] (HHI) indexes were calculated based on information from the railway statistical yearbooks from 2002 to 2014, since the previous yearbooks do not specify the routes concessioned (Table 5.4).

63. The Herfindahl-Hirschman index indicates the level of concentration of a market, it is calculated by adding the square of the value of the companies' market share percentages, therefore the highest value that the index can take is 10,000 points. The U.S. Department of Justice (Horizontal Merger Guidelines, 2015), indicates that mergers in highly concentrated markets that increase the HHI by 200 points or more, are very likely to strengthen their market power. Highly concentrated markets have an HHI above 2500 points.

Table 5.4. Number of kilometers given railway routes concessioned by company (Mexico 2002-2014, Pre-concentration, Post-concentration. and Ex post difference)

Company / Year	Pre-concentration				Post-concentration								
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
FERROMEX	8,427	8,427	8,427	8,427	8,427	8,427	8,427	8,427	8,427	8,427	8,427	8,427	8,121
FERROSUR	1,479	1,479	1,479	1,955	1,955	1,955	1,955	1,955	1,955	1,955	1,955	1,955	1,737
TFM 2/	4,283	4,283	4,283	4,283	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	Nnt	nt	4,283	4,283	4,283	4,283	4,283	4,283	4,283	4,283	4,251
FTVM	297	297	297	297	297	297	297	297	297	297	297	297	286
L COAH-DGO	974	974	974	974	974	974	974	974	974	974	974	974	974
CF CHIA-MAY	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550
FIT	207	207	207	207	219	219	219	-	219	219	219	219	207
ADMICARGA	71	71	71	71	71	71	71	71	71	71	71	71	71
Total kilometers under concession	17,288	17,288	17,288	17,764	17,776	17,776	17,776	17,557	17,776	17,776	17,776	17,776	17,197
Industry HHI (No concentration)	3179.97	3179.97	3179.97	3063.4	3059.4	3059.4	3059.4	3134.6	3059.4	3059.4	3059.4	3059.4	3060.8
Industry HHI (With concentration)	3179.97	3179.97	3179.97	3063.4	4102.2	4102.2	4102.2	4203.6	4102.2	4102.2	4102.2	4102.2	4014.8
Ex post difference	-	-	-	-	1042.8	1042.8	1042.8	1069.0	1042.8	1042.8	1042.8	1042.8	954.0

Notes: 1/ Since the highest concentration is recorded in November 2005, it is assumed that it is effective from 2006.
2/ Ceases operations after 2005 and is acquired by KCSM.
3/ KCSM acquires the TFM line and begins operations.
Na. There is no information available to the company in the document consulted.
nt. It does not transport or does not operate in the market during that period. Company \ Year Pre-concentration Post- concentration.
Sources: Own elaboration with data obtained from “Railway Statistical Yearbook”, General Directorate of Multimodal Railway Transport: SCT (2002-2014).

The evidence shows over time the stability in concessioned routes (Table 5.3) and in the number of concessioned kilometers per company (Table 5.4) because of the law, since it allows and establishes long-term concessions to the participating companies. However, the higher concentration resulting from the combined activities of FERROSUR and FERROMEX in the same consortium under the parent company ITM, induced a significant growth in the HHI of concessioned kilometers at the company level.

Following the analysis of railway usage, it is possible to identify the distribution of effective freight among companies by industry sector, through the tons transported (Table 5.5). In this case, we observe that all industries (except for the transportation of inorganics) show more post-concentration activity, i.e., there has been a significant increase in the tons transported by the railway freight industry in the country.

Table 5.5. Effective load of the railway transport network, Mexico 2002-2014, Averages Pre-concentration, Post-concentration and Ex post difference (Thousands of tons transported throughout the network, total and disaggregated by industry)

Period	Year	National total	Forest	Agricultural	Animals	Minerals	Petroleum	Inorganic	Industrial
Pre-concentration	2002	80,450.9	514.2	13,049.7	356.3	10,060.4	4,497.7	6,425.4	39,884.3
	2003	85,168.0	616.6	13,978.8	325.5	13,667.0	4,512.8	5,475.6	40,941.5
	2004	88,096.7	571.5	14,306.8	306.1	12,623.2	5,506.9	5,612.5	42,969.0
	2005	89,440.3	553.7	15,347.4	270.9	11,487.9	5,491.2	5,237.7	45,715.9
	2006	95,288.1	891.5	18,009.7	377.8	10,579.3	5,008.0	5,591.3	47,651.0
	2007	99,424.9	997.1	17,681.8	432.9	12,245.5	5,070.1	5,892.2	48,758.1
	2008	99,307.9	940.7	18,349.7	423.9	13,196.8	5,051.6	5,742.8	47,702.0
	2009	90,320.5	803.1	25,242.1	446.8	10,867.3	6,411.2	4,811.6	41,738.4
	2010	104,564.5	924.2	27,124.6	485.6	13,749.0	7,717.9	5,641.2	48,921.9
	2011	108,433.2	1,023.0	26,501.9	472.0	15,160.7	8,384.1	6,005.0	50,886.1
	2012	111,607.3	1,095.9	26,697.5	468.8	15,396.5	8,689.7	5,841.3	53,417.3
	2013	111,932.8	1,098.3	25,173.0	422.2	15,699.1	9,254.0	5,384.4	54,912.2
	2014	116,936.4	1,157.4	27,095.3	383.1	15,211.4	10,756.9	5,807.5	56,524.6
Averages 1/									
Pre-concentration (2002-2005)		85,789.0	564.0	14,170.7	314.7	11,959.6	5,002.2	5,687.8	42,377.7
		3,980.7	42.5	948.1	35.8	1,547.6	573.8	515.5	2,567.3
Post-concentration (2006-2014)		104,201.7	992.4	23,541.7	434.8	13,567.3	7,371.5	5,635.3	50,056.8
		8,758.8	113.7	4,207.7	37.9	1,977.0	2,093.9	358.8	4,484.9
Ex post difference		**18,412.8 [c]**	**428.4 [c]**	**9,371.1 [c]**	**120.1 [c]**	**1,607.7 [c]**	**2,369.3 [c]**	**-52.5 [c]**	**7,679.2 [c]**
		3,681.2	**45.5**	**1,561.3**	**22.3**	**1,042.7**	**794.0**	**287.3**	**2,040.0**

Notes: Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
1/ Relevant standard deviation in italic typography.
Sources: Own elaboration with data obtained from "Railway Statistical Yearbook", General Directorate of Multimodal Railway Transport: Secretariat of Communications and Transport (2002-2014).

Similarly, if we normalize the load transported to measure the tons per kilometer transported by each company, and compare across the different types of industries served by the railway sector, we also observe a significant growth in the intensity of use of the network, being the agricultural and industrial sectors those that have increased their absolute and relative share of the demand served by the rail freight transport sector (Table 5.6).

Finally, if a diagnosis is made of historical HHI both at the national level and by industry, in the two dimensions of network use (tons transported, and tons per kilometer transported) it is possible to conclude that despite the growth in service provision, there has also been a parallel increase in the concentration of the activity provided around the companies that are now part of the same business consortium (Tables 5.5 and 5.6).

Table 5.6. Effective load of the railway transport network, Mexico: 2002-2014, National total and by industry, Pre-concentration averages, Post-concentration and Ex post difference (Thousands of tons transported throughout the network, total and disaggregated by industry)

Period	Year	National total	Forest	Agricultural	Animals	Minerals	Petroleum	Inorganic	Industrial
Pre-concentration	2002	51,616.1	307.5	10,663.9	408.8	6,972.3	2,090.2	2,850.8	24,767.7
	2003	54,132.0	376.2	10,502.1	391.8	8,219.4	2,255.6	2,582.3	25,922.1
	2004	54,387.3	324.6	8,203.5	357.3	8,502.7	2,984.2	2,525.3	27,132.8
	2005	54,048.3	339.3	8,173.7	310.3	7,737.0	3,623.7	2,233.1	28,085.9
	2006	66,154.6	645.3	14,549.6	494.2	8,325.5	2,944.6	2,408.2	31,968.1
	2007	71,125.8	762.5	15,486.3	573.2	9,023.7	2,719.7	2,596.1	33,708.6
	2008	68,456.9	689.1	15,729.0	556.8	8,567.2	2,758.3	2,565.6	31,479.7
	2009	62,321.1	593.4	20,069.9	627.7	7,558.2	3,418.1	2,152.2	27,901.6
	2010	72,300.2	692.4	22,436.2	700.8	8,125.7	3,677.4	2,901.5	33,766.5
	2011	72,727.7	777.7	21,275.3	670.4	8,750.5	4,029.3	2,774.7	34,449.5
	2012	72,157.0	818.0	19,336.1	685.3	8,459.9	4,222.5	2,453.8	36,181.5
	2013	69,309.4	813.5	18,465.6	628.6	7,913.0	3,868.2	2,381.0	35,238.8
	2014	72,936.6	849.4	19,561.2	532.9	7,790.4	4,449.0	2,442.7	37,311.1
Averages 1/									
Pre-concentration (2002-2005)		53,545.9	336.9	9,385.8	367.1	7,857.9	2,738.4	2,547.9	26,477.1
		1,294.6	29.2	1,384.0	43.5	669.7	706.5	253.3	1,443.2
Post-concentration (2006-2014)		69,721.0	737.9	18,545.5	607.8	8,279.3	3,565.2	2,519.5	33,556.1
		3,591.4	87.1	2,734.8	72.2	475.7	642.8	222.4	2,817.3
Ex post difference		**16,175.1[c]**	**401.0 [c]**	**9,159.7 [c]**	**240.7 [c]**	**421.5**	**826.8 [b]**	**-28.3**	**7,079.0 [c]**
		1,425,234.1	**34.1**	**1,189.0**	**33.5**	**374.7**	**420.0**	**149.1**	**1,230.0**

Notes: Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
1/ Relevant standard deviation in italic typography.
Sources: Own elaboration with data obtained from "Railway Statistical Yearbook", General Directorate of Multimodal Railway Transport: Secretariat of Communications and Transport (2002-2014).

In this case, after the merger of the companies, there was an increase in industrial transportation activity (measured by tons and tons per kilometer), particularly in the agricultural, oil-related, and industrial industries. These results would suggest that such concentration does not appear to have decreased the growth in network usage, or that the participating companies did not act strategically by reducing the provision of the service to their clients. Despite this evidence, it is necessary to analyze other relevant market dimensions to understand the competitiveness conditions of the industry, specifically the evolution of fees, costs, and margins generated by the rail freight sector.

Table 5.7. HHI concentration indexes for the freight railway market, Mexico 2002-2014, National total and by industry, Pre-concentration, Post-concentration averages and Ex post difference (Concentration in thousands of tons transported per company during the year)

Period	Year	National total	Forest	Agricultural	Animals	Minerals	Petroleum	Inorganic	Industrial
Pre-concentration	2002	3,122.2	2,575.9	5,475.2	4,523.4	3,771.2	3,200.1	2,138.2	3,680.7
	2003	3,110.8	2,503.9	5,378.3	4,610.9	3,191.3	4,093.9	2,053.6	3,606.8
	2004	3,035.7	2,201.2	5,063.7	4,585.2	3,477.9	4,458.1	2,170.5	3,418.2
	2005	3,079.9	2,224.2	4,995.7	4,617.9	3,634.5	4,600.2	2,241.0	3,431.5
	2006	4,556.0	5,622.0	8,784.8	5,171.6	4,122.6	5,082.1	2,751.3	4,780.0
	2007	4,541.3	5,724.4	8,884.0	5,308.9	3,720.0	5,594.3	2,681.8	4,942.3
	2008	4,560.0	7,422.4	8,667.8	5,259.1	3,840.3	5,032.5	2,561.5	4,961.0
	2009	4,777.6	7,331.3	5,781.5	5,119.9	4,048.7	5,475.0	2,589.5	5,046.1
	2010	4,825.8	7,808.8	5,830.6	5,352.5	4,793.4	5,903.1	2,611.6	4,965.5
	2011	4,815.3	7,518.5	5,763.0	5,360.0	4,988.8	6,031.2	2,563.7	4,957.5
	2012	4,765.0	5,923.3	5,632.4	5,652.6	5,129.8	6,383.9	2,524.0	4,927.9
	2013	4,834.4	5,845.1	5,924.7	5,725.9	5,206.5	6,187.5	2,531.0	4,936.2
	2014	4,788.0	6,062.7	5,590.9	5,780.5	5,272.8	6,288.1	2,642.5	4,909.7
Averages 1/									
Pre-concentration (2002-2005)		3,087.1	2,376.3	5,228.2	4,584.4	3,518.7	4,088.1	2,150.8	3,534.3
		38.7	*191.4*	*234.3*	*43.0*	*249.0*	*629.2*	*77.7*	*130.1*
Post-concentration (2006-2014)		4,718.1	6,584.3	6,762.2	5,414.6	4,569.2	5,775.3	2,606.3	4,936.2
		126.4	*905.1*	*1,516.7*	*243.8*	*628.9*	*505.0*	*74.7*	*70.0*
Ex post difference		**1,631.0 [c]**	**4,208.0 [c]**	**1,534.0 [c]**	**830.2 [c]**	**1,050.5 [c]**	**1,687.2 [c]**	**455.5 [c]**	**1,401.9 [c]**
		48.7	**334.0**	**548.9**	**88.8**	**254.9**	**361.7**	**47.0**	**69.6**

Notes: Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
1/ Relevant standard deviation in italic typography.
Sources: Own elaboration with data obtained from "Railway Statistical Yearbook", General Directorate of Multimodal Railway Transport: Secretariat of Communications and Transport (2002-2014).

Table 5.8. HH concentration indices for the market in freight railways, Mexico 2002-2014, National total and by industry, Pre-concentration averages, Post-concentration and Ex post difference (Concentration in thousands of tons transported per company during the year)

Period	Year	National total	Forest	Agricultural	Animals	Minerals	Petroleum	Inorganic	Industrial
	2002	3,847.8	3,016.3	7,837.5	4,762.9	6,423.0	3,655.6	2,928.7	4,021.6
	2003	3,742.7	3,257.4	7,509.4	4,864.9	4,665.4	3,927.8	2,906.7	4,003.0
	2004	3,664.4	2,725.8	6,725.0	4,761.6	5,455.5	4,326.0	3,021.5	3,847.6
	2005	3,705.3	2,849.9	6,623.4	4,796.7	5,511.7	5,372.5	3,214.2	3,844.1

Notes: Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
1/ Relevant standard deviation in italic typography.
Sources: Own elaboration with data obtained from "Railway Statistical Yearbook", General Directorate of Multimodal Railway Transport: Secretariat of Communications and Transport (2002-2014).

Table 5.8. HH concentration indices for the market in freight railways, Mexico 2002-2014, National total and by industry, Pre-concentration averages, Post-concentration and Ex post difference (Concentration in thousands of tons transported per company during the year)

Pre-concentration	2006	5,116.5	5,974.9	9,209.4	5,660.3	5,966.2	5,181.9	4,908.8	4,858.8
	2007	5,080.7	6,118.6	9,263.8	5,721.9	5,501.0	5,618.6	4,512.0	4,963.1
	2008	5,138.5	8,083.7	9,198.7	5,644.9	5,462.4	5,322.0	4,103.1	5,017.9
	2009	5,459.2	8,054.3	6,128.1	5,744.9	6,358.5	6,094.0	4,252.5	5,146.8
	2010	5,442.2	8,169.5	6,301.0	6,259.7	7,411.7	6,229.4	4,186.4	5,045.7
	2011	5,418.2	8,090.4	6,302.2	6,133.4	7,360.7	6,111.1	4,075.2	5,035.4
	2012	5,382.0	6,602.4	6,102.8	6,643.1	7,584.2	6,522.2	3,965.2	5,039.2
	2013	5,303.8	6,324.1	6,379.0	6,939.7	7,248.9	5,971.3	4,122.7	4,982.4
	2014	5,224.6	6,615.9	5,896.3	6,965.2	7,408.4	5,804.1	4,332.2	4,984.5
Averages 1/									
Pre-concentration (2002-2005)		3,740.1	2,962.3	7,173.8	4,796.5	5,513.9	4,320.4	3,017.8	3,929.1
		78.6	229.9	593.7	48.4	718.8	753.4	140.1	96.4
Post-concentration (2006-2014)		5,285.1	7,114.9	7,197.9	6,190.4	6,700.2	5,872.7	4,273.1	5,008.2
		149.1	956.2	1,526.1	544.4	876.9	435.1	286.8	77.5
Ex post difference		**1,545.0 [c]**	**4,152.5 [c]**	**24.1**	**1,393.8 [c]**	**1,186.3 [b]**	**1,552.3 [c]**	**1,255.4 [c]**	**1,079.1 [c]**
		65.8	**357.1**	**615.8**	**194.0**	**474.6**	**406.9**	**123.2**	**55.4**

Notes: Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
1/ Relevant standard deviation in italic typography.
Sources: Own elaboration with data obtained from "Railway Statistical Yearbook", General Directorate of Multimodal Railway Transport: Secretariat of Communications and Transport (2002-2014).

5.5.4. Evolution of prices/rates of the railway market in Mexico.

This section analyzes the evolution of railway freight rates for Mexico, considering their importance and performance under two different scenarios. First, we study the relative evolution with respect to the rest of the economy's producer prices, and then, we study the relative evolution in an international context, particularly by analyzing the behavior related to the railway industry in the rest of North America, i.e., Canada and the United States of America.

Measurement of national relative price indexes/rates

The first analysis consists of studying the evolution of absolute and relative prices of producer rates in the railway transport industry.

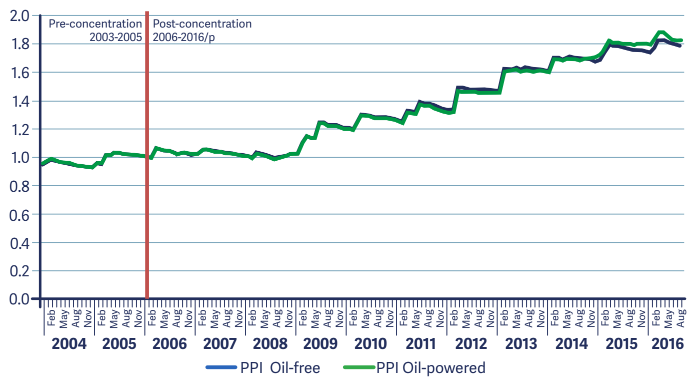
In this case, Figure 5.10 shows the evolution of the relative price index of the railway industry with respect to the producer price index under two schemes: when oil is considered, and when it is excluded from the calculation of the latter. The information shows that prior to the merger, the relative price of the industry was very close to one, i.e., its evolution was similar to the observed increase in the aggregate producer prices.

However, after the merger, the growth in rates was much higher than that observed in the economy, being almost 80 percent compared to its initial value in 2006.

A first hypothesis is that the real growth observed in the price of railway transport is due to transport sector factors such as high relative costs, or increased uncertainty and risk.

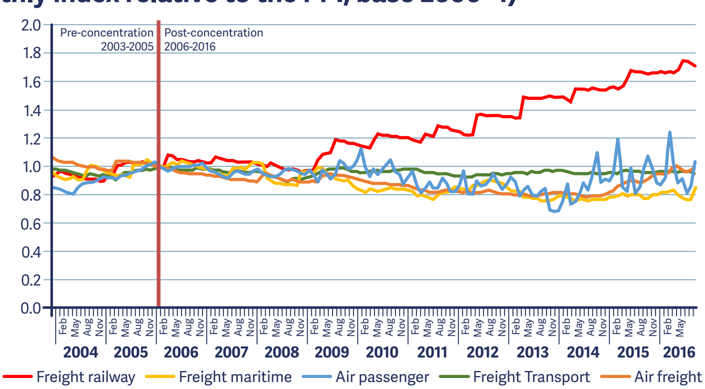
Therefore, Figure 5.11 compares the evolution of the relative real price indexes of different sectors of the transportation industry in Mexico, using 2006 first month as base.

Figure 5.10. Evolution of real relative price index of freight railway industry with respect to the producer price index (with and without oil), Mexico 2003-2016 (Monthly price index, base 2006=1)



Source: Own estimates with information from INEGI (2016).

Figure 5.11. Evolution of real relative prices of the freight railway industry and other transport industries, Mexico 2003-2016 (Monthly index relative to the PPI, base 2006=1)



Source: Own estimates with information from INEGI (2016) in price series 1457 (air passenger transport), 1458 (air freight transport), 1459 (railway freight transport), 1460 (maritime freight transport), and 1461 (cargo auto transport).

As can be seen, the price dynamics of the railway transport sector are very different from those of the rest of the transport industries. In particular, the growth in real relative prices recorded in the period is not consistent with the prices observed in other industries such as maritime freight, where their real index value has fallen over time to represent 80 per cent of their real relative value at the time of the highest concentration observed in the railway sector.

Given the above, Table 5.9 performs a set of statistical tests to determine whether the difference is statistically significant with respect to the behavior of the aggregate producer price index, as well as a significant change in the relative price of the railway industry before and after the operations of higher concentration in the number of suppliers. This difference will allow us to have a first estimate of average growth in the real value of industry rates.

Table 5.9. Average evolution of Producer Price Indexes of the Freight Railway Transport Industry, before and after greater concentration (Absolute and relative values, monthly periodicity, prices in base value 2006=1)

Average period 1/	PPI N.P.P. /2	PPI C.P.P. /3	ITFC /4	ITFC difference with respect to:		Relative Price using base:	
				PPI N.P.P. /2	PPI C.P.P. /3	PPI N.P.P. /2	PPI C.P.P. /3
Pre-concentration (2002-2005)	0.9517	0.9485	0.9351	-0.0167	-0.0135	0.9819	0.9852
	0.0301	0.0318	0.0554	0.0126	0.0128	0.0353	0.0338
Post-concentration (2006-2014)	1.291	1.2942	1.8108	0.5199 [c]	0.5166 [c]	1.3697	1.3672
	0.1583	0.1532	0.5794	0.0531	0.0787	0.2836	0.2924
Difference ex post	**0.3392 [c]**	**0.3457 [c]**	**0.8758 [c]**	**0.5365 [c]**	**0.5301 [c]**	**0.3877 [c]**	**0.382 [c]**
	0.0152	**0.015**	**0.0524**	**0.197**	**0.197**	**0.026**	**0.026**

Notes: Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
1/ Relevant standard deviation in italic typography.
2/ The national producer price index does not include oil as an input.
3/ The national producer price index includes oil as an input.
4/ National price index of freight rail transport.
Source: Own estimates using INEGI (2016).

The first point to analyze is the growth in the price index in the producer price series and in railway freight transport. In the two indicators of producer prices (with and without oil) the average cumulative price growth before and after concentration, this is November 2005, implies a price accumulation of about 34 and 35 percent on average between 2003-2005 and the period 2006-2016. For the same period, the average in the railway sector, the cumulative difference in its growth before and after concentration is about 88 percent, this difference being statistically significant at 1%. Hypothetically, the rapid growth in the sector's prices may have been due to changes in the sector's costs derived from hydrocarbon costs (e.g.); this hypothesis will be explored in more detail in the next section.

The above table allows us to construct and analyze the evolution and adjustment of the relative real price of rates, that is, the index of the producer cost of rail services with respect to the rest of the prices that are integrated into the economy's costs. The last two columns show in their last line, the two statistical tests for changes in the relative prices index of the railway sector, with respect to the National Producer Price Index (NPPI) excluding and integrating the price of the petroleum. In this case, the average difference in the real value of rail rates before and after the concentration is 38.77 and 38.20 percent higher than those of the NPPI without and with oil respectively, this difference being positive and statistically significant.

Thus, it was identified that railway tariffs increased at a higher rate than the rest of the costs, which could have impacted the rest of the production system.

Measurement of tariffs at the company level

The railway service tariff has different components associated with the industrial sector it serves, in particular it has a "fixed cost" component and a "variable cost" component per ton/kilometer transported. Fixed costs are highly heterogeneous between companies and years, and it is not possible to reconstruct a data base that allows companies to be compared consistently before and after the concentration.

For this reason, for this section, we reconstructed the average tariffs for "variable cost" at the company level, using access to some previous versions of the SCT website, in its "current rates" section.[64]

With the available information, we reconstructed the average rates for each year for each company among all the sectors that provide its service, and subsequently proceeded to measure these rates in units of Mexican pesos at constant value.

From the tariff analysis at the company level it is possible to infer two relevant facts regarding the intra-industry tariff setting. First, FERROMEX, FERROSUR, and KCST are the concessionaires that consistently set the highest rates at the points analyzed. Second, the largest increases in rates recorded are also in these three companies (Table 5.10). The following sections of this research on tariffs seek to answer two relevant questions: How do these rates compare to the international environment?

Are these high tariffs justifiable?

Table 5.10. Behavior of average variable collection tariffs per ton/km, Railway freight industry, Mexico (Absolute values in pesos, prices at 2016 real value)

Company / Year	Pre-concentration				Post-concentration						
	2002	2003	2004	2005	2007	2011	2012	2013	2014	2015	2016
FERROMEX	0.5036	0.515	0.5096	0.5192	0.5721	0.7708	0.8395	0.9142	0.9426	0.9952	1.026
FERROSUR	0.5188	0.5165	0.5207	0.5681	0.5896	0.7407	0.8572	0.941	0.9688	1.0196	1.0453
TFM[3/]	0.4847	0.459	0.5553	0.5127	NT	NT	NT	NT	NT	NT	NT
KCSM[4/]	NT	NT	NT	NT	0.5997	0.7625	0.8691	0.9566	0.986	1.0355	1.0788
L COAH-DGO	0.4724	0.4742	0.4475	0.4394	0.4188	0.4466	0.4591	0.4513	0.5071	0.6061	0.6274
CF CHIA-MAY	0.5034	0.5016	0.4993	0.461	0.4773	0.5808	0.6295	0.7017	0.7237	0.7624	0.777
FTVM	0.3426	0.3245	0.3061	0.2827	NA	NA	NA	NA	NA	NA	NA
Average	0.4709	0.4652	0.4731	0.4638	0.5315	0.6603	0.7309	0.7930	0.8256	0.8838	0.9109

Notes: 1/ Average of the item "Variable collection factor $ ton-km" for the relevant company, average tariff in force in the corresponding year.
2/ Each average tariff was deflated using the corresponding annual average of the National Producer Price Index, base year 2016=1.
3/ TFM ceases operations after 2005 and is acquired by KCSM.
4/ KCSM acquires the TFM line and begins operations as such.
NA. There is no information available to the company.
NT. It does not transport or does not operate in the market during that period.
Source: Own estimates using historical information reconstructed in retrospect from the page of the Ministry of Communications and Transport, several years.

64. In this case, there is no access to a historical electronic archive documenting all the tariffs in effect in the railway sector over time. Specifically, SCT only publishes the tariffs in force at the time the page was consulted, therefore our information series at the company level does not have data for the years 2005, 2006, 2008, 2009 and 2010.

The evidence in the previous section shows an increase in real rates of about 38 percent for the freight rail industry. However, this growth could be due to structural factors of the international industry. In this section we analyze whether Mexican industry's price behavior is significantly different from that of the industries of the country's main trading partners, specifically Canada and the United States.

Table 5.11. Ex post difference in average variable collection fees per ton/km, at the company level Rail freight industry, Mexico (Absolute values, 2016 real value prices)

Concession Company	Average period		Average difference ex post	Average Growth ex post
	Pre-concentration (2001-2004)	Post-concentration (2007-2016)		
FERROMEX	0.5118	0.8658	0.3539 [c]	69.2% [c]
	0.0068	0.1563	0.0592	
FERROSUR	0.531	0.8803	0.3493 [c]	65.8% [c]
	0.0248	0.1647	0.0635	
TFM / KCSM	0.5029	0.8983	0.3954 [c]	78.6% [c]
	0.0412	0.1688	0.067	
L COAH-DGO	0.4584	0.5023	0.044	9.6%
	0.0176	0.0826	0.0325	
CF CHIA-MAY	0.4913	0.6646	0.1733 [c]	35.3% [c]
	0.0203		0.0101	
FTVM	0.314			
	0.0256			
AVERAGE	0.4682 0.0044	0.7623 0.1332	0.294 [c] 0.0504	62.8% [c]

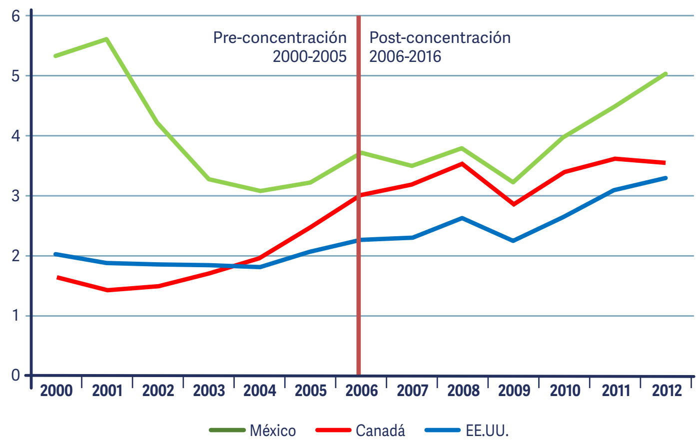
Notes: Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
1/ Average of the item "Variable collection factor $ ton-km" for the relevant company, average tariff in force in the corresponding year.
2/ Each average tariff was deflated using the corresponding annual average of the National Producer Price Index, base year 2016=1.
3/ TFM ceases operations after 2005 and is acquired by KCSM.
4/ KCSM acquires the TFM line and begins operations as such.
Source: Own estimates using historical information reconstructed in retrospect from the Secretariat of Communications and Transport, several years.

Measurement of international relative railway tariffs

In this section we analyze whether the price behavior of the Mexican industry is significantly different from that of the industries of the country's main trading partners, specifically Canada and the United States.

In this case, we follow the work and results of Thompson (2013) where he estimates the real value, in constant dollars, of freight rail tariffs in the three countries. This section reconstructed the railroad rates reported by the author for the three North American countries in constant dollars, originally in 2012 value but adjusted to the 2006 real value, for the average rates of transporting 1 ton per kilometer traveled in each country. Figure 5.12 shows the rate comparison between Canada, Mexico, and the United States in constant dollars on 2006 base year, the year in which operations are assumed to begin with the new organizational structure concentrated.

Figure 5.12. Evolution of relative real prices of the railway freight and other transportation industries, Mexico 2003-2016 (Monthly index relative to the NPPI, base 2006=1)



Source: Evolution of tariffs of the freight railway transport industry, international comparative Canada, Mexico and the United States
(US cents per ton/km, annual average, 2006-dollar value $1=1)

In the figure above we observe that tariffs in Mexico before the concentration, i.e., between 2000 and 2006, were absolutely higher in dollar terms with respect to their peers in Canada and the United States. However, these tariffs were converging because of a relative reduction in the price for Mexico, and the increase in fees for this service for the other two countries. However, the timely exploration of these rates shows that prices in the railway transport sector in Mexico, are relatively higher than in the United States and Canada (particularly towards the end of the sample considered), but price increases have been relatively synchronized in all three countries. Using this international comparative information, the next step is to construct the estimators of differences before and after the highest concentration to quantify the statistical validity of the changes observed in the tariff structure of each country, and of Mexico relative to the other countries.

To make the information of international tariffs comparable with the results of the previous section in terms of information on INEGI's producer price indexes, the average rates were constructed by restricting the sample before the concentration to two sub-periods, namely 2000-2005 and 2003-2005.

Table 5.12. Evolution of average rates of the Freight Transport Railway Industry, before and after higher concentration: Canada, the United States and Mexico (Annual average, US cents per ton/km transported, value at 2006 prices=$1) 1/

Period 2/	Average for the period	Mexico	Canada	USA	Difference between countries	
					Mex-Can	Mex-USA
Pre-Concentration	(A) : 2000-2005	4.13 1.1241	1.7815 0.3867	1.9309 0.1025	2.3486 0.4853	2.1991 0.4608
	(B) : 2003-2005	3.1998 0.1014	2.0436 0.3948	1.9207 0.13	1.1562 0.2353	1.2791 0.0952
Post-Concentration	(C) : 2006-2012	4.0084 0.66	3.3568 0.2937	2.6563 0.4233	0.6515 0.2731	1.352 0.2964
Difference ex post	(C) - (A) :	-0.1217 0.5223	1.5754 0.193	0.7254 0.1654	-1.697 0.2234	-0.8471 0.219
	(C) - (B) :	0.8086 0.5965	1.3132 0.2317	0.7357 0.248	-0.5046 0.1706	0.0729 0.1248

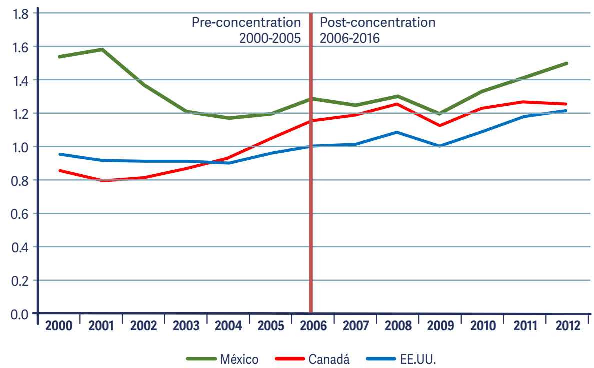
Notes: Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
1/ Because the highest concentration of suppliers was carried out in November 2005, it is considered as a relevant period for the study of the beginning of effects in 2006 inclusive.
2/ Relevant standard deviation in italic typography.
Source: Own estimates based on Thompson (2014).

When studying the information for each country separately, Table 5.12 shows that while for Mexico there is no evidence that the average dollar rates in the pre- and post-concentration periods have increased significantly, on the other hand, the rates in Canada and the U.S. increased on average by 1.58 and 0.73 cents at 2006 values respectively, when the entire available sample is analyzed, or by 1.31 and 0.74 cents for each country when the sub-sample 2003-2005 is studied as a basis for comparison before and after the highest concentration observed in Mexico.

However, when we analyzed the estimators of "double differences" in the average rates for the entire sample, we found that as a result of the observed increases in the average rates in Canada and the United States, the difference in Mexico's ton per kilometer tariff with respect to Canada has been significantly reduced by 1.70 cents and with respect to the United States has been reduced by 0.85 cents at 2006 values, i.e., in terms of the average annual difference in initial rate, it represents a 72.26 percent and 35.52 percent reduction in value of the initial gap with respect to Canada and the U.S. correspondingly. However, this difference in the case of Mexico-United States is no longer significant in the 2003-2005 sub-period, so by reducing the pre-concentration study period, there is no statistical evidence to conclude that, at least for the U.S., the gap in tariffs has closed, with Mexico being relatively more expensive.

If we set the objective of the study not on the evolution of the absolute tariff values, but rather on costs related to the United States, to reference the level of competitiveness of the Mexican industry has with respect to the United States, and we focus our analysis on 2006 (the year of the highest market concentration), we found that despite the reduction in the gap between Mexican and U.S. tariffs before and after the merger, the relative value of Mexican tariffs is higher, representing for the last year about 1.5 times the value of the last rate recorded for the U.S., 20 percent higher than the last recorded value for Canada. This 20 percent observed for the last available year could have an impact on the competitiveness of the country's aggregate industry, and if it's not justified by an increase in the industry's costs, it would be a suspicion of a higher margin. The study of costs is the main topic of the next section of the study.

Figure 5.13. Evolution of tariffs of the freight transport railway industry, international comparison Canada, Mexico and the United States (Dollar value index per ton/km, Annual index, value 2006=1)



Source: Own estimates based on information from Thompson (2013).

5.5.5. *Competitiveness vs. margin of the freight transport network*

Estimation of operating costs of the railway industry

One hypothesis relevant to the increase in observed tariffs refers to the increase in the operating costs of railway companies, particularly when they are highly dependent on inputs such as oil and diesel in their operation.

On the other hand, if the hypothesis of economies of scope and networks is true, then a reduction in costs should be observed because of the improvement in the management of productive inputs, efficiently reallocating factor demands according to the new adapted production technology.

This section analyzes the operating costs of the railway industry by estimating a real costs index based on the use of the technological coefficients of the Input-Output Matrix (IOM), presented by INEGI. In the case of our interest, we use in particular an approximately comparable version of the 2003, 2008 and 2012 IOMs, with the intention of quantifying the potential effect of technological changes associated with the new structure of suppliers, before the concentration (IOM 2003), during the first stage of the concentration (2008), and time after the concentration (2012).

If we use the notation studied in the methodology, let_{kj} be the technological weighting of input x_j, with $j \in \{1,2,\ldots,J\}$ in the production of an industry Y_k, under the assumption that the production of this industry presents a perfect complementarity in the sense of Leontief, we know that the mathematical function representing this technology is:

$$Y_k = Min\left\{ \frac{X_{k,1}}{a_{k,1}}, \frac{X_{k,2}}{a_{k,2}}, \ldots, \frac{X_{k,J}}{a_{k,J}} \right\} \tag{11}$$

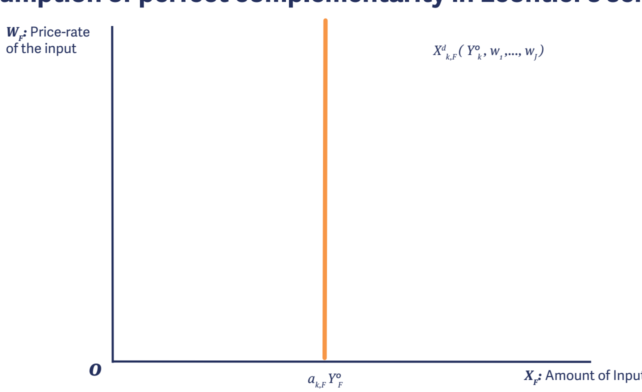
Let jw be the cost of the production input xj for $j \in \{1, 2,\ldots,J\}$, then under this technological criterion, the demand function for the input $x^d_{k,j}\ (Y^o_k, w_1,\ldots ,w_J)$ for an output level Y^o_k is:

$$x^d_{k,j}\ (Y^o_k, w_1,\ldots ,w_J) = a_{k,j} \bullet Y^o_k \tag{12}$$

For all input $j \in \{1, 2,\ldots,J\}$

The above type of input demand function would have the graphical representation illustrated in Figure 5.14.

Figure 5.14. Conditional demand of the factor of production "railway transport" for an industry "*k*" in the relevant market, under the assumption of perfect complementarity in Leontief's sense.



Source: Based on Varian (1992), Nicholson (2004) and Tirole (1988).

Therefore, the total cost function of industry $k \in \{1, 2,...,K\}$ takes a perfect linear function by combining the inputs given the production costs and the desired level of product represented by the following mathematical expression:

$$C\,(Y^{o}_{K}, w_1, ..., w_J) = \sum_{j=-1}^{J} w_j a_{k,j} \bullet Y^{o}_{k} \tag{13}$$

$$C\,(Y^{o}_{K}, w_1, ..., w_J) = Y^{o}_{k} \sum_{j=-1}^{J} w_j \bullet a_{k,j} \tag{14}$$

Thus, given that the technology and cost function assume constant returns of scale, it is possible to infer that the average and marginal cost of industry $k \in \{1,2,...,K\}$ is given by the following function:

$$\frac{\partial}{\partial Y_k} C_k(X_k, w_1, ..., w_k) = \frac{C_k(X_k, w_1, ..., w_J)}{Y_k} = \sum_{j=1}^{J} a_{k,j} w_j \tag{15}$$

In particular, if the railway freight transport industry as a supplier of a X_F input requires for the output of this service Leontief type technology such as that described above, its competitive supply and relevant marginal cost, are identified through the following function:

$$x^{s}_{F}\,(w_F; w_1, ..., w_J) = \frac{\partial}{\partial X_F} C_F\,(X_F, w_1, ..., w_J)$$

$$= \frac{C_F\,(X_F, w_1, ..., w_J)}{X_F} = \sum_{j=1}^{J} a_{F,j} \bullet w_j = C'_F \tag{16}$$

This would mean that the industry presents constant returns of scale, and that its competitive marginal costs are perfectly elastic at the level described, as shown in Figure 5.15 below:

Figure 5.15. Supply of the production factor "railway transport" in the relevant market, under assumption of production of the service with perfect complementarity in the sense of Leontief.

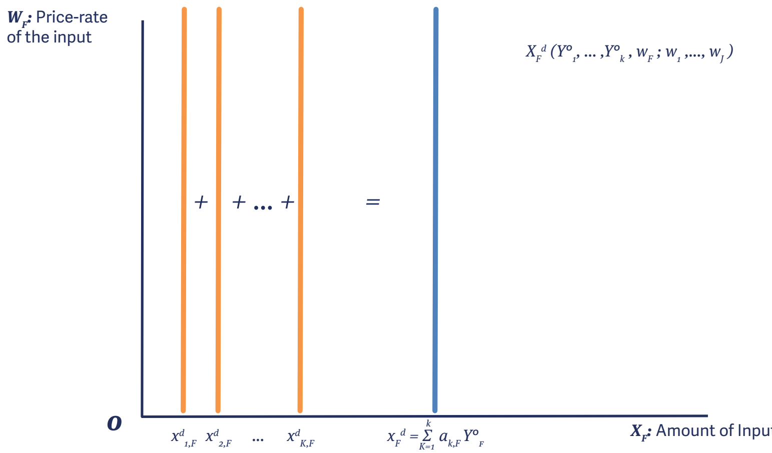
Source: Based on Varian (1992), Nicholson (2004) and Tirole (1988).

Finally, if it is in our interest to obtain the total aggregate competitive demand for freight railway transport service of all industries, to define the total relevant market of the railway sector, this is equivalent to adding the individual demands for each of the industries of the economy, that is:

$$x^s_F (Y^o_1 ,..., Y^o_k , w_F ; w_1 ,...,w_J) = \sum_{k=1}^{K} a_{k,F} \bullet Y^o_k \qquad (17)$$

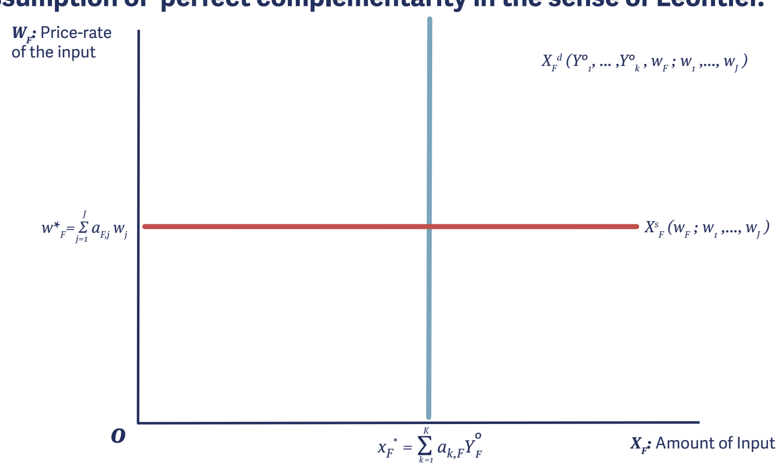
This aggregate demand is represented by Figure 5.16.

Figure 5.16. Aggregate demand of the production factor "railway transport" for all industries in the relevant market, under the assumption of perfect complementarity in the sense of Leontief.



Source: Based on Varian (1992), Nicholson (2004) and Tirole (1988)

Figure 5.17. Competitive equilibrium of production factor "railway transport" for all industries in the relevant market, under the assumption of perfect complementarity in the sense of Leontief.



Source: Based on Varian (1992), Nicholson (2004) and Tirole (1988).

In this way, the competitive equilibrium of the freight railway industry is the one that allows to match the competitive supply and the competitive demand of the market, this occurs at the following corresponding levels:

$$x^{*}_{F} = \sum_{k=1}^{K} a_{k,F} \bullet Y^{o}_{k} \tag{18}$$

$$x^{*}_{F} = \sum_{j=1}^{J} \sum_{j=1}^{J} a_{F,j} \bullet w_{j} \tag{19}$$

This competitive equilibrium of the railway industry is represented in Figure 5.17 and is entirely identified through the technological production coefficients of the different industries that make up the market, including the rail freight industry.

The economic tool that will allow us to estimate and know the characteristics of the relevant market in technological terms, is the input-output matrix, which in the case of Mexico, is estimated by the National Institute of Statistics, Geography and Informatics, INEGI.

An input-output matrix (IOM, hereinafter) summarizes all the information corresponding to the inputs as input of each economic sector, as outputs to the product that requires the use of other inputs; in other words, it represents an accounting matrix that allows to integrate in its rows the participation of each sector as an input in the rest of the industry, and in its columns, the global and technological importance of every sector in producing each product in the economy.

Table 5.13. Prototypical input-output matrix for a country's national accounts

		Industria	Demanda final	Producción total
		Demanda intermedia		
		1 … J	CIG X-M	
Industrias	1 … J			
Valor agregado	Salarios Ganancias Capital Impuestos netos Exportaciones Importaciones			
Producción insumo total				

Source: Own elaboration based on INEGI (2012).

Using the output input matrixes, it is first possible to recover the structure of technological cost coefficients. $\{ a_{F,j} \}^{J}_{j=1}$ of the freight railway transport industry, corresponding to branch code 4821 according to the classification of sector, subsector and branches of the SCIAN 2014. Thus it is also possible to reconstruct the technological coefficients for each of the $k \in \{1,2,\dots,K\}$ productive industries, i.e., the collection of $K \times J$ technical coefficients: $\{ a_{k,j} \}_{k \in \{1,2,\dots,K\},\, j \in \{1,2,\dots,J\}}$.

Table 5.14 shows the estimation of the technological coefficients associated with the costs and production of the industry, using as a basis the "Output of the Total Economy at Basic Prices", as well as the expenses reported in the cells to each branch of the corresponding IOM. In the cost structure, it is possible to identify that, despite changes in the relative uses of production inputs, the main intermediate inputs are those associated with the petroleum products and transport services subsector.

We also note that gross surpluses, which can be associated with payments to capital, represent the main relative cost and have relatively increased in importance with respect to 2003.

In the three IOMs analyzed (2003, 2008, and 2012) the importance of intermediate factors of production represent about 50% of production costs, and the rest is distributed among the factors of labor, capital, and net payment of taxes.

In this way, given this cost indicator, it is possible to use the different price indexes for each subsector, and build an average cost index that, given this technology, allows quantifying the relative performance of costs with respect to a base reference price (the NPPI in this case), as well as its evolution over time given the changes in the economic environment.

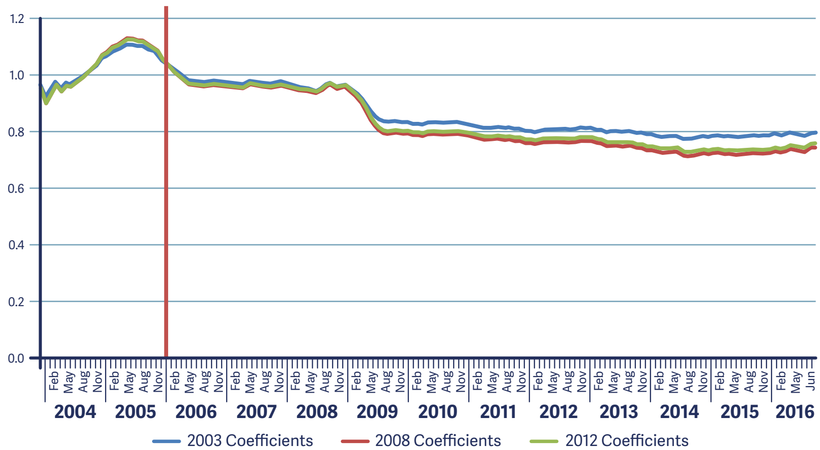
Table 5.14. Direct estimation of Leontief technological cost coefficients of the railway transport industry at the level of economic subsector, ordered by SCIAN code 2014 /1 (Based on Input-Output Matrix Studies: 2003, 2008, 2012, INEGI)

"SCIAN Key"	Subsector	2003	2008	2012
11	Agriculture, forestry, fishing and hunting	0.0000%	0.0000%	0.0000%
21	Mining	0.0000%	0.0000%	0.0000%
22	Generation, transmission, and distribution of electricity, water, and gas to the final consumer	0.3768%	0.2788%	0.1996%
23	Construction	0.0064%	0.5241%	0.7188%
31	Manufacturing Industries - Food, Beverages, and Tobacco	0.1401%	0.0000%	0.0000%
32	Manufacturing Industries - Wood, Paper, Chemicals, Petroleum Products*	9.2096%	16.6508%	19.2282%
33	Manufacturing Industries - Metal Products and Equipment	5.9490%	3.2210%	3.7654%
43	Wholesale	4.5233%	2.7024%	2.3747%
48	Transport service	10.3838%	3.5811%	5.0245%
49	Postcards, mails, and storage	0.0252%	0.8058%	0.6014%
51	Information in mass media	1.5837%	0.6572%	0.5074%
52	Financial and insurance services	2.1585%	0.9372%	0.7946%
53	Real estate and rental services for movable and intangible property	7.8523%	2.9855%	2.4112%
54	Professional, scientific and technical services	0.3484%	4.7513%	3.7796%
55	Corporate	0.0000%	5.5208%	4.9663%
56	Business support services and waste and waste management, and remediation services	4.4280%	3.3725%	2.5635%
61	Educational services	0.0035%	0.0000%	0.0000%
62	Health and social care services	0.0000%	0.0000%	0.0000%
71	Cultural and sports leisure services, and other recreational services	0.0000%	0.0000%	0.0000%
72	Temporary accommodation and food and beverage preparation services	0.5872%	0.5788%	0.5084%
81	Other services except government activities	2.5999%	1.3351%	1.0973%
Total Intermediate Inputs		50.1758%	47.9024%	48.5410%
Added Value	Wages and Remuneration (Payment to Work)	17.0330%	16.3949%	14.7721%
	Gross Surpluses (Payment to Capital)	29.8591%	40.9329%	39.3128%
	Taxes and Net Subsidies	0.00%	0.62%	0.16%

Notes: 1/ North American Industrial Classification System 2013 (SCIAN 2013)
2/ The sum does not add 1 for details associated with errors and rounding of the original data.
3/ Gross surpluses include income and payments to capital, as well as dividends. In this case they are integrated as production costs by representing a payment to the productive factor.
Source: Own estimates with information from INEGI (2016).

Figure 5.18 presents the estimates of the real average cost indexes for the 2003-2012 period, using January 2006 as the basis of the index, to quantify the relative impact at the time of the greater concentration of suppliers in the market. The intention of integrating the different bases of technological coefficients is to test if there was indeed an improvement in efficiency once the changes in the prices of the production inputs of this service are considered.

Figure 5.18. Index of Average Real Costs for the Freight Railway Transport Industry in Mexico, 2005-2012 (Based on Technological Coefficients of Input-Output Matrix: 2003, 2008, 2012, INEGI)



Source: Own estimates with information from IOMs and producer price indices at the subsector level SCIAN 2014, INEGI (2016).

In this case, the different indexes show a reduction in the real relative costs that the industry faces, this despite the increase in the price of diesel and other petroleum derivatives. The foregoing obeys a reduction in the relative costs of capital (derived from the low interest rates, and therefore low cost of capitalization, observed after the 2008 crisis), a reduction in the real index of labor costs (represented by the labor productivity indicator), as well as other minor factors that, combined, result in a real reduction with respect to the prices of the NPPI that integrates the value of oil.

In addition to the above, when exploring the figure, we observe that the structure of estimated coefficients of the 2003 IOM in general leads to higher costs levels, so theoretically there is the possibility of a technological improvement resulting from the higher concentration.

To analyze the statistical properties of the estimated cost series, Table 5.15 presents an analysis of differences, and double differences, to study the evolution of the real costs of the railway sector.

When studying the efficiency gains of the sector, measured as a reduction in the average of the real cost before and after the concentration of suppliers, under the assumption of constant technological coefficients, we observe that these reductions are significant and around 17.12, 21.17, and 20.07 percent, if the estimated coefficients of the 2003, 2008 and 2012 IOMs are used, respectively. This means that, regardless of the technology employed, the average real costs of railway inputs in Mexico have been reduced over time.

Table 5.15. Estimation of the real cost index structure of the Freight Railway Transport Industry in Mexico, using different profiles of technological coefficients 1/ (Based on Input-Output Matrix Studies: 2003, 2008, 2012, INEGI)

Period 2/	List of Technological Cost Coefficients			Difference Associated with Technologies	
	2003	2008	2012	2008-2003	2012-2003
Pre-Concentration (2003-2006)	0.9966	1.001	1.0005	0.0044	0.0038
	0.0582	0.0707	0.0701	0.0183	0.0182
Post-Concentration (2006-2016)	0.8255	0.7893	0.7997	-0.0361 [c]	-0.0257 [b]
	0.0758	0.0945	0.0899	0.0107	0.0104
Ex post difference in Real Cost Index	-0.1712 [c]	-0.2117 [c]	-0.2007 [c]	-0.0405 [c]	-0.0295 [c]
	0.0134	0.0164	0.0161	0.0038	0.0038

Notes: / Statistically significant econometric test at: [a]=10%, [b]=5%, [c]=1%.
1/ Using information from INEGI (Input-Output Matrixes: 2003, 2008, 2012) and producer price indexes in intermediate goods, deflating by National Producer Price Index including Oil.
2/ Relevant standard deviation in italic typography.
Source: Own estimates with information from INEGI (2016).

However, the same table allows us to know if there is a marginal contribution associated with using a different technological base to calculate the real costs of production. In this case, we observe that before the concentration, i.e., the 2003-2006 period, there is no significant difference in the actual costs associated with the use of different technological weighting factors when compared to 2003. However, in the 2006-2016 period, the estimated costs of using the coefficients of 2008 and 2012 as technological profiles induce a lower cost estimate in the order of 3.61 and 2.57 percent, with this difference being statistically significant at 1% confidence. In addition, using a double difference estimator with respect to the change in costs, before and after the concentration, using different production technologies, the estimators suggest that the cost reductions observed in the industry could be partially explained by technological improvements that would result in cost reductions of 4.05 or 2.95 percent if the technologies of 2008 or 2012 are used instead of using the initial technological profile of 2003.

In this way, the estimation of lower **marginal and average** costs join with the more intensive use of the network demonstrated in the first section of the empirical study, allows us to infer that the higher concentration in the sector leads to greater efficiency in the use of the network, i.e., that the hypothesis of economies of scope and networks holds in the railway freight transport industry; however, as analyzed in section 5.2 of this paper, railway industry's tariffs have not been reduced in real terms, but rather have increased substantially as a result of the higher concentration observed.

Therefore, it is necessary to analyze a last link in the competitiveness chain to analyze whether these gains in cost reduction have resulted in better conditions for the industry: the price margin indicator (markup) of the industry, combining the results of real tariff and real costs indexes.

Estimation of margin indexes of the railway industry

When we combine the two indicators of relative fees and relative costs, using the same period as a base, it is possible to know whether the increase or decrease in these indicators corresponds to a higher or lower market overprice.

The Lerner index allows to measure the markup or overprice (margin, hereinafter) in an industry $k \in \{1,2,\ldots,K\}$ in the period "t" and is defined as the percentage markup of the actual price faced by, P^E_{kt} with respect to the marginal cost of an industry, C'_{kt}, that is, with respect to the price that competitively should prevail.

In this case, our relevant industry is "$k=F$", i.e. the input "railway freight" is the relevant market, therefore let us define the relevant price paid by users of the service as the effective fee, $wEkt$, in this case, the margin would be defined by:

$$M_{F,t} = \frac{w^E_{F,t} - C'_{F,t}}{w^E_{F,t}} = 1 - \frac{C'_{F,t}}{w^E_{F,t}} \qquad (20)$$

When analyzing the observed change in margin over time for the *“F”* railway freight industry, the following approximation is useful. If we assume that $M_{F,t}$ is relatively small[65], then:

$$1+M_{F,t} = -\frac{C'_{F,t}}{w^{E}_{F,t}} \tag{21}$$

$$ln\,(1+M_{F,t}) \approx ln\,(M_{F,t}) \approx -\,ln\left(\frac{C'_{F,t}}{w^{E}_{F,t}}\right) \tag{22}$$

$$ln\,(M_{F,t}) \approx ln\,(w^{E}_{F,t}) - ln\,(C'_{F,t}) \tag{23}$$

Therefore, if we take logarithms and differentiate over time, it is possible to obtain the continuous time growth rates of the margin based on the growth rates of the rates and costs of the industry, that is:

$$\frac{\partial}{\partial t}\,ln\,(M_{F,t}) = y^{M}_{F} \approx [\,y_{w^{E}_{F}} - y_{c'_{F}}\,] \tag{24}$$

And if we focus the study on an initial margin value, it is possible to reconstruct its evolution at that initial point and given the growth rates in prices and cost

$$M_{F,t}=M_{F,0} \bullet e^{yMF} \tag{25}$$

Where y^{M}_{F} shows the growth rate accumulated over time of the margin in the industry, $y_{w^{E}_{F}}$ is the growth rate in the price of the industry, and $y_{c'_{F}}$ is the growth in the marginal cost of the industry.

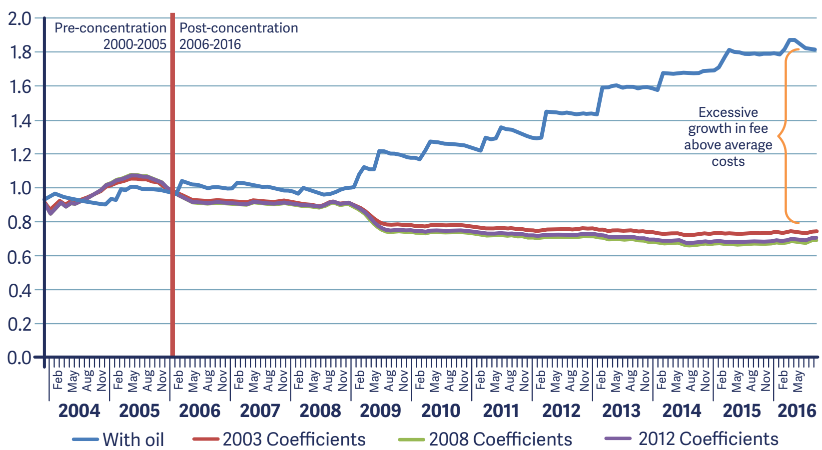
Thus, if we start from an initial point with real values for the effective price indexes faced by the demanders of the service and the marginal costs of the industry, $w^{E}_{F,t}$ and $C'_{F,t}$, the increase in margin will be approximately the difference between the growth in prices and the growth in

65. In this case we use two results widely used in economic growth theory, first $ln(x) \approx ln(1+x)$, and second is $\frac{\partial}{\partial t} ln(x_t) = \frac{1}{x}\,\frac{\partial}{\partial t} x_t = Y_{x_t}$, the growth rate of a variable in continuous time.

the costs of the industry. That is: if the costs increase relatively more than the price, the margin will be reduced; if costs decrease relatively faster than prices, the margin will increase; on the other hand, if prices increase and costs decrease, both forces contribute to a greater margin in the industry.

Figure 5.19 presents the relative price and cost dynamics in the industry, starting from an initial margin base at the point in time where the highest concentration of suppliers in the market is generated (based on indexes with value 1 January 2006, to be consistent with the impact estimate in the other sections). This is equivalent to **an event study**, where the evolution and growth of the margin will be relative to the time point of concentration.

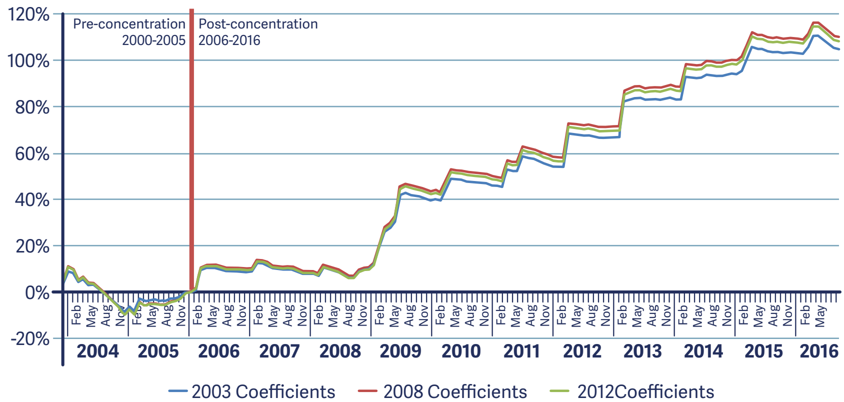
Figure 5.19. Evolution of real effective fee indexes and real average cost for the Freight Railway Transport Industry in Mexico, 2003-2016, Base January 2006 = 1 (Based on Producer Price Indexes and Technological Coefficients of 2003-2008-2010, INEGI)



Source: Own estimates with information on IOMs and producer price indices at the level of the SCIAN subsector 2014, INEGI (2016).

In this case, the growth of the margin above the level at the event point is of the order of 100 percent, regardless of the technological IOM coefficients used. This implies that, with respect to the initial value of the margin at the time of the concentration, the effective markup being paid by the industries requiring the railway input is twice the effective marginal cost of the industry. The growth of the margin is greater if the benefits associated with the reduction in costs resulting from the change in technological coefficients are considered, in addition to integrating the reduction in the real prices of the inputs necessary for the provision of the railway freight transport service.

Figure 5.20. Evolution of the accumulated growth in margin for the Freight Railway Transportation industry in Mexico, 2003-2016, Base January 2006 = 1 (Based on Producer Price Indexes and Technological Coefficients of 2003-2008-2010, INEGI)



Source: Own estimates with information from IOMs and producer price indices at the subsector level SCIAN 2014, INEGI (2016).

Table 5.16. Estimation of growth in margin 1/ of the Railway Freight Transport Industry in Mexico, using different profiles of technological coefficients. 2/ 1/ (Based on Input-Output Matrix Studies: 2003-2008-2010, INEGI)

Period 2/	List of Technological Cost Coefficients			Difference Associated with Technologies	
	2003	2008	2012	2008-2003	2012-2003
Pre-Concentration (2003-2006)	-0.0114	-0.0158	-0.0152	-0.0044	-0.0038
	0.0471	0.0585	0.0581	0.015	0.015
Post-Concentration (2006-2016)	0.5417	0.5779	0.5675	0.0361	0.0257
	0.3599	0.3785	0.3742	0.0462	0.0459
Ex post difference in Real Cost Index	0.5532 [a]	0.5937 [a]	0.5827 [a]	0.0405 [a]	0.0295 [a]
	0.0332	0.0354	0.0351	0.0051	0.005

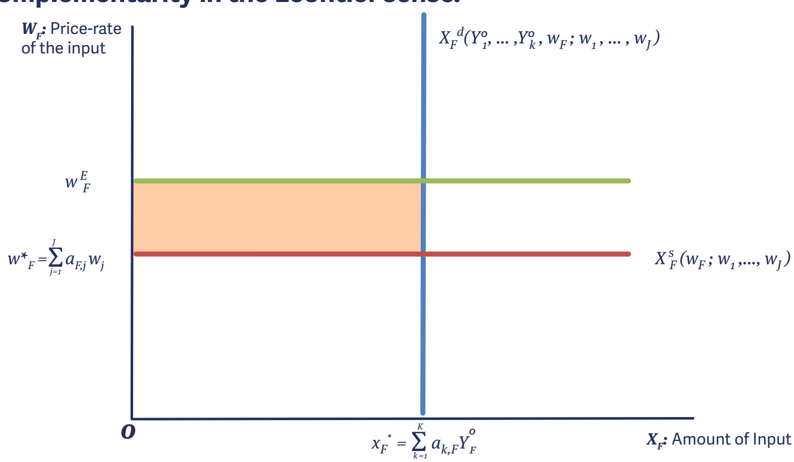
Notes: / Statistically significant econometric test at: [a]=1%.
1/ Margin growth refers in this context to growth above the level before concentration.
2/ Using information from INEGI (Input-Output Matrixes: 2003, 2008, 2012) and producer price indices in intermediate goods, deflating by National Producer Price Index including Oil.
3/ Relevant standard deviation in italic typography.
Source: Own estimates with information on IOMs and producer price indices at the level of the SCIAN subsector 2014, INEGI (2016).

Estimation of impact on the welfare of the economy: counterfactual of aggregate prices and costs

Finally, considering the unexplained cost growth in the prices of the railway freight industry and the growth in the margin level with respect to value before the effective concentration in November 2005, this section constructs the indicators of aggregate impact on welfare by identifying the effects on production costs of high freight transport input prices on other industries.

For this purpose, let's analyze the hypothetical case presented in the methodology based on Leontief perfect complements technologies and in the corresponding technological coefficients estimated using the different IOMs. In particular, let us suppose that the railway industry charges a surcharge above the competitive level (Figure 5.21).

Figure 5.21. Comparison of equilibria in the railway freight market under a competitive industry and a non-competitive industry, and welfare loss due to overpricing under the assumption of perfect complementarity in the Leontief sense.



Source: Based on Varian (1996), Nicholson (2004) and Tirole (2000).

Given the assumptions in terms of Leontief technologies, the loss in welfare due to the surcharge charged to the users would be determined by the shaded region *[o,* X^*_F *] x [* w^*_F *,*w^E_F *]*.

Mathematically, the loss of welfare in the relevant market for a given period $\Delta_{F,t}$ is determined by the following equation:

$$\Delta\mathbb{C}_{F,t} = [\, w^{E}_{k,t} - C'_{k,t} \,] \bullet X^{*}_{F,t} \tag{26}$$

However, recalling that by definition, Lerner's market power index measured by margin in the railway industry is:

$$M_{F,t} = \frac{w^{E}_{k,t} - C'_{k,t}}{w^{E}_{k,t}} \tag{27}$$

$$w^{E}_{k,t} - C'_{k,t} = M_{F,t} \bullet w^{E}_{k,t} \tag{28}$$

Therefore, the loss of welfare is a function of the margin, the effective price paid by the demanders of the freight railway service and the quantity provided of the service as follows:

$$\Delta\mathbb{C}_{F,t} = M_{F,t} \bullet w^{E}_{F,t} \bullet X^{*}_{F,t} \tag{28}$$

Thus, we observe that the loss in welfare depends on the point of time of assessment and is increasing the higher the requirements of the entire economy by railway freight service $X^{*}_{F,t}$, and the higher the effective price it faces above the marginal cost.

If we normalize the total social burden with respect to an index value, for example the effective price of the service paid by the demanders, then we have to the burden in real terms, with respect to a base year $t=0$ is:

$$\frac{\Delta\mathbb{C}_{F,t}}{w^{E}_{F,0}} = M_{F,t} \left[\frac{w^{E}_{F,t}}{w^{E}_{F,0}} \right] X^{*}_{F,t} = M_{F,t} \bullet I_{F,t} \bullet X^{*}_{F,t} \tag{30}$$

Where $I_{F,t}$ is the price index of effective fees at constant prices based on "$t=0$" faced by service demanders in the railway industry.

This metric allows comparing values at constant prices, and in our case, it would be with respect to the relevant base year, which can be the year of highest concentration or a recent year that allows a valid point of comparison.

$$\frac{\Delta \mathbb{C}_{F,t}}{w^{E}{}_{F,0}} = [M_{F,p}\, e^{y_{MF}}] \bullet I_{F,t} \bullet X^{*}{}_{F,t} \tag{31}$$

$$\text{where } \gamma^{M}{}_{F} = [\gamma_{p}{}^{E}{}_{F} - \gamma_{c'}{}_{F}]$$

In this way, we know that the social burden of the effective markup is a function of the real monetary value of the transactions carried out in the railway freight market $I_{F,t}\, X^{*}{}_{F,t}$ and cumulative growth in margin over the initial reference margin MF.0.

Therefore, given the properties of the demand and supply functions associated with the Leontief functions and used as the foundation of the OIM methodology, the relative social cost of the markup with respect to the value of the effective railway production observed is:

$$\theta_{F,t} = \frac{\left[\dfrac{\Delta \mathbb{C}_{F,t}}{w^{E}{}_{F,0}}\right]}{[I_{F,t}\, X^{*}{}_{F,t}]} = M_{F,0} \bullet e^{[y_{p}{}^{E}{}_{F} - y_{c'}{}_{F}]} \tag{32}$$

This means that, by studying the growth in the margin of the railway sector, it is possible to infer the relative social cost of the surcharge, and subsequently the absolute total cost if this value is multiplied by the total activity of the railway sector.

In this way, the social cost in real terms is

$$\left[\frac{\Delta \mathbb{C}_{F,t}}{w^{E}{}_{F,0}}\right] = \theta_{F,t} \bullet I_{F,t} \bullet X^{*}{}_{F,t} \tag{33}$$

A useful aspect of the proposed methodology is that, given the aggregation properties of the demand for the service, it is possible to decompose the social cost for each sector that demands the freight railway service, thus allowing us to measure the incidence of said overcharge throughout all the $k \in \{1,2,...,K$ industries of the economy, that is, given the Leontief technology of each sector and industry we have:

$$\left[\frac{\Delta\mathbb{C}_{F,t}}{w^{E}_{F,0}}\right] = \theta_{F,t} \bullet I_{F,t} \sum_{k=1}^{K} x^{d}{}_{F,t} \qquad (34)$$

$$\left[\frac{\Delta\mathbb{C}_{F,t}}{w^{E}_{F,0}}\right] = \theta_{F,t} \bullet I_{F,t} \sum_{k=1}^{K} a_{k,F} Y_{k,t} \qquad (35)$$

$$\left[\frac{\Delta\mathbb{C}_{F,t}}{w^{E}_{F,0}}\right] = \sum_{k=1}^{K} \theta_{F,t} \bullet I_{F,t} \bullet a_{k,F} \bullet Y_{k,t} \qquad (36)$$

$$\left[\frac{\Delta\mathbb{C}_{F,t}}{w^{E}_{F,0}}\right] = \sum_{k=1}^{K} \left[\frac{\Delta\mathbb{C}_{F,t}(k)}{w^{E}_{F,0}}\right] \qquad (37)$$

Therefore, the total actual markup $\frac{\Delta_{F,t}}{w^{E}_{F,0}}$ is the sum of the individual overcharges $\frac{\Delta_{F,t}(k)}{w^{E}_{F,0}}$ faced by each of the $k \in \{1,2,...,K\}$ industries in a particular way according to the effective demand for railway service that is required.

Using the Leontief technological coefficients estimated for each branch in the different IOMs of INEGI analyzed in this document, we reconstructed the coefficients associated with the sector, subsector, and the aggregate level of the economy (Table 5.17). These coefficients show the relative importance of the railway sector within each industry, being for the entire aggregate economy around 0.03 percent.

When estimating the initial margin, we take as a reference the importance of gross surpluses of value added, which is an approximation to income or capital payment. Between 2003 and 2008, this payment went from representing 29.85 to 40.94 percent of the total value of production respectively. Therefore, in order to focus the study, we will consider that the margin at the time of the highest concentration, focused on the date of the base event that we studied "first month of 2006" for comparable terms, is $M_{2006:01,\,F} = 36.5\%.5\%.$[66]

Table 5.17. Leontief technological coefficients of railway freight transportation costs for the different industries of Mexico, grouped by SCIAN 2014 key at the Subsector level (Coefficient estimates for IOMs 2003, 2008, and 2012)

SCIAN Key	Industrial sector of the economy	2003	2008	2012
11	Agriculture, forestry, fishing and hunting	0.0832%	0.0305%	0.0290%
21	Mining	0.0345%	0.0116%	0.0147%
22	Generation, transmission and distribution of electricity, water and gas to the final consumer	0.1609%	0.0585%	0.0691%
23	Construction	0.1078%	0.0370%	0.0341%
31-33	Manufacturing	0.0968%	0.0503%	0.0535%
43-46	Wholesale and retail trade	0.0246%	0.0083%	0.0100%
48-49	Transportation and Warehousing	0.0618%	0.0349%	0.0329%
51	Information in mass media	0.0260%	0.0182%	0.0239%
52	Financial and insurance	0.0079%	0.0034%	0.0049%
53	Real estate rental and leasing	0.0114%	0.0028%	0.0031%
54	Professional, scientific and technical services	0.0372%	0.0042%	0.0053%
55	Management of Companies and Enterprises	0.0111%	0.0015%	0.0016%
56	Administrative, Support, Waste Management and Remediation Services	0.0292%	0.0046%	0.0057%
61	Educational services	0.0086%	0.0024%	0.0029%
62	Health care and social services	0.0279%	0.0163%	0.0221%
71	Arts, Enterteinment and recreation services	0.0353%	0.0075%	0.0085%
72	Accommodation and food services	0.0408%	0.0134%	0.0155%
81	Other services except public administration	0.0392%	0.0163%	0.0173%
93	Public administration	0.0238%	0.0114%	0.0154%
	Total Primary Sector	0.0832%	0.0305%	0.0290%
	Total Secondary Sector	0.0923%	0.0310%	0.0307%
	Total Tertiary Sector	0.0554%	0.0276%	0.0300%
	TOTAL NATIONAL ECONOMY	**0.0616%**	**0.0283%**	**0.0301%**

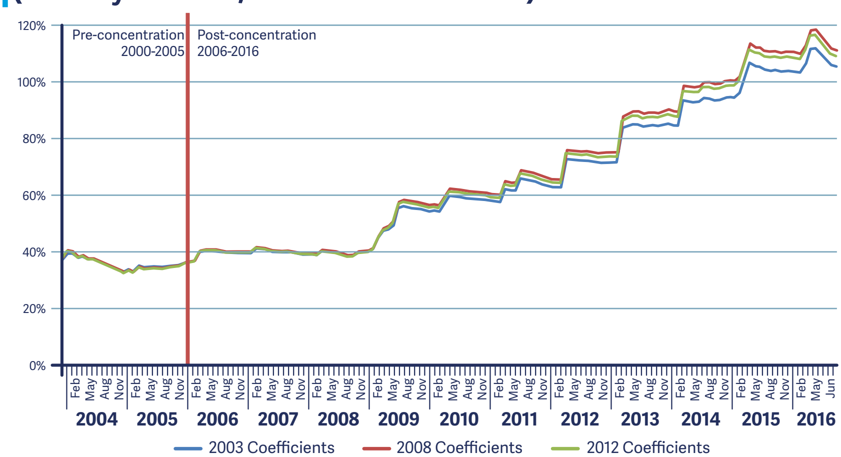
Notes: 1/ The aggregation of coefficients in this methodology is not the linear sum, but through the sum of cost and aggregate production subtotals in each subsector of the matrix.
Source: Own estimates using the Input-Output Matrixes for 2003, 2008, 2012. INEGI.

66. This approximate value is obtained as follows: be $M_{2003,F} = 29.85\%$ and $M_{2008,F} = 40.94\%$, the gross operating surpluses of each year respectively, the average difference is a growth of 2.21% for each year. If we add the three cumulative years between 2003 and 2006 (6.63%) to the base value of 2003 (28.85%), this is 36.5%.

As a first exercise, we estimate the values associated with $\theta_{F,t}$ using the accumulated growth rates and the initial value in the margin, as set out in equation *(32)* resulting in Figure 5.22 which presents the monthly overcharge estimate.

The above estimates show that the overcharge has increased from its initial value to a relative level of more than 100%. In particular, the growth in overcharge accelerated in 2009, since until then, it represented about 40% of the total cost. As of 2015, the growth in overcharge of the rail freight industry according to the results is between 96% and 117% (depending on the technological coefficients used) that is, the industries that demand this service face twice the real competitive cost, and this is precisely equivalent to the social burden of the surcharge in this market.

Figure 5.22. Evolution of cumulative rate of overcharge $\theta_{F,t}$ for the railway industry given the growth in margin of the industry. (Monthly estimate, Mexico 2003:12-2016:8)



Source: Estimates own using the Input-Output Matrixes, 2003, 2008, 2012, as well as producer price indexes in several years, INEGI.

Thus, by integrating technological coefficients, the production of each sector, the growth in the real price of inputs, and the “markup” loaded from equation *(13)* it is possible to reconstruct the historical overcharges faced by each industry, based on different assumptions of productive technology of the sector (Tables 5.18 - 5.20).

Had there been no changes in production coefficients and if the economy had prevailed under the production technology in place in 2003, the aggregate loss associated with the production overcharge for the first quarter of 2016 would be $20,275.5 million pesos, with the tertiary sector being the main one harmed by facing a total overcharge of $14,054.5 million Mexican pesos. If, on the other hand, we use the most recent technology estimate (i.e., the sectoral coefficients implicit in the IPM 2012), this burden is reduced by almost 50% by going to an extra cost for the entire industry of $ 9,658.9 million Mexican pesos in that same quarter, of which $ 7,361.2 million Mexican pesos are faced by the tertiary sector of the economy.

Table 5.18. Estimated overcharge in each industry by growth in railway industry margin, valued at millions of pesos from 2016, Mexico 2012-2016 (Technolog with Leontief coefficients 2003)

SCIAN Key 2014	Industrial Sector of the Economy	2012/01	2012/02	2012/03	2012/04	2013/01	2013/02	2013/03	2013/04	2014/01	2014/02	2014/03	2014/04	2015/01	2015/02	2015/03	2015/04	2016/01	2016/02
11	Agriculture, forestry, fishing and hunting	600.6	701.9	538.5	790.7	774.6	931.8	705.2	1055.1	962.7	1154.8	902.9	1285.4	1227.1	1372.4	1070.1	1493.8	1402.5	1569.3
21	Mining	665.1	690.7	708.5	739.5	830.2	862	865.8	926.2	965.1	1027.9	1073.3	1169.9	1248.6	1257.7	1318.2	1367.6	1409.6	1428.6
22	Generation, transmission and distribution of electricity, water and gas to the final consumer	906.6	864	963.5	934.4	1146.9	1115.4	1278.9	1271.2	1452.1	1451.1	1659.1	1641.8	1912.1	1761.7	2041.4	2001.7	2163.4	2064.8
23	Construction	2151.5	2154.7	2153.4	2170.9	2774.3	2776.4	2817.5	2874.5	3295.3	3327.2	3312.8	3257.8	3844	3650.3	3710.8	3655.4	4131.4	3847.6
31-33	Manufacturing	4149	4190.1	4126.6	4122.5	5277.5	5542.5	5545.5	5537.3	6539	6850.4	6846.3	6943.9	8332.2	8376.6	8367.5	8323.4	9336.3	9373.4
43-46	Wholesale and retail trade	948	966	943	997.4	1224.4	1295.6	1285.4	1336	1471.2	1578.1	1587.5	1682.6	1907.7	1956.7	1972.4	2056.9	2193.3	2204.6
48-49	Transportation and Warehousing	909.3	914.7	904.7	930.7	1184.2	1221.1	1226.4	1258.1	1445.4	1514.3	1495.8	1560.6	1842.5	1852	1852.4	1890.2	2100.1	2100.5
51	Information in mass media	207.7	212.3	220.9	235.7	297.7	293.2	302.5	307.6	354.8	359.9	350.4	369.1	462.8	446.9	462.6	516	568.3	533.6
52	Financial and insurance services	85.6	83.5	87.2	92.8	121	124.6	126.6	130.8	146.7	146.6	147	153.9	180.6	173.2	177.6	185.6	213.9	204.6
53	Real estate, rental and leasing	358	344.4	348.6	355.6	469.5	452.7	461.4	469.7	564.3	554.2	561.2	573.5	709.4	680.1	680.3	687.8	804.6	762.8
54	Professional, scientific and technical services	205.3	204.8	207.6	229	272.4	271.1	270.9	303.7	324	319.9	327.6	383.1	405.4	404.1	401.9	463	486.7	479.9
55	Management of Companies and Enterprises	15.7	17	17.8	19.3	20.9	22.4	23.9	22.3	26.1	28.2	30.2	29.9	31.5	33.8	38	36.3	36.5	38.8

Notes: 1/ The aggregation of coefficients in this methodology is not the linear sum, but through the sum of cost and aggregate production subtotals in each subsector of the matrix.
Source: Own estimates using the Input-Output Matrixes 2003, 2008, 2012. INEGI.

Table 5.18. Estimated overcharge in each industry by growth in railway industry margin, valued at millions of pesos from 2016, Mexico 2012-2016 (Technolog with Leontief coefficients 2003)

SCIAN Key 2014	Industrial Sector of the Economy	2012/01	2012/02	2012/03	2012/04	2013/01	2013/02	2013/03	2013/04	2014/01	2014/02	2014/03	2014/04	2015/01	2015/02	2015/03	2015/04	2016/01	2016/02
56	Administrative, Support, Waste Management and Remediation Services	228.6	230.8	232.1	249.7	314.5	313	314.7	338.8	371	383.1	373.4	395.9	471.1	457.2	445.1	467.3	539.2	520
61	Educational services	85.4	78.9	81.8	85.6	110	104.5	108.3	113.2	131.3	123.7	130.1	134.8	161.3	148.6	155.1	161.1	179.4	168
62	Health care and social services	147.1	138.8	147.3	145	194.5	182.6	192	189.5	226.4	218.1	227.9	226.3	282.7	263.7	272.8	269.9	314.2	297
71	Arts, Enterteinment and recreation	37.8	38.4	40.5	44.8	51.5	51	54.8	60.6	59	59.8	66.6	70.6	75	75	83.2	86.7	85.2	86.3
72	Accommodation and food services	214.7	213.9	220.6	222.7	287	280.1	293.6	297.8	344.9	350.3	356.4	368.7	441.9	434.7	452.8	468.9	524	490.5
81	Other services except public administration	204.5	202.5	208	211.7	271	269.4	279.1	281.8	319.8	326.1	341.7	346.5	407.5	392.9	411	421	478.2	461.2
93	Public administration	223.8	237.6	217	231.3	284.6	298.2	289	309.5	344.8	362.5	350.6	376.3	449.5	446.5	419.6	444.5	484.6	489.6
1	Total Primary Sector	600.6	701.9	538.5	790.7	774.6	931.8	705.2	1055.1	962.7	1154.8	902.9	1285.4	1227.1	1372.4	1070.1	1493.8	1402.5	1569.3
2	Total Secondary Sector	3723.2	3709.3	3825.4	3844.8	4751.4	4753.7	4962.1	5071.9	5712.5	5806.2	6045.2	6069.6	7004.6	6669.8	7070.3	7024.6	7704.4	7341
3	Total Tertiary Sector	8020.4	8073.8	8003.9	8173.8	10380.6	10722.1	10774.3	10956.6	12668.7	13175.2	13192.6	13615.6	16161.2	16142	16192.3	16478.5	18344.4	18210.9
TOTAL NATIONAL ECONOMY		**12344.1**	**12485**	**12367.9**	**12809.4**	**15906.6**	**16407.6**	**16441.7**	**17083.6**	**19343.9**	**20136.1**	**20140.7**	**20970.6**	**24392.9**	**24184.2**	**24332.8**	**24996.9**	**27451.2**	**27121.1**

Notes: 1/ The aggregation of coefficients in this methodology is not the linear sum, but through the sum of cost and aggregate production subtotals in each subsector of the matrix.
Source: Own estimates using the Input-Output Matrixes 2003, 2008, 2012. INEGI.

Table 5.19. Estimated overcharge in each industry by growth in railway industry, valued at millions of pesos from 2016, Mexico 2012-2016 (Technological base with Leontief coefficients 2008)

SCIAN Key 2014	Industrial Sector of the Economy	2012/01	2012/02	2012/03	2012/04	2013/01	2013/02	2013/03	2013/04	2014/01	2014/02	2014/03	2014/04	2015/01	2015/02	2015/03	2015/04	2016/01	2016/02
11	Agriculture, forestry, fishing and hunting	230.2	269.3	206.7	303.7	298.4	359.5	272.5	408.9	372.9	448.9	351.4	501.2	478.7	534.8	417.4	583.0	544.7	608.4
21	Mining	233.2	242.3	248.7	259.7	292.4	304.1	305.9	328.3	341.8	365.4	381.9	417.1	445.4	448.2	470.2	488.1	500.7	506.5
22	Generation, transmission and distribution of electricity, water and gas to the final consumer	344.1	328.2	366.1	355.3	437.4	426.0	489.3	487.7	556.8	558.4	639.2	633.8	738.6	679.8	788.3	773.5	831.9	792.5
23	Construction	770.9	772.7	772.5	779.3	998.8	1001.1	1017.6	1041.2	1192.9	1208.8	1205.0	1187.3	1401.7	1329.7	1352.8	1333.5	1499.8	1394.2
31-33	Manufacturing	2253.1	2277.3	2243.7	2242.7	2879.6	3028.9	3035.6	3039.8	3587.6	3772.1	3774.1	3835.3	4604.8	4624.4	4623.2	4602.0	5136.7	5147.8
43-46	Wholesale and retail trade	332.8	339.4	331.5	350.8	431.9	457.8	454.9	474.2	521.9	561.8	565.8	600.9	681.7	698.4	704.6	735.3	780.2	782.8
48-49	Transportation and Warehousing	535.9	539.6	533.9	549.5	701.3	724.3	728.7	749.6	860.7	905.0	895.0	935.6	1105.2	1109.7	1110.9	1134.3	1254.1	1252.1
51	Information in mass media	151.8	155.3	161.7	172.6	218.6	215.7	222.9	227.3	262.0	266.8	260.0	274.4	344.2	332.1	344.0	384.0	420.8	394.4
52	Financial and insurance services	38.1	37.2	38.9	41.4	54.1	55.9	56.8	58.9	66.0	66.2	66.5	69.7	81.9	78.4	80.5	84.2	96.5	92.2
53	Real estate rental and leasing	91.7	88.3	89.4	91.3	120.8	116.7	119.1	121.6	146.0	144.0	145.9	149.4	184.9	177.1	177.3	179.4	208.8	197.6
54	Professional, scientific and technical services	24.3	24.3	24.6	27.2	32.4	32.3	32.4	36.4	38.8	38.4	39.4	46.2	48.9	48.7	48.5	55.9	58.4	57.5
55	Management of Companies and Enterprises	2.2	2.4	2.5	2.7	2.9	3.2	3.4	3.1	3.7	4.0	4.3	4.2	4.5	4.8	5.4	5.2	5.2	5.5
56	Administrative, Support, Waste Management and Remediation Services	37.6	38.0	38.2	41.1	51.9	51.8	52.1	56.3	61.6	63.8	62.3	66.2	78.8	76.4	74.4	78.2	89.8	86.4

Source: Own estimates using the Input-Output Matrixes 2003, 2008, 2012. INEGI.

Table 5.19. Estimated overcharge in each industry by growth in railway industry, valued at millions of pesos from 2016, Mexico 2012-2016 (Technological base with Leontief coefficients 2008)

SCIAN Key 2014	Industrial Sector of the Economy	2012/01	2012/02	2012/03	2012/04	2013/01	2013/02	2013/03	2013/04	2014/01	2014/02	2014/03	2014/04	2015/01	2015/02	2015/03	2015/04	2016/01	2016/02
61	Educational services	24.8	22.9	23.8	24.9	32.1	30.5	31.7	33.2	38.5	36.4	38.4	39.8	47.7	43.9	45.8	47.6	52.8	49.4
62	Health care and social services	90.1	85.1	90.3	89.0	119.7	112.6	118.5	117.3	140.1	135.4	141.7	141.0	176.2	164.2	170.0	168.3	195.0	184.0
71	Arts, Enterteinment and recreation	8.4	8.6	9.0	10.0	11.5	11.4	12.3	13.6	13.3	13.5	15.0	16.0	17.0	17.0	18.8	19.7	19.2	19.4
72	Accommodation and food services	73.4	73.2	75.6	76.3	98.6	96.4	101.2	103.0	119.2	121.5	123.8	128.3	153.9	151.2	157.6	163.3	181.6	169.7
81	Other services except public administration	88.8	88.0	90.4	92.1	118.2	117.7	122.2	123.7	140.3	143.6	150.6	153.0	180.0	173.4	181.5	186.1	210.3	202.5
93	Public administration	112.0	119.0	108.7	116.0	143.1	150.2	145.8	156.6	174.3	183.9	178.1	191.5	228.9	227.1	213.6	226.5	245.6	247.7
1	Total Primary Sector	230.2	269.3	206.7	303.7	298.4	359.5	272.5	408.9	372.9	448.9	351.4	501.2	478.7	534.8	417.4	583.0	544.7	608.4
2	Total Secondary Sector	1348.2	1343.2	1387.4	1394.3	1728.6	1731.2	1812.8	1857.2	2091.6	2132.6	2226.1	2238.2	2585.7	2457.7	2611.3	2595.2	2832.3	2693.2
3	Total Tertiary Sector	3865.1	3898.6	3862.3	3927.6	5017.1	5205.4	5237.6	5314.8	6174.1	6456.4	6460.7	6651.4	7938.6	7926.9	7956.2	8069.9	8955.2	8889.0
TOTAL NATIONAL ECONOMY		**5443.5**	**5511.1**	**5456.4**	**5625.5**	**7044.1**	**7296.1**	**7323.0**	**7580.8**	**8638.5**	**9037.9**	**9038.2**	**9390.8**	**11003.0**	**10919.4**	**10984.9**	**11248.1**	**12332.2**	**12190.6**

Source: Own estimates using the Input-Output Matrixes 2003, 2008, 2012. INEGI.

Table 5.20. Estimated overcharge in each industry by growth in railway industry, valued at millions of pesos from 2016, Mexico 2012-2016 (Technological base with Leontief coefficients 2008)

SCIAN Key 2014	Industrial Sector of the Economy	2012/01	2012/02	2012/03	2012/04	2013/01	2013/02	2013/03	2013/04	2014/01	2014/02	2014/03	2014/04	2015/01	2015/02	2015/03	2015/04	2016/01	2016/02
11	Agriculture, animal husbandry and exploitation, forestry, fishing and hunting	215.7	252.4	193.7	284.5	279.4	336.8	255.4	383.0	349.0	420.2	328.9	469.3	448.4	500.9	391.1	546.4	510.7	569.7
21	Mining	290.9	302.3	310.3	323.9	364.5	379.2	381.7	409.3	425.9	455.3	476.0	520.0	555.4	558.8	586.5	609.0	624.9	631.4
22	Generation, transmission and distribution of electricity, water and gas to the final consumer	400.8	382.3	426.5	413.7	509.1	496.1	570.0	567.9	647.9	649.8	743.8	737.7	859.9	791.2	918.2	901.1	969.5	922.5
23	Construction	701.3	703.0	702.9	708.7	908.1	910.5	925.9	946.9	1084.1	1098.5	1095.1	1079.3	1274.6	1208.8	1230.7	1213.3	1365.1	1267.5
31-33	Manufacturing	2361.0	2386.6	2351.4	2349.4	3015.5	3173.0	3181.4	3184.3	3755.4	3948.5	3950.7	4016.1	4823.3	4842.6	4844.5	4822.9	5385.5	5390.8
43-46	Wholesale and retail trade	399.0	406.9	397.5	420.4	517.5	548.6	545.4	568.3	625.0	672.8	677.6	719.8	816.8	836.7	844.6	881.6	935.8	937.8
48-49	Transportation and Warehousing	497.6	501.0	495.8	510.0	650.7	672.3	676.6	695.7	798.3	839.3	830.0	868.0	1025.7	1029.6	1031.4	1053.3	1164.9	1161.7
51	Information in mass media	196.5	201.0	209.3	223.3	282.9	279.1	288.6	294.2	338.8	345.0	336.2	355.0	445.4	429.6	445.3	497.1	545.0	510.3
52	Financial and insurance	53.9	52.7	55.1	58.6	76.5	79.0	80.4	83.3	93.3	93.6	93.9	98.6	115.8	110.9	113.9	119.1	136.6	130.3
53	Real estate rental and leasing	99.3	95.6	96.8	98.8	130.8	126.4	129.1	131.7	158.0	155.7	157.9	161.7	200.2	191.7	192.0	194.3	226.3	213.9
54	Professional, scientific and technical services	30.3	30.3	30.7	33.8	40.4	40.2	40.3	45.3	48.3	47.8	49.0	57.5	60.8	60.6	60.3	69.6	72.8	71.6
55	Management of Companies and Enterprises	2.3	2.5	2.6	2.8	3.1	3.3	3.5	3.3	3.9	4.2	4.5	4.5	4.7	5.0	5.7	5.4	5.4	5.8
56	Administrative, Support, Waste Management and Remediation Services	45.6	46.1	46.4	49.9	63.0	62.8	63.3	68.3	74.7	77.4	75.5	80.3	95.6	92.7	90.3	94.9	109.0	104.8

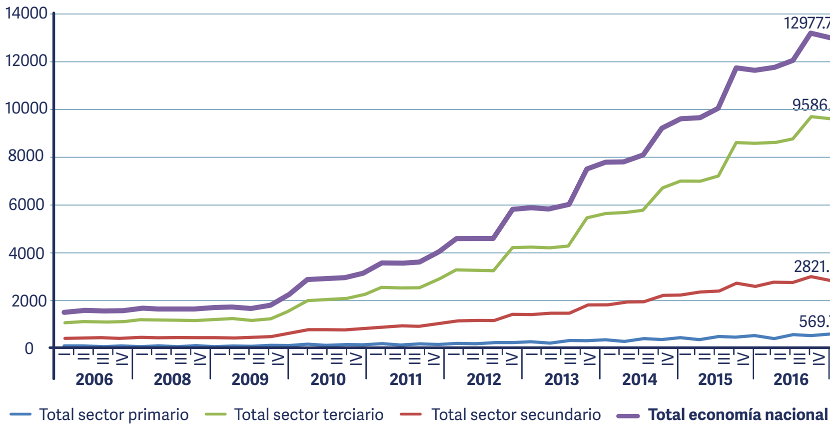
Source: Own estimates using the Product Input Matrices, 2003, 2008, 2012. INEGI.

Table 5.20. Estimated overcharge in each industry by growth in railway industry, valued at millions of pesos from 2016, Mexico 2012-2016 (Technological base with Leontief coefficients 2008)

SCIAN Key 2014	Industrial Sector of the Economy	2012/01	2012/02	2012/03	2012/04	2013/01	2013/02	2013/03	2013/04	2014/01	2014/02	2014/03	2014/04	2015/01	2015/02	2015/03	2015/04	2016/01	2016/02
61	Educational services	29.8	27.6	28.6	29.9	38.5	36.7	38.1	39.9	46.2	43.7	46.1	47.8	57.3	52.7	55.1	57.2	63.5	59.2
62	Health care and social services	119.9	113.3	120.2	118.4	159.2	149.8	157.8	156.1	186.3	180.1	188.4	187.5	234.4	218.4	226.3	224.0	259.7	244.7
71	Arts, Enterteinment and recreation	9.3	9.5	10.0	11.0	12.7	12.6	13.6	15.1	14.7	14.9	16.6	17.7	18.8	18.8	20.8	21.7	21.3	21.5
72	Accommodation and food services	83.8	83.5	86.2	87.0	112.4	110.0	115.5	117.4	135.8	138.4	141.0	146.2	175.4	172.3	179.8	186.3	207.3	193.4
81	Other services except public administration	92.7	91.9	94.4	96.1	123.3	122.8	127.5	129.1	146.3	149.7	157.0	159.6	187.9	180.9	189.5	194.3	219.7	211.3
93	Public administration	149.0	158.4	144.7	154.3	190.3	199.8	194.0	208.3	231.8	244.5	236.8	254.7	304.5	302.1	284.3	301.4	327.1	329.5
1	Total Primary Sector	215.7	252.4	193.7	284.5	279.4	336.8	255.4	383.0	349.0	420.2	328.9	469.3	448.4	500.9	391.1	546.4	510.7	569.7
2	Total Secondary Sector	1393.0	1387.6	1439.7	1446.3	1781.7	1785.7	1877.6	1924.2	2157.9	2203.6	2314.9	2337.0	2690.0	2558.9	2735.4	2723.4	2959.5	2821.5
3	Total Tertiary Sector	4170.1	4206.8	4169.6	4243.8	5416.9	5616.3	5655.2	5740.2	6656.5	6955.6	6961.3	7174.7	8566.7	8544.4	8583.9	8723.2	9680.0	9586.5
	TOTAL NATIONAL ECONOMY	5778.9	5846.7	5803.0	5974.6	7478.0	7738.9	7788.2	8047.4	9163.5	9579.4	9605.1	9981.1	11705.2	11604.2	11710.5	11993.0	13150.2	12977.7

Source: Own estimates using the Product Input Matrices, 2003, 2008, 2012. INEGI.

Figure 5.23. Total impact on welfare by growth in margin (markup) of the freight railway industry in Mexico, 2006-2016. Millions of pesos at the value of 2016 (Based on Technological Coefficients of MIP 2012, INEGI)



Fountain: Own estimates with information from the Input-Product Matrix and producer price indices at the level of the SCIAN 2014 subsector, INEGI (2016).

Finally, if we follow up on the total quarterly overcharge incurred by the industrial sector due to margin growth, we observe that this process of deterioration in the overcharge accelerated at the beginning of 2009, and increased considerably for the entire economy, but particularly for the tertiary sector, which has been the main sector affected (Figure 5.23).

Thus, the evidence in this section allows us to infer that, despite the gains in technology and efficiency associated with production in the railway sector service, these have not been transmitted in benefits observed for the demanders of the service, and that the greater provision in the use of the network has occurred with growth in the levels of fees above the growth in production costs, which have induced overcharges in all sectors of the Mexican economy.

A final exercise for estimating costs is derived from the first estimates in this same section. In this case, it was shown that the elasticity of the railway sector with respect to aggregate production is less than unity, i.e. growth in the sector is less than proportional to the growth of national industry.

If we continue with the interpretation of a factor demand under Leontief technology the following modified version is proposed at an elasticity of production different from unity and with potential changes over time. If we concentrate on the aggregate function of GDP production technology for a country, Yt this is mathematically equivalent to:

$$Y_t = Min\left\{\left[\frac{x_{1,t}}{a_{1,t}}\right]^{1/\eta_1},...,\left[\frac{X_{F,t}}{a_{F,t}}\right]^{1/\eta_F},...,\left[\frac{X_{J,t}}{a_{J,t}}\right]^{1/\eta_J}\right\} \qquad (38)$$

Given this technology, the conditional demand of the railway factor $x_{t,F}$ is given by the following equation:

$$x^d_{F,t}(w_{F,t}, Y_t; w_{1,t},..., w_{J,t}) = a_{F,t} \bullet Y_t^{\eta_F} \qquad (39)$$

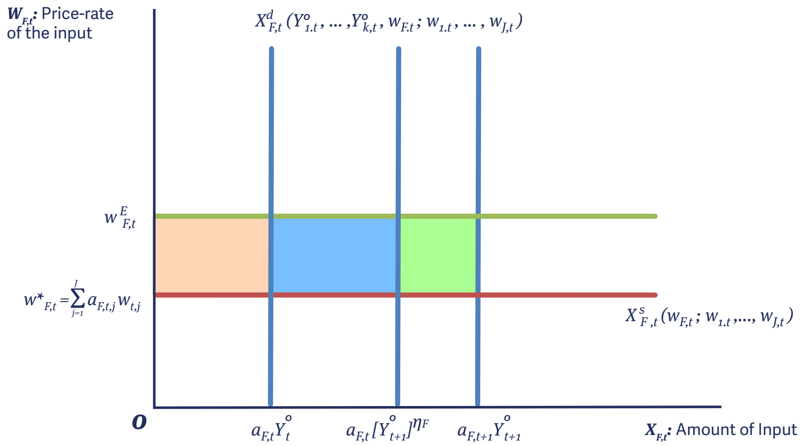
And therefore, the function of production costs associated with the railway sector, given this assumption, is given by:

$$C_{F,t}(Y_t, w_{F,t}) = w_{F,t} \bullet a_{F,t} \bullet Y_t^{\eta_F} \qquad (40)$$

Under this assumption, the production technology of the economy for the railway sector in the *"t"* period still requires all factors of production *{x1,...,xJ}* but the technology admits that the railway factor has a production elasticity given by η.

In terms of our cost estimation target, if we think of aggregate industry as an aggregate technology, graphically this equates to Figure 5.24:

Figure 5.24. Comparison of equilibria in the railway freight transport market under a competitive industry and a non-competitive industry, and loss of welfare due to overpricing under the assumption of complementarity in the sense of Leontief and product elasticity $\eta<1$.



Note: The figure assumes that the railway industry has the same cost structure, and that only demand changes its demand structure by factor.
Source: Based on Varian (1996), Nicholson (2004) and Tirole (2000).

Thus, the cost of the concentration in an environment of growing demand for the input does not grow at exactly the same rate as output, but at a proportion determined by the output elasticity of conditional demand.

In this case the increase in the estimated cost under this proposed technology is determined by the shaded region $[0,a_{F,t+1}[Y^o_{t+1}]^{\eta_F}]\ x[w^*_{F,t},w^E_{F,t}]$. As the elasticity of production approaches unity η-->1 and there is no change in the technological coefficients such that $a_{t,F}=a_{t+1,F}=a_F$, the cost converges to the estimate in the previous section:

In particular, under the new context of the new Leontief technology-based conditional augmented model, the social cost faced for overpricing is given by:

$$\frac{\Delta \mathbb{C}_{F,t}}{w^E_{F,0}} = [M_{F,0}\, e^{yM_F}] \bullet I_{F,t} \bullet a_{F,t} \bullet Y^{\eta}_t \qquad (41)$$

Suppose the structure of the conditional demand model of the railway input takes the following structure:

$$X_{F,t}=a_{F,t} \bullet Y_t^{\eta_F} \tag{42}$$

In this case, the technological coefficient is a normalization that grows continuously at the rate δ per unit of time.

Obtaining logarithms in the above equation we have:

$$log(X_{F,t}) = log(a_{F,t}) + \eta_F \bullet log(Y_t) \tag{43}$$

Returning to the ideas of the econometric model put forward in the macroeconomic analysis of this chapter, we know that the data series $\{x_{F,t}\}_{t \in T}$ and $\{log(X_{F,t})\}_{t \in T}$ are not stationary, therefore, in order to estimate the model and identify the relevant parameters we use as dependent and independent variables to the first differences in the previous logarithmic transformation, assuming that the technological coefficients remain constant.

$$[log(X_{F,t}) - log(X_{F,t})] = \eta_F^{\bullet 1} [log(Y_t) - log(Y_{t-1})] \tag{44}$$

This is, in terms of first differences of logarithms, equivalent to estimating growth rates:

$$\Delta log(X_{F,t}) = \eta_F^{\bullet 1} [\Delta log(Y_t)] \tag{45}$$

If we add the unknown or observed factors associated with the technology in the form of classical error in a linear regression $t\varepsilon$, then the following equation allows us to identify the parameters corresponding to the adjusted demand for railway factor in an empirical model.

$$\Delta log(X_{F,t}) = \beta_0 + \beta_1 \Delta log(Y_t) + e_t \tag{46}$$

In this case, in our empirical model of growth rates we consider variations associated with fixed effects of each quarter, where a set of 3 dichotomous variables $\{D_2,D_3,D_4\}$ are integrated for every quarter different from the first (to avoid the correlation problem) perfect), we have:

$$\Delta log(X_{F,t}) = \beta_0 + \beta_1\, \Delta log(Y_t) + \delta_2 D_2 + \delta_3 D_3 + \delta_4 D_4 + u_t \tag{47}$$

Therefore, the reduced empirical model is determined according to the quarter and is:

$$\Delta log(X_{F,t}/Q_t) = \alpha_{F,t}(Q_t) + \beta_1\, \Delta log(Y_t) + u_t \tag{48}$$

In this case, the econometric identification of the parameters of the demand for the railway input is given by a set of original technical coefficients that depend on the quarter of demand assessment, and the estimated product-elasticity:

$$\alpha_{F,t}(Q_t) = \begin{cases} \hat{\delta}_1 & si\ \ Q_t{=}1 \\ \hat{\delta}_1 + \hat{\delta}_2 & si\ \ Q_t{=}2 \\ \hat{\delta}_1 + \hat{\delta}_3 & si\ \ Q_t{=}3 \\ \hat{\delta}_1 + \hat{\delta}_4 & si\ \ Q_t{=}4 \end{cases} \tag{49}$$

$$\hat{\eta}_F = \beta_1$$

Using the generalized least squares method it is possible to estimate and identify the parameters $\{\eta_F,\delta_1,\delta_2,\delta_3,\delta_4\}$ and therefore estimate the effective demand in the Leontief function, and the effective cost given the parameters of the elasticities and technology, and the paremeter $\hat{a}_{F,0}$ is calibrated in three possible scenarios, according to the central moment of the estimation of the IOM (2003, 2008, y 2012) using the rest of the parameters and the true value, that is, for each $t{=}0$ centered on those years, it is possible to infer the coefficient using the conventional Leontief method of the previous section:

$$[X_{F,t} = a_0 Y_t^{\eta_F}] \Rightarrow \hat{a}_0 = \left.\frac{X_{0,F}}{Y_0^{\hat{\eta}_F}}\right|_{t=0,\ t\in\{2003.2008,2012\}} \tag{50}$$

Thus, in particular, the estimated effective demand for a service of the economy is:

$$\hat{x}_{F,t} = \hat{a}_{F,t}\,(Q_t)\,Y_t^{\hat{\eta}_F} \tag{51}$$

$$\alpha_{F,t}(Q_t) = \begin{cases} \hat{a}_0 e^{\hat{\delta}_1} & si \;\; Q_t=1 \\ \hat{a}_0 e^{[\hat{\delta}_1+\hat{\delta}_2]} & si \;\; Q_t=2 \\ \hat{a}_0 e^{[\hat{\delta}_1+\hat{\delta}_3]} & si \;\; Q_t=3 \\ \hat{a}_0 e^{[\hat{\delta}_1+\hat{\delta}_4]} & si \;\; Q_t=4 \end{cases}$$

Using this information, in particular, we know that conditional in the quarter and year, it is possible to estimate the cost, but this time, using the functional form proposed for the study:

$$\frac{\Delta \mathbb{C}_{F,t}}{w^E_{F,0}} = [M_{F,0}\, e^{yM_F}] \bullet I_{F,t} \bullet \hat{a}_{F,t} \bullet Y^{\eta}_t \tag{52}$$

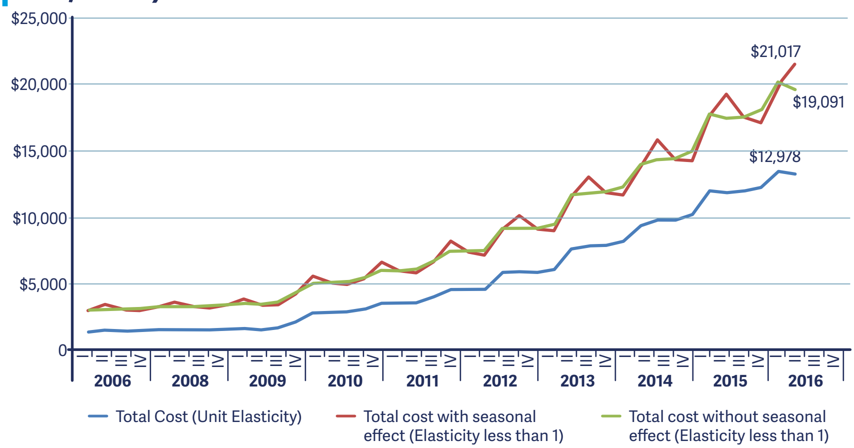
$$\alpha_{F,t}(Q_t) = \begin{cases} \hat{a}_0 e^{\hat{\delta}_1} & si \;\; Q_t=1 \\ \hat{a}_0 e^{[\hat{\delta}_1+\hat{\delta}_2]} & si \;\; Q_t=2 \\ \hat{a}_0 e^{[\hat{\delta}_1+\hat{\delta}_3]} & si \;\; Q_t=3 \\ \hat{a}_0 e^{[\hat{\delta}_1+\hat{\delta}_4]} & si \;\; Q_t=4 \end{cases}$$

Compared to Figure 5.24 where the coefficient a_0 is kept fixed, in this new model this coefficient varies according to the seasonality of the product series. Using the most recent technical coefficients, i.e. the 2012 IOM , the technical adjusted coefficient using the elasticity of the fullest model in that year is from $\hat{a}_0=0.031372191$ with the seasonal fluctuations given by the exponential rates estimated in the corresponding elasticity model.

With this technical coefficient and given the specifications of the model, the total cost in terms of efficiency has increased over time also in this case, going from \$3,032 million Mexican pesos in 2006 at the beginning of the concentration to \$21,016.7 million Mexican pesos in the second quarter of 2016, all in value of pesos of 2016. (See Figure 5.25).

In this case, the increase in cost, although it is reduced by the elasticity of the product, the technical coefficient implicit in this model is greater, therefore, it expands the impact of the estimated cost in a proportion to the previously proposed cost.

Figure 5.25. Total welfare impact of markup growth (markup) of the freight railway transport industry under two input elasticity of demand elasticity by input in Mexico, 2006-2016. Millions of pesos at the value of 2016 (Based on Technological Coefficients of MIP 2012, INEGI)



Source: Own estimates with information from the Input-Output Matrix and producer price indices at the level of the SCIAN 2014 subsector, INEGI (2016).

In this way, regardless of whether one considers a railway input demand model with a unit product elasticity or one with elasticity less than 1 but whose demand adjusts seasonally to increases in production, the costs associated with the greater concentration of suppliers have been incremental over time for Mexico, costing the industry in total efficiency for the last available quarter from $13,000 to $21,000 million Mexican pesos in 2016 value.

5.6. Conclusions

The railway network in Mexico has not changed significantly in its length, routes, or concessionaires, but it has significantly increased the intensity of its use, measured by tons and tons per kilometer transported in the network. In particular, after the higher concentration of suppliers observed in November 2005 associated with the merger of FERROMEX and FERROSUR under the same parent holding company ITF, there is a significant change in the concentration indices of Herfindhal-Hirschman in all performance indicators of sector, and for all economic sectors that require the railway freight industry. However, estimates suggest that increases in the performance of the railway sector are associated with increases in demand for the service, rather than increased concentration.

The present study finds that from the highest concentration in 2005 there is an increase in the values of railway freight rates above the average of producer prices in the economy, and this significant and substantial increase was not shared in the equivalent fees of other transport industries that potentially face the same demand and cost shocks as air, of motor transport, and maritime; on the contrary, these other industries showed reductions in their actual relative fees in that same period, with the railway industry substantially differing from the rest in both trends and levels of real growth.

When testing the efficiency hypothesis by economy of scope and networks, the results of the work suggest that after the concentration there was a reduction of between 3 and 4 percent in the marginal and average costs of the industry attributable to the reorganization of technology and efficiency improvements of the sector. However, these gains did not turn into observed reductions in the prices (fees) at which the transport service is provided to other sectors.

The study finds that after the increased concentration there has been an accelerated increase in the effective rates faced by rail service users, above the growth in costs. For the second quarter of 2016, this growth represented around 115% in over implicit competitive rates. This means that in terms of social burden per surcharge, this represents almost the total cost of competitive production.

Finally, two types of railway factor demand models were estimated to estimate the aggregate social cost. Using the cost estimation method under the assumptions of the Input-Output Matrix, and the most recent production technology for each sector of the economy (IOM-INEGI, 2012), if we consider a model of product elasticity for the second quarter of 2016 this surcharge translated into an increase of approximately 0.05% of the aggregate cost of production, this is equivalent to an aggregate cost damage of $12,977.7 million Mexican pesos at market value. The sector that faces a greater burden of the overcharge is the tertiary sector that faces a overcharge of $9,586.5 million Mexican pesos, followed by the secondary sector with an extra cost of $2,821.5 million Mexican pesos, and finally the primary sector with an extra cost of $569.7 million Mexican pesos.

In the case of using a model of decreasing elasticity, the estimate of the national cost for the surcharge faced by the industry during the second quarter of 2016 increases to 21,016.7 million pesos at the value of 2016 if seasonal effects are considered, and to 19,091.3 million pesos in case these effects are ignored.

Based on the analysis developed in this work, the following recommendations regarding the freight railway transport market are derived.

1. In order to evaluate the performance of the market under study in the future, it is essential to create integrated sources of information of the supplier participants, with greater periodicity, and accessible to the regulatory authority, in this case the COFECE, and the authority in charge of promoting the sector, the SCT.
2. The initial characteristics of the market reflect that concession contracts are established for a very long term, which could generate incentives for possible collusive practices. Therefore, it is recommended that route concessions obey long-term economic efficiency criteria, allowing the free entry of potential participants who compete in dimensions such as fees offered to users, rotation time of concessions, quality of the service offered, and infrastructure investment projects, allowing co-participation with the corresponding government area.
3. From the previous point, it is recommended to explore the possibility that the opening of route concessions in the railway freight transport be staggered over time, so as to reduce the incentives for collusion and the coordination capacity of the service providers.
4. In order to study in greater detail the potential sources of growth in prices in the freight railway sector above industry costs and above those observed in other competing sectors such as air freight and truck freight, it is recommended to request from the participating companies a detailed analysis of information related to operating expenses, investment, and management of each company. This will allow the regulatory agency, COFECE, to analyze new sources of growth outside the prices of the inputs already studied in this document.

5. The cost in efficiency of the growth in prices of the freight railway sector above the growth of its costs, measured in the last section of this work, implies that this sector generates effects on the efficiency of other intermediate and final industries, which have consequences on the welfare of final consumers; therefore, it is recommended to continue the study of the competitiveness of the freight railway sector respecting its role within the productive chain, and integrating the indirect costs that it generates on the other industries.

5.7. Bibliography

Aiyagari, S. R., Braun, R., & Eckstein, Z. (1998). Transaction services, inflation, and welfare. Journal of Political Economy, 106, 1274-1301.

Block, M. K., Nold, F. C., & Sidak, J. G. (1981). The deterrent effect of antitrust enforcement. Journal of Political Economy, 89, 429-445.

Breen, D. A. (2004) The Union Pacific/Southern Pacific rail merger: A retrospective on merger benefits. Review of Network Economics.

Perloff, J. M., & Carlton, D. W. (1999). Modern industrial organization. Addison Wesley Longman.

Clark, J. M. (1940) Toward a concept of workable competition. The American Economic Review, 241-25.

Chow, G. C. (1960) Tests of equality between sets of coefficients in two linear regressions. Econometrica, 28(1), 591-605.

COFECE. (2006) . CNT-132-2005. Resolution.

COFEMER. (2015) . Revisión del marco regulatorio del sector ferroviario [Review of the regulatory framework of the railway sector.] Retrieved from: https://conamer.gob.mx/varios/adjuntos/2016.02.09/Diagnosticos_ ASF/2_Stre/6_Diagnostico_Ferroviario_2.pdf

Davis, P., & Garcés, E. (2009). Quantitative Techniques for Competition and Antitrust Analysis (1st ed.). Princeton University Press.

Gorostiza, F. J. (2011) . Renaissance of Mexican freight railroads.

Mexico: Mexican Association of Railways.

Grimm, C. M., & Harris, R. G. (1983) Structural economics of the US rail freight industry: concepts, evidence, and merger policy implications. Transportation Research Part A: General, 271-281.

Harris, R. G., & Winston, C. (1983). Potential benefits of rail mergers: An econometric analysis of network effects on service quality. The Review of Economics and Statistics, 32-40.

Hayashi, F. (2000) Econometrics. New Jersey, Princeton: Princeton University Press.

Heckman, J. J., & Vytlacil, E. (2005). Structural equations, treatment effects, and econometric policy assessment. Econometrica, 73, 669-738.

Hosken, D. S., Olson, L. M., & Smith, L. K. (2018). Do retail mergers affect competition? Evidence from grocery retailing. Journal of Economics & Management Strategy, 3-22.

Ivaldi, M., & McCullough, G. J. (2005). Welfare trade-offs in US rail mergers.

Jimenez Espriu, J. (2011). Las concesiones en materia de telecomunicaciones [Concessions in the field of telecommunications]. In J. Rivera Hernandez, & J. Fernández Ruiz, La concesión de las telecomunicaciones (pp. 119-147). UNAM-IIJ.

Nicholson, W. (2004). Microeconomic theory; Theory: Basic Principles and Extensions. South-Western.

Oum, T. H., Waters, W. G., & Y°n, J.-S. (1992) . Concepts of price elasticities of transport demand and recent empirical estimates: An interpretative survey. Journal of Transport Economics and Policy, 26, 139-154.

Schwartz, J., Guasch, J. L., Wilmsmeier, G., & Stokenberga, A. (2009).. Logistics, transport and food prices in lac: Policy guidance for improving efficiency and reducing costs. Sustainable Development Occasional Papers Series(2), 1-38.

Shepherd, W. G. (1997). The Economics of Industrial Organization: Analysis, Markets, Policies. Prentice Hall.

Shepherd, W. G. (2000) Wrong Numbers: MCI WorldCom, Sprint, and Monopoly Power in the Long-Distance Market. Economic Policy Institute Briefing Paper.

Shy, O. (1995) Industrial organization: theory and applications. MIT Press.

Tirole, J. (1988). The theory of industrial organization. MIT press.

Thompson, L. S. (2013) . Recent developments in rail transportation services.

OECD Working Party No. 2 on Competition and Regulation.

Varian, H. R. (1992). Microeconomic analysis. WW Norton.

Whinston, M. (2006). Lectures on Antitrust Economics. MIT Press.

Whinston, M. D. (2007). “Antitrust policy toward horizontal mergers.”. In M. Armstrong, & R. H. Porter, Handbook of industrial organization 3 (pp. 1557-2440).

World Bank. (2017) . Railway Reform: Toolkit for Improving Rail Sector Performance.

Table 5.A1. Net tons transported per company (thousands)

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	30,205.50	32,410.50	30,003.50	29,226.80	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	31,938.10	36,956.40	36,051.40	29,058.60	33,780.80	35,457.20	36,434.80	36,105.80	38,845.80
FERROMEX	30,223.80	31,479.90	34,397.10	36,374.30	42,173.70	42,628.80	42,893.90	41,563.60	49,605.70	50,352.00	51,338.00	52,570.30	53,655.20
FERROSUR	13,282.30	13,904.70	15,763.70	16,277.90	13,440.70	13,045.00	13,445.10	13,537.90	14,544.10	15,861.60	16,370.60	16,220.30	17,162.00
FTVM	1,121.90	1,201.70	1,435.30	1,447.40	1,501.70	1,926.40	1,787.00	1,513.61	1,448.16	1,657.60	2,348.90	2,132.69	2,360.54
LCOAH-DGO	3,665.50	3,859.70	3,954.90	3,666.20	4,125.30	4,468.90	4,433.00	3,762.90	4,167.10	4,105.00	4,166.40	4,030.30	4,145.70
CFCHM	1,951.90	2,311.50	2,542.20	2,447.70	2,108.60	399.40	697.50	588.70	710.00	753.20	695.70	599.00	561.40
Fit	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	295.23	308.63	246.55	252.90	274.40	205.80
"Total tons Transported (thousands)"	80,450.90	85,168.00	88,096.70	89,440.30	95,288.10	99,424.90	99,307.90	90,320.54	104,564.49	108,433.15	111,607.30	111,932.79	116,936.44
"Industry HHI (No Concentration)"	3,122.17	3,110.80	3,035.72	3,079.91	3,307.37	3,416.18	3,390.46	3,398.09	3,506.09	3,456.75	3,415.58	3,473.23	3,441.19
"Industry HHI (With concentration)"	3,122.17	3,110.80	3,035.72	3,079.91	4,555.95	4,541.27	4,560.02	4,777.59	4,825.80	4,815.28	4,765.00	4,834.40	4,788.01
Difference	0.00	0.00	0.00	0.00	1,248.58	1,125.09	1,169.56	1,379.50	1,319.71	1,358.53	1,349.42	1,361.18	1,346.82

Notes: 1/ Since the highest concentration is recorded in November 2005, it is assumed that it is effective from 2006.
2/Stops operating after 2005.
3/ KCSM acquires the TFM line.
Sources: Own elaboration with data from the statistical railway yearbooks (2002-2014).

Table 5.A2. Tons-Kilometer transported per company (millions)

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	19,326.10	21,684.70	21,213.40	20,247.30	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	22,603.90	26,779.90	24,663.00	19,397.60	22,879.40	23,080.60	23,363.20	23,242.80	25,716.60
FERROMEX	24,911.10	24,305.00	24,319.80	25,072.40	36,191.10	37,747.71	37,165.90	36,352.40	42,712.70	42,449.70	41,583.20	38,818.80	39,781.90
FERROSUR	5,403.30	5,734.70	6,248.90	6,401.70	5,358.50	5,286.10	5,244.50	5,399.30	5,458.10	5,842.70	5,908.50	5,977.10	6,230.60
FTVM	37.16	38.3	45.1	41.8	45.5	59.64	53.96	47.73	52.22	70.79	107.24	86.12	83.46
LCOAH-DGO	886.2	1,019.60	1,011.10	813.3	978.3	1,069.10	1,049.40	892.1	903.2	917.8	917.5	927.2	914.2
CFCHM	1,052.20	1,349.70	1,549.00	1,471 80	977.3	183.3	280.1	224.9	287	358.1	269.5	247.4	202.7
FJT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	7.05	7.54	7.98	7.86	9.99	7.13
Total tons-kilometer transported (millions)	51,616 06	54,132.00	54,387.30	54,048.30	66,154.60	71,125.75	68,456.86	62,321 08	72,300.16	72,727.67	72,157.00	69,3094 1	72,936.59
Industry HHI (No Concentration)	3,847.85	3,742.68	3,664.44	3,705.27	4,230.30	4,291.82	4,306.68	4,448.51	4,550.20	4,480.36	4,438.26	4,337.78	4,292.78
Industry HHI (With concentration)	3,847.85	3,742.68	3,664.44	3,705.27	5,116.54	5,080.68	5,138.52	5,459.23	5,442.17	5,418.18	5,382.03	5,303.78	5,224.64
Difference	0	0	0	0	886.25	788.86	831.85	1010.72	891.97	937.82	943. 77	966	931.87

Notes: 1/ Since the highest concentration is recorded in November 2005, it is assumed that it is effective from 2006.
2/Stops operating after 2005.
3/ KCSM acquires the TFM line.
Sources: Own elaboration with data from the statistical railway yearbooks (2002-2014).

Table 5.A3. Net tons transported per company (thousands), Industry: Forest Products.

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	205.00	236.60	162.00	161.80	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	ntT	nt	nt	637.20	720.30	804.80	683.10	812.20	879.50	800.60	789.50	857.30
FERROMEX	74.80	64.50	67.20	95.00	187.50	212.10	77.20	70.40	78.30	112.10	250.90	269.20	252.60
FERROSUR	114.30	139.00	142.20	143.50	4.70	3.90	3.70	3.60	6.00	2.30	13.80	16.40	24.90
FTVM	nt	nt	1.30	nt	nt	nt	nt	nt	1.34	0.32	nt	nt	nt
LCOAH-DGO	70.30	79.30	75.40	59.00	62.10	60.30	50.50	20.80	5.40	8.50	7.50	10.30	9.80
CFCHM	49.80	97.20	123.40	94.40	nt	0.50	4.50	11.20	13.10	13.30	15.80	5.90	5.40
FIT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	14.01	7.91	7.03	7.30	7.00	7.40
"Total tons Transported (thousands)"	514.20	616.60	571.50	553.70	891.50	997.10	940.70	803.11	924.24	1,023.05	1,095.90	1,098.30	1,157.40
"Industry HHI (No Concentration)"	2,575.88	2,503.90	2,201.24	2,224.15	5,599.83	5,707.76	7,415.92	7,323.40	7,797.75	7,513.58	5,865.63	5,771.86	5,968.83
"Industry HHI (With concentration)"	2,575.88	2,503.90	2,201.24	2,224.15	5,622.00	5,724.40	7,422.38	7,331.26	7,808.75	7,518.51	5,923.29	5,845.06	6,062.74
Difference	0.00	0.00	0.00	0.00	22.18	16.64	6.46	7.86	11.00	4.93	57.66	73.20	93.91

Notes: 1/ Since the highest concentration is recorded in November 2005, it is assumed that it is effective from 2006.
2/Stops operating after 2005.
3/ KCSM acquires the TFM line.
Sources: Own elaboration with data from the statistical railway yearbooks (2002-2014).

Table 5.A4. Tons-Kilometer transported per company (millions) Industry: Forest Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	122.00	176.30	101.00	103.80	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	473.30	568.90	616.60	529.50	622.20	695.10	641.90	617.90	669.00
FERROMEX	92.10	73.80	89.60	114.00	154.70	176.79	57.40	55.10	63.80	77.10	164.60	184.70	156.00
FERROSUR	69.60	95.30	99.50	92.90	2.00	1.70	1.90	1.70	3.30	1.10	7.70	6.80	16.40
FTVM	nt	nt	0.03	nt	nt	nt	nt	nt	0.02	0.01	nt	nt	nt
LCOAH-DGO	15.60	18.20	17.90	14.20	15.30	15.00	12.20	5.50	1.40	2.20	1.90	2.60	2.51
CFCHM	8.20	12.60	16.60	14.40	nt	0.10	1.00	1.50	1.60	2.10	1.80	1.40	5.40
FIT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	0.12	0.06	0.07	0.05	0.06	0.09
"Total tons-kilometers transported (millions)"	307.50	376.20	324.63	339.30	645.30	762.49	689.10	593.42	692.38	777.68	817.95	813.46	849.40
"Industry HHI (No Concentration)"	3,016.32	3,257.36	2,725.77	2,849.95	5,960.04	6,108.28	8,079.11	8,048.98	8,160.71	8,087.55	6,564.52	6,286.18	6,544.96
"Industry HHI (With concentration)"	3,016.32	3,257.36	2,725.77	2,849.95	5,974.90	6,118.62	8,083.71	8,054.30	8,169.50	8,090.36	6,602.40	6,324.14	6,615.88
Difference	0.00	0.00	0.00	0.00	14.86	10.34	4.59	5.32	8.78	2.80	37.89	37.96	70.92

Notes: 1/ Since the highest concentration is recorded in November 2005, it is assumed that it is effective from 2006.nt2/ Stops operating after 2005.
3/ KCSM Acquires the line TFM.
nt: No transports in this year,
NA: There is no information available in the yearbook consulted.
Sources: Own elaboration with data from the Statistical Railway Yearbook", General Directorate of Multimodal Railway Transport: SCT (2002-2014).

Table 5.A5. Net tons transported per company (thousands) Industry: Agricultural Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	205	236.6	162	161.8	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	637.2	720.3	804.8	7,073.20	7,448.30	7,581.60	7,410.80	6,145.00	7,539.90
FERROMEX	8,903.40	9,415.40	9,290.90	9,838.00	12,467.40	12,460.00	13,148.80	12,862.80	14,409.20	13,473.50	12,325.70	12,720.00	13,160.30
FERROSUR	3,726.80	4,042.50	4,125.30	4,535.00	4,396.90	4,188.00	3,911.30	4,977.90	4,915.00	5,160.70	6,279.10	5,645.20	5,630.00
FTVM	21.1	67.8	197.8	353.9	232.7	278.9	389.3	200.7	267.57	210.52	624.1	626.45	727.72
LCOAH-DGO	0.3	7	41.5	56	11.2	9.5	6.9	14.7	3.8	nt	nt	nt	nt
CFCHM	193.1	209.5	489.3	402.7	264.3	25.1	88.6	nt	nt	nt	nt	nt	nt
FIT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	112.77	80.73	75.58	57.8	36.3	37.4
Total tons transported (thousands)	13,049.70	13,978.80	14,306.80	15,347.40	18,009.70	17,681.80	18,349.70	25,242.07	27,124.60	26,501.90	26,697.50	25,172.95	27,095.32
Industry HHI (No Concentration)	5,475.18	5,378.32	5,063.67	4,995.66	5,404.63	5,545.83	5,613.01	3,771.64	3,905.40	3,782.99	3,460.69	3,658.35	3,572.42
Industry HHI (With concentration)	5,475.18	5,378.32	5,063.67	4,995.66	8,784.81	8,883.95	8,667.78	5,781.48	5,830.56	5,762.99	5,632.38	5,924.71	5,590.86
Difference	0	0	0	0	3380.18	3338.12	3054.78	2009.84	1925.16	1980	2171.69	2266.36	2018.44

Notes: 1/ Since the highest concentration is recorded in November 2005, it is assumed that it is effective from 2006.nt2/ Stops operating after 2005.
3/ KCSM Acquires the line TFM.
nt: No transports in this year,
NA: There is no information available in the yearbook consulted.
Sources: Own elaboration with data from the Statistical Railway Yearbook", General Directorate of Multimodal Railway Transport: SCT (2002-2014).

Table 5.A6. Tons-Kilometer transported per company (millions) Industry: Agricultural Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	122	176.3	101	103.8	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	473.3	568.9	616.6	5,250.00	5,483.00	5,200.30	5,084.30	4,357.40	5,624.30
FERROMEX	9,378.80	9,022.70	6,615.10	6,514.60	12,767.00	13,726.20	14,058.90	13,313.10	15,563.70	14,632.70	12,388.80	12,473.80	12,390.50
FERROSUR	1,068.60	1,168.90	1,185.30	1,324.80	1,187.10	1,168.20	1,014.10	1,495.00	1,380.80	1,436.50	1,835.20	1,616.00	1,537.30
FTVM	0.61	0.98	3.5	5.7	3.7	4.65	7.72	4.06	5.06	3.3	25.86	16.88	7.94
LCOAH-DGO	0.1	1.7	10.9	13.7	3	2	0.9	3.3	1	nt	nt	nt	nt
CFCHM	93.8	131.5	287.7	211.1	115.5	16.3	30.8	nt	nt	nt	nt	nt	nt
FIT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	4.49	2.61	2.5	1.93	1.51	1.14
Total tons-kilometers transported (millions)	10,663.91	10,502.08	8,203.50	8,173.70	14,549.60	15,486.25	15,729.02	20,069.95	22,436.17	21,275.30	19,336.09	18,465.59	19,561.19
Industry HHI (No Concentration)	7,837.52	7,509.39	6,725.01	6,623.42	7,777.51	7,926.53	8,046.10	5,139.89	5,447.13	5,373.44	4,886.57	5,196.65	4,900.71
Industry HHI (With concentration)	7,837.52	7,509.39	6,725.01	6,623.42	9,209.39	9,263.75	9,198.65	6,128.12	6,300.97	6,302.21	6,102.77	6,379.00	5,896.31
Difference	0	0	0	0	1431.87	1337.23	1152.55	988.23	853.84	928.77	1216.2	1182.34	995.61

Notes: 1/ Since the highest concentration is recorded in November 2005, it is assumed that it is effective from 2006.nt2/ Stops operating after 2005.
3/ KCSM Acquires the line TFM.
nt: No transports in this year,
NA: There is no information available in the yearbook consulted.
Sources: Own elaboration with data from the Statistical Railway Yearbook", General Directorate of Multimodal Railway Transport: SCT (2002-2014).

Table 5.A7. Net tons transported per company (thousands), Industry: Animals and their Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	195	169	173.7	160.3	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	153.6	161.9	163.1	176.1	167.6	166	142.4	123.6	110.9
FERROMEX	137.3	141.7	111.2	87.7	215.03	233.5	234.5	248.2	298.3	291.6	303.5	282.6	254.3
FERROSUR	23.4	14.6	20.6	22.4	9.1	37.2	26.1	18.6	14.9	11.5	18.9	12	15
FTVM	0.6	0.2	0.6	0.5	0.1	0.3	0.23	- nt	0.83	0.16	1.1	1.32	0.08
LCOAH-DGO	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
CFCHM	nt	nt	nt	nt	nt	nt	nt	Na	nt	nt	nt	nt	nt
FIT	Na	Na	Na	Na	Na	Na	Na	3.9	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt		3.94	2.78	2.9	2.7	2.8
Total tons transported (thousands)	356.3	325.5	306.1	270.9	377.83	432.9	423.93	446.8	485.57	472.04	468.8	422.22	383.08
Industry HHI (No Concentration)	4,523.38	4,610.95	4,585.18	4,617.91	4,897.44	4,381.90	4,577.94	4,657.43	4,975.46	5,059.02	5,130.59	5,345.43	5,260.65
Industry HHI (With concentration)	4,523.38	4,610.95	4,585.18	4,617.91	5,171.59	5,308.91	5,259.06	5,119.94	5,352.48	5,360.02	5,652.60	5,725.88	5,780.51
Difference	0	0	0	0	274.14	927.01	681.12	462.51	377.02	300.99	522.01	380.46	519.86

Notes: 1/ Since the highest concentration is recorded in November 2005, it is assumed that it is effective from 2006.nt2/ Stops operating after 2005.
3/ KCSM Acquires the line TFM.
nt: No transports in this year,
NA: There is no information available in the yearbook consulted.
Sources: Own elaboration with data from the Statistical Railway Yearbook", General Directorate of Multimodal Railway Transport: SCT (2002-2014).

Table 5.A8. Tons-Kilometer transported per company (millions) Industry: Animals and Their Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	196.3	179.8	177.4	171.4	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	157.3	177.7	178.4	192.7	174.5	175.6	146.2	118.5	99.4
FERROMEX	202.4	205.7	171	129.3	333	380.5	367.1	426.8	519.9	489.8	530.9	505	427
FERROSUR	10.1	6.3	8.9	9.6	3.9	15	11.3	8.2	6.4	5	8.2	5.1	6.5
FTVM	0.01	0	0.01	0.01	0	0	0.01	nt	0.01	0	0.02	0.03	0
LCOAH-DGO	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
CFCHM	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
Fit	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	0.01	0.01	0	0	0	0
Total tonne-kilometres transported (millions)	408.81	391.8	357.31	310.31	494.2	573.2	556.81	627.71	700.82	670.4	685.32	628.63	532.9
Industry HHI (No Concentration)	4,762.94	4,864.88	4,761.55	4,796.71	5,553.96	5,374.43	5,377.31	5,567.29	6,124.25	6,024.46	6,457.68	6,809.39	6,769.74
Industry HHI (With concentration)	4,762.94	4,864.88	4,761.55	4,796.71	5,660.31	5,721.85	5,644.90	5,744.94	6,259.74	6,133.44	6,643.07	6,939.74	6,965.21
Difference	0	0	0	0	106.35	347.42	267.6	177.65	135.49	108.98	185.38	130.35	195.47

Notes: 1/ Since the largest concentration herself Records in November of 2005, Assumes What is it effective to split of 2006.
2/ Stop operate after of 2005. 3/ KCSM Acquires the line TFM.
nt: No Transports in this year,
NA: No Exists information available in the yearbook Consulted.
Sources: Elaboration own with data Obtained of "Yearbook Statistical Railway", Address General of Transport Railway Multimodal: SCT (2002-2014).

Table 5.A9. Net tons transported per company (thousands), Industry: Mineral Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	1,454.60	4,396.70	3,068.00	2,830.90	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	1,965.40	3,198.50	3,403.50	2,300.90	1,997.30	2,184.10	2,078.20	2,115.20	1,881.10
FERROMEX	5,280.70	5,623.60	6,142.50	5,797.70	5,932.60	5,926.50	6,814.70	5,963.90	8,807.10	10,018.30	10,421.80	10,677.30	10,371.00
FERROSUR	503.2	786.9	576	324.4	nt	118.2	nt	26.5	32.9	54.6	18.6	88.6	142.5
FTVM	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
LCOAH-DGO	2,813.20	2,834.40	2,818.40	2,496.30	2,661.10	3,002.30	2,976.10	2,576.00	2,911.70	2,903.70	2,877.90	2,818.00	2,816.80
CFCHM	8.7	25.4	18.3	38.6	20.2	nt	2.5	nt	nt	nt	nt	nt	nt
Fit	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
Total tons transported (thousands)	10,060.40	13,667.00	12,623.20	11,487.90	10,579.30	12,245.50	13,196.80	10,867.30	13,749.00	15,160.70	15,396.50	15,699.10	15,211.40
Industry HHI (No Concentration)	3,771.21	3,191.31	3,477.88	3,634.53	4,122.56	3,626.59	3,840.31	4,021.97	4,762.78	4,941.16	5,113.45	5,129.71	5,145.10
Industry HHI (With concentration)	3,771.21	3,191.31	3,477.88	3,634.53	4,122.56	3,720.02	3,840.31	4,048.73	4,793.44	4,988.76	5,129.81	5,206.48	5,272.84
Difference	0	0	0	0	0	93.43	0	26.76	30.66	47.6	16.35	76.77	127.74

Notes: 1/ Since the largest concentration herself Records in November of 2005, Assumes What is it effective to split of 2006.
2/ Stop operate after of 2005. 3/ KCSM Acquires the line TFM.
nt: No Transports in this year,
NA: No Exists information available in the yearbook Consulted.
Sources: Elaboration own with data Obtained of "Yearbook Statistical Railway", Address General of Transport Railway Multimodal: SCT (2002-2014).

Table 5.A10. Tons-Kilometer transported per company (millions) Industry: Mineral Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	637.9	2,083.50	1,538.00	1,480.90	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	1,443.90	1,933.40	1,834.60	1,037.70	560.1	653.2	497.5	570.5	487.2
FERROMEX	5,502.70	5,145.40	6,035.40	5,516.00	6,234.00	6,362.59	6,018.20	5,900.40	6,940.20	7,430.00	7,320.60	6,645.90	6,628.20
FERROSUR	105.1	165.1	125.2	116.7	nt	3.8	nt	4.5	5.2	21	2.2	34.3	28.1
FTVM	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
LCOAH-DGO	725.7	821.7	796.3	600.1	637.7	723.9	712.8	615.6	620.2	646.3	639.6	662.3	646.93
CFCHM	0.9	3.7	7.8	23.3	9.9	nt	1.6	nt	nt	nt	nt	nt	nt
Fit	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
Total tonne-kilometres transported (millions)	6,972.30	8,219.40	8,502.70	7,737.00	8,325.50	9,023.69	8,567.20	7,558.20	8,125.70	8,750.50	8,459.90	7,913.00	7,790.43
Industry HHI (No Concentration)	6,423.04	4,665.37	5,455.54	5,511.69	5,966.24	5,495.06	5,462.43	6,349.17	7,400.72	7,319.94	7,579.69	7,176.05	7,347.03
Industry HHI (With concentration)	6,423.04	4,665.37	5,455.54	5,511.69	5,966.24	5,501.00	5,462.43	6,358.47	7,411.66	7,360.70	7,584.19	7,248.87	7,408.41
Difference	0	0	0	0	0	5.94	0	9.3	10.93	40.75	4.5	72.81	61.38

Notes: 1/ Since the largest concentration herself Records in November of 2005, Assumes What is it effective to split of 2006.
2/ Stop operate after of 2005. 3/ KCSM Acquires the line TFM.
nt: No Transports in this year,
NA: No Exists information available in the yearbook Consulted.
Sources: Elaboration own with data Obtained of "Yearbook Statistical Railway", Address General of Transport Railway Multimodal: SCT (2002-2014).

Table 5.A11. Net tons transported per company (thousands) Industry: Oil and its Derivatives

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	1,400.30	720.1	872	721.8	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	947.6	1,066.10	1,343.90	1,543.40	1,624.10	1,859.10	1,620.80	1,821.10	2,238.00
FERROMEX	1,971.90	2,677.70	3,476.33	3,552.30	3,275.20	3,264.20	3,008.50	4,042.80	4,228.70	4,303.20	5,008.60	4,776.30	4,774.20
FERROSUR	512.5	410.1	484.7	546.5	131.1	363.1	298.4	434.2	1,467.30	1,933.40	1,738.80	2,266.10	3,454.30
FTVM	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
LCOAH-DGO	11.7	11.7	10.9	12.9	202	277.4	301	1.5	1.6	1.9	1.8	1.9	1.8
CFCHM	601.3	693.2	663	657.7	452.1	99.3	99.8	232.3	232	179.5	170.3	196.6	169.2
Fit	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	157.02	164.23	106.99	149.4	192	119.4
Total tons transported (thousands)	4,497.70	4,512.80	5,506.93	5,491.20	5,008.00	5,070.10	5,051.60	6,411.22	7,717.93	8,384.09	8,689.70	9,254.00	10,756.90
Industry HHI (No Concentration)	3,200.10	4,093.94	4,458.14	4,600.24	4,739.73	4,672.16	4,328.89	4,620.86	3,819.83	3,664.02	4,077.27	3,659.67	3,437.59
Industry HHI (With concentration)	3,200.10	4,093.94	4,458.14	4,600.24	5,082.13	5,594.31	5,032.48	5,474.99	5,903.14	6,031.20	6,383.94	6,187.47	6,288.06
Difference	0	0	0	0	342.41	922.15	703.59	854.12	2083.31	2367.18	2306.68	2527.79	2850.47

Notes: 1/ Since the largest concentration herself Records in November of 2005, Assumes What is it effective to split of 2006.
2/ Stop operate after of 2005. 3/ KCSM Acquires the line TFM.
nt: No Transports in this year,
NA: No Exists information available in the yearbook Consulted.
Sources: Elaboration own with data Obtained of "Yearbook Statistical Railway", Address General of Transport Railway Multimodal: SCT (2002-2014).

Table 5.A12. Tons-Kilometer transported per company (millions) Industry: Oil and its Derivatives

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	671.9	435.5	523	369.5	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	593.8	706.5	813.1	820.1	849.1	954.6	898	973.5	1,260.20
FERROMEX	1,018.20	1,255.20	1,821.22	2,575.40	2,003.40	1,832.30	1,739.80	2,399.10	2,292.10	2,343.00	2,714.40	2,083.60	2,064.60
FERROSUR	74.9	86.1	145.8	167.3	10.7	78.4	99	139.4	482.9	657.9	575.2	741.9	1,081.60
FTVM	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
LCOAH-DGO	3.8	3.7	3.4	4.1	51.8	70.6	76.6	0.2	0.3	0.3	0.3	0.3	0.29
CFCHM	321.4	475.1	490.8	507.4	284.9	31.9	29.8	57	50.7	70.7	30.4	62.2	38.1
Fit	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	2.27	2.31	2.82	4.21	6.74	4.17
Total tonne-kilometres transported (millions)	2,090.20	2,255.60	2,984.22	3,623.70	2,944.60	2,719.70	2,758.30	3,418.07	3,677.41	4,029.32	4,222.51	3,868.24	4,448.96
Industry HHI (No Concentration)	3,655.59	3,927.75	4,325.97	5,372.45	5,132.45	5,230.14	4,869.20	5,521.54	4,592.41	4,212.25	4,770.82	3,905.18	3,547.68
Industry HHI (With concentration)	3,655.59	3,927.75	4,325.97	5,372.45	5,181.89	5,618.56	5,321.97	6,094.04	6,229.37	6,111.14	6,522.21	5,971.34	5,804.07
Difference	0	0	0	0	49.45	388.42	452.77	572.5	1636.96	1898.89	1751.39	2066.16	2256.4

Notes: 1/ Since the largest concentration herself Records in November of 2005, Assumes What is it effective to split of 2006.
2/ Stop operate after of 2005. 3/ KCSM Acquires the line TFM.
nt: No Transports in this year,
NA: No Exists information available in the yearbook Consulted.
Sources: Elaboration own with data Obtained of "Yearbook Statistical Railway", Address General of Transport Railway Multimodal: SCT (2002-2014).

Table 5.A13. Net tons transported per company (thousands) Industry: Inorganic Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	1,645.40	1,022.70	928.4	870.3	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	1,103.90	1,352.50	1,463.70	1,075.00	1,622.00	1,565.60	1,503.70	1,406.70	1,308.10
FERROMEX	951.2	740.9	779.6	560.9	809.3	759.3	677.5	603.3	1,014.40	1,148.40	804.9	729.6	1,045.50
FERROSUR	1,878.10	1,638.90	1,785.80	1,772.60	1,440.70	1,349.80	1,240.20	1,025.50	882.1	841.1	818.4	872.5	905.8
FTVM	1,088.90	1,128.60	1,232.70	1,090.90	1,262.00	1,511.50	1,368.99	1,193.14	1,143.05	1,424.92	1,701.20	1,415.07	1,620.74
LCOAH-DGO	687	752	807.9	858.1	842.6	863.4	857.5	872.5	876.7	889.2	900.6	885.5	874.1
CFCHM	174.8	192.5	78.1	84.9	132.8	55.7	134.9	41.4	88.9	119.7	103.9	75	53.3
Fit	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	0.79	14.07	16.11	8.6	nt	nt
Total tons transported (thousands)	6,425.40	5,475.60	5,612.50	5,237.70	5,591.30	5,892.20	5,742.79	4,811.63	5,641.22	6,005.02	5,841.30	5,384.37	5,807.54
Industry HHI (No Concentration)	2,138.17	2,053.60	2,170.51	2,240.96	2,005.41	2,091.41	2,051.92	2,055.05	2,049.20	2,028.00	2,137.93	2,091.84	2,080.90
Industry HHI (With concentration)	2,138.17	2,053.60	2,170.51	2,240.96	2,751.32	2,681.82	2,561.47	2,589.51	2,611.56	2,563.72	2,524.05	2,530.98	2,642.47
Difference	0	0	0	0	745.91	590.42	509.55	534.46	562.36	535.72	386.12	439.15	561.57

Notes: 1/ Since the largest concentration herself Records in November of 2005, Assumes What is it effective to split of 2006.
2/ Stop operate after of 2005. 3/ KCSM Acquires the line TFM.
nt: No Transports in this year,
NA: No Exists information available in the yearbook Consulted.
Sources: Elaboration own with data Obtained of "Yearbook Statistical Railway", Address General of Transport Railway Multimodal: SCT (2002-2014).

Table 5.A14. Tons-Kilometer transported per company (millions) Industry: Inorganic Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	901.2	835.8	763.8	607.1	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	543.7	789.8	956	695.8	1,186.50	1,045.00	901.3	831.3	757.4
FERROMEX	605.1	488.5	522.2	374.6	566.1	586.08	471.8	477.9	813.9	816.1	656.8	649.1	777.4
FERROSUR	1,084.10	985.8	1,024.70	1,035.60	1,019.20	955.9	850	724.1	627.3	597.9	580.3	617.4	626.1
FTVM	36.37	37.2	41.5	36	41.6	49.94	45.75	39.94	46.31	67.08	80.9	67.88	75.32
LCOAH-DGO	119.1	128.6	131.6	134.7	182.3	191.1	185.1	197.2	189.6	197.9	190.7	192.2	188.14
CFCHM	104.9	106.4	41.5	45.1	55.3	23.3	56.9	17.2	37	49.8	43.3	23.1	18.3
Fit	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	0.05	0.86	0.96	0.52	nt	nt
Total tonne-kilometres transported (millions)	2,850.77	2,582.30	2,525.30	2,233.10	2,408.20	2,596.12	2,565.55	2,152.19	2,901.47	2,774.74	2,453.82	2,380.98	2,442.66
Industry HHI (No Concentration)	2,928.66	2,906.66	3,021.51	3,214.20	2,919.03	2,849.58	2,884.55	2,758.31	2,973.42	2,807.66	2,699.21	2,708.83	2,700.72
Industry HHI (With concentration)	2,928.66	2,906.66	3,021.51	3,214.20	4,908.77	4,512.03	4,103.11	4,252.50	4,186.36	4,075.18	3,965.20	4,122.66	4,332.23
Difference	0	0	0	0	1989.75	1662.45	1218.56	1494.19	1212.94	1267.52	1265.99	1413.83	1631.52

Notes: 1/ Since the largest concentration herself Records in November of 2005, Assumes What is it effective to split of 2006.
2/ Stop operate after of 2005. 3/ KCSM Acquires the line TFM.
nt: No Transports in this year,
NA: No Exists information available in the yearbook Consulted.
Sources: Elaboration own with data Obtained of "Yearbook Statistical Railway", Address General of Transport Railway Multimodal: SCT (2002-2014).

Table 5.A15. Net tons transported per company (thousands), Industry: Industrial Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	19,349.80	19,694.90	18,647.90	19,236.10	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	19,638.10	21,270.60	20,285.70	16,206.80	20,109.20	21,221.20	22,878.20	23,704.70	24,910.50
FERROMEX	12,904.60	12,816.10	14,529.20	16,442.60	19,286.70	19,774.00	18,932.60	17,772.30	20,769.70	21,005.00	22,222.50	23,115.30	23,797.30
FERROSUR	6,611.40	7,156.30	8,418.10	8,681.90	7,133.80	7,103.10	7,847.10	7,051.70	7,225.90	7,857.90	7,482.90	7,319.70	6,989.50
FTVM	11.30	5.00	2.90	2.13	6.90	135.60	28.48	119.78	35.38	21.68	22.40	89.85	12.00
LCOAH-DGO	83.00	175.40	200.70	183.80	346.30	256.00	240.90	277.30	368.00	301.70	378.60	314.60	443.20
CFCHM	924.20	1,093.80	1,170.20	1,169.40	1,239.20	218.80	367.20	303.80	376.00	440.60	405.70	331.50	333.50
Fit	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	6.68	37.76	38.07	27.00	36.50	38.60
"Total tons transported (thousands)"	39,884.30	40,941.50	42,969.00	45,715.93	47,651.00	48,758.10	47,701.98	41,738.36	48,921.93	50,886.15	53,417.30	54,912.15	56,524.60
"Industry HHI (No Concentration)"	3,680.73	3,606.84	3,418.21	3,431.49	3,568.10	3,760.63	3,655.16	3,607.30	3,711.33	3,682.64	3,762.36	3,813.91	3,868.53
"Industry HHI (With concentration)"	3,680.73	3,606.84	3,418.21	3,431.49	4,779.99	4,942.26	4,960.96	5,046.09	4,965.47	4,957.49	4,927.90	4,936.15	4,909.72
Difference	0.00	0.00	0.00	0.00	1211.89	1181.62	1305.80	1438.79	1254.14	1274.85	1165.54	1122.24	1041.19

Notes: 1/ Since the largest concentration herself Records in November of 2005, Assumes What is it effective to split of 2006.
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Table 5.A16. Tons-Kilometer transported per company (millions) Industry: Industrial Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	13,097.70	13,854.80	13,692.20	13,874.10	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	14,216.30	15,775.40	13,540.20	10,871.80	14,004.00	14,356.80	15,194.10	15,773.60	16,819.10
FERROMEX	8,111.70	8,113.90	9,065.30	9,848.40	14,132.80	14,683.05	14,452.70	13,780.00	16,519.20	16,661.00	17,807.10	16,276.70	17,338.20
FERROSUR	3,013.20	3,287.20	3,619.60	3,646.30	3,018.80	3,066.90	3,264.40	3,026.40	2,952.40	3,123.10	2,899.90	2,955.30	2,934.60
FTVM	0.17	0.08	0.10	0.05	0.15	5.04	0.48	3.74	0.81	0.41	0.45	1.33	0.20
LCOAH-DGO	21.90	45.70	51.00	46.50	88.30	66.50	62.00	70.30	90.70	71.10	84.90	69.70	76.33
CFCHM	523.00	620.40	704.60	670.50	511.70	111.70	159.90	149.20	197.70	235.50	193.90	160.60	140.90
Fit	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	0.12	1.70	1.63	1.14	1.62	1.72
"Total tons-kilometer transported (millions)"	24,767.67	25,922.08	27,132.80	28,085.85	31,968.05	33,708.59	31,479.68	27,901.56	33,766.51	34,449.53	36,181.49	35,238.85	37,311.05
"Industry HHI (No Concentration)"	4,021.64	4,003.00	3,847.61	3,844.11	4,023.87	4,170.47	4,065.75	4,075.43	4,190.23	4,158.52	4,250.31	4,207.70	4,253.48
"Industry HHI (With concentration)"	4,021.64	4,003.00	3,847.61	3,844.11	4,858.82	4,963.09	5,017.93	5,146.82	5,045.73	5,035.42	5,039.23	4,982.43	4,984.46
Difference	0.00	0.00	0.00	0.00	834.95	792.62	952.19	1071.39	855.50	876.90	788.92	774.74	730.98

Notes: 1/ Since the largest concentration herself Records in November of 2005, Assumes What is it effective to split of 2006.
2/ Stop operate after of 2005. 3/ KCSM Acquires the line TFM.
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Table 5.A17. Tons-Kilometer transported per company (millions) Industry: Industrial Products

	2002	2003	2004	2005	2006 1/	2007	2008	2009	2010	2011	2012	2013	2014
TFM 2/	13,097.70	13,854.80	13,692.20	13,874.10	nt	nt	nt	nt	nt	nt	nt	nt	nt
KCSM 3/	nt	nt	nt	nt	14,216.30	15,775.40	13,540.20	10,871.80	14,004.00	14,356.80	15,194.10	15,773.60	16,819.10
FERROMEX	8,111.70	8,113.90	9,065.30	9,848.40	14,132.80	14,683.05	14,452.70	13,780.00	16,519.20	16,661.00	17,807.10	16,276.70	17,338.20
FERROSUR	3,013.20	3,287.20	3,619.60	3,646.30	3,018.80	3,066.90	3,264.40	3,026.40	2,952.40	3,123.10	2,899.90	2,955.30	2,934.60
FTVM	0.17	0.08	0.10	0.05	0.15	5.04	0.48	3.74	0.81	0.41	0.45	1.33	0.20
LCOAH-DGO	21.90	45.70	51.00	46.50	88.30	66.50	62.00	70.30	90.70	71.10	84.90	69.70	76.33
CFCHM	523.00	620.40	704.60	670.50	511.70	111.70	159.90	149.20	197.70	235.50	193.90	160.60	140.90
Fit	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na
ADMICARGA	nt	nt	nt	nt	nt	nt	nt	0.12	1.70	1.63	1.14	1.62	1.72
"Total tons-kilometer transported (millions)"	24,767.67	25,922.08	27,132.80	28,085.85	31,968.05	33,708.59	31,479.68	27,901.56	33,766.51	34,449.53	36,181.49	35,238.85	37,311.05
"Industry HHI (No Concentration)"	4,021.64	4,003.00	3,847.61	3,844.11	4,023.87	4,170.47	4,065.75	4,075.43	4,190.23	4,158.52	4,250.31	4,207.70	4,253.48
"Industry HHI (With concentration)"	4,021.64	4,003.00	3,847.61	3,844.11	4,858.82	4,963.09	5,017.93	5,146.82	5,045.73	5,035.42	5,039.23	4,982.43	4,984.46
Difference	0.00	0.00	0.00	0.00	834.95	792.62	952.19	1071.39	855.50	876.90	788.92	774.74	730.98

Notes: 1/ Since the largest concentration herself Records in November of 2005, Assumes What is it effective to split of 2006.
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ASSESSMENT CONCLUDED IN 2017

6. Ex post assessment of a merger in the market of film exhibition, acquisition of film exhibition rights and leasing of commercial premises for movie theaters

Alberto Alexander Elbittar Hein, Elisa V. Mariscal Medina and Rubén Guerrero García

6.1. Introduction and scope of the report

The objective of this report is to make an ex-post assessment of the merger between *Cinemark* and *Cinemex* in the market for the exhibition of films in movie theaters, carried out in 2013.

The analysis presents information related to the possible effects of the merger on variables other than price, such as the number of attendees and the opening of new complexes, the latter indicator being used as a proxy for the effects on investment in the market.

Likewise, the effects of the merger on the price of movie tickets which may affect a person's decision to attend the cinema, are quantitatively analyzed.

The main source of information for this analysis is the information on box office revenue and attendance in movie theaters generated by ComScore, a leading media measurement company, as well as confidential information from the file CNT-010-2013 shared under a confidentiality agreement. In addition, we use public information on price indexes from INEGI and information related to the film exhibition sector in movie theaters generated by other public bodies.

This report studies the effects of the merger of two of the main film exhibitors in movie theaters in the country. The ex-post analysis of this particular case is relevant, since in the first instance the Board of Commissioners of the former CFC determined that such operation could generate problems for competition and free market access and therefore decided not to authorize it. It was not until an Appeal for Review that the Board of Commissioners of the then recently created Federal Economic Competition Commission (hereinafter, COFECE) authorized the merger. Thus, the exercise presented in this report will allow to identify the effects of the merger on the market and, ultimately, to evaluate whether the resolution reached by COFECE was correct.

To identify the effect of the merger on non-price variables, trends for different variables for periods before and after the merger are identified. The results of this analysis only provide indications of the possible effects, more detailed information on consumer perceptions and business strategies of the different chains is needed to determine the effects more precisely.

On the other hand, to identify the effect of the merger on prices, an econometric analysis will be carried out using the technique known as difference-in-differences (hereinafter, DID) to determine the behavior of prices after the transaction was authorized in the markets that were indicated as those where the process of competition and free market access would be potentially affected.

The analysis comprises two different levels. First, an overall assessment of the effect of the merger on the studied markets, i.e., those markets in which Cinemark participated, is presented. To conduct this analysis, the markets affected by the merger were used as the treatment group, while the markets that were not affected by the merger (i.e. those where Cinemark was not present) are taken as the control group. At a second level, the effect of the merger is evaluated in each of the markets where the merger affected the structure. In this case, the treatment group are the merging parties, while the control group are the competitors of the merged firms that have a presence in each of the indicated markets. The latter determination is common in other studies in the literature on ex - post evaluations (see Aguzzoni et al.,2013a; Aguzzoni, et al.,2013b; McCabe, 2002; and Ashenfelter and Hoksen, 2010).

The results of this analysis show that although there are markets in which the real prices of tickets sold by the agents that participated in the merger increased more than the prices of their competitors, the increase is not substantial and is below the increase of the national consumer price index.

Finally, the possible effects of the merger on other activities carried out in the exhibition complexes, such as the sale of candy, are discussed. Some notes are also made on the bargaining power of the merging chains and a review of the behavior of attendees during the period analyzed.

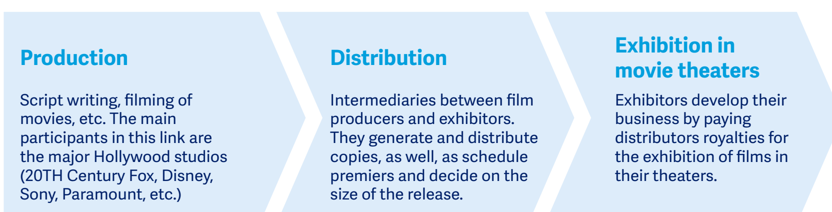
The report is organized as follows: Section 6.2 describes some characteristics of the market of exhibition of films in movie theaters and summarizes the analyzed merger . Section 6.3 presents the analysis of the effects on non-price variables. Section 6.4 presents the analysis of price effects and details the empirical strategy and results. Section 6.5 presents a discussion of the effects of the merger on other activities and finally Section 6.6 presents the conclusions.

6.2. Merger between Cinemex and Cinemark

6.2.1. The market of exhibition of films in movie theaters.

The exhibition of films at movie theaters comprises the last link in the value chain of the film industry. In the first link is the production of films, while distribution is in the second link. Figure 6.1 shows a description of the main activities of each of the aforementioned links:

Figure 6.1. Activities of the film industry



There is a strong relationship between the first two links in the production chain. In Mexico, large film production companies distribute their films through their own distributors or are associated with large distributors, so there is a high concentration in the distribution of blockbuster films.[67] During 2016, the top five distributors concentrated 75% of box office revenues in Mexico despite the fact that only two of these are within the top five distributors with the most releases during that year (Canacine, 2017).[68]

67. Resolution of file CNT-010-2013 dated July seventeenth, 2013 of the CFC.
68. Said distributors were: Disney, Warner, Fox, Universal and Sony.

Concerning the exhibition of films, Mexico is an important market, being one of the countries with the highest number of visits to movie theaters. During the last seven years, attendance at movie theaters has increased steadily, measured in number of tickets sold. In 2016 alone, 11.7% more tickets were sold than in 2015 (Canacine, 2017), placing Mexico in seventh place with respect to the increase in ticket sales. This has placed Mexico in fourth place worldwide in terms of tickets sold, only behind India, China and the United States, countries where the film industry is very important. Revenues obtained in Mexico represented 2.2% of worldwide box office revenues in 2016, which places it within the top 10 countries in terms of box office revenues (Canacine, 2017).

Finally, the increase in attendance to movie theaters can also be reflected in the number of movie screening rooms. According to Canacine (2017), Mexico ranked fourth among countries with the largest number of movie theaters and established itself as the second country where more movie theaters were built, adding 355 theaters to the exhibition infrastructure in 2016.

6.2.2. The operation notified before the CFC

The merger consisted in the acquisition by Grupo Cinemex, S.A. de C.V. ("Cinemex"), of all of the shares representing the capital stock of Cinemark de México, S.A. de C.V. ("Cinemark"), Cinemark del Norte, S.A. de C.V. and Servicios Cinemark, S.A. de C.V. The transaction was notified to the CFC on February 15, 2012.

At that time, Cinemark was owned by Cinemark Holding, Inc. a U.S. company with operations in several countries, including the United States of America, Brazil, Argentina, Chile, Colombia, Peru, Ecuador, Honduras, El Salvador, Nicaragua, Costa Rica, Panama and Guatemala.

At the time of the notification of the transaction, Cinemex operated 195 multiplexes, with 1940 screens, in 69 cities across Mexico, including the Federal District and its metropolitan area. Cinemark operated 31 multiplexes, with 308 screens, in 19 cities in Mexico, including the Federal District and its metropolitan area.

On July 17, 2013, the Board of Commissioners of the CFC did not authorize the merger based on the analysis of the opinion issued by the Executive Secretariat. In its opinion, the Executive Secretariat determined that the relevant market corresponded to the operation of movie theaters with a local geographic dimension.[69] For the delimitation of the relevant markets, the CFC drew a circle around each of the Cinemark complexes that would be acquired by Cinemex, the radius of such circles was 5 kilometers for Mexico City, and 6 kilometers for the rest of the country.

Although Cinemark had 31 movie theater complexes, the CFC identified that only 26 of them overlapped with Cinemex complexes within the determined areas of influence. Based on these areas of influence, the CFC determined 24 relevant markets, and observed that in 19 of these markets the dominance index would be reduced as a consequence of the merger and increases in the Herfindahl indexes. For the remaining 5 relevant markets, increases in the Herfindahl indexes above 75 points and increases in their respective dominance indexes were observed,[70] for which it warned that competition problems could arise.

The risks of the merger of said companies identified by the CFC consisted of an increase in the concentration levels of the industry. This would make it difficult for a new competitor to enter the market, as it would require the establishment of a wide network of complexes to compete effectively in the market. This risk situation increases when considering that, recently, the location of movie theaters inside shopping malls has become relevant to compete, since shopping malls will prefer to lease the available space to a recognized chain to increase the flow of people.[71]

In addition, the CFC pointed out that the merger would reduce the asymmetries between Cinepolis and Cinemex, so there is a risk of coordinated effects and the possibility of generating joint substantial power. Finally,

69. The analysis of the CFC also identified as relevant markets the acquisition of rights for the exhibition of films and the leasing of facilities. Regarding the effects of the merger in the market for the acquisition of rights for the exhibition of films, where the parties act as major purchasers, the CFC considered that, if the merger were consummated, the negotiation conditions would not change. Likewise, it referred to the market of leases for the exhibition of films, and stipulated that, since Cinemex had a greater presence at a national level, it would be able to better compete against Cinépolis and thus have a more balanced bargaining capacity.

70. In accordance with the "RESOLUTION announcing the method for calculating the indexes to determine the degree of concentration that exists in the relevant market and the criteria for its application", published in the Federal Official Gazette on July 24, 1998, a merger was considered unlikely to affect the process of competition and free market access if any of the following results were obtained: (i) the increase in the HI was less than 75 points; (ii) the value of the HI was less than 2,000 points; (iii) the value of the DI decreased; or (iv) the value of the DI was less than 2,500 points.

71. See pages 35 to 37 of the resolution of file number CNT-010-2013.

the opinion also warns that if the merger were to be carried out, there could be an increase in barriers to entry for new competitors. Therefore, the CFC decided not to authorize the notified operation.

In view of the refusal to authorize the merger, on August 20, 2013, Cinemex and Cinemark filed an appeal for review before the CFC, stating that the information that provided elements to conclude that the merger would not harm the process of competition and free competition was not considered. As a result, on October 29, 2013, COFECE resolved to authorize the notified transaction. The resolution states that despite the reduction from three to two competing companies, the merger is not expected to generate incentives and facilitate coordination between Cinemex and Cinépolis. The main arguments to resolve the foregoing are: 1) that at a national level there will continue to be a marked asymmetry between these two competitors; 2) that Cinépolis has grown consistently over the last 10 years and is not likely to change its strategy to collude with Cinemex; 3) that movie theater prices have experienced increases lower than the National Consumer Price Index; 4) that the market for the exhibition of films is not a mature nor a declining market, since the number of movie theater openings has increased; 5) that movie theater chains differ in the services they offer (premium, standard theaters); 6) that Cinemark's position prevents it from being considered a true competitive pressure for Cinépolis and Cinemex; and 7) that there is no evidence of coordinated behavior prior to the merger.

6.2.3. General overview of the market of film exhibition and its behavior in Mexico

Movie exhibitors compete on multiple dimensions to attract audiences to their theaters. Some of these dimensions refer to the quality they offer to attendees such as: the audio systems used in their theaters; the definition of the screens; the types of seats used; hygiene; etc. (DOJ, 2010a).

In addition, some competition authorities have asserted that exhibitors also compete via prices. In this regard, in its review of the merger between Cineworld Plc and City Screen Limited, the Office for Fair Trading of the United Kingdom established that one of the dimensions of competition between exhibitors was price; therefore, in order to establish whether the merger could have anticompetitive effects, it estimated the diversion ratio[72] of the exhibitors under analysis in different locations, as well as the Gross Upward Pricing Pressure Index (GUPPI).[73] The results of its analysis show that the merger analyzed could generate incentives to increase prices, calculating diversion ratios of up to a margin between 30% and 40% and GUPPI of up to 17% (OFT, 2013).

As it is possible to observe, the competitive dynamics in the movie exhibition market is complex, since differentiation in quality, location and prices are elements considered by consumers when choosing the complex where they will go to see a movie. Regardless of the above, the CFC, like other competition authorities (see DOJ, 2010a and OFT, 2013), has established that competition between complexes of different exhibitors is local, which implies that within a given distance consumers respond to variations in quality and price among different movie exhibitors.

With respect to quality, in the resolution of the file CNT- 013-2013, the CFC established that the main exhibition chains have similar quality levels, in particular the following:[74]

> *"There is a similar sustained behavior, implicit or explicit, between **Cinemex** and **Cinépolis**, which is materialized in the leasing and preferential location of the movie complexes; **in addition, these chains offer the same or similar services, with the same advantages, such as loyalty systems, frequent customers, similar quality, possibility of making online reservations, marketing of products such as carbonated beverages under the scheme of exclusivity, centralized acquisition of movies and exhibition of practically the same movies.**" (emphasis added)*

Concerning price competition, the CFC established that within a locality (i.e. relevant market) consumers respond to prices, hence the rationale for determining areas of influence to define the geographic dimension of the relevant market based on the distance consumers are willing to

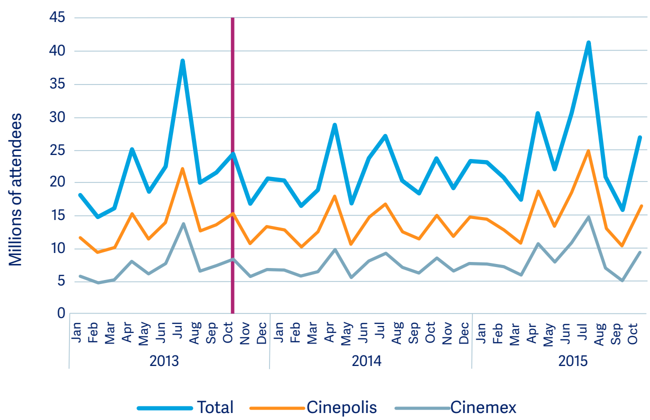
72. The diversion ratio estimates the sales losses that an economic agent has after an increase in the price of its good or service and the proportion in which these losses are captured by another economic agent.
73. This index seeks to measure the incentives that economic agents involved in a merger will have to raise prices after the merger occurs. The estimates of this index are compared against a threshold, 5% or 10%, to conclude whether the merger will be able to affect prices (Salop and Moresi, 2009).
74. Page 38 of the resolution of file CNT-010-2013

travel. The DOJ has applied this logic of analysis in the evaluation of mergers among movie exhibitors.

In its analysis of the merger between AMC Entertainment Holdings, Inc. and Kerasotes Showplace Theaters, LLC, the DOJ considered that these theater chains were very close competitors in Chicago, Illinois, Colorado, and Indianapolis, where the markets were highly concentrated. Acceptance of such a merger would have significantly decreased competition in the relevant markets, since they estimated that if one of the two chains decided to increase its prices in one of the relevant markets, and the other did not follow suit, the chain that raised its price would lose business at the expense of its competitor (DOJ, 2010a). This indicates that price competition is a factor to be evaluated.

Prior to presenting the analysis of the effects of the merger between Cinemex and Cinemark on the competition process, general data on the evolution of the market during the study period (January 2013 to October 2015) are presented.

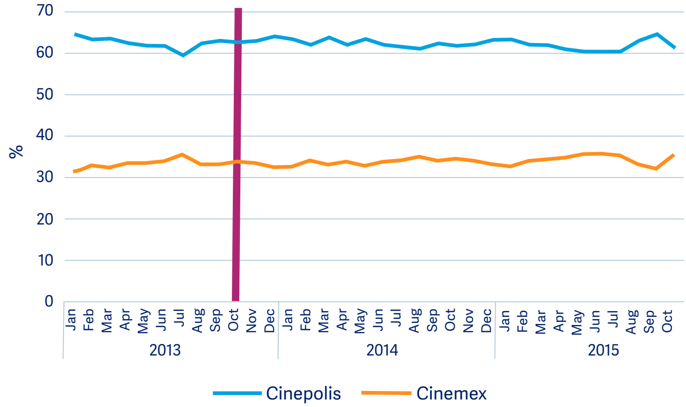
Figure 6.2. Attendance at movie theaters.



Source: Own elaboration with information from ComScore

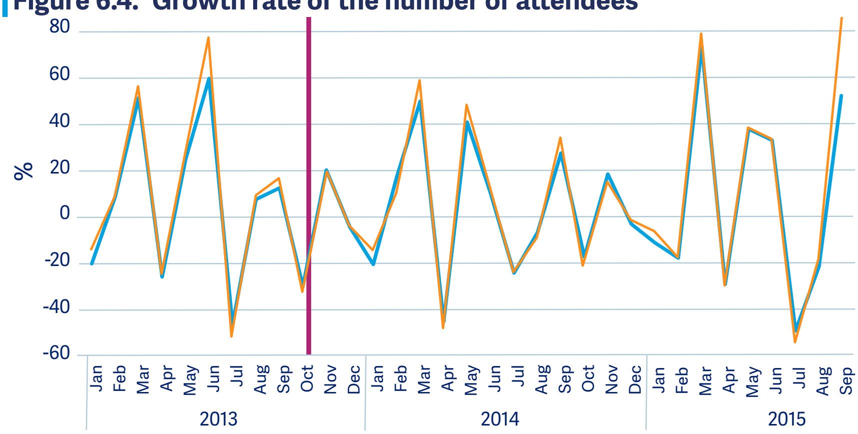
The information regarding the number of attendees at movie theaters in Mexico shows a strong seasonal component (Figure 6.2). Additionally, during the study period there is no trend in the growth of attendees or changes in market conditions. The market share of the main competitors, in terms of attendees, remained constant during the analysis period (Figure 6.3) and both present similar attendance growth rates (Figure 6.4). Likewise, the pre- and post-merger information analyzed does not show any shock or any change that would indicate the existence of any post-merger adjustment or modification of the market structure.

Figure 6.3. Proportion of attendees at Cinepolis and Cinemex



Source: Own elaboration with information from ComScore.

Figure 6.4. Growth rate of the number of attendees

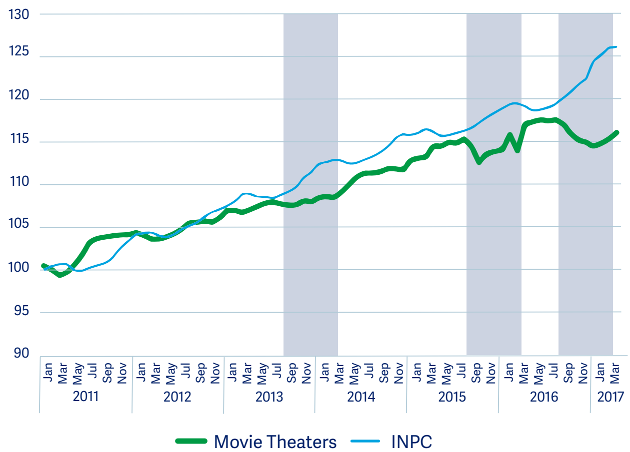


Source: Own elaboration with information from ComScore.

The average prices of movie tickets have decreased since 2013, according to data from Canacine (2017). In said source it can be observed that between 2013 and 2014 there was a 5% increase in the prices in real tems, and subsequently there was a decrease in the growth rate of prices, of 1.7% in 2015 and 2.5% in 2016.

The movie theater price index shows an increasing trend over the period of 2011 and 2017, but lower than the National Consumer Price Index (INPC for its acronym in Spanish). In the period during and after the merger, i.e. from September 2013 to March 2014, there is a decrease in the movie theater price index that could be associated to some factor related with the merger or other factors that data do not allow to determine. However, that same behavior is observed in the same months for previous years as shown in Figure 6.5, thus it cannot be determined that it is a specific behavior related to the merger.

Figure 6.5. Evolution of the INPC and the movie theatre price index. 2011 to 2017



Source: Own elaboration with information e ComScore.

6.3. Effect on non-price variables.

This section presents some data on the evolution of the attendees in the markets affected by the merger analyzed and the increase rate of new complexes of the main competitors in the market.

Given the lack of information on non-price variables that could have been affected by the merger, the results of this study only provide an indication of behavior after the merger occurred. Due to the characteristics of the Mexican market, it is necessary to have data on consumer perceptions or on the innovations introduced by the movie theater chains in order to have a better understanding of the effects of the transaction studied.

6.3.1. Analysis of non-price variables that may be affected by a merger.

As previously indicated, competition between film exhibitor chains has several dimensions in addition to price. In this industry, additional services or the quality offered are differentiating factors that have been used by the main market participants.

According to the Merger Guidelines of the United States, the increase of market power of a firm may be reflected, in addition to price increases, in the imposition of conditions that harm consumers, such as the reduction of quality, reduction of variety, decreases in the services offered or decreases in innovation (DOJ, 2010b).

Empirical studies that have assessed the effects of mergers on non-price variables have focused on evaluating mainly two types of categories: quality and innovation, finding as a result that mergers have not improved quality for consumers nor have price increases been compensated by quality (Kwoka, 2016).

Analyzing whether the merger harmed consumer welfare in terms of quality within the market of film exhibition in Mexico is a complicated task since, as previously mentioned, according to the CFC the quality levels offered by the different chains are the same. In this sense, it is difficult that as a result of the merger, Cinemex decides to decrease its quality since it could lose customers to Cinepolis, which would not modify the quality of its service.

On the innovation side, improvements in theaters depend to a large extent on innovations in other markets that may be out of reach of movie exhibitors. For example, sound systems or projectors, even the quality of the elements with which films are shot are not developed by the chains but adopted by them to improve their service. The introduction of these innovations can be affected, but given the structure of the market, where there are two main competitors, it is unlikely that either will forego introducing them.

Due to the above mentioned, it is necessary to have information about the perception of consumers regarding quality of the complexes of the different exhibitors to be able to reach a conclusion regarding the possible effects of the merger; likewise, it is necessary to have information about the adoption rate of new technologies or improvements in the complexes that allow to determine to what extent this sphere could have been affected.

For the elaboration of this document, there is no information on the perception of the quality of the service of the concentrated movie theater chains or their competitors. Therefore, a description of the evolution of attendees in each of the markets affected by the merger is presented as an approach to possible changes in quality. The hypothesis behind this is that, ceteris paribus, consumers will stop visiting a complex if they perceive that quality has declined.

With respect to innovation, the only data available is the number of theaters opened in periods after the merger. This provides us with a measure of the investments levels that competitors have maintained in the market.

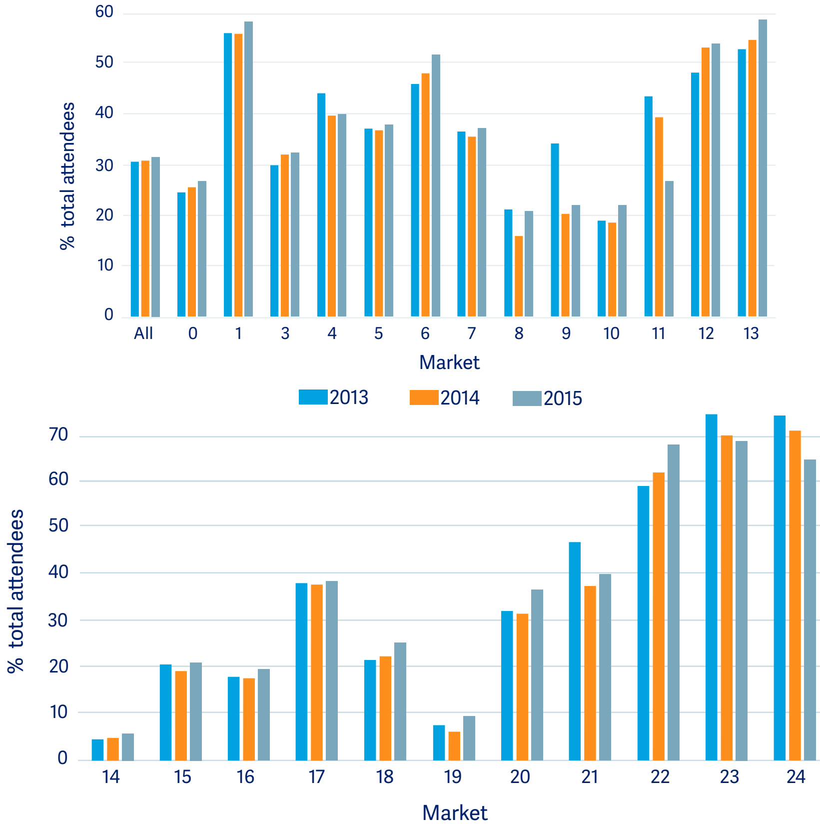
6.3.2. Evolution of attendance in the markets affected by the merger.

Figure 6.3 shows that the share of the two main competitors in the film exhibition market did not show significant variations during the analyzed period. Cinemex's share, in terms of attendees, has remained constant in levels close to 30%. On its part, Cinepolis showed shares close to 65% between January 2013 and October 2015.

At the level of markets affected by the merger, Cinemex´s market share shows different behaviors. With a minimum share of 4% (in market 14, corresponding to the city of Guadalajara) and a maximum of 70% (in market 24, corresponding to the Polanco and Reforma areas of Mexico City).

Figure 6.6 shows the evolution of Cinemex's market share in different markets affected by the merger, as well as its behavior in the markets that were not affected by it (i.e., there wasn't a complex from Cinemark), which are identified as markets 0.

Figure 6.6. Evolution of the INPC and the movie theater price index. 2011 a 2017



It is observed that the behavior is diverse in the different markets, presenting mainly an increase in their market shares, losing market share in only 7 markets. It is important to note that in 4 of these 7 markets, Cinepolis opened complexes in periods after the merger, which may explain the drop in Cinemex's market share, being the market with the largest drop in terms of market share the one in which Cinepolis opened the largest number of complexes in periods subsequent to the merger (market 11, corresponding to the city of Monterrey).

In general, it can be observed that the evolution of Cinemex's market share in terms of attendees has been positive, with an increase in the number of attendees in periods after to the merger, so it is not possible to affirm that there is a possibility that said economic agent has decreased the quality of film exhibition.

Finally, and as a side comment to the discussion presented in this section, the information regarding the stability of attendance may indicate that the merger did not affect the prices of advertising in the exhibitions. Advertising, being considered as a two-sided market, seeks observers to sell to advertisers. In this sense, since the proportion of moviegoers has remained fixed over time, it is unlikely that Cinemex has been able to increase the prices of this activity.

6.3.3. New complex openings in periods after the merger.

In the resolution of the file CNT-010-2013, the CFC indicated that the main film exhibitors in Mexico are chains, which present standardized services in all their complexes and try to provide the same experience for the attendees to any of their complexes, differentiating only in premium services. There is no information regarding the introduction of new projection and sound technologies in the different complexes, although it is reasonable to assume that these are introduced in the complexes with higher traffic of people where higher prices can be charged.

For the elaboration of this document, there is no information on improvements or introduction of new technologies in the complexes, although it is assumed that investments had to be made in the former Cinemark complexes to adapt them to the standards offered by Cinemex. In addition to these investments, there is information on the opening of new complexes, which could give an indication of the investment made by market participants. The results presented are not conclusive because there is information only regarding the ten months prior to the merger, so it is not possible to determine an opening rate since most of the complexes included in the analysis were already open for previous periods.

Prior to the merger, Cinemex had 262 complexes, including regular and platinum theaters, while Cinepolis had 296, including regular and VIP theaters. In periods subsequent to the merger, Cinemex opened 31 complexes, 7 of which are Platinum theaters. Meanwhile, Cinepolis opened 43 complexes, 8 of which correspond to VIP theaters.

Most of the openings of these chains took place in markets that were not affected by the merger, 26 of Cinemex's openings were in markets where Cinemark was not present, while Cinepolis opened 34 in these markets. In terms of overlap in the opening of new complexes in affected markets, Cinemex opened new complexes in 5 different relevant markets, while Cinepolis opened new complexes in 6 different markets.

There is only overlap in 2 markets, market 7, corresponding to Guadalajara, and market 24, corresponding to the Polanco and Reforma areas of Mexico City.

These results do not imply that competition was affected in the markets where the merger had an effect, through a decrease in investment, since it may correspond to the development of real estate projects of commercial plazas that were planned in those locations before the merger took effect.

6.4. Effect on movie ticket prices

This section identifies the effects of merger on the price of movie tickets. It is important to note that the analysis on prices could be limited by the fact that the movie theater chains obtain revenues from different activities. Indeed, according to the information provided by the parties, the opinion of the CFC states that the participants in such market have three different sources of income: i) ticket sales or box office; ii) candy store; and iii) advertising. However, there is no information regarding the revenue obtained from the sales of candy and advertising for periods after the merger was notified.

However, the same resolution points out that ticket sales are the main source of income for movie theaters, so the results presented may be representative of the possible harm or benefit to consumers that, if any, the merger may have generated, since it will allow us to observe whether it allowed for a significant increase in prices or whether it made competition stronger given a possible reduction in the asymmetries of the main exhibitors.

6.4.1. Difference-in-Differences Analysis.

One of the methods used to perform ex post assessments of the effects of a merger on economic competition is DID (OECD 2016). This method consists of comparing two similar groups (markets or market segments)-treatment or control groups- to explain changes over time in a variable of interest. When comparing these two groups, the effect measured by this method is that of a particular event in the variable of interest, an event that only occurs in the treatment group. Thus, to explain that the change in the variable of interest does have a statistically significant effect, the control group is taken as a counterfactual; in this control group the event does not occur (which as we will see below are the markets where the merger had no effect, i.e. where Cinemark had no presence and, additionally, the behavior of Cinemex's competitors), but presents similar conditions or characteristics to the treatment group (i.e., except for the event, both groups are susceptible to the same exogenous shocks). That is, these groups would yield similar results over time on the variable of interest, had the event not occurred (Gertler et al. 2017).

This report analyzes the effect of the merger between Cinemex and Cinemark at two different levels. The first level will determine the overall effect of the operation in the 24 markets where the merger had an effect, at this level we evaluate the average price response in the markets where the number of competitors was reduced.

In this exercise, the DID analysis uses the markets affected by the merger as the treatment group, while the markets where the merger did not modify the structure will be considered as the control group.

The equation to estimate is as follows:

$$price_{injt}=\sum_{j=2}^{765}\alpha_j+\beta_1\bullet merger_j+\beta_2\bullet post_t+\delta\bullet(merger_j\bullet post_t)+\gamma\bullet X_i+\varepsilon_{injt} \tag{1}$$

Where $price_{injt}$ is the price of the movie ticket i charged by company n in complex j at time t. The expression $\sum_{(j=2)}^{765}\alpha_j$ corresponds to dummies for each of the complexes, which can be interpreted as a fixed effect that captures the characteristics of each complex.[75] In turn, $post_t$ is a dummy variable that takes the value 1 for the periods after the merger; $merger_j$ is a dummy variable that takes the value 1 for the firms that participate in any of the markets affected by the transaction; and finally, X_i is a set of control variables that indicate different characteristics of the firms or exhibition theaters.

Under this specification, δ is our parameter of interest because it captures the additional variation in price in the markets where the merger had an effect with respect to those markets where the merger did not modify the structure. It is important to note that, under the aforementioned

75. Generally, film exhibitors discriminate prices by complex, so it is common that within the same city two complexes of the same chain of exhibitors present different prices. In this regard, these parameters attempt to capture the information considered by the chains to make such discrimination.

specification, parameter δ represents the effect on the average price of the markets affected by the merger, so it also captures the price movement of those agents that did not participate in the merger but compete in those markets. Therefore, to determine the effect of the merger on the prices of each of the chains in the affected markets, the following equation will also be estimated:

$$price_{injt} = \sum_{j=2}^{765} \alpha_j + \beta_1 \bullet merger_j + \beta_2 \bullet post_t + \delta_1 \bullet (merger_j \bullet post_t \bullet cinemex_j)$$
$$+ \delta_2 \bullet (merger \bullet post_t \bullet cinepolis_j) + \gamma \bullet X_i + \varepsilon_{injt} \qquad (2)$$

Where $cinemex_j$ and $cinepolis_j$ are dummy variables that take the value of 1 if the complex belongs to one or the other chain and 0 in any other case.

In the second level of analysis, a DID model will be estimated for each of the markets affected by the merger. In this specification, the treatment group corresponds to those agents participating in the merger and their competitors within that particular market are considered as the control group. The economic literature points out that an advantage of using this control group is that it allows separating the effects of the merger from any other effects affecting demand or costs that are common to all firms in the market (Aguzzoni et al., 2013a). In this way, the extent to which merged firms change their prices relative to other market participants can be identified (Ashenfelter et al., 2013). On the other hand, and as noted with respect to the specification of the first level, it is possible that the operation modifies the behavior of the rival firms so that they do not necessarily modify their prices in response to a change in the prices of the merging firms, but as a response to the new competitive environment, so that in this exercise the results of the DED analysis will indicate the direction of the changes in prices, but not the true magnitude of this.

At this level of analysis, the equation to be estimated is the following:

$$price_{injt} = \sum_{j=2}^{J} \alpha_j + \beta_1 \bullet merger_j + \beta_2 \bullet post_t + \delta 1 \bullet (merger_j \bullet post_t) + \gamma \bullet X_i + \varepsilon_{injt} \qquad (3)$$

Where $price_{injt}$ is the price of the movie ticket i charged by firm n at complex j at time t for a particular market. α_j are fixed effects for firm n and for complex j. The expression $\sum_{(j=2)}^{J} \alpha_j$ corresponds to dummies for each of the complexes comprised within the market under study; $post_t$ is a dummy variable that takes the value 1 for the post-merger periods; $merger_j$ is a dummy variable that takes the value 1 for the firms participating in the merger; and finally, X_i is a set of control variables indicating different characteristics of the firms or showrooms.

As in the previous case, δ is our parameter of interest as it captures the additional variation in the price of the merging parties with respect to the average change of the other market participants in a particular market.

6.4.2. The database

The database used to perform the DID analysis allows to compare the ticket prices to access an exhibition in the different complexes of each of the companies participating in the market.

The information is generated by ComScore, a media measurement company. The available information has a monthly periodicity and covers from January 2013 to October 2015. The database shows information on box office revenues for each of the films exhibited in the different movie complexes of each chain. It also presents data on attendees to each film at the different complexes. With this information, it was possible to obtain the implicit ticket price (the revenue per attendee) for each film in each one of the different movie complexes of the companies participating in the market.

The database includes information for 9 different cinema chains and includes, under the same classification, several independent exhibition companies. The total number of complexes is 764 and the number of films for which information is available is 1,386.

To conduct our analysis, we deflated the implicit ticket price with the national consumer price index for cinema service published by INEGI and chose 2017 as the base year.

Table 6.1 presents the average real prices for each company for the years 2013 to 2015, as well as their growth rates.

Table 6.1. Change in Consumer Welfare as a Proportion of the Annual Budget

	Average Real Price			Variation %	
	2013	2014	2015	2013-2014	2014-2015
BBTR	46.93	51.45	52.25	9.61	1.57
Citi cinemas	49.84	49.64	52.03	-0.40	4.81
Cine Magic	35.12	28.57	28.68	-18.65	0.38
Cinemex	46.12	46.39	46.52	0.58	0.28
Cinepolis	53.99	53.13	52.01	-1.61	-2.10
EALT	35.22	37.65	38.07	6.92	1.09
EDB	35.47	37.19	36.50	4.84	-1.87
Henry Cinemas	37.45	36.65	39.06	-2.15	6.57
Independientes	38.86	39.92	40.06	2.72	0.36
Extra cinemas	36.95	36.41	30.73	-1.45	-15.60
General	49.14	48.99	48.56	-0.31	-0.88

Source: Own elaboration with information from ComScore.

Taking into consideration all the complexes and all the companies, the average real price of movie tickets showed decreases of less than 1% during the period analyzed, so it is possible to state that the ticket price remained constant between 2013 and 2015. At the company level, the behavior is differentiated, being BBTR the one that presented the largest increase in the ticket price (9.6% for the period 2013 - 2014) and Cine Magic the one that has shown the largest decreases (18.65% for the period 2013-2014).

Regarding the relevant companies for our analysis, Cinemex, the company that carried out the merger, has maintained its prices relatively stable, with an increase of less than 1% between 2013 and 2015. On the other hand, Cinemex's main competitor, Cinepolis, presented a continuous decrease in its prices, reaching decreases of 2%. It is important to note that on average the price of a ticket at Cinepolis is $7 higher than at Cinemex, so it is possible that the price variations shown by both chains are an indication that the merger increased competition between them.

To conduct the analysis, the treatment group is taken as the markets where the merger had an effect, i.e. the relevant markets defined by the CFC in the resolution of the file CNT-010-2013. In these markets Cinemark had at least one exhibition complex that after the merger became part of Cinemex's infrastructure. In these markets a competitor disappeared, so it is important to evaluate the effect on the prices of the transaction.

In its resolution, the CFC identified that *Cinemark* had 31 multiplexes in different cities in Mexico. After determining the area of influence of such complexes, it found that in 5 of them there was no overlap with any *Cinemex* theater, so the market structure, in terms of the number of participants, would not be modified. For the remaining multiplexes, he found 24 areas of influence where the merger would modify the structure.[76]

Based on these 24 areas of influence, the markets used for the analysis were constructed by comparing the information provided by COFECE and the results of INEGI's 2017 National Statistical Directory of Economic Units (DENUE, for its acronym in Spanish) regarding economic units engaged in film exhibition.

The DENUE provides information on the identification and location of all active establishments in the national territory. The DENUE seeks to measure the number of movie complexes in the relevant markets defined by COFECE in the post-merger analysis case.

The classification of the North American Industrial Classification System (SCIAN) is used, with code 51213, under the name of Exhibition of films and other audiovisual materials, which includes movie theater complexes and other services such as film services or video stores. The database was manually cleaned to detect and eliminate cases where the name is linked to services other than movie theaters.

Using the DNUE database on movie theater complexes, the Cinemark complexes acquired by Cinemex were located according to the relevant markets defined by COFECE. For each Cinemark complex object of the merger by market, the defined areas of influence were measured; 5 kilometers in Mexico City and 6 kilometers in the rest of the country. With the longitude and latitude of the DENUE base, the distance was measured with the haversine formula of each Cinemark complex subject to the merger. The same criterion of definition of areas of influence used by the CFC was followed to perform the analysis, since the objective is to evaluate the effects of the merger subsequently authorized by COFECE, modifying the criteria of kilometers traveled by consumers would result in markets different from those analyzed by the CFC.

76. The CFC established that the remaining 26 complexes comprised only 24 areas of influence, since in the case of 2 complexes their area of influence overlapped with other areas. These complexes are the ones indicated as: Parque Tezontle - Plaza Oriente in Mexico City and Mirador - Metro Centro in Hermosillo, Sonora.

The treatment group includes a total of 197 complexes between standard and premium theaters, a little more than half of which belong to the merged parties and the rest to Cinepolis, the largest chain in Mexico, and only 5 complexes belong to other movie exhibitors.

6.4.3. Control variables

For the conduction of the estimates, some control variables were introduced that allow to capture the differences in the characteristics of the complexes that can modify their supply and demand relationships and therefore affect the behavior of prices (the variables contained in the vector X_i of the equations to be estimated) without necessarily being related to the merger

The available information allows us to construct 3 different control variables that help explain the movement in ticket prices in each complex for reasons other than the merger. These three variables are used to estimate the different equations.

The first control variable used considers the exclusive content that is exhibited in the different complexes of each chain. The hypothesis underlying the use of this variable is that movie theater chains with a greater number of exclusive films are able to charge higher prices, since during the time such films are exhibited, it will be the only option where the film will be exhibited that is not shown in another chain.[77]

For the construction of said variable, an exclusive film was considered to be any film shown by a single company, or by an independent exhibitor and a movie theater belonging to a commercial chain. The implicit assumption in this separation is that commercial chains do not compete with independent exhibitors. This assumption is plausible, since the database shows that independent chains are the ones that exhibit films that are not shown by commercial chains. It is important to note that this variable changes over time, as films move in and out of the cartel, so this variable calculates the overall impact of having exclusive content and not of a particular content.

77. Given that it is possible that this variable could be affected by the merger given increases in bargaining power, exercises were carried out without including it, with no changes in the results obtained. It is important to note that 257 exclusive contents belonging to Cinepolis or Cinemex were identified out of a total of 1386 titles available in the sample, so the effect of these is marginal.

For the case of exclusive films shown in the main chains (*Cinepolis* and *Cinemex*), most of them belong to a film festival or are broadcasts of special events such as live soccer games or concerts. From the available information, it is observed that *Cinepolis* exhibited the largest number of exclusive contents during the study period; 163 compared to 94 exhibited by *Cinemex*.

This variable is introduced to the regression through a dummy variable, *exc*, which takes the value 1 if the movie is exhibited exclusively by any commercial chain in a given month.

The second control variable considered is *vip*, which attempts to capture the extra payment charged on tickets for movies shown in theaters that offer *premium* services, provided by *Cinepolis* and *Cinemex* through their VIP or Platinum theaters, respectively. The variable considers that films may be shown in theaters of different quality, and therefore the ticket price differs among the different types of theaters. Only 3 of the 24 markets indicated as those where the merger was carried out have these types of theaters. This variable takes the value of 1 if the exhibition complex has a higher category (*Cinepolis VIP* or *Cinemex Platinum* theaters).[78] As previously mentioned, in periods after the merger, few theaters offering premium services were opened, so the effect of this variable is the price of theaters already established in the market.

Finally, we consider as a control variable the complexes that were opened after the merger was approved. The hypothesis underlying the use of this variable is that the price of these movie theaters already considers the new market structure, so that not controlling for this variable could underestimate or overestimate the effect of the merger, depending on the effect that the transaction has had on the market. As noted above, most of the new openings took place in markets not affected by the merger, so this variable will capture the differences in price that could result from the opening of *new* rooms in unaffected areas.

This is included in the analysis as a dummy variable, new, which takes the value 1 if the theater belongs to a complex that was opened after the merger was approved and/or in any other case.

78. The opinion of the CFC considered that there was no difference between these types of rooms and therefore considered them to be within the same relevant market. However, from the available database it is clear that the implicit prices in these rooms are higher than in the rest.

6.4.4. Results

This section presents the results of the econometric analysis. It begins by showing the results of the general analysis of the effect of the merger in all the markets where it had an effect, and continues by showing the effect of the merger in each of the markets defined by the CFC.

General Analysis of the Effect of the merger in the market of film exhibition at the national level

Table 6.2 presents the results of the DID analysis, based on equations *(1)* and *(2)* referred above. The results presented in this table are general for all markets, so the result will show the average variations in prices.

Table 6.2. Results of the DID analysis for the general market.

Variable	Equation	
	1	2
Post	**-1.667*****	**-1.650*****
	(0.037)	(0.036)
Merger	**-11.4696*****	**-10.738*****
	(0.387)	(0.396)
post*merger	**-0.341*****	
	(0.077)	
post*merger*cnmx		**0.460*****
		(0.086)
post*merger*cnpl		**-1.371*****
		(0.121)
Exc	**9.694*****	**9.711*****
	(0.302)	(0.303)
New	**-27.718*****	**-27.723*****
	(0.735)	(0.735)
Vip	**81.851*****	**81.851*****
	(1.049)	(1.050)
Observations R^2	**389,213**	**389,213**
	0.833	**0.8327**
F	**3117.87*****	**3118.68*****

Notes: The estimation method was Ordinary Least Squares. The null hypothesis is $H0{:}\beta k=0$; *, ** and *** indicate rejection of the null hypothesis at 5%, 1% and 0.1%, respectively. Robust standard errors were used for heteroscedasticity. The value of the parameters associated with the dummies of each of the complexes is omitted.

The results of equation 1 indicate that on average the real price of tickets decreased in those markets where the merger modified the ticket structure. The decrease is statistically significant, albeit of a small magnitude. The result indicates that prices decreased on average by about $0.30 (thirty cents of peso).

The control variables included in the regression are statistically significant and indicate that VIP and Platinum theaters, as well as movies that are shown exclusively are on average more expensive than those exhibited in a regular theater that are not exclusive to any chain. On the contrary, the average ticket price in theaters opened after the merger occurred is lower.

Equation 2 attempts to capture the average price effect of each of the main chains in the markets where the merger modified the structure. In this case, differentiated effects by chain are observed, which are statistically significant.

The results suggest that the average prices of *Cinepolis* decreased in the markets affected by the merger, while the average prices of *Cinemex* increased. It is important to note that the decrease in *Cinepolis* prices is more than three times the increase in *Cinemex* prices, which is consistent with the result obtained in equation 1. This could indicate that the merger reduced the asymmetries between these chains, which generated greater competitive pressure in the affected markets, the final result of which was a reduction in the average price of tickets in those markets.

Analysis of the effect of the merger by affected market

This section presents the results of the analysis of the effect of the merger between *Cinemex* and *Cinemark* in the Mexican market for each of the markets where the transaction had an effect. As in the previous subsection, a DID analysis is used to evaluate the effects. Since the analysis will be done at the market level, in this section we will use as a treatment group the movies that were exhibited in the theaters of the agents that merged and as a control group, their competitors within each market. As for the control variables, the same variables will be used as in the analysis of the general price effect, which are the films shown exclusively by each chain, the premium theaters of each of the main chains, and whether the complex opened its doors after the merger occurred.

Before presenting the results for each of the markets affected by the merger, a result is presented on the effect that the merger had on *Cinemex's* prices in general after the transaction was authorized. The parameter of interest in this exercise is equivalent to the parameter that indicated the effect of *Cinemex* in the markets affected by the merger, presented in equation 2 shown in Table 6.3, so the result is expected to be similar to the one obtained previously, i.e. a small increase in *Cinemex's* prices.

Table 6.3. Results of the DID analysis for the general market taking all Cinemex complexes as the treatment group.

Variable	Equation
Post	-2.038***
	(0.046)
Merger	-12.824***
	(0.318)
post*merger	0.659***
	(0.064)
Exc	9.688***
	(0.303)
New	-3.733***
	(0.702)
Vip	69.686***
	(1.096)
Observations	389,213
R^2	0.833
F	3081.61***

Notes: The estimation method was Ordinary Least Squares. The null hypothesis is H0:βk=0; *, ** and *** indicate rejection of the null hypothesis at 5%, 1% and 0.1%, respectively. Robust standard errors were used for heteroscedasticity. The value of the parameters associated with the dummies of each of the complexes is omitted.

As can be seen in Table 6.3, the results are consistent with those obtained in the previous specification. The results indicate that *Cinemex* generally increased its prices after it merged with *Cinemark*. This increase in prices is statistically significant, although it is not very high, less than $1.

In the analysis by market, different patterns are observed: there are some markets where the real price of the companies that participated in the transaction increases and others where it decreases. Table 6.4 shows only the value of the coefficient δ of the estimates made by market, which indicates how *Cinemex's* prices behaved after the merger was authorized.

Table 6.4. Results of the DID analysis by affected market

Market	Estimated δ parameter	Market	Estimated δ parameter
m1	**-1.960*** **	m14	**5.564*** **
	(-0.481)		(0.580)
m3	**8.853*** **	m15	**-0.984** **
	(1.071)		(.389)
m4	**5.324*** **	m16	**-1.922*** **
	(0.739)		(0.522)
m5	**4.173*** **	m17	**-2.056*** **
	(0.654)		(0.592)
m6	**2.272*** **	m18	**-0.392**
	(0.866)		(0.445)
m7	**2.918*** **	m19	**-2.525*** **
	(0.444)		(0.632)
m8	**-1.584*** **	m20	**0.768**
	(0.572)		(0.577)
m9	**0.616**	m21	**0.958**
	(1.101)		(0.595)
m10	**-1.626** **	m22	**0.896**
	(0.637)		(0.888)
m11	**2.119** **	m23	**-3.718*** **
	(0.993)		(0.736)
m12	**5.891*** **	m24	**0.770** **
	(0.814)		(0.735)
m13	**1.150**		
	(0.878)		

Notes: The estimation method was Ordinary Least Squares. The null hypothesis is H0:βk=0; *, ** and *** indicate rejection of the null hypothesis at 5%, 1% and 0.1%, respectively. Robust standard errors were used for heteroscedasticity.

As can be observed, the variations in *Cinemex's* ticket prices in the markets affected by the merger are greater than the overall price variation experienced by *Cinemex* after the merger (results shown in Table 6.4), with the largest increase being close to \$8 and the largest decrease being almost \$4.

Price increases in the market do not seem to be associated with the levels of concentration in the market. As shown in Figures 6.7 and 6.8, 6.7 and 6.8, there is no clear relationship between the value of the coefficients and the HHI calculated by the CFC for after the merger, nor with the variations calculated in it, which indicates that the movements in prices respond to other factors, rather than to market concentration.[79]

Figure 6.7. HHI levels and price changes after the merger.

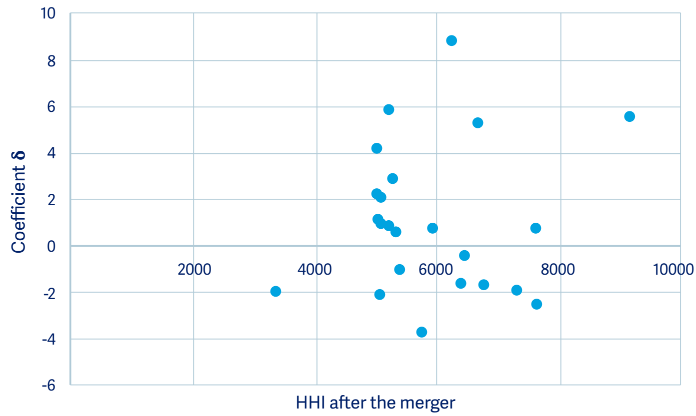
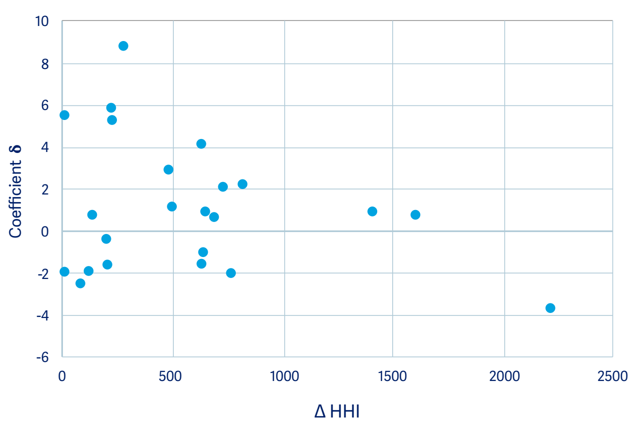


Figure 6.8. Variation in HHI levels and price variations after the merger.



79. Running a regression between the estimated coefficient and the value of the HHI after the merger gives a positive parameter of 0.0002557 and not significant. When doing the same exercise with the HHI variations, a negative coefficient of 0.0015853 is obtained, which is not significant.

6.5. Effects on other markets affected by the merger.

The results shown in the previous section indicate the effects that the merger between *Cinemex* and *Cinemark* had on the real price of movie tickets. The general results suggest that price of movie tickets decreased only slightly in the markets affected by the merger, although the prices of Cinemex in these went up. This suggests that competitors reacted to the merger by being more aggressive, that is, competition between participating agents was stronger.

The analysis presented so far does not provide a complete answer to the effects of the merger, since box office revenues represent a portion of the total revenues of the film exhibition chains. The sale of candy and food inside the complexes, as well as the sale of advertising, are other sources of income of the participants in this market, activities that could also have been affected as a result of the merger. Likewise, it is possible that film exhibitors have increased their bargaining power *vis-à-vis* distributors in order to obtain better conditions in the acquisition of exhibition rights.

The available information comprises mainly the exhibition activity, which hinders an in-depth analysis of the effects in some of the activities mentioned. This section presents some of the observations that may be useful to understand the competition dynamics in said activities and visualize what the effect of the merger between *Cinemex* and *Cinemark* may have been. Finally, the section concludes with a brief discussion on the behavior of movie theatre attendance after the merger.

6.5.1. Sales of candy and food inside movie theaters.

Given that the ComScore database only includes data on attendance and box office revenue in each complex, and the lack of public information regarding this item, it is not possible to make inferences about the effect that the merger between Cinemex and Cinemark had on the candy store. However, COFECE, under a confidentiality agreement, provided information contained in the file CNT-010-2013 that allowed inferences to be made regarding the effect on the candy store after the merger between *Cinemex* and *Cinemas Lumière*.

It is considered that the merger between *Cinemex* and *Cinemas Lumière* can help to provide an answer as to the possible effect of the merger between *Cinemex* and *Cinemark*, since it is the closest merger registered in the sector to the one studied and the same agent is involved, so it could give indications of this agent's behavior on dates subsequent to the acquisition of a competitor.

According to information provided by COFECE, the sale of candies and food is a relevant source of income. This source provides data on revenues and costs of the candy store. The complexes to be analyzed are those in which the referred economic agents participated jointly. For the selection of these complexes, information provided by COFECE in the first installment was used, which contains disaggregated information for 112 markets with the market share of each participant. Of these 112 markets, it was observed that only in 9 of them *Lumière* and *Cinemex* participated (see Table 6.5).[80]

Table 6.5. Markets where the participation of Lumière and Cinemex was identified.

Market	Economic agent	Complex
Center-east	Lumière	Centro Telmex
	Cinemex	Palacio Chino
	Cinemex	Real Cinema
Pachuca	Lumière	Gran Patio Pachuca
	Cinemex	Plaza Q
Puebla	Cinemex	Del Parque
	Lumière	Plaza Dorada Puebla
	Cinemex	Puebla
Centro oriente 2	Cinemex	Galerias
	Lumière	Reforma
Coapa	Cinemex	Coapa
	Lumière	Prado Coapa
Coacalco	Cinemex	Coacalco
	Cinemex	Maxiplaza Tultitlan
	Lumière	Plaza Bella Coacalco
Ixtapaluca	Lumière	Cortijo
	Cinemex	Ixtapaluca

80. There are two other markets where Cinemas Lumière had a presence, but Cinemex did not participate. These markets are Chalco and Zapopan.

Table 6.5. Markets where the participation of Lumière and Cinemex was identified.

Market	Economic agent	Complex
Izcalli	Cinemex	Izcalli
	Lumière	La Joya
	Lumière	La Via
Sur	Cinemex	Altavista
	Cinemex	Cuicuilco
	Cinemex	Gran Sur
	Cinemex	Loreto
	Lumière	Tlalpan

Once the complexes were selected, the information provided by COFECE was used. With this information, the gross margin of the candy store for the *Cinemex* complexes competing in those markets was calculated.[81] Only information for *Cinemex* is used since it is the agent for which there is information for periods before and after the merger. The period of analysis selected is from January 2011 to the last available data (February 2013).[82]

The gross margin is used as an approximation of the possible increase in *Cinemex's* market power, however, caution should be exercised with the interpretation of the results shown in this section, since an increase in gross margins does not necessarily imply a harm to competition through price increases, since it could also imply an increase in profitability derived from the merger resulting from some type of efficiency.

From the visual inspection of the gross margin values in the different complexes, with the exception of the Izcalli and Coapa complexes, it is not observed that they have presented abrupt variations in the periods

81. The database includes information on total candy store revenues and candy store costs, from which the gross margin was calculated. It is possible that there are common costs that are not accounted for in the candy costs and therefore the margins presented may be overestimated. Notwithstanding the above, the exercise presented looks for differences in margins between different periods and does not make inferences about the value of these margins.

82. The Cinemas Lumière information available in the database provided by COFECE begins in March 2012, so we assume that the purchase was completed in February 2012. In order to have a similar time period between information before the merger and after the merger, January 2011 was chosen as the starting value.

immediately after the merger took place. Inspecting the average margins for the months before and after the merger, it is observed that in some complexes the margins increased (Cinema Real, Plaza Q, Del Parque, Galerias, Coapa, Coacalco, Izcalli, Cuicuilco and Loreto), being Coapa the complex with the highest increase , where the margin was on average three percentage points higher. As for the complexes that decreased, the gross margin of the candy store (Palacio Chino, Puebla, Ixtapaluca, Altavista and Gran Sur), with the Altavista complex showing the largest decrease, dropping just over two percentage points.

Figure 6.4 shows a scatter diagram comparing the average candy store gross margins for the period prior to the merger with the average in the period after the transaction. As can be observed, the data are very close to a 45-degree line suggesting that they were unchanged after the transaction.

One test that may be useful to identify whether gross margins changed after the merger would be to assess whether margins as a whole behave as a stationary series, i.e. their mean and variance are constant over time. To test this for the set of affected markets, we apply the panel unit root test proposed by Levin, Lin and Chun (2002).[83]

Table 6.6. Results of the Levin, Lin and Chun unit root test.

```
Levin-Lin-Chu unit-root test for margen
---------------------------------------
Ho: Panels contain unit roots                Number of panels  =     14
Ha: Panels are stationary                    Number of periods =     26

AR parameter: Common                         Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 9.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic       p-value
------------------------------------------------------------------------------
 Unadjusted t        -18.0797
 Adjusted t*          -5.6952         0.0000
------------------------------------------------------------------------------
```

Dado que los complejos analizados pertenecen a Cinemex pueden existir elementos similares afectando los márgenes de los distintos complejos. En estos casos, los autores de la prueba sugieren los promedios de los individuos en el panel para corregir errores en los resultados arrojados por la prueba. La siguiente tabla presenta los resultados con las correcciones sugeridas.

83. These authors suggest using their test in moderate size panels considering those with between 10 and 250 individuals; and 25 to 250 observations per individual. Our case applies to this methodology since we have 14 individuals and 26 observations per individual.

Table 6.6. Results of the Levin, Lin and Chun unit root test.

```
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Levin-Lin-Chu unit-root test for margen
───────────────────────────────────────
Ho: Panels contain unit roots                   Number of panels  =     14
Ha: Panels are stationary                       Number of periods =     26

AR parameter: Common                            Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 9.00 lags average (chosen by LLC)
──────────────────────────────────────────────────────────────────────────────
                     Statistic      p-value
──────────────────────────────────────────────────────────────────────────────
 Unadjusted t        -17.7130
 Adjusted t*          -4.9017        0.0000
──────────────────────────────────────────────────────────────────────────────
```

The results of this test are shown in Table 6.6, which indicate that the null hypothesis that the panel contains unit roots is rejected. That is, it cannot be rejected that the variables contained in the panel are stationary, i.e., that their mean and variance are constant over time. Therefore, it is possible to interpret this result as an indication that the merger did not affect the sale of candy and food within the movie complexes.

One possible explanation for this result could be that once attendees to exhibition complexes purchase their tickets, they are captive customers of the chain, given the existing restriction to introduce food from other agents. Therefore, the chains can charge the highest price (probably close to the monopoly price given the elasticity of demand for tickets and food), so that increases in the prices of food or other services within their complexes would result in a drop in their profits. Therefore, it is possible that the chains compete in offering better ticket prices to attract a greater number of people and generate profits through the sale of goodies. There is not enough information to test this hypothesis. However, it is a line of investigation that may be of interest to COFECE.

6.5.2. Increase in the bargaining power of the agents involved in the merger.

It is possible that after a merger, the firms that merge may have greater bargaining power with their suppliers, which would force them to offer them better conditions or limit their relationship with their competitors. Therefore, it is important to consider in the analysis of a merger whether there are sufficiently large buyers that limit the merged firm's ability to increase its prices (Motta, 2004) or whether the merger grants purchasing power that affects related markets.

In the case of the merger between *Cinemex* and *Cinemark*, it is possible that the relationship with distributors may be affected, since the merged firms have a larger number of seats available and therefore want to obtain advantageous conditions. With the information available, it is not possible to know the conditions under which *Cinemex* acquired the movie exhibition rights before or after the merger with *Cinemark*. However, it is possible to make some remarks related to one of the control variables used in the analysis in section 5 above.

The variable *exc* indicates the movies or events exhibited exclusively by any chain, so a review of the number of exclusivities may give some indication of *Cinemex's* bargaining power with content distributors before and after the merger.

During the period from January 2013 to October 2015, *Cinepolis* and *Cinemex* had a total of 257 exclusive contents, 163 from *Cinepolis* and 94 from *Cinemex*. According to the ComScore database, during the period prior to the merger, *Cinemex* had 35 exclusives, while *Cinepolis* had 45 exclusives. Thus, it is observed that during this period the proportion of exclusive contents was similar between the two chains (46% vs. 54%). For periods after the merger, the proportion of exclusive content available between *Cinepolis* and *Cinemex* was in favor of *Cinepolis*, offering 67% of the exclusive content available between these two chains, while *Cinemex* offered the remaining 33%. This result indicates that *Cinepolis* has a higher percentage of exclusive content, even though both chains offered a greater number of exclusives.The above result only indicates the volume of content but not the quality, which could be a more appropriate indicator to evaluate the bargaining power of the participants in the exhibition market. It is clear that the quality of a content is subjective; however, we can approximate quality if we consider the number of attendees to these movie shows, which could be a measure of how attractive the titles exhibited in each chain were to the public,[84] without implying that consumers liked them once they saw them.

To evaluate whether the exclusive content was attractive to attendees, the number of attendees was divided by the number of exclusive contents for each chain in each of the periods analyzed. In other words, the number of attendees per content was obtained for each of the chains

84. At least not in the same window.

for the periods before and after the merger as an approximation of the attractiveness or quality of the exhibitions.

For the period prior to the merger, *Cinemex* concentrated 17% of the attendees for the movies shown exclusively in each chain, while *Cinepolis* serviced the remaining 83%. For the post-merger period, *Cinemex's* share increased to 39% while *Cinepolis*' share decreased to 61%. This is indicative of the fact that *Cinemex's* exclusive broadcast movies became more attractive during the period after the merger.

This result should be evaluated with caution since it does not directly imply that *Cinemex* increased its bargaining power and was able to obtain better exclusive content from distributors. However, it is important that in future evaluations in this sector a more in-depth analysis of the evidence presented here regarding bargaining power be made.

6.6. Conclusions

The effect of the merger between *Cinemex* and *Cinemark*, chains that exhibit films in movie theaters, was studied. This market has the characteristics of a fast-changing industry, since movies released in one period are not available at another time, and competition takes place on different dimensions.[85]

The analysis of the effects of the merger on non-price variables does not allow us to conclude that consumers were affected in terms of quality or innovation after the merger. However, the information available does not allow for a more precise assessment of these dimensions

On the other hand, the results show that in the markets affected by the merger, the real price of tickets decreased by a small magnitude. The evaluation of the behavior of the participants in these markets shows that the overall reduction in ticket prices can be explained by the decrease in prices of *Cinepolis*, the largest competitor at the national level. These results show that within the affected markets, *Cinemex*, *Cinemark's* acquirer, increased its prices, although also by small magnitudes.

The latter result is consistent with an alternative specification of the DID model, where *Cinemex* was taken as the treatment group, instead

85. A closer indicator would be to evaluate the occupancy rate of the theaters that exhibit exclusive content, but this information is not available. Likewise, income is not a good indicator since it may reflect variations in prices and not whether the film was attractive to moviegoers.

of the affected market, so the results presented are robust. At the level of each market the results are diverse; there are markets where *Cinemex* increased its prices significantly and others where the decreases are also significant. However, there is no relationship between the changes in prices and the concentration levels resulting from the merger or the changes of such levels.

On the other hand, the participants in the movie exhibition market also carry out other activities in their complexes that could have been affected by the merger. In the particular case of the sale of candy and food, we analyzed whether the merger between *Cinemex* and *Cinemas Lumière* had any effect on the gross profit margin.

The results show that the profit margin of the candy store remained constant between January 2011 and February 2013, so there is no evidence that the merger affects those markets. A possible explanation for the sale of sweets within the complexes they serve to captive demand, and therefore exhibitors may have high margins.

Additionally, evidence was found that in periods after the authorization of the merger, a greater number of people attended *Cinemex's* exclusive screenings, which could indicate that the quality of the films or events it obtains for its exhibition improved. A more complete analysis is needed to determine whether this was due to an increase in its bargaining power.

Finally, the available information shows that in the analyzed period, movie theater attendance did not present major changes: the number of people who attended in 2013 was similar to the number of people who attended in 2014. Likewise, the structure of the sector did not change and attendance in each of the main chains increased in almost equal amounts. This could be explained by several reasons, including the existence of a demand inelastic to price that only responds to distance.

This document leaves several questions open given the lack of information, but it may help COFECE to identify what elements should be reviewed when assessing a merger, as well as to justify the obligation to provide information for a considerable period to those agents that are authorized to merge.

Possible questions or topics for future research include:

- Identify whether in a captive demand scenario economic agents impose, as a general rule, a monopoly price.
- The competition authority should take action to prevent economic agents from exercising their power *vis-à-vis* captive consumers.
- To what extent the accumulation of infrastructure increases the bargaining power of the economic agents involved in a merger.

6.7. Bibliography

Aguzzoni, L., Argentesi, E., Buccirossi, P., Ciari, L., Duso, T., & Tognoni, M. (2011). The Ex-post Evaluation of Two Merger Decisions. Reporte para la UK Competition Commission.

Aguzzoni, L., Argentesi, E., Ciari, L., Duso, T., Tognoni, M., & Vitale, C. (2013). They Played the Merger Game: A Retrospective Analysis in the UK Videogames Market. Deutsches Institut für Wirtschaftsforschung.

Aguzzoni, L., Argentesi, E., Ciari, L., Duso, T., & Tognoni, M. (2012). Ex Post Merger Evaluation in the UK Retail Market for Books. The Journal of Industrial Economics, 170-200.

Allain, M.-L., Chambolle, C., Turolla, S., & Villas-Boas, S. B. (2013). The Impact of Retail Mergers on Food Prices: Evidence from France.

Ashenfelter, O. C., & Hosken, D. (2010). The Effect of Mergers on Consumer Prices: Evidence from Five Mergers on the Enforcement Margin. Journal of Law and Economics, 417-466. doi:10.3386/w13859

Ashenfelter, O. C., Hosken, D. S., & Weinberg, M. C. (2013). The price effects of a large merger of manufacturers: A case study of Maytag-Whirlpool. American Economic Journal:Economic Policy, 239-261.

CANACINE. (2017). Resultados definitivos 2016. Obtenido de: http://canacine.org. mx/wp-content/uploads/2014/04/Resultados-Definitivos-2016-1.pdf

COFECE. (2013). CNT-010-2013. Resoluciont

COFECE. (2013). RA-029-2013. Appeal for Review

DOJ (U.S. Department of Justice). (2010). AMC Entertainment holdings, Inc. and.

Washington, D.C.

DOJ (2010). Horizontal Mergers Guidelines. Washington, D.C.

Gertler, P. J., Martinez, S., Premand, P., & Rawlings, L. B. (2017). La Evaluación de Impacto en la práctica. World Bank Publications.

Gundlach, G. (2016). Non-price effects of mergers: A primer. documento preparado para el Symposium on the Non-Price Effects of Mergers del American Antitrust Institute. Öbtenido de: https://www.antitrustinstitute.org/wp-content/ uploads/2018/08/Gundlach-2016-NON-PRICE-EFFECTS-OF-MERGERS.-A- PRIMER_0-1.pdf

Kwoka, J., & Shumilkina, E. (2010). The price effect of eliminating potential competition: Evidence from an airline merger. The Journal of Industrial Economics, 58, 767-793. Obtenido de: http://www.antitrustinstitute.org/sites/ default/files/kwokapresentation.pdf

Levin, A., Lin, C.-F., & Chia-Shang, J. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. Journal of econometrics, 1-24.

McCabe, M. J. (2002). Journal pricing and mergers: a portfolio approach. American Economic Review, 259-269.

Motta, M. (2004). Competition Policy:Theory and Practice. Cambridge University Press.

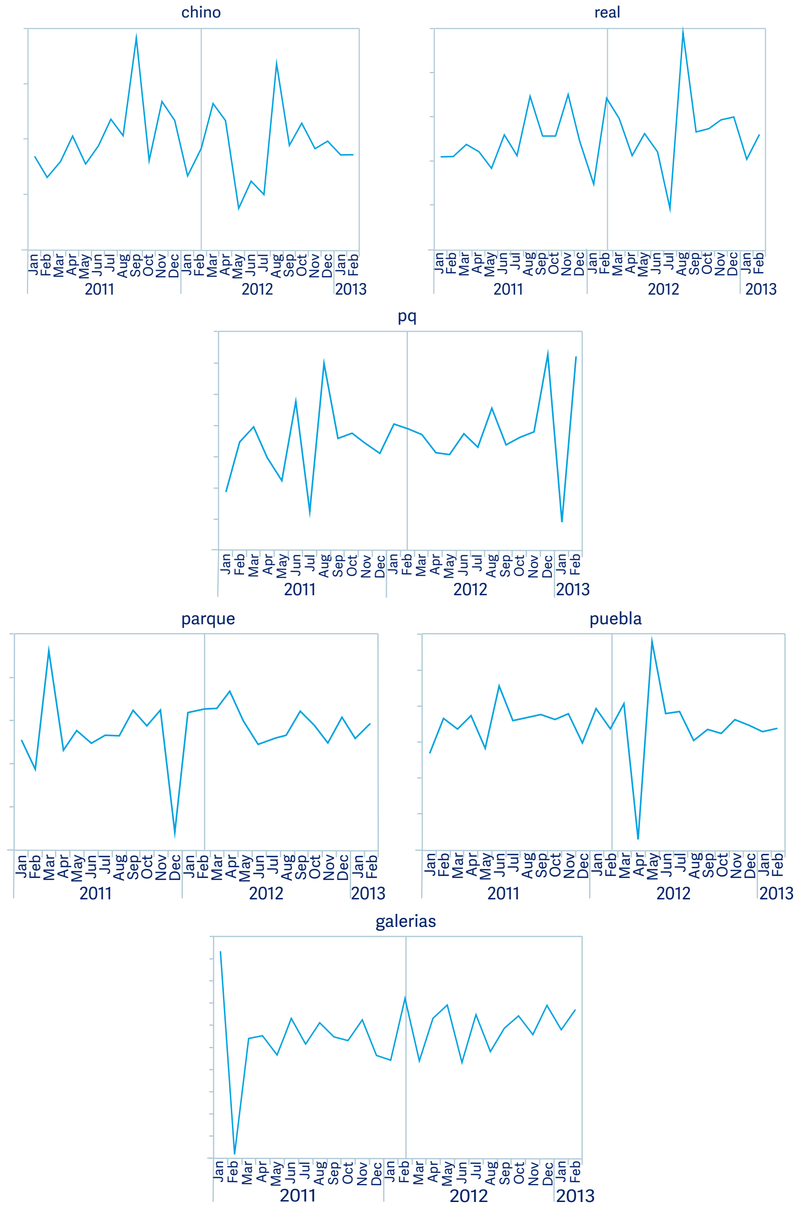
OECD (2016). Reference guide on ex-post evaluation of competition agencies' enforcement decisions. Retrieved from https://www.oecd.org/daf/ competition/Ref-guide-expost-evaluation-2016web.pdf

OFT (Office or Fair Trading) (2013). Completed acquisition by Cineworld plc of City Screen Limited.

Salop, S. C., & Moresi, S. (2009). Updating the Merger Guidelines: Comments. Obtenido de: https://www.ftc.gov/sites/default/files/ documents/public_comments/horizontal-merger-guidelines-review-proje ct-545095-00032/545095-00032.pdf

Appendix

Figure 6.A1. Gross margin in the selected markets[86]



86. The value of the margin is omitted because it is considered confidential information. The line indicates the period when the concentration occurred.

Figure 6.A1. Gross margin in the selected markets[86]

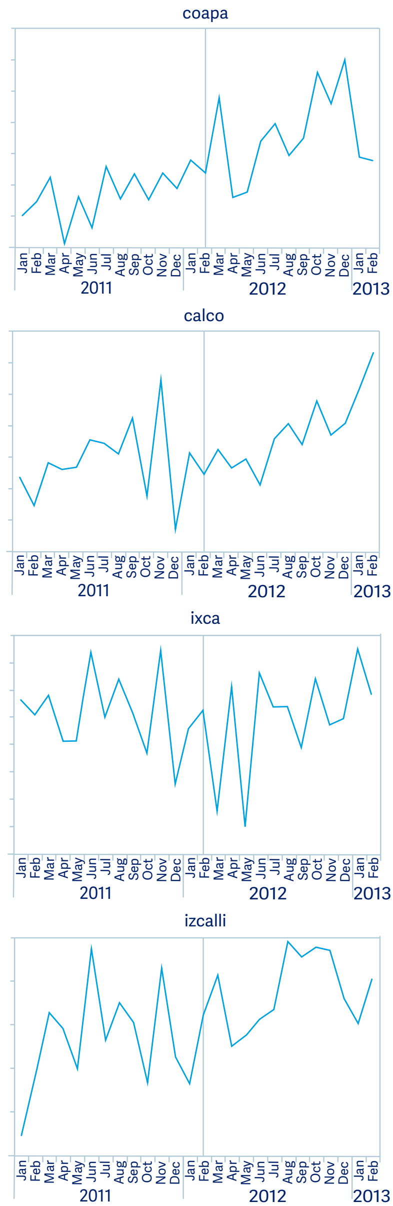
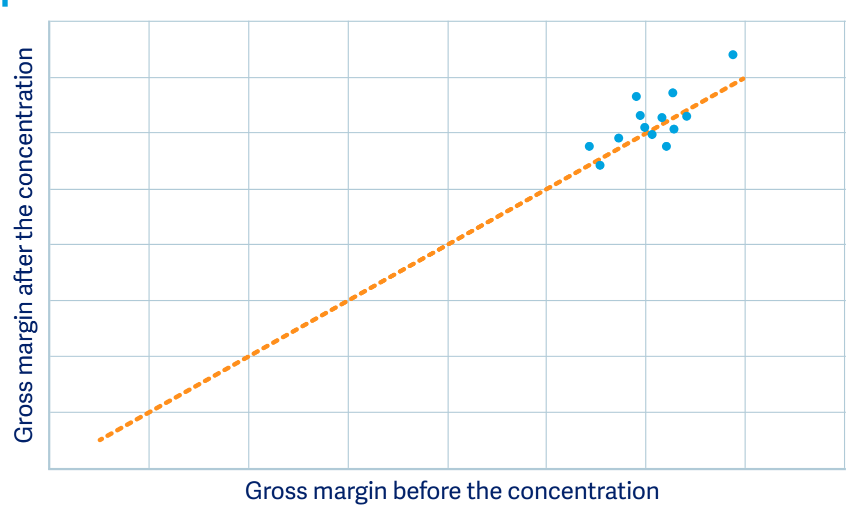


Figure 6.A1. Gross margin in the selected markets[86]

Figure 6.A2. Gross Margin in periods before and after the concentration[87]



87. The value of the margin is omitted since it is considered confidential information.

ASSESSMENT COMPLETED IN 2019

7. Application of the methodology of COFECE for ex post assessments to the conditioned concentration between Aeromexico and Delta

Mauricio Acosta García and Julio César Arteaga García[88]

7.1. Introduction

In May 2015, the airlines *Aeromexico* and Delta notified the Federal Economic Competition Commission (COFECE) of their intention to ally after reaching a joint cooperation agreement. This notification was registered under file CNT-050-2015. This agreement would establish the joint operation of all their flights between Mexico and the United States. In March 2016, the Board of Commissioners of COFECE authorized the conditioned concentration; however, before the conditions imposed were fulfilled, in November 2016, the same airlines requested COFECE's approval of Delta's acquisition of up to 32.33% of the common shares representing the social capital of *Aeromexico*. This new notification was registered under file CNT-127-2016. In February 2017, the Board of Commissioners of COFECE also resolved to condition the new application.

Periodically, COFECE carries out impact assessments of the cases resolved by the Board of Commissioners, with the purpose of quantifying the magnitude of the effect that resolutions have on the markets. In this regard, the purpose of this document is to assess the impact of the conditioned concentration between *Aeromexico* and Delta on the market of public passenger air transport between Mexico and the United States. The results show that having objected to the concentration between

88. We appreciate the comments and suggestions of Jorge Omar Moreno Treviño and anonymous reviewers who contributed to improve the empirical strategy. To Víctor Alan Dávila Montes de Oca we thank him for his support in forming the database. All mistakes belong to us.

these airlines, as originally notified, and having authorized it subject to the compliance with conditions, contributed to the fact that the volume of passengers on the Mexico-United States routes did not decrease. Likewise, a gain in the consumers surplus is estimated to be between 1.09 and 2.48 times the budget allocated to COFECE in 2018.

In the next section, the analysis of the two resolutions issued in connection with both concentration applications is presented. The third section presents characteristics of the air transport market between Mexico and the United States, while in the fourth segment a theoretical model that can characterize this industry is developed. The fifth section of the chapter explains how the difference-in-differences methodology can help estimate the impact of COFECE's intervention, and the sixth section details how the database used in this assessment is built. The estimates of the effect of the intervention by COFECE, as well as its impact on the welfare generated in this market, are presented in the seventh and eighth sections, respectively.

7.2. Case description

In this section, the cases registered in COFECE under files CNT-050-2015 and CNT-127-2016, related to the concentration applications between Delta and *Aeromexico*, presented in May 2015 and November 2016, and resolved in March 2016 and February 2017, respectively, are analyzed.

7.2.1. First concentration application (file CNT-050-2015)

On 8 May 2015, the companies notified COFECE of their intention to concentrate on the air transport market; COFECE assigned file CNT-050-2015 to this application.

The operation analyzed between Delta and *Aeromexico* consists of an alliance to jointly operate all its flights between the United States and Mexico, through a joint cooperation agreement. COFECE considered this action as a co-investment agreement, so that it does constitute a concentration since competing economic agents would be joining assets.

Among the characteristics that can be mentioned of the applicant companies is the fact that the airports where Delta bases its operations (hubs) are Atlanta, Cincinnati, Detroit, Los Angeles, Minneapolis-St. Paul, New York-LaGuardia, New York-JFK, Salt Lake City and Seattle, while *Aeromexico's* main hub is Mexico City (AICM), having three other secondary hubs: Monterrey, Guadalajara, and Hermosillo. By the end of 2014, Delta had 772 aircraft and *Aeromexico* had 124.

Regarding regulatory aspects of the industry, in Mexico, the regular national air transport service is provided exclusively by providers that 1) are legal entities of Mexican nationality and 2) have a concession from the Secretariat of Communications and Transportation (SCT). In addition, there are restrictions on foreign investment. As for the international air transport service, the SCT may authorize the provision of the service to both domestic concessionaires and foreign legal entities. To offer the international service, in addition to the authorization of the SCT, the provider must comply with what was agreed (by treaty or agreement) with the country to which the route is operated.

Mexico and the United States signed, in 1960, a Bilateral Air Transport Agreement restricting to two the number of airlines from each country that can provide services between each pair of cities, except for some destinations where up to three airlines per country are allowed. In November 2014, the aeronautical authorities agreed on a new text for the bilateral agreement, which removes the limit on the number of airlines that can provide air transport services between each pair of cities. However, until March 31, 2016, the date of issuance of the resolution on this file, the agreement had not been approved by the Senate of the Republic or published in the Official Gazette of the Federation, so COFECE, in its resolution, considered the one signed in 1960.

COFECE determined that the relevant market for the analysis of this concentration was the regular air transport of passengers between Mexico and the United States, through the networks formed by direct and indirect flights. One element that was taken into consideration to determine this relevant market is an econometric study that analyzes the determinants of *Aeromexico's* prices for round tickets between Mexico and the United States. The information was provided by *Aeromexico*. For the estimates, there were 531,530 observations of round trips between Mexico and the United States sold by this company. Based on the descriptive statistics presented in the econometric annex, it can be inferred that from the tickets sold by *Aeromexico* in the relevant market: 1) in only 1.2%, this company lacks competition at the airport of origin of the flight, 2) in 14.4%, the routes are not offered by other competitors, 3) in 23.0%, the origin of the flight is a Delta hub, 4) 47.8% has origin in Mexico, 5) 32.1% start at the AICM, and 6) 84.3% is on routes in which Delta also operates. It is relevant to mention that, given points 4 and 5, it is concluded that 67.2% of the round tickets sold by *Aeromexico* whose origin is Mexico and its destination is the U.S., depart from the AICM. The results of the econometric study indicate that all variables have the expected signs and impacts, in comparison with other academic studies. In particular, it is observed that 1) the more competition, the more *Aeromexico* sells tickets at lower prices; 2) if the origin of the trip is the AICM, or the itinerary has a stopover at this airport, *Aeromexico* charges, respectively, 18% or 21% more expensive; 3) if Delta operates the route, *Aeromexico* charges 4% less; and 4) if stopovers are included in the flight, the cost is, on average, 12.5% lower.

Based on public information from the General Directorate of Civil Aeronautics of the SCT, COFECE calculates that the concentration would increase the Herfindahl-Hirschman Index (HHI) by 291 points, going from 1,482 to 1,773. Although the level of the index, assuming concentration, would be below 2,000 points, elements related to barriers to entry are analyzed. In fact, the resolution mentions that they are/could be barriers to entry 1) the development of a network of travel agencies (for new airlines), 2) the Bilateral Agreement in force at the time of the resolution, 3) the positioning held in the country by the *Aeromexico* brand, 4) frequent flyer programs, 5) incentives for travel agencies, 6) the strategic use of designations within the framework of the Bilateral Agreement in force at the time of resolution, 7) slots available at saturated airports.

In the resolution, COFECE states that the concentration could have the object or effect of hindering, diminishing, damaging or impeding economic competition or free market access in the relevant market for regular passenger air transport services between Mexico and the United States, through direct or indirect flights. Delta and *Aeromexico* presented a proposal of binding conditions for the concentration that could help prevent the process of competition and free market access from being reduced, damaged, or impeded as a result of the concentration. In this way, the resolution of COFECE of file CNT-050-2015 is the authorization of the concentration conditioned to: 1) the parties assign 8 pairs of slots in the AICM (equivalent to the amount Delta used in 2015) to current or potential competitors on cross-border flights (Mexico and the U.S.), 2) the slots to be transferred have been used in at least one year by the assignor, 3) the slots to be assigned are in the time band between seven and twenty-two hours with fifty-nine minutes, 4) the parties do not take any action that would in any way prevent the obtaining of permits or authorizations, nor interfere with the operations of the Assignee(s), 5) only one of the parties maintains the designation on non-stop routes where they overlap.

7.2.2. Second concentration application (file CNT-127-2016)

On 7 November 2016, the companies notified COFECE of their intention to carry out another concentration in the air transport market; COFECE assigned file CNT-127-2016 to this application. In this new application, it is specified that Delta would acquire up to 32.33% of the ordinary shares of the social capital of Grupo *Aeromexico*, and that the operation would not include a non-competition clause. It should be noted that when the resolution of this new file is issued, on the 23rd of February 2017, Delta and *Aeromexico* had not finished complying with the conditions they accepted derived from file CNT-050-2015.

According to this new file, Delta's hubs are Atlanta, Boston, Detroit, Los Angeles, Minneapolis-St. Paul, New York-LaGuardia, New York-JFK, Salt Lake City and Seattle, while *Aeromexico's* main hub is AICM, having three other secondary hubs: Monterrey, Guadalajara, and Hermosillo. It is indicated that by the end of 2014, Delta had 809 aircraft and *Aeromexico*, by the end of 2015, 125.[89] Another interesting point is that, between files, they stop reporting Cincinnati as Delta's hub and Boston is included as such.[90] In addition, *Aeromexico* reports 19 destinations to the United States and Canada in 2015, three more destinations than those reported in 2014, for the previous file.

An important regulatory change between files is the entry into force of the new Bilateral Air Transport Agreement that was not considered in the resolution of the previous file, as it was not approved in Mexico. With the new Bilateral Agreement in force, each country has the right to designate as many airlines as it wishes for the operation of international air transport, as well as to cancel or modify such designations, for any route (this is known as an open skies agreement).

89. It would seem relevant to point out that the number of Delta aircraft differs from that mentioned in file CNT-050-2015 (809 vs. 772), so perhaps the 809 aircraft correspond to the data for the end of 2015

90. However, on page 28 of the resolution of the file, Cincinnati is included again and Boston is excluded.

For this application, and after considering the influence that the concentration could have in other regions of the world, COFECE maintained its definition of a relevant market: regular air passenger transport between Mexico and the United States, through the networks made up by direct and indirect flights.

The analysis conducted for the resolution of this new file considers the same elements of the previous file as barriers (or possible barriers) to entry, except those associated with the Bilateral Agreement; that is: 1) the development of a network of travel agencies (for new airlines), 2) the positioning held in the country by the *Aeromexico* brand, 3) frequent flyer programs, 4) incentives for travel agencies, and 5) the slots available in saturated airports. Likewise, it is considered that as a result of the operation, the network of *Aeromexico* and Delta: 1) would grow geometrically in the part of cross-border flights, being able to connect almost 11,000 pairs of cities, giving incentives to consumers to change their current preferences from other competitors (with smaller networks) towards *Aeromexico* and Delta; 2) would accumulate slots in the AICM which would allow the size and density of the current network of these companies to increase with respect to their competitors; 3) would eliminate or reduce the competitive pressure that Delta currently exerts on *Aeromexico*, implying that the latter could increase prices across the U.S.-Mexico network.

In the resolution, COFECE points out that this new concentration could also have the object or effect of hindering, diminishing, damaging, or preventing economic competition or free market access in the relevant market for regular passenger air transport services between Mexico and the United States, through direct or indirect flights, so it should also object to this concentration. Similar to what happened in the resolution of the previous file, Delta and *Aeromexico* presented, as a proposal of binding conditions to the concentration, the commitment not to carry out the operation until the conditions agreed in the resolution of the previous file are met, except those related to the renunciations of route designations, due to the new Bilateral Agreement. Particularly, the Board of Commissioners of COFECE considered that the obligation to effectively transfer the portfolio of eight pairs of slots before the public offer for *Aeromexico* shares was made would eliminate the possible risks to the process of competition and free market access identified in the analysis.

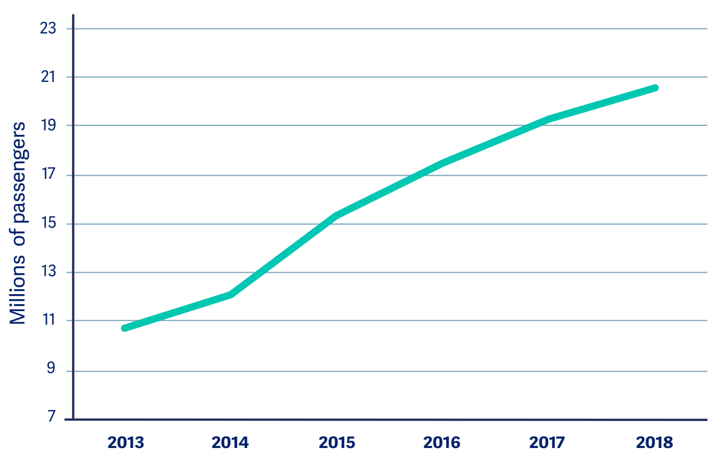
7.3. Description of the studied market

The analyzed market is that of passenger air transport between Mexico and the United States. It covers all flights whose purpose is to transport passengers between these two countries in regular service, and whose origin is in one of these countries and their destination in the other. That is, the charter service, or charter flights, is not included.

Among the information used to describe this market, is that presented on its websites by both the Federal Civil Aviation Agency (AFAC, as per its Spanish acronym) of the SCT and the Bureau of Transportation Statistics (BTS) of the United States Department of Transportation. In the period 2013 – 2018, the AFAC reports 707 routes in the relevant market, while the BTS, 1,207. A total of 655 routes are those that overlap in both sources of information. The analysis presented below is based on these overlapping routes and corresponds to direct flight routes.

In relation to the size of the market, Graph 7.1 shows the number of passengers that are served by airlines on these routes during the period 2013 – 2018. A growing trend is observed during this period, at an average annual rate of 8%.

Graph 7.1. Passengers transported between Mexico and the United States



Source: Own elaboration with data from AFAC and BTS.

Table 7.1 presents the number of companies that have competed in this market since 2013, as well as the number of routes covered in each year of this period. It is observed that the number of competitors decreases between 2016 and 2017; in addition, for 2018, of the 14 participating companies, 5 are Mexican airlines and the rest are from the United States. This table also shows that the number of routes covered each year has ranged from 493 to 516 (241 and 254, originating in Mexico). If the routes served each year are compared with the 655 routes considered for analysis, it can be inferred that airlines constantly adjust their aircraft scheduling and logistics process. In fact, further analysis shows that only 356 of the 655 routes (54%) report passenger information carried in each of the years of the analysis.

Table 7.1. Number of companies and served routes

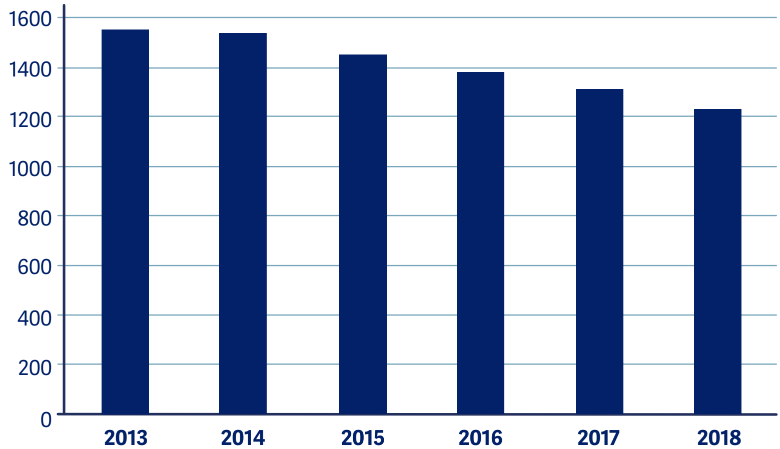
	2013	2014	2015	2016	2017	2018
Airlines	15	16	16	16	14	14
Served Routes	498	493	516	493	503	500
- with origin in Mexico	242	241	254	243	250	253

Source: Own elaboration with data from the AFAC and the BTS.

In the last six years, the number of passengers went from just under 21 million to approximately 31 million, a 47.6% increase; however, the number of airlines and the quantity of routes served have remained relatively stable. Therefore, it is interesting to analyze in greater detail the evolution of some of the elements that characterize the structure of this market.

In addition to the number of competitors in an industry, another element of the market structure is to how passengers are distributed among airlines. This is done through the HHI; this index helps us to know the level of concentration in the analyzed industry and, in this context, helps to know how new customers are distributed among companies. Graph 7.2 shows the evolution of this indicator for the last six years, considering all routes as a single market. It is observed that market concentration has a downward trend, even though fewer companies are participating. In this way, it is possible to argue that the distribution of the increase in the number of passengers in recent years has favored companies with lower market share.

Graph 7.2. Evolution of the HHI in the cross-border air market



Source: Own elaboration with data from the AFAC and the BTS.

Based on the technical criterion of COFECE for the calculation and application of a quantitative index in the analysis of possible effects on competition to measure a market concentration[91], having values less than 2000 in this first approximation, which means that it is not an industry where concentrations of competitors hinder, diminish, damage or impede free market access or economic competition. On the other hand, based on the criteria used by the Department of Justice of the United States, this market would be classified as a competitive market, since the HHI values are below 1500 points as of 2015. However, it is possible that the aggregation of passengers transported for all routes hides possible problems of high levels of concentration on some of these routes or other aspects related to the existence of barriers to entry.

Table 7.2 presents the five airlines that transported the most passengers in this market for each year of the 2013–2018 period, as well as their respective market share. One aspect that stands out is that the order of the first four airlines does not change and, of these, only Delta increases its market share over the years. Similarly, it can be observed that American and United have market shares that are significantly higher than the rest. Another aspect that stands out in Table 7.2 is that the five most important airlines in this market together serve more than 70% of the customers for all the years presented.

91. Published in the Federal Official Gazette on May 14, 2015.

Table 7.2. Main airlines and their market share

Position	2013		2014		2015		2016		2017		2018	
1	AA	25.8	AA	24.3	AA	23.2	AA	21.3	AA	20.0	AA	18.8
2	U	22.0	U	22.8	U	20.6	U	20.3	U	19.9	U	18.3
3	AM	13.4	AM	13.2	AM	14.6	AM	13.7	AM	12.6	AM	12.6
4	D	8.8	D	10.6	D	11.3	D	11.0	D	11.7	D	11.8
5	A	7.7	Vo	7.7	Vo	8.8	Vo	10.0	Vo	9.9	Vo	9.5

Source: Own elaboration with data from the AFAC and the BTS.
A = Alaska; AA = American; D = Delta; AM = Aeromexico; U = United; Vo = Volaris.

A relevant consideration in this market is the existence of barriers to entry. Prior to August 2016, the Air Transport Agreement that governed this market served as a barrier to entry since it allowed the existence of a maximum of two companies by each country on a route.[92] Therefore, the ways to respond to greater demand for a specific route could be 1) for airlines approved to compete on that route to schedule higher frequencies, 2) for aircraft with more seats, or 3) for increasing prices on that route. As of August 2016, the new agreement on Air Transport between Mexico and the United States entered into force, so that there is no longer a legal restriction that limits the number of airlines that serve a particular route, which helps explain the decrease in the HHI observed in Table 7.2.

Another barrier to entry that is identified in this market relates to one of the essential facilities that airlines require to provide the service: slots. In the aviation industry, a slot refers to a space of time that a company has to make use of the runway. The International Air Transport Association (IATA) classifies airports depending on how restrictive the quantity of slots available is. An airport is called Level 2 if demand for slots is close to capacity, while it is classified as Level 3 if demand has already exceeded capacity. Table 7.3 presents the airports in Mexico and the United States that have been classified as levels 2 or 3 by IATA for the year 2019. It is observed that the AICM and the John F. Kennedy in New York are classified as level 3 and 6 other airports in the United States, level 2. The fact that the number of companies that can offer their services is limited by the availability of slots at these airports, means that the airlines that already operate in them can exercise market power.

92. The Agreement allowed, on certain routes, up to three airlines.

Table 7.3. Airports with slot restrictions in 2019

Airport	Level
Chicago-O' Hare	2
Los Angeles	2
Mexico City	3
New York-J.F. Kennedy	3
Newark	2
Orlando	2
San Francisco	2
Seattle-Tacom International Airport	2

Source: Own elaboration with data from IATA.[93]

In the United States, there are airlines that operate routes on behalf of commercial airlines. These alliances are carried out as a strategy of commercial airlines to lower labor costs or to avoid investment to acquire aircrafts. In this way, they facilitate the expansion of a commercial airline's presence. Table 7.4 presents the four main airlines that make alliances with commercial airlines.[94]

Table 7.4. Evolution of alliances by year

Position	2013	2014	2015	2016	2017	2018
Compass Airlines	D	D	D	D	AA, D	AA, D
Mesa Airlines	U, US	U, US	AA, U	AA, U	AA, U	AA, U
Republic Airline	F, US	U, US	AA, U	AA, U	AA, U	AA, U
SkyWest Airlines	A, D, U	A, AA, D, U, US	A, AA, D, U	A, AA, D, U	A, AA, D, U	A, AA, D, U

Source: Own elaboration with information from The US General Services Administration.
A = Alaska; AA = American; D = Delta; F = Frontier; U = United; US = USAirways.

According to the available information, between 2013 and 2016, Compass only had alliances with Delta, but as of 2017, it also has with American Airlines. For its part, it can be observed that SkyWest is the airline that has alliances with more commercial airlines.

93. The most recent update to the list was made on August 5, 2019 and the full list can be found in www.iata.org/policy/slots/Pages/slot-guidelines.aspx (accessed August 28, 2019).
94. Reports obtained from www.gsa.gov (accessed August 2, 2019).

7.4. Market equilibrium conditions model

Based on the information presented in the previous section, it can be thought that in the relevant market for regular air passenger transport services between Mexico and the United States there are two leaders, two first followers and N second followers. Thus, in this section, we model this market as one in which quantities are competed sequentially; that is, we developed a three-stage Stackelberg model, where first the two leaders simultaneously decide their output levels; in a second stage, the first two followers decide at the same time their outputs and, finally, in the third stage, the N second followers decide at the same time how much to produce. It is important to note that the assumption that airlines compete on quantities is appropriate because of the logistics and aircraft scheduling process they perform; that is, keeping everything else constant, it is relatively more difficult for them to modify quantities (size of the plane for an already scheduled flight) than the fees charged on that flight.[95]

We assume a homogeneous good whose inverse linear demand function is $P = a - bQ$, where a and b are positive parameters and $Q = \sum_i q_i$ for $i = 1, 2, \ldots, N+4$. Similarly, for simplicity, we assume that all companies have the same marginal cost of production, which is constant and equal to c.

Being a dynamic game, the solution comes from using the backward induction method. Thus, in the third stage, each of the N companies selects how much to produce, q_n, with the aim of maximizing their profits and knowing the levels produced by the other four companies. In the second stage, each first follower company incorporates the solution of the third stage in its objective function and maximizes its profits, knowing how much each of the leaders produced. In the first stage, each leading company incorporates solutions from stages 2 and 3 into their objective functions and maximizes their profits independently.

Given that at each stage the decisions of the companies are simultaneous, and that identical companies in terms of their production costs, companies that overlap at some stage produce the same; however, leading companies

95. Competition in quantities is one of the solutions to Bertrand's paradox. If it is wanted to have prices as a strategic variable, it would be necessary to introduce product differentiation in the model to obtain different results from those of the paradox. Another reason why quantities are considered a strategic variable is that the information available for the empirical part is the number of passengers.

produce more than the first followers, who in turn produce more than the second followers. It is not difficult to obtain the equilibrium production levels, represented in the following equations, for the leading companies, first followers and second followers, respectively.

$$q^*_L = \frac{(a-c)}{3b} \quad for\ L = 1, 2 \tag{1}$$

$$q^*_S = \frac{(a-c)}{9b} \quad for\ S = 1, 2 \tag{2}$$

$$q^*_n = \frac{(a-c)}{9b + (N+1)} \quad for\ S = 1, 2,..., N \tag{3}$$

With these equilibrium levels, the price and quantity that will prevail in the market are presented in equations 4 and 5, respectively.

$$p^*_0 = \frac{a + (9N+8) \bullet c}{9\ (N+1)} \tag{4}$$

$$Q^*_0 = \frac{(a-c) \bullet (9N+8)}{9b \bullet (N+1)} \tag{5}$$

The equilibrium that is synthesized in the previous equations can be visualized as the situation in the aviation industry before the concentration between *Aeromexico* and Delta.

The information presented in the previous section allows us to assume that *Aeromexico* and Delta are the first followers. In addition, we will assume that when merging the composition of the industry changes since there will be three leading companies (two from the previous scenario and the one that arises from the concentration between *Aeromexico* and Delta) and only two stages, in the first stage the three leaders decide and in the second, the N followers. Similarly, with the purpose of incorporating the possible efficiencies caused by the expansion of the network available to the concentrated company, we will assume that its marginal cost of production is reduced, while that of the other companies remains the same as in the previous scenario, $cr < c$.

The solution of using the backward induction method in the case where *Aeromexico* and Delta have concentrated is presented in the following set of equations.

$$q_L^* = \frac{a+(N+1)\bullet c_r-(N+2)\bullet c}{4b} \quad \textit{for } L = 1,2 \tag{6}$$

$$q_S^{**}= \frac{a+(3N+2)\bullet c-3(N+1)\bullet c_r}{4b} \quad \textit{concentrated company} \tag{7}$$

$$q_n^{**}= \frac{a-(N+2)\bullet c+(N+1)\bullet c_r}{4b\bullet(N+1)} \quad \textit{for } n = 1, 2, \dots N \tag{8}$$

With the new equilibrium levels of production, the price and quantity that will prevail in the market once the concentration occurs are presented in equations 9 and 10, respectively.

$$p_1^* = \frac{a+(3N+2)\bullet c+(N+1)\bullet c_r}{4\bullet(N+1)} \tag{9}$$

$$Q_1^* = \frac{(4N+3)a-(3N+2)c-(N+1)\bullet c_r}{4b\bullet (N+1)} \tag{10}$$

The difference in equations 9 and 4 indicates how the market price changes when companies concentrate without any conditions. Similarly, the effect on quantity is obtained by subtracting equation 5 from 10. These calculations are presented in Table 7.5.

Table 7.5. Theoretical effects of a concentration without conditions

Effect on price	$\Delta p^*=p_1^*-p_0^*= \dfrac{5\bullet(a-c)+9\bullet(N+1)\bullet(c_r-c)}{36\bullet(N+1)}$
Effect on quantity	$\Delta Q^*=Q_1^*-Q_0^*= \dfrac{-5\bullet(a-c)-9\bullet(N+1)\bullet(c_r-c)}{36\bullet(N+1)}$

From Table 7.5, it is easy to note that the effects of the unconditioned concentration between *Aeromexico* and Delta on price and quantity move in opposite directions. In the same way, it is observed that if there were no efficiencies through the network $(c_r = c)$, without ambiguity, the effect on price would be positive, while the effect on quantity would be negative.

In this way, it can be said that if the efficiency gains resulted from the effect of the network created by the concentration are small, then it would generate increases in price and reductions in market size, hence COFECE has objected to the concentration as originally been notified and subjected its authorization to the fulfillment of conditions so as not to hinder, diminish, damage or impede economic competition or free competition.

7.5. Model of the behavior of market participants

The intervention of COFECE, through the resolutions of the cases with files CNT-050-2015 and CNT-127-2016, consists of allowing the concentration between *Aeromexico* and Delta, but conditioned to a series of commitments. In this way, the information observed from the relevant market corresponds to situations where the concentration has not occurred (before the resolutions) and once it has been conditioned; that is, the scenario in which the concentration is carried out without the intervention of COFECE is not observed.

Since there is no public information on the fares charged in either the AFAC or the BTS, but the latter does present information on passengers transported by route by airline, the scheme to follow for the identification of the model and estimation technique focuses on the volume of passengers transported on routes between Mexico and the United States. Thus, the equilibrium conditions of the relevant market will be estimated before and after the conditioned concentration. It would be expected that, when comparing the situation prior to the intervention of COFECE with the situation of the conditioned concentration, this conditioning has not reduced the volume of passengers on the market and, preferably, increased it.

The methodology used to perform the ex-post assessment of this conditioned concentration is one of difference-in-differences, which is widely used in the area of economics (for example, see Meyer, 1995 and Arcelus et al., 2019). In this case, the observation units will be the routes between those whose origin is Mexico or the United States and those which destination is in a city in the other country.

We define as a treatment group, the routes where Delta or *Aeromexico* participate. On the other hand, the control group will be made up by the routes where these airlines does not operate.[96] COFECE's intervention is the objection to the concentration as originally notified and the authorization subject to the fulfilment of conditions, which occurs from period *t*. Table 7.6 presents the description of our empirical strategy.

Table 7.6. Equilibrium conditions for the ex-post assessment

	Passengers before the concentration*	Passengers after the concentration*	Difference
Routes with Delta or *Aeromexico* present	Q_{10}	Q_{11}	$Q_{11}-Q_{10}$
Routes without Delta or *Aeromexico* present	Q_{20}	Q_{21}	$Q_{21}-Q_{20}$
Difference	$Q_{10}-Q_{20}$	$Q_{11}-Q_{21}$	$(Q_{11}-Q_{10})-(Q_{21}-Q_{20})$

* Concentration subject to fulfillment of conditions.

If the difference in the volumes of passengers transported before the concentration on routes where Delta or *Aeromexico* are present and on those where they are not, $Q_{10} - Q_{20}$, is positive, means that these two airlines serve routes with higher volumes of passengers since before their intention to concentrate, which could be a reason that led them to seek their association. On the other hand, the difference between the volume of passengers on routes where Delta and *Aeromexico* do not intervene after the concentration and before it, $Q_{21} - Q_{20}$, will determine changes in the volume of passengers that are exogenous to the intervention of COFECE.[97]

The difference between volumes of passengers on routes where Delta and *Aeromexico* are present, after and before the concentration, $Q_{11} - Q_{10}$, and the volumes of passengers on routes where they are not present, after and before the concentration, $Q_{21} - Q_{20}$, gives us the degree to which the routes served by Delta and *Aeromexico* modify their volume due to the conditioned concentration after considering the possible

96. The idea of a control group is to identify observation units that have not participated in the intervention. In that sense, the routes in which neither *Aeromexico* nor Delta participate before and after the intervention are considered adequate, although it is recognized that there may be characteristics that make both groups of routes different.
97. One of these exogenous changes is the entry into force of the new agreement on Air Transport between Mexico and the United States.

exogenous changes. Alternatively, the difference $(Q_{11} - Q_{10}) - (Q_{21} - Q_{20})$ can be obtained from subtracting from the difference in the volumes of passengers transported after concentration on routes where Delta or *Aeromexico* are present and those where they are not, $Q_{11} - Q_{21}$, the difference that motivated them to seek their association, $Q_{10} - Q_{20}$. This difference in differences quantifies the effect of COFECE's intervention in authorizing the concentration subject to certain conditions. The effect on the quantity of Table 7.5 shows that the volume of passengers would have been reduced if the concentration had not been conditioned, thus, since Table 7.6 compares the scenario of the conditioned concentration with that which is prior to it, it would be expected that this difference of differences is not negative; that is, that COFECE has intervened to maintain the size of the relevant market or even increased it due to the network effect that the authorized conditional concentration brings (greater efficiency when connecting more destinations increases the quantity).

In this way, when using this estimation technique, the differential $Q_{10}Q_{20}$ quantifies the incentives of Delta and *Aeromexico* to associate, $Q_{21}Q_{20}$ measures changes due to issues exogenous to the intervention of COFECE, while the difference differences $(Q_{11} - Q_{10}) - (Q_{21} - Q_{20})$, o $(Q_{11} - Q_{21}) - (Q_{10} - Q_{20})$, quantifies the effect of having conditioned the concentration. It is important to point out that in order to attribute these effects to the respective differences, the following assumptions are required:

1. The effects of the intervention of COFECE are only manifested on the routes in which Delta or *Aeromexico* participate and are not transferred to routes that are not served by them.
2. The exogenous effect of the intervention of COFECE is similar on all routes, regardless of whether Delta or *Aeromexico* are present or not.

The estimate of the difference of differences measures the effect of the intervention by COFECE. On the other hand, to measure the impact on welfare of this intervention, it is necessary to infer the volume of passengers that would have resulted in the relevant market if this Commission had not objected to the concentration; that is, it is required to construct the counterfactual of the volume of passengers in each group of routes with the hypothetical scenario and calculate the change in the volume of passengers in the relevant market that would have been if COFECE had not objected to the merger as originally notified and subject their authorization to the fulfillment of conditions.[98]

Since detailed information on prices is not available, the change in volume is used, together with estimates of price elasticity of demand from previous studies, to infer changes in prices and proceed to estimate the impact on the welfare of the population from the intervention of COFECE on two components of consumer surplus in the relevant market: 1) the impact of overpricing and 2) the impact of unrealized demand. In the case of component 1, the variation caused on the price of cross-border flights between Mexico and the United States must be calculated and multiplied by the number of passengers that would have been transported if the concentration had not been challenged. For its part, component 2 is obtained by multiplying the change in the volume of passengers if the concentration had not been objected by the variation in price by 0.5, given the assumption of linear demands established in the document "Methodology for the elaboration of ex post assessments of COFECE interventions".

7.6. Analysis of available information

The main source of information to carry out the impact assessment of the conditioned concentration carried out by *Aeromexico* and Delta in the public passenger air transport service market between Mexico and the United States comes from the BTS of the United States Department of Transportation. The database used is the "T-100" for the international segment, for the period 2013-2018.[99] This is a monthly basis that contains the information reported by airlines, U.S. or foreign, of the direct single trips made; this is the reason for using this database and not the one provided by the AFAC, which only identifies the volume of passengers and number of flights for each route but not by airline.

98. A reviewer suggests constructing another counterfactual scenario where concentration is not authorized; its purpose could serve to ensure that COFECE's decision has generated the greatest impact on welfare. The assessment carried out in this work does not consider this exercise since it is not considered in the document that describes the methodology for the elaboration of ex-post assessments of COFECE interventions. (Available at: https://www.cofece.mx/wp-content/uploads/2014/04/Metodologia_ev_expost_COFECE.pdf#pdf).

99. Reports obtained from www.bts.gov (accessed July 2, 2019).

The first thing that is done with the main base is to eliminate the observations that did not have passengers transported or that the route involved a city in Puerto Rico. Afterwards, the information of airlines that do not offer scheduled service (i.e., that offer only charter travel) is eliminated. On the other hand, as mentioned in the third section, there are airlines that operate routes on behalf of the commercial companies with which they have alliances; Thus, a process is carried out to assign the information of Compass Airlines, Mesa Airlines, Republic Airline and SkyWest Airlines to those airlines with which they have alliances, according to certain criteria.[100] In the case of information from these four airlines which does not meet the established criteria, it is chosen to eliminate it. After these processes, there are 71,556 observations from airlines reporting flights between Mexico and the United States in some month between January 2013 and December 2018 on 1,207 routes.

The next step in cleaning the database is to verify that the analyzed routes are in the AFAC records as routes with regular service. In total, the information of 552 routes that do not appear in the Mexican records[101] is eliminated, so there are 70,169 observations.[102] Information from the Open Flights organization is then used to determine the distance in miles between U.S. airports for the purpose of determining potential substitutes.[103] If the distance between airports is less than 50 miles, it is considered as substitutes and analyzed as the same route.[104] With this step, observations are not eliminated but routes are, which are located at 599.

Since between May 2015 and February 2017 the concentration applications and their respective resolutions happen, the information of the years 2015, 2016 and 2017 is eliminated, in addition, the information of 2013 is eliminated. Thus, we have the information for 2014, as a pre-intervention period, and that for 2018, as a post-intervention. The information

100. Information is assigned to a certain commercial airline when it meets at least one of the following criteria: 1) it only has an agreement with that airline that year, 2) the city involved in the United States is the hub of the airline, or 3) the airport of the Mexican city reports only one U.S. airline that covers that route.

101. From the information of the AFAC, 707 routes with regular service in the relevant market for this work are counted

102. The analysis in section 3 uses the information at this level.

103. Information obtained from openflights.org (accessed July 28, 2019).

104. Airports classified as substitutes are 1) Los Angeles, Ontario and Santa Ana, 2) Miami and Fort Lauderdale, 3) New York and Newark, 4) San Francisco, Oakland and San Jose, and 5) Washington and Baltimore.

of each route is added on a quarterly basis and the routes that are not in each of the quarters of these two years are eliminated. Until this step, there are 20,735 observations that make up 272 routes that have observations every quarter of 2014 and 2018.[105]

Table 7.7. Distribution of the observations for the ex-post assessment

	Before the concentration*	After concentration*
Treatment group	344	344
Control Group	472	472

Routes where the presence of *Aeromexico* or Delta is intermittent are eliminated. In this way, the routes where *Aeromexico* or Delta are always present make up the treatment group, while the control group are those routes on which they have never been present. As shown in Table 7.7, to carry out the assessment there are 1,632 observations of 204 routes, of which 688 observations (86 routes) make up the treatment group. It is relevant to indicate that the volume of passengers on the routes considered for this assessment represents 75.4% of the total transported in 2014. For 2018, 22,657,005 passengers were transported on these routes, representing 74.2% of the total in the relevant market.

The dependent variable is the natural logarithm of the number of passengers transported. A dichotomous variable is also created that distinguishes the cities in Table 7.3 by having airports where there is a problem of slot scarcity.[106] For each route, the HHI is constructed and the number of potential competitors on that route is identified (an airline is considered a potential competitor on a route if it does not participate in that route but serves other routes from the city of origin).

7.7. Estimation of empirical models and presentation of results

To apply the difference-in-differences methodology in this work, a procedure similar to that used, among others, by Arcelus et al. (2019). In the case of the ex-post assessment, the variable to explain is the natural

105. Since there may be information for each quarter of each year, but not for each month of the year, the number of observations is not divisible by 8. Also, according to the available information, there are 266 routes that are present every quarter of the period 2013 – 2018.
106. Seattle, WA Airport is not included in this study as it does not report routes in each of the quarters of 2014 and 2018.

logarithm of the volume of passengers per route per quarter, $Ln\ Q_{it}$.[107] The observation units are the routes whose origin is Mexico, or the United States and their destination is a city in the other country and that have passengers transported in each quarter of 2014 and 2018. In particular, the following equation is estimated:

$$Ln\ Q_{it} = \alpha + \beta_1 \bullet Treatment_i + \beta_2 \bullet Resolution_t + \beta_3 \bullet Interaction_{it} + \gamma \bullet z_{it} + \varepsilon_{it}, \qquad (11)$$

where $Treatment_i$ is a dichotomous variable that distinguishes the treatment group since it takes the value of 1 when in that route and in each quarter of 2014 and 2018 *Aeromexico* or Delta participates and 0, in any other case. $Resolution_t$ is another dichotomous variable that takes the value of 1 for the quarters of 2018 and 0, for the quarters of 2014. $Interaction_{it}$ is the interaction between these two dichotomous variables, so that it takes the value of 1 for the routes in which *Aeromexico* or Delta participates during 2018. Equation *(11)* also includes variables relating to characteristics of the routes, z_{it}, that help explain the volume of passengers.

Table 7.8. Interpretation of coefficients in regression of the logarithm of the volume of passengers

	Before resolution*	After the resolution*	Difference
Routes with Delta or *Aeromexico* present	$\alpha + \beta_1$	$\alpha + \beta_1 + \beta_2 + \beta_3$	$\beta_2 + \beta_3$
Routes without Delta or *Aeromexico* present	α	$\alpha + \beta_2$	β_2
Difference	β_1	$\beta_1 + \beta_3$	β_3

* Concentration subject to the fulfilment of conditions.

Table 7.8 presents the interpretation of the regression coefficients of the difference-in-differences methodology. In particular, β_1 is the estimate prior to the intervention of COFECE, of the average difference in

107. Some jobs use a standardized version of it as a dependent variable, such as passengers per kilometer; however, not all papers reviewed do so (see Smyth and Pearce, 2008, Kwoka and Shumilkina, 2010, Carson et al., 2011 and Arcelus et al., 2019).

the logarithm of the volume of passengers transported on routes where *Aeromexico* or Delta are present relative to routes where these airlines are not present; $\beta_1 > 0$ would imply that, even before the merger, *Aeromexico* and Delta served routes with higher volumes of passengers, which could have generated the incentives to implement actions aimed at concentrating. The coefficient β_2 estimates the average difference, due to issues exogenous to the intervention of COFECE, in the logarithm of passengers transported on routes where the airlines that presented the concentration application are not present; $\beta_2 > 0$ would imply that volume of passengers grows between 2014 and 2018. β_3 estimates the degree to which the routes in which *Aeromexico* or Delta participate modify their volume of passengers transported due to the conditioned concentration, after taking into account the differences in the averages of the volumes transported on the two types of routes (β_1) or the exogenous effects of the intervention of COFECE (β_2). The intervention of COFECE would be expected to limit the exercise of market power of the airlines involved, so the intervention should not reduce the size of the market, even if $\beta_3 > 0$ it would be associated with benefits of extending the network of these two airlines.

Before applying the difference-in-differences methodology, we proceed to determine the variables that contribute to explaining the logarithm of the volume of passengers, that is, those that integrate z_{it}. Although most of the literature tries to explain the prices, reviewing them serves as a guide to observe that socioeconomic characteristics of the cities involved are generally included, such as population, per capita income, or if it is a tourist destination, as well as conditions of competition of the route, such as the HHI, the number of real or potential competitors and if one of the points is a city with an airport that has a *slot* restriction.[108] In this way, an exercise is done in which we start from a model in which all the available variables are included and the variable with the highest *p-value* is eliminated.[109] Once that variable is eliminated, the model is re-estimated and the elimination method is repeated. This process is continued

108. Among the works reviewed we can mention Kwoka and Shumilkina (2010), Arcelus et al. (2019) and Annex A of the resolution of file CNT-050-2015 of COFECE.

109. This first model includes as independent variables the GDP per capita, the number of homicides in the Mexican city on the route, if the Mexican city is a beach, a trend, if any city on the route has an airport with slot restrictions, the HHI and the number of potential competitors.

until all but one of the included variables are statistically different from zero. Thus, the variables that make up z_{it} of equation *(11)* are the dichotomous *slots*, a trend, the HHI and the number of potential competitors, whose *p-value* is 0.11.[110] Table 7.9 presents the descriptive statistics of the variables used in the assessment.

Table 7.9. Descriptive statistics of the variables included in the ex post assessment

Variable	Media	Standard deviation	Maximum value	Minimum value
Log (passengers)$_{it}$	9.29	1.35	12.05	4.58
Treatment$_i$	0.42	.49	1	0
Resolution$_t$	0.50	.50	1	0
Slots$_i$	0.31	0.46	1	0
HHI$_{it}$	7484.53	2779.23	10000	2068.36
Potential competitors$_{it}$	3.80	2.82	11	0

From Table 7.9, it can be inferred that the range of passengers transported per quarter per route ranges from just under 100 to around 171,000. Likewise, 31% of the routes considered involve a city with a shortage of slots. The HHI by route shows the high concentration on the routes of the relevant market. In fact, further analysis shows that 48% of routes have an HHI equal to 10,000 and most of these routes lack the participation of *Aeromexico* or Delta. For its part, the average number of potential competitors is 3.8, which is very similar to that reported in Annex A of the resolution to the first application for concentration, where only routes on which *Aeromexico* sells tickets are considered.

Table 7.10 presents the preliminary results of estimating equation *(11)* through least ordinary squares.

110. One reviewer comments that there may be risks of omitted variables in the final version as there are no proxy variables for income and prices. However, the econometric strategy used (backward stepwise) excludes GDP per capita as it is not significant. In the case of prices, there is no public information by route that allows us to include them.

Table 7.10. Results prior to assumption violation tests

Variable	Coefficient
Constant	**11.0908***** (0.1283)
Treatment	**-0.2907***** (0.0768)
$Resolution_t$	**0.3339***** (0.1120)
$Interaction_{it}$	**0.1985*** (0.1025)
$Slots_i$	**0.7700***** (0.0608)
t_t	**-0.0669***** (0.0225)
HHI_{it}	**-0.1727 **** (-0.0873)
$Potential\ Competitors_{it}$	**0.0144** (0.0091)
R^2 Adj. Observations	**0.43** **1632**

We test whether the estimation presented in Table 7.10 has problems of violations of basic assumptions such as heteroscedasticity and multicollinearity. The tests results show that it should be corrected for heteroscedasticity.[111] Column A of Table 7.11 presents the estimates in which the detected problem of heteroscedasticity is corrected.

Table 7.11. Estimation of the effect of the intervention of COFECE

Variable	(A)	(B)
Constant	**11.0908*****	**8.0168*****
	(0.1311)	(0.0824)
$Treatment_i$	**-0.2907*****	**-0.1793****
	(0.0829)	(0.0793)
$Resolution_t$	**0.3339*****	**0.2832*****
	(0.1097)	(0.1066)
$Interaction_{it}$	**0.1985***	**0.0810**
	(0.1031)	(0.1005)
$Slots_i$	**0.7700*****	**0.5979*****
	(0.0637)	(0.0632)
t_t	**-0.0669*****	**-0.0595*****
	(0.0226)	(0.0223)

Notes: Robust standard errors in parentheses.
* Significant at 10%. ***Significant at 1%.

111. The Breusch-Pagan/Cook-Weisberg test generates a calculated $\chi 2$ value of 42.26, so it is rejected that the errors are homoscedastic and no value of the VIF test is greater than 5, so multicollinearity problems can be ruled out.

Table 7.11. Estimation of the effect of the intervention of COFECE

Variable	(A)	(B)
HHI_{it}	**-0.0003*** **	
	(0.00001)	
$Competitors_{it}$		**0.5937*** **
		(0.0228)
Potential $competitors_{it}$	**0.0144**	**0.0194***
	(0.0109)	(0.0107)
R^2 Adj.	**0.43**	**0.47**
Observations	**1632**	**1632**

Notes: Robust standard errors in parentheses.
* Significant at 10%. ***Significant at 1%.

The results presented in column A of Table 7.11 show that the intervention of COFECE in objecting to and conditioning the concentration between *Aeromexico* and Delta had the expected effect on the volume of passengers on routes between Mexico and the United States: with a significance level of 10%, the coefficient for the variable $Interaction_{it}$ implies that the volume of passengers increases 22.0%.[112] Additionally, it can be observed that the increase in the volume of passengers due to issues exogenous to the intervention (Resolution coefficient) is even greater. On the other hand, it is observed that *Aeromexico* and Delta participate in routes that have a lower volume of passengers.

As an alternative estimate, column B of Table 7.11 presents the results obtained from replacing the HHI with the number of competitors offering flights on each of the routes. An increase in the power of explanation of the included variables is observed and, although the coefficients retain the same signs, they change the level of significance; particularly, the coefficient of potential competitors is statistically different from zero to 10%, while the coefficient for $Interaction_{it}$ is no longer statistically different from zero. Obtaining a coefficient equal to zero is also expected since the intervention of COFECE is to, at least, maintain the market as it was in the situation prior to the concentration; that is, that the volume of passengers does not decrease.

112. According to the work of Kennedy (1981) and van Garderen and Shah (2002), the correct formula for calculating percentage changes of a dichotomous variable in a semi-logarithmic regression is $100 \times [\, e^{\beta - 0.5V(\beta) - 1}]$, where β is the coefficient associated with the dichotomous variable and $V(\beta)$ is the estimated variance of that coefficient.

In relation to the characteristics of competition on the routes, the expected signs are obtained since it is observed that both a greater number of competitors (current or potential) and a lower level of concentration on the route increase the volume of passengers. Likewise, it is obtained that the effect on the volume of passengers is greater for the case of current competitors than for potential ones.

7.8. Estimation of the impact of the intervention on welfare

As mentioned in the previous section, β_3 quantifies the effect of the intervention when compared to the scenario prior to the association between the two airlines; however, to measure the impact on welfare of the intervention of COFECE, it is necessary to infer the volume of passengers that would have resulted in the relevant market if this body had not objected to the concentration and compare it with the volume of passengers observed since the concentration was conditioned.

Table 7.12 presents the difference between $Q_{11'}$ and Q_{11} plus the difference between $Q_{21'}$ and Q_{21} quantifies the change in the volume of passengers during 2018 that would have been if COFECE had not objected and conditioned the concentration.

Table 7.12. Description of the counterfactual for measuring the impact on welfare

	Volume with conditioned concentration	Volume with unconditioned concentration	Change in the Volume of Passengers in 2018
Routes with Delta or *Aeromexico* present	Q_{11}	$Q_{11'}$	$Q_{11'} - Q_{11}$
Routes without Delta or *Aeromexico* present	Q_{21}	$Q_{21'}$	$Q_{21'} - Q_{21}$

To build the 2018 counterfactual, $Q_{11'} + Q_{21'}$, a scenario is constructed in which *Aeromexico* and Delta are considered as a single airline, and the HHI and the number of potential competitors for each route are calculated, under that assumption. It should be noted that the HHI on a route is modified only if *Aeromexico* and Delta are actual competitors. The number of potential competitors is reduced if one of these airlines participates in the route and the other is a potential competitor or if both are potential competitors. In the construction of the counterfactual scenario, the estimated coefficients presented in column A of Table

7.11 are used. Given this, the counterfactual for each route is obtained by making the calculation indicated in equation 12, for the routes in which *Aeromexico* and Delta participate and equation 13 for the other routes.

$$\begin{aligned} Ln\ \hat{Q}_{it}^{SC} = \ & 11.0908 - 0.2907 + 0.3339 + 0.1985 \\ & + 0.7700\ Slots_i - 0.0669\ tt\ - 0.0003\ H\hat{H}I_{it} \\ & + 0.0144\ P\hat{o}tential\ competitors_{it} \end{aligned} \tag{12}$$

$$\begin{aligned} Ln\ \hat{Q}_{it}^{SC} = \ & 11.0908 - 0.3339 + 0.7700\ Slots_t - 0.0669\ t_t \\ & - 0.0003\ H\hat{H}I_{it} + 0.0144\ P\hat{o}tential\ competitors_{it} \end{aligned} \tag{13}$$

It should be noted that Carson et al. (2011) show that to predict demand for air transport in the United States, it is better to use a method that aggregates individual markets relative to one that uses aggregated domestic data. Likewise, in order to make a more appropriate comparison of the counterfactual with the value that prevails given the scenario of the conditioned concentration, instead of comparing it with the information observed for 2018[113], it is compared with the predicted value given the results of column A from Table 7.11. This comparison allows controlling for the possible prediction errors of the model since the adjusted R^2 is 0.43. That is, it is calculated based on equations 14 and 15, for the routes where *Aeromexico* or Delta are present and in which they do not actively participate, respectively.

$$\begin{aligned} Ln\ \hat{Q}_{it}^{CC} = \ & 11.0908 - 0.2907 + 0.3339 + 0.1985 \\ & + 0.7700\ Slots_i - 0.0669\ t_t\ - 0.0003\ HHI_{it} \\ & + 0.0144\ Potential\ competitors_{it} \end{aligned} \tag{14}$$

$$\begin{aligned} Ln\ \hat{Q}_{it}^{SC} = \ & 11.0908 - 0.3339 + 0.7700\ Slots_t - 0.0669\ t_t \\ & 0.0003\ HHI_{it} + 0.0144\ Potential\ competitors_{\imath t} \end{aligned} \tag{15}$$

It is observed that for the routes that comprise the control group, equations 13 and 15 differ only in the use of the number of potential competitors, while the difference between equations 12 and 14 is both the value used for the HHI and potential competitors. With the estimates

113. During 2018, the routes considered in the sample used make the assessment transported just under 22.7 million passengers.

of equations 12 to 15 the volume of passengers for 2018 can be computed in each scenario, which is presented in the Table 7.13. It is observed that, if COFECE had not objected to the concentration as it was originally notified, and conditioned it, the volume of passengers would have been 3.62% lower. This reduction would come mainly from the routes on which *Aeromexico* or Delta are present.

Table 7.13. Estimated passenger volume under the factual and counterfactual scenarios

	Volume with conditioned concentration	Volume with unconditioned concentration	Change in the Volume of Passengers in 2018
Routes with Delta or *Aeromexico* present	10,463,923	9,894,337	- 569,587
Routes without Delta or *Aeromexico* present	5,586,141	5,574,117	- 12,024
Total	**16,050,065**	**15,468,454**	**- 581,611**

As previously mentioned, there is no public information on prices by route, so to determine the effect on the percentage change in price, the literature that estimates price elasticities of demand in the passenger air transport market is reviewed. For example, Brons et al. (2002) review 37 papers that report 204 price elasticities of demand for air transport whose values range from -3.20 to 0.21, with an average price elasticity of -1.146 and standard deviation of 0.619. In addition, Escañuela (2018) reports that the distance on the routes influences the price elasticity of demand for the case of the United States; in particular, it points out that routes with itineraries greater than 1,500 miles have a demand that is price elastic and for routes with intermediate itineraries (between 500 and 1,500 miles), their demand is inelastic; likewise, it estimates a price elasticity of demand for the domestic market of -1.11. Similarly, Symth and Pearce (2008) provide five different elasticities, depending on the level of scope of the market analyzed: 1) at the class level (economy or first), 2) airline level, 3) route/market level, 4) national level, and 5) supranational level. These authors point to the region formed by the United States and Canada as the reference market since it is a well-established market with a demand with unit price elasticity. Latin America is assigned a price elasticity of -1.25. Table 7.14 presents the estimates of elasticity reported by these authors for the United States and Canada region and for Latin America at different levels of aggregation and flight duration. It is observed that the greater the aggregation or the longer the duration of the flight, the less elastic the demand becomes.

Table 7.14. Price elasticities of demand for passenger air transport

	Route/Market		National		Supranational	
Region	**Short**	**Long**	**Short**	**Long**	**Short**	**Long**
United States and Canada	- 1.5	- 1.4	- 0.9	- 0.8	- 0.7	- 0.6
Latin America	- 1.9	- 1.8	- 1.1	- 1.0	- 0.8	- 0.8

Fuente: Smyth y Pearce (2008).

According to the values reported by Smyth and Pearce (2008), the average price elasticity between these two regions is -1,125, which generates a value very similar to that reported by the works of Brons et al. (2002) and Escañuela (2018). In this way, the strategy to assign values to the elasticity is through the simple average of the elasticities reported at each level of Table 7.14 for both regions, for which three scenarios are constructed for the calculation of the impact on welfare, according to the elasticities reported in Table 7.15.

Table 7.15. Demand price elasticities used for the calculation of welfare

Route/Market	National	Supranational
- 1.650	- 0.950	- 0.725

Source: Own elaboration based on information from Smyth and Pearce (2008).

The percentage change in price is obtained from the price elasticity formula. Table 7.16 shows that, if the concentration had not been conditioned, prices would have increased between 2.20% and 5.00%, depending on the level of aggregation used to calculate the price elasticity of demand.

Table 7.16. Estimation of the percentage change in price

	Route/Market	National	Supranational
$\Delta\% \, Q$	- 3.624		
Elasticity	- 1.650	- 0.950	- 0.725
$\Delta\% \, P$	2.196	3.814	4.998

To calculate the impact on welfare it is necessary to have an estimated price for 2018 of the observed situation (conditioned concentration). For this, the public information of Annex A of the resolution of the file CNT-050-2015 is considered and it is assumed to be information from 2014. On page 5 of that annex, it is noted that the average price per km in dollars is 0.094 and the average distance of flights is 2,447.4 kilometers. In this way, the average price of a round ticket in 2014 is 230.06 dollars, or 3,059.80 pesos[114], so it is inferred that the price of a single trip in 2014 is 115.03 dollars (1,529.90 pesos). To estimate the price of a single trip between Mexico and the United States in 2018, the evolution of the price indices of air transport fares from or to Latin America and the Caribbean published by the U.S. Bureau of Labor Statistics is observed.[115] According to this information, between 2014 and 2018, fares were reduced, on average, by 11.9%, so the estimated dollar price of a single trip in 2018 is 101.34, or 1,949.81 pesos. Table 7.17 shows what the estimated price would be in the scenario where the concentration would not have been conditioned, given the elasticities at each level of aggregation, as well as the amount by which the cost of single flights would have increased.

Table 7.17. Price calculation in the counterfactual scenario

	Route/Market	National	Supranational
Elasticity	- 1.650	- 0.950	- 0.725
P without intervention	1,992.63	2,024.18	2,047.27
ΔP	42.82	74.37	97.46

According to the document “Methodology for the elaboration of ex-post assessments of COFECE interventions” issued by this Commission, the impact on the welfare of COFECE’s intervention is measured on two components of the consumer surplus in the relevant market: 1) the impact of overpricing and 2) the impact of unrealized demand. Assuming linear demands, for the first component, the variation caused on the price of cross-border flights between Mexico and the United States must be calculated and multiplied by the number of passengers that would have

114. According to the website of the Bank of Mexico, the average daily exchange rate for 2014 is 13.30, and for 2018, 19.24.

115. The indices considered are Import Price Index (Balance of Payments): Air Passenger Fares for Latin America/ Caribbean and Export Price Index (Balance of Payments): Air Passenger Fares for Latin America/Caribbean. Both are obtained from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series.

been transported if the concentration had not been objected to. Component 2 is obtained by multiplying the absolute value of the change in the volume of passengers in 2018 presented in Table 7.13 by the variation in price by 0.5. The impact estimate is presented in Table 7.18, where it is observed that its quantification is estimated at just under 675 million pesos if the estimate of price elasticity is used at the route or market level, and can reach just over 1,535 million pesos, if the level of aggregation is supranational.

Table 7.18. Estimation of the impact on welfare

	Route/Market	National	Supranational
Component 1 ($\Delta P * Q$ *without intervention*)	\$ 662,385,894.44	\$ 1,150,459,711.40	\$ 1,507,498,932.18
Component 2 ($\Delta Q * \Delta P * 0.5$)	\$ 12,452,793.36	\$ 21,628,535.83	\$ 28,340,840.06
Monetary impact of the intervention	674,838,687.80	1,172,088,247.23	1,535,839,772.23

In Table 7.18, it is observed that component 1, that is, having avoided the overprice, represents 98.2% of the monetary impact of having conditioned the concentration between *Aeromexico* and Delta. On the other hand, in order to measure the monetary impact of the intervention of COFECE in the cross-border air transport market between Mexico and the United States, it is compared with the total value of flights made in 2014 and with the annual budget of COFECE in 2018.

Table 7.19. Comparison of the monetary impact of the intervention

	Route/Market	National	Supranational
Monetary impact of the intervention	\$ 674,838,687.80	\$ 1,172,088,247.23	\$ 1,535,839,772.23
Relative to the market value in 2014	0.026	0.046	0.060
Relative to COFECE's budget in 2018	1.09	1.90	2.48

Table 7.19 shows that the monetary impact of the intervention of COFECE in authorizing the concentration between *Aeromexico* and Delta subject to certain conditions represents between 2.6% and 6.0% of the market value prior to these airlines being associated. It should be noted that in the routes considered for this assessment, 16,670,572 passengers

were transported in 2014, which generates a market with a value of $25,504,308,102.80.[116] Similarly, given that COFECE's annual budget in 2018 is $618,149,978, it is observed that the impact of the intervention represents between 1.09 and 2.48 times the budget of this commission.[117] This impact is higher than that estimated in the ex-ante assessment carried out on the occasion of the first concentration application, which estimated an equivalence of 62% of the budget of COFECE in 2016.

7.9. Conclusions

In May 2015, *Aeromexico* and Delta began a concentration process requesting its authorization from COFECE and in November 2016 they decided to expand their alliance, so they made a second application to that body. In both cases, the economic competition authority objected to the concentration as originally notified and allowed it subject to the fulfilment of conditions.

This research analyzes the passenger air transport market between Mexico and the United States. It is observed that between 2013 and 2018, the volume of passengers has grown at an average annual rate of 8%, while for 2018 it exceeds 30 million single trips; in addition, the five main airlines transport more than 70% of passengers. It is also observed that this market presents a large number of changes in the routes offered, so that airlines constantly make adjustments to their scheduling and logistics process.

A theoretical model of competition type Stackelberg is developed in three stages in which the companies that are first followers merge. Based on this model it is easy to notice that the effects of the unconditioned concentration between *Aeromexico* and Delta on price and quantity move in opposite directions and if the efficienciy gains resulted from the effect of the network created by the association between these companies are small, then it would generate increases in price and reductions in market size. This result justifies the intervention of COFECE by objecting to the concentration as originally notified and subjecting its authorization to fulfilment of conditions.

116. The regression model estimates a volume of passengers transported in 2014 of 11,186,379; so the estimated market value in that year would be $17,114,041,232.10.
117. The annual budget of COFECE is Annex 24.10 of the Budget of Expenditures of the Federation for Fiscal Year 2018 that was published in the Official Gazette of the Federation of November 29, 2017.

To carry out the ex-post assessment of the conditioned concentration, difference-in-differences methodology is used, where the treatment group is the routes where Delta or *Aeromexico* always participate, while the control group is composed of the routes where these airlines are never present. The intervention of COFECE is the objection to the concentration as originally notified and the authorization subject to the fulfillment of conditions, which occurs from period t. This methodology is applied to routes that have passengers transported every quarter of 2014 (pre-intervention) and all quarters of 2018 (post-intervention). These routes transport around 75% of passengers in the cross-border market. The results of applying this methodology show that the intervention of COFECE in authorizing the concentration between *Aeromexico* and Delta, subject to fulfilment of conditions, has the expected effect on the volume of passengers on routes between Mexico and the United States, since it increases it (if the HHI is used) or does not modify it (if the number of competitors present is used).

As for the impact on welfare, the counterfactual scenario (concentration without conditioning) is constructed and it is observed that if COFECE had not conditioned the concentration, the volume of passengers would have been 3.62% lower and prices would have increased between 2.20% and 5.00%. In this way, the monetary impact of the intervention of COFECE represents between 2.6% and 6.0% of the market value in 2014, before these airlines were associated. Alternatively, the impact represents between 1.09 and 2.48 times the budget of COFECE in 2018 and is higher than that calculated in the ex-ante assessment corresponding to the first concentration application.

This work contributes to the assessment of the decisions taken by COFECE regarding the passenger air transport market and finds benefits for consumers due to the intervention of this body. A future line of research to evaluate COFECE's actions could be the construction of scenarios associated with alternative decisions that could have been taken (for example, the non-authorization of the concentration) and evaluate whether the decision taken is the one that generates the greatest impact on welfare.

A limitation of the information used is that it does not take into account flights with a stopover.

7.10. Bibliography

Arcelus, A., Booth, R., Fix, A. M., Lehmann, J.-Y. K., Mantovanelli, F. G., & Pindyck, R. S. (2019). Scarcity, market power, and prices at slot-constrained airports. Journal of Transport Economics and Policy, 53, 119-134.

Brons, M., Pels, E., Nijkamp, P., & Rietveld, P. (2002). Price elasticities of demand for passenger air travel: a meta-analysis. Journal of Air Transport Management, 8, 165-175.

Carson, R. T., Cenesizoglu, T., & Parker, R. (2011). Forecasting (aggregate) demand for US commercial air travel. International Journal of Forecasting, 27, 923-941.

Escañuela Romana, I. (2018). La elasticidad precio de la demanda de transporte aéreo de pasajeros en los Estados Unidos. MPRA Paper(83572).

Jan van Garderen, K., & Shah, C. (2002). Exact Interpretation of dummy variables in semilogarithmic equations. Econometrics Journal, 5, 149-159. doi:10.1111/1368-423X.00078.

Kennedy, P. E. (1981). Estimation with correctly interpreted dummy variables in semilogarithmic equations. American Economic Review, 71, 801-801.

Kwoka, J., & Shumilkina, E. (2010). The price effect of eliminating potential competition: Evidence from an airline merger. The Journal of Industrial Economics, 58, 767-793.

Meyer, B. D. (1995). Natural and Quasi-Experiments in Economics. Journal of Business & Economic Statistics, 13, 151-161.

Smyth, M., & Pearce, B. (1995). Air Travel Demand. IATA Economics Briefing (9).

ASSESSMENT CONCLUDED IN 2019

8. Impact of a cartel in the Mexican market of sugar

Nicolas Melissas and Jaime Sempere[118]

8.1. Introduction

During the months of October, November, and December 2013 some producers and distributors of refined sugar agreed to artificially increase the price of sugar. That collusive agreement was detected by the Federal Economic Competition Commission (COFECE) and the companies involved had to pay a total fine of 88.8 million Mexican pesos.

This document calculates the harm caused by the cartel to the market. This harm will be identified as an indicator of the social benefit generated by COFECE when the practice ceased.

The sugar market in Mexico satisfies many of the structural conditions present in markets prone to collusion. Among these we highlight: Product homogeneity, excess capacity, reduced profits than in previous periods, concentrated markets, and barriers to entry.

To quantify the harm caused to the market, the counterfactual scenario was constructed, defined by the prices that would have prevailed in the absence of the cartel and by the units that would have been sold at these estimated prices. To estimate the prices that would have prevailed in the absence of the cartel, the information contained in the price series obtained from the National System of Information and Market Integration (SNIIM for its acronym in Spanish) of the Secretariat of Eco-

118. The authors appreciate the detailed comments of José Nery Pérez Trujillo, Erik David Velasco García, Jesús Balcázar Conde and other COFECE staff who read the preliminary version.

nomy (SE) and the estimation methodology based on Autoregressive Integrated Moving Average (ARIMA) models developed by Box and Jenkins were used. Several models were tested, and it was concluded that the one that provided the best statistical results is an ARIMA (1,1,0). To quantify the reduction in quantities resulting from the price increase caused by the cartel, a demand function was estimated. To calculate the demand, several instrumental supply variables were used, and it was concluded that the best estimates are obtained using as an instrumental variable the "weight of sucrose in the juice divided by the weight of sucrose in the cane".

To estimate the harm, the following were calculated: 1. the area of the rectangle defined by the difference between the prices that would have prevailed due to the cartel and counterfactuals multiplied by the quantities sold, and 2. the area of the triangle defined by the loss of consumer surplus due to the lower sales that occurred with respect to the counterfactual situation due to the price increase caused by the cartel. The sum of these two areas gives us the estimate of the loss due to the existence of the cartel.

The total estimated harm amounts to just over 215 million pesos. This harm is significant, especially considering that the cartel was active for just over a month and a week.

This harm is greater than that obtained by COFECE, which was of 106 million pesos, so the advantages of the intervention that we estimate are greater. The reasons for this discrepancy come from the fact that our estimate was made with the prices that took place in the next stage of the value chain that had a greater increase than those used by COFECE, that our counterfactual price had a greater fall than that considered by COFECE and that, in addition, we have considered the loss of efficiency derived from the quantities that stopped being consumed due to the price increase.

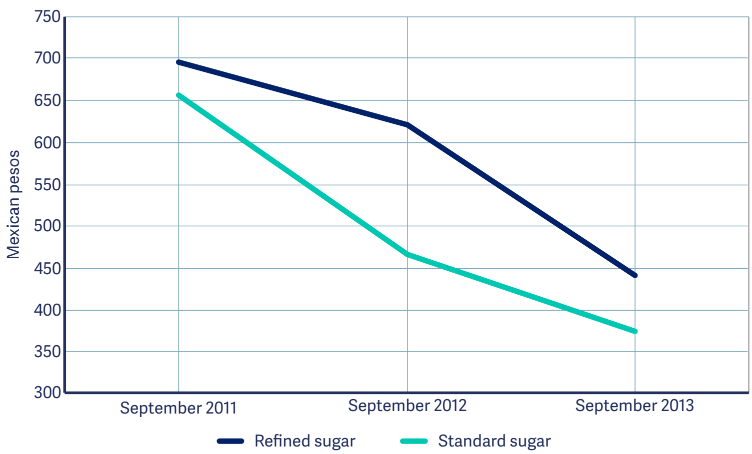
The document is structured as follows: Section 8.2 presents a description of the case. Section 8.3 describes the market where the practice took place. Section 8.4 highlights the elements of that market that make it more prone to collusive practices such as the one that occurred. Section 8.5 presents the proposed methodology for assessing harm from practice. Section 8.6 examines the information available for analysis. Section 8.7 estimates the models and presents the results. Section 8.8

presents the estimate of the impact of COFECE's intervention on welfare. Section 8.9 concludes the study. Three annexes present technical details of the study.

8.2. Description of the case

After a sequence of sugar price hikes between 2009 and 2011, several phenomena occurred in the 2012 to 2013 cycle that led to a reduction in the profits of sugar companies. On the one hand, the area harvested with sugarcane increased by nearly 10.9% and yields were privileged by favorable weather conditions. As a result, sugarcane production was 32.9% higher than in the previous cycle, implying an increase in production of 38.2% with respect to the previous cycle.[119]This situation occurs in a context of oversupply on the North American market. This led to a negative impact on prices that resulted in a drop in the profits of companies in the sector. The national average price of standard sugar went from 598.45 pesos per 50-kilo bag for the 2011-2012 sugar cycle to 400.8 pesos per bag, on average, for the 2012-2013 cycle. In fact, in the last month of that period, the price stood at 374.66 pesos. On the other hand, given the high levels of production, the expectation was that the decline would continue over time. Figure 8.1 illustrates evolution of prices.

Figure 8.1. Sugar prices at the end of the sugar cycle (50-kilo bag)



Source: SNIIM.

119. CONADESUCA data reported in the National Sugarcane Agroindustry Program, 2014-2018. See http://www.dof.gob.mx/nota_detalle_popup.php?codigo=5343244

In view of this situation, on October 29, 2013 a group of economic agents engaged in the production and commercialization of sugar agreed to raise the price of standard and refined sugar to 350 pesos per 50-kilogram package, counteracting the downward trend in the price. On the other hand, they also agreed to restrict the supply of these products to the main distributors and wholesalers. The latter because these companies, with their capacity to store the product for resale in times of greater scarcity, could hinder the effectiveness of the agreement. To reach the agreement, different competitors in the production and commercialization of sugar held meetings at the National Chamber of Sugar and Alcohol Industries (CNIAA, asper its acronym in Spanish) in order to manipulate the price of standard and refined sugar to prevent it from continuing to fall. The agreement was implemented through communications via email.

The CNIAA played a decisive role as a coadjutant. On the one hand, it facilitated the agreements by providing a meeting point for the companies, by convening an extraordinary meeting of the Executive Committee to agree on the actions to be implemented, as well as two more sessions to follow up. On the other hand, it facilitated the monitoring of compliance with the agreement through a mechanism known as "the sales table" (which went into operation on November 19, 2013) and that consisted of a physical place where representatives of the colluded companies met to commercialize the product individually to their customers. Through the table, the CNIAA and the participants were verified and informed about the offers that each company made to its clients, indicating the mill, type of sugar, volume sold, price and delivery conditions. The "sales table" operated *de facto* as a control and monitoring mechanism for compliance with the collusive agreement.

On December 11, 2013, COFECE initiated an ex officio investigation for the alleged commission of an absolute practice in the market for the production, distribution, and commercialization of sugar in the national territory. The investigation was initiated by the analysis of the average national wholesale sugar prices, as well as statements made by market participants regarding the price of sugar and the problem of overproduction in various newspaper articles. COFECE learned of the communications exchanged between directors and managers of the sugar groups involved, which revealed many of the details of the sanctioned agreements. As a result of the investigation, which included inspection visits, requests for information and appearances of different economic agents, COFECE determined that there were sufficient elements to prove the collusive practice. The Board of Commissioners of COFECE resolved to sanction 7 companies, 10 individuals and the CNIAA as coadjutant. The fines imposed for carrying out absolute monopolistic practices totaled 88.8 million pesos.

According to COFECE, the practice lasted forty-two days, between October 29 and December 9, 2013. On the other hand, the investigation reports that, although the companies failed to consolidate the target price of 350 pesos per 50-kilo package of sugar, evidence of an artificial increase in the price of around 6.21% during the term of the agreement was shown. On the other hand, the imposition of restricting supply generated a 2.3% reduction in demand. The harm estimated by COFECE was 106 million pesos (at 2016 prices). To calculate the overprice, COFECE based on information provided by the companies about the price before the collusive period and the average price that prevailed during that period.[120] The sale price of sugar companies is an intermediate price for which there is no public information.

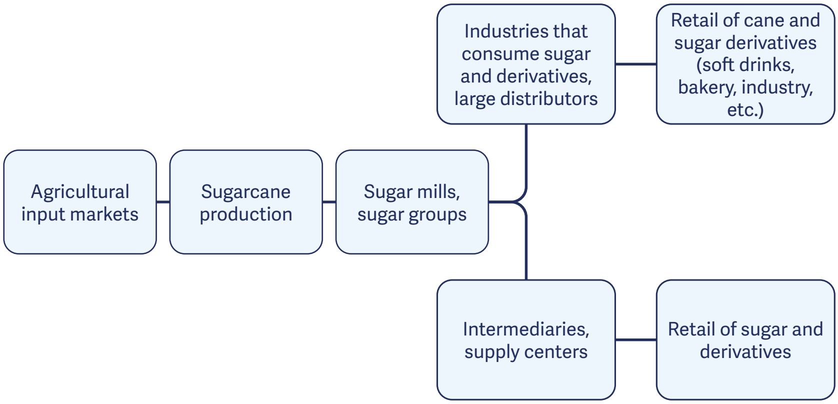
The case can be considered as a case of "naked" or evident collusion, and therefore, in view of the evidence presented by COFECE, it would not require further discussion.

8.3. Description of the studied market

The absolute practice that COFECE sanctioned occurred in one part of the sugar value chain. This chain includes the producers of cane and other inputs, the producing mills (which also produce other cane by-products, such as alcohol, and sell directly to companies that use sugar as an input and also to other agents), wholesale distributors, intermediaries (such as the entrepreneurs of the supply centers who sell to retailers and other companies that use sugar as an input), retailers and final consumers (who consume the product directly and through processed products, such as soft drinks and various types of pastries, among others.

120. This is a widely accepted methodology based on international standards.

Figure 8.2. Sugar value chain



In this value chain there are agents that cover various links. For example, all the large sugar groups have sugar mills and distribute sugar. Since the anti-competitive practice occurred in the production and distribution part, the study will focus on these links. However, the effect of the anticompetitive practice on the final consumer also depends on the structure and functioning of intermediary markets, producers using sugar as an input, and retail distribution. If the companies belonging to these links in the chain do not operate competitively, they will charge margins that will amplify the anticompetitive effects of the practice that occurred in the previous link.

8.3.1. Investigated Market

Sugar is a sweetener of natural origin, solid, crystallized, consisting essentially of loose crystals of sucrose, obtained from sugar cane or sugar beet by industrial processes. In Mexico, it is obtained mainly from cane and the cultivation of beet is marginal and has had other uses (among others, animal feed).

Cane has unrefined derivatives such as molasses, *panela* and muscovado sugar and refined derivatives, such as white and brown sugars. Its manufacturing process includes the transition from raw sugar[121],

121. The crystallized product obtained by boiling sugar cane or sugar beet juice , consisting essentially of loose sucrose crystals covered by a film of their original mother honey.

as the first step, to refined sugar[122] as the last. The main types produced in the country are special white (2%), refined (34%), raw (63%) and muscovado (1%).[123]

Although the case we are analyzing is an absolute practice and it is not necessary to define the relevant market[124], we can mention some resolutions of competition authorities in other parts of the world that do define it. The European Commission in several of its decisions on relative practices in the sugar market, such as Napier Brown-British Sugar[125] and Irish Sugar PLC[126], has defined the relevant market as white granulated sugar[127]. This same criterion is followed by the Spanish Competition Tribunal on its economic concentration file No. 31/98[128]. We do not know of more recent studies that carry out this type of analysis.

To adopt its criteria, in the files of the above-mentioned resolutions, the European Commission conducts a substitution analysis between different sugars (granulated sugar and special sugars, liquids and syrups) and between granulated sugar and other sweeteners (such as saccharin).

According to the analysis of the European Commission, special sugars, liquid sugars and sweetening syrups do not meet the same needs and are not substitutes for sugar from the consumer's point of view. On the other hand, glucose and fructose, which are derived from high-fructose corn syrups, have greater sweetening power than sucrose and are generally used as a complement and not as a substitute for sugar because they have different specific properties. Artificial sweeteners such as

122. The crystallized product consisting essentially of loose sucrose crystals obtained from the melting of raw or white sugars and by appropriate industrial processes.

123. See A. Santillan-Fernandez, L. R. Garcia-Chavez, N. Vasquez-Bautista, V. H. Santoyo-Cortes, M. Melgar-Morales,
W. Pereira, J. Larrahondo-Aguilar, A. Merino-Garcia A. (2017), "Impacto de la sustitución del azúcar de caña por edulcorantes de alta intensidad en Mexico"[Impact of the substitution of sugarcane by high-density sweetners in Mexico], Chapingo, State of Mexico. Mexico: Universidad Autónoma Chapingo.

124. In fact, COFECE does not define the relevant market in this case.

125. See 88/518/EEC: Commission Decision of 18 July 1988 relating to a proceeding under Article 86 of the EEC Treaty (Case No IV/30.178 Napier Brown - British Sugar) https://eur-lex.europa.eu/legal-content/EN/ TXT/?uri=CELEX%3A31988D0518

126. See Commission decision of 14 May 1997 relating to a proceeding pursuant to Article 86 of the EC Treaty (IV/34.621, 35.059/F-3 - Irish Sugar plc) https://eur-lex.europa.eu/eli/dec/1997/624/oj

127. It is defined as cooking sugar (which could include standard and refined sugar).

128. In which the merger of the companies Sociedad General Azucarera de España, S. A. and Ebro Agrícolas, Compañía de Alimentación S. A. is analyzed.

saccharin or aspartame are restricted in their use by industry to the manufacture of sugar-free products, whose commercialization is limited for dietary products. Isoglucose could compete in terms of sweetening qualities with liquid sugar. However, its widespread use by the entire food industry would require a substantial modification of the production techniques of this industry so that, although in theory it could be a good substitute for granulated sugar, in practice it is not. The conclusion of the analysis of the European Commission in its files is that the relevant product market is granulated sugar. In Mexico we could make a similar reasoning to conclude that the relevant market is standard and refined sugar, although, for the analysis elaborated in this document, it is not required to define the relevant market.

Retail distribution is done in one-kilo packages and wholesale distribution is done in 50-kilo packages. Differences in packaging, distribution and consumer profile generally lead to different prices and, therefore, could be considered different products. However, the public price data available to us are the prices at the supply central for 50-kilogram packages, so we will not distinguish between these markets.

Although, as we will see later, Mexican foreign trade in sugar is relevant, studies by competition authorities in other countries (see Spanish Competition Tribunal, Economic Concentration File No. 31/98[129]) would imply that transportation costs are important in relation to the value of the product. The SNIIM database indicates that there are different prices in different supply centers in the country, which would indicate that, if we were to define the relevant market, it would probably have a smaller geographic dimension than national.

8.3.2. Barriers to entry

An absolute practice would not be effective if supply substitution is high. To evaluate supply substitution, we consider companies that do not currently offer the product but that, in the event of a price increase, could easily offer it without incurring high costs. For this purpose, it is very important to determine if there are barriers to entry.

129. In this file, sugar transport costs are calculated per kilogram within Spain and from other European countries to Spain, concluding that the relevant geographic market is the national one.

A barrier to entry may be the need for high investment in advertising. However, this does not seem to be the case in this industry as the manufactured product is considered homogeneous, especially at the intermediate link level in the value chain.

Another type of barrier to entry may be the requirement of a high initial investment. To enter the sugar production market, a sugar mill is required. Since the investment in a mill is specific to produce sugar, as an indicator of barrier to entry we can take the cost of acquiring a mill. In 2015 the Mexican government put several sugar mills up for sale by public auction and there is public information provided by the Service for Administration and Alienation of Assets (SAE for its acronym in Spanish) about the sale values.[130] The San Luis Plan, located in Ciudad Valles, San Luis Potosí, was awarded to Promotora Industrial Azucarera S.A. de C.V. for an amount of one thousand 653 million pesos. The El Modelo mill, located in Ciudad Cardel, Veracruz, was sold to the company Ingenio San Sebastián S.A. de C.V. for an amount of one thousand 165 million pesos.

Consequently, acquiring a sugar mill requires high investments and this can act as a barrier to entry to the market.

8.3.3. Market concentration

We are not aware of public data that allow us to construct reliable concentration indicators. For example, to calculate the HHI we need the market shares held by each of the sugar producers, and this information is not publicly available. The only information that is available is what we find on the websites of several of the sugar groups (which may own several mills). On the other hand, this information is only available for a moment in time so a dynamic analysis cannot be done. The available information and the type of market (it is not one characterized by disruptive innovations) can give us a rough idea about the concentration that exists in that market that is sufficient for the purposes of this study.[131]

130. See SAE website http://www.sae.gob.mx/es/POT/Resoluciones/2016/Documents/Resoluci%C3%B3n%20CT%2021-17.pdf

131. If we were analyzing a concentration it is necessary to have fully reliable concentration indicators because the decision to authorize it can be based on changes in the concentration in the market.

The references consulted indicate that there are 51 sugar mills in the Republic. Veracruz has 18 sugar mills, followed by Jalisco with 6 and San Luis Potosí with 4.[132] The National Committee for the Sustainable Development of Sugarcane (CONADESUCA, as per its acronym in Spanish) presents self-reported production by the mill. However, information obtained from the sugar groups would indicate that many of them own several mills. Since price and quantity decisions are made at the group level and not independently by the mills, the concentration that needs to be approximated to analyze whether the market is prone to collusion is at the sugar group level. The following table summarizes the market share of the large sugar groups.

Table 8.1. Market share of the five largest sugar groups in the sweeteners market

NAME OF THE COMPANY	Market share[133]
Beta San Miguel	13.08%
Zucarmex	10%
Grupo Piasa	10%
Grupo Porres	5.25%
Grupo Azucarero Mexicano (GAM)	8%

It can be seen that, together, the five largest sugar groups produce more than 40% of Mexico's annual production. According to the sources consulted, these five companies have just over 47% of the sugar mills in Mexico. A priori, we could say that the concentration is not high enough to prohibit a merger between these companies based on the concentration levels. However, the number of companies is not high enough, nor the market sufficiently deconcentrated, for an absolute practice to be ineffective.

132. See methodological note of the Center for Studies on Sustainable Rural Development and Food Sovereignty (Chamber of Deputies) http://www.cedrssa.gob.mx/files/b/9/87nota_precio_ca%C3%B1a.pdf

133. The data about the company Beta San Miguel comes from the website: http://www.bsm.com.mx/empresa.html (Accessed 4 August 2019). Data on Zucarmex and GAM come from the website Zafranet: https://www.zafranet. com/2019/04/estas-son-las-cinco-azucareras-mas-grandes-de-mexico/) Data on Grupo Piasa is from the website: https://grupopiasa.com/site/index.php/nuestra-empresa (Accessed 4 August 2019). That same website states that Grupo Piasa produces 35% of refined sugar in Mexico, ranking in the 2016-2017 harvest, as the first producer group of refined quality sugar in Mexico. The data about Grupo Porres is from the website: http://www.grupoporres.com.mx/Perfil_Corp.html (Accessed on August 4, 2019).

8.3.4. Foreign trade

Mexico is a net exporter of sugar in international markets. For example, for the period October 2017 to September 2018 sugar production was 6,009,220 tons, imports 126,000 and exports 1,494,798[134] and for the 2018/2019 cycle, from October to June production was 6,425,919 tons, imports 15,162 and exports 1,536,732[135].

8.4. Behavioral model of market participants

In the wholesale sugar production and distribution market, the product is perceived as homogeneous and, in these cases, competition usually occurs in prices, so we could model this market as a Bertrand oligopoly. However, since we are talking about markets based on agricultural inputs where there could be capacity restrictions (since production cannot be increased without limit in the relevant period), the type of competition to which we could refer is that of Bertrand-Edgeworth. In this type of market model, firms offer a homogeneous product (i.e. consumers want to buy from the seller who charges them less for the product) and compete on prices, but there is a limit to the output that companies can sell at a certain price. In this type of models, results can be produced qualitatively (not necessarily quantitatively) that reproduce those of a Cournot model.[136] The equilibria of Bertrand-Edgeworth models are generally in mixed strategies.[137] In order to estimate a structural model where competition occurs à la Bertrand-Edgeworth we would need data on the capabilities of each mill and about which mills belong to which group. Therefore, we are unable to make this estimate. On the other hand, an additional reason for not proposing a defined competition model is that, although it seems that Bertrand-Edgeworth is the most reasonable form of competition in this market, we would be imposing a theoretical structure on the data, and we do not have a way to prove that this way is, in fact, correct.

134. https://www.gob.mx/cms/uploads/attachment/file/348133/Balance_estimado_az_car_y_edulcorantes_ Ciclo_2017-18_julio.pdf
135. https://www.gob.mx/cms/uploads/attachment/file/478970/Balance_Az_car_junio_2019.pdf
136. See, for example, Vives X. (2001), Precios y Oligopolio [Prices and Oligopoly], Antoni Bosch editor, Madrid.
137. See, for example, Vives X. (2001), cited above.

In any case, the harm caused does not depend on the type of competition assumed (Cournot, Bertrand or Bertrand-Edgeworth), but on the anti-competitive pricing agreement. In the event that a pricing agreement is sustainable (the sustainability of a size K cartel would imply internal stability $\Pi^{ext}(K\text{-}1) \leq \Pi^{in}(K)$ and external stability $\Pi^{ext}(K) \geq \Pi^{in}(K+1)$, where $\Pi^{i}(j)$ are the profits of a company i where i may be internal *(in)* or external *(ext)* to the cartel and j is the size of the cartel), the economic theory[138] does not help to predict a certain price in the event that collusion occurs because there are generally a multiplicity of solutions that can sustain cooperation in repeated games.

In what follows we will focus on the structural characteristics of this market that make collusion viable.

Competition policy experts[139] cite certain structural elements that make collusion easier. Harrington (2015) classifies the conditions for collusive agreements as "participation condition", "stability condition" and "coordination condition".

8.4.1. Participation conditions

First, Harrington (2015) mentions the "participation conditions" that define the circumstances under which collusion is desirable for companies. These are the conditions that imply that the incremental benefit of colluding with others is high. Among these, it mentions the existence of homogeneous products with excess capacity, that the current profit is lower in relation to recent periods, that demand is decreasing (a fact that, with excess capacity, would imply very intense price competition). These conditions imply that free competition leads to low profits (or a perception that profits are low because there were times when they were higher) so firms have an incentive to agree. In the sugar market in Mexico several of the "participation conditions", à la Harrington are satisfied given that:

138. See, for example, Kaplow, L. and C. Shapiro (2007) "Antitrust" en Polinsky and Shavell, eds. Handbook of Law and Economics, Elsevier, 1077-1225

139. See, for example, Kaplow, L. and C. Shapiro (2007), cited above, and Harrington, J. (2015), "Thoughts on why certain markets are more susceptible to collusion and some policy suggestions for dealing with them", DAF/COMP/ GF(2015)8, background paper for the Global Forum on Competition, OECD, October 2015.

- **Product homogeneity.** The companies agreed on the selling price of sugar on an intermediate market. Sugar is a homogeneous product and companies that buy this product to sell it at retail or to transform it into other products do not differentiate between companies.
- **Excess capacity.** In the period in which the practice occurred, companies maintained high inventories so we could say that they had excess capacity for sale. This, coupled with product homogeneity, could lead to reduced prices and margins.
- **Lower profits than previous periods.** Between 2009 and 2011 there was a sequence of increases in the price of sugar that led to greater profits than those that prevailed in the cycle in which the cartel was carried out.

8.4.2. Stability conditions

Secondly, Harrington (2015) mentions the necessary conditions for the existence of a cartel or "stability conditions". These conditions can be internal or external to the cartel and depend on the balance between the profits of maintaining collusion and the profits of undoing the agreement. It is therefore important to consider the frequency of transactions (which define the discount rate). Also important are the conditions that make it easy to detect deviations from the agreement. Among them, Harrington refers the homogeneity of the product, the excess capacity maintained by companies and, in particular, the ease of detecting deviations, where the predictability of demand is very important. He also mentions external conditions and, by this, refers to the threat to the agreement by companies outside the cartel. Among these external conditions, he mentions that the cartel is sufficiently inclusive and that there are barriers to entry. On the other hand, if the market is not concentrated, the cartel's supply restriction would not impact prices. In the sugar market it is satisfied:

- **Frequency of the transactions.** Due to the characteristics of the product, transactions in the wholesale market are frequent. Therefore, the discount factor can be high, facilitating collusion.

- **Concentrated markets.** Five companies produce more than 40% of Mexico's annual production annually. These five companies have just over 47% of the sugar mills in Mexico.[140]
- **Barriers to entry.** Building or buying a sugar mill can lead to high investments that can constitute a barrier to entry into sugar manufacturing.[141]

8.4.3. Coordination conditions

Third, Harrington mentions the "coordination conditions" that determine when collusion is achievable. A condition that can be important is communication between companies and everything that facilitates reaching an agreement.

- **Exchange of information between companies.** The CNIAA facilitated the agreements by providing a meeting point for companies to exchange information.

8.4.4. Effects of the cartel on competition in the next link of the value chain

The final effects on consumer welfare will also depend on the conditions of competition in the next link in the value chain since the effect of collusion at the production-commercialization stage can be extended and even amplified if the next stage in the chain is also characterized by lack of competition or is prone to collusion. Regarding the behavior of the agents operating in the supply centers, there is no "hard" information that allows us to characterize their behavior. However, intuitively the following reasoning would show that, if a firm's costs rise by x% and if demand is linear, then firms should raise their prices by a proportion less than x%.

In what follows we assume that $Q=a-b \bullet P$, where a and b are positive numbers. This hypothesis could be justified by our data (see Annex 3).

Additionally, we will make the extreme assumption (which would imply the maximum margin) that the companies that sell sugar in the supply centrals act as a monopoly and that they set prices to maximize their profits (later we will assume, alternatively, that there is perfect competi-

140. See subsection "Market concentration" in section 8.3 and the reasoning presented there.
141. See subsection "Barriers to entry" in section 8.3.

tion between these companies). The sale price in the supply centrals is then calculated by solving the following maximization problem:

$$\max_{p} \pi = P \bullet Q(P) - c \bullet Q(P)$$

where π denotes profits and where C denotes the price of a 50 kg package purchased from the sugar cartel. From the implicit function theorem, we know that the change in the optimal price P^* derived from a change in cost c is equal to:

$$\frac{dP^*}{dc} - \frac{\frac{\partial \pi'}{\partial c}}{\frac{\partial \pi'}{\partial P}}$$

Multiplying both sides by c/P, we get:

$$\frac{dP^*}{dc} \bullet \frac{c}{P^*} = -\frac{\frac{\partial \pi'}{\partial c}}{\frac{\partial \pi'}{\partial P}} \bullet \frac{c}{P^*}$$

The left side of that latter equation represents the price elasticity P if cost c rises by 1%. Using the fact that $Q = a - b\,P$, it can be verified that

$$-\frac{\frac{\partial \pi'}{\partial c}}{\frac{\partial \pi'}{\partial P}} \bullet \frac{1}{2}$$

That last equation, together with the fact that $c < P^*$, shows that $\frac{dP^*}{dc} \bullet \frac{c}{P^*} > 1$; that is, if the cost rises by $x\%$, the sale price should rise less than $x\%$.

Suppose now that there is perfect competition between the companies in the different supply centrals. In the Resolution (page 195) it is mentioned that the cartel managed to increase the price of sugar from 19.55 pesos during the month of November 2013. If there is perfect competition between the different companies that operate in the supply centers, then they should also raise their prices of 19.55 pesos. Since $c < P$, this implies that the percentage change in price P is less than the percentage change in cost c.

Thus, at the two extremes (monopoly and perfect competition) the elasticity of price P with respect to cost c is less than one. However, it seems more reasonable to assume that competition between the companies that sell sugar in the supply plants lies between these two extremes. However, inequality $\frac{dP*}{dc} \cdot \frac{c}{P*} > 1$ will continue to be fulfilled if companies compete à la Cournot.

However, the data presented in section 8.6 indicate that the increase in wholesale sugar prices at the central supply was greater than the price increase at the front link in the value chain. This is a fact that deserves further investigation.

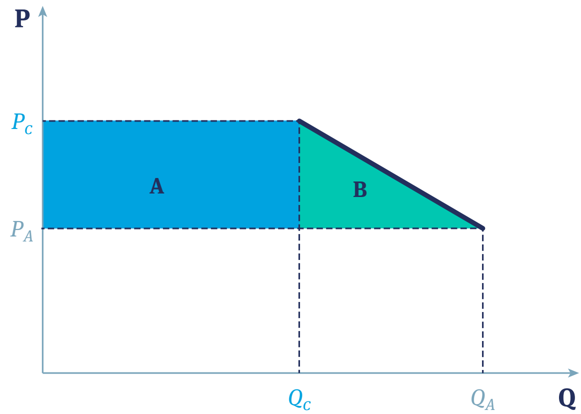
8.5. Methodology for welfare loss estimation

The evaluation of an absolute practice such as that described in the file requires assessing the counterfactual scenario that would have occurred if the practice had not taken place. Subsequently, the counterfactual scenario must be compared with the one that actually occurred during the period in which the practice lasted.

If the practice had not taken place, prices would have been lower. The practice caused a reduction in consumer surplus since consumers who continued to buy did so at a higher price and, in addition, there were consumers who stopped buying given the higher price.

To illustrate our methodology for calculating cartel harm, consider the following figure.

Figure 8.3. Estimated cartel harm



In the figure above:

- Q represents the sales volume (per ton) of standard sugar in a given month.
- P represents the monthly price per ton of sugar in a given month.
- Q_c represents the total volume sold during the month; this is, Q_c is an observed quantity. The subscript "*c*" denotes that it is the quantity sold during the operation of the cartel.
- P_c represents the price at which the sugar was sold during a certain month when the cartel was active.
- Q_A represents the quantity that would have been sold in the absence of the cartel.

As can be seen in Figure 8.3, the cartel succeeded in increasing the prices of P_A up to P_c. That increase in price reduced consumer surplus. The estimated harm of the cartel represents this decrease in consumer welfare and is calculated using the following formula:

$$\textit{Monthly harm from the sugar cartel} = (P_C - P_A) \bullet Q_C + \tfrac{1}{2} \bullet (P_C - P_A) \bullet (Q_A - Q_C)$$

The first term on the right-hand side of the previous equation represents a loss on the part of consumers. In practice, consumers bought Q_c tons of sugar at an overprice equal to $P_c - P_A$. Graphically, this term corresponds to area A in Figure 8.3. The second term represents a loss caused by the fact that, as a result of the price increase, some consumers stopped consuming sugar (or consumed less). Graphically, that term represents area B in Figure 8.3.

Therefore, to estimate harm, we have to answer the following two questions:

1. What prices would have prevailed in the absence of the cartel?
2. How many units would have been sold at these estimated prices?

This would define our counterfactual scenario. The previous section justifies the difficulty of estimating a structural model of oligopolistic behavior to estimate counterfactual prices and quantities. Therefore, to estimate the prices that would have prevailed in the absence of the cartel, we will use the information contained in the price time series obtained from the National System of Information and Market Integration (SNIIM) of the Ministry of Economy and we will use the estimation methodology developed by Box and Jenkins based on ARIMA models.[142] This methodology works relatively well for price estimation over short periods of time and is widely used.

To estimate the reduction of quantities resulting from the price increase caused by the cartel, we will have to estimate a demand function. The estimation methodology for this demand function shall be detailed in the subsection "Demand estimation" of section 8.7.

8.6. Analysis of the available information

For the empirical part, a database was built with the following variables:

- The wholesale price of a standard 50-kilogram package of sugar in several supply centrals in Mexico. The data for this variable comes from the SNIIM.[143] Data is weekly and ranges from October 2008 to July 2019. The price was multiplied by twenty to have it by tons.
- The wholesale price of a 50-kilogram package of refined sugar in several supply centrals in Mexico. The source of this data is the same as that of standard sugar.
- Monthly sugar consumption in Mexico *(Q)*. The data on this variable comes from the website datos.gob.mx,[144] these are monthly, and range from October 2008 to June 2019. Unfortunately, the data does

142. See Harvey, A. (1993), Time Series Models, MIT press.
143. See: http://www.economia-sniim.gob.mx/Sniim-anANT/e_SelAzu.asp
144. See: https://datos.gob.mx/busca/dataset/balance-nacional-de-azucar-y-edulcorantes

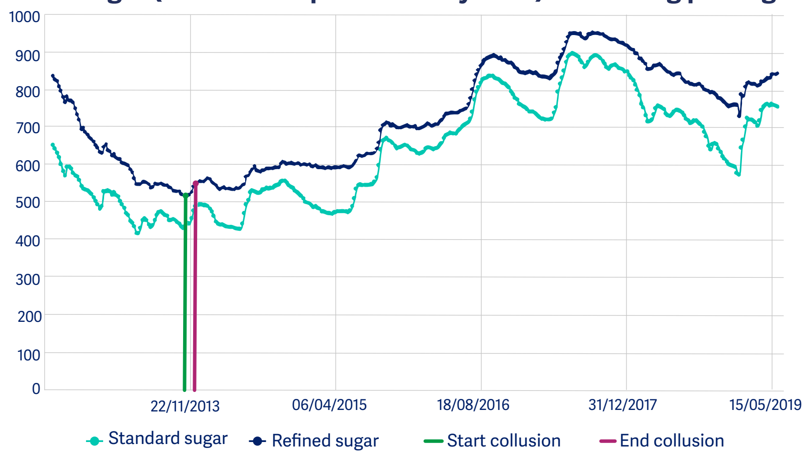
not always make a distinction between standard sugar and refined sugar. For the period August 2012-September 2014, the volume of both variables is reported. For the other months, however, only the sum of both volumes is reported.

- The Global Index of Economic Activity (IGAE, as per its Spanish acronym). These series come from INEGI.[145]
- Factory efficiency (EEF per its acronym in Spanish): This variable also comes from the website datos.gob.mx and measures the proportion of Pol (sucrose content) in sugar between Pol in cane.[146] The higher the quality of the cane (the higher the Pol in the cane), the lower the EEF variable. The data is monthly and ranges from October 2012 to May 2019. In the months of August, September and October there are no data on this variable, which is intuitive since sugar production is concentrated almost exclusively in the months of November-June of each harvest.
- PSJEPSC (as per its acronym in Spanish): Weight of sucrose in juice divided by the weight of sucrose in cane. This variable also comes from the website datos.gob.mx and measures the quality of sugarcane. The higher the quality of the cane (the greater the weight of sucrose in the cane), the lower the variable PSJEPSC. In the months without production there is no data on this variable.
- TP (as per its acronym in Spanish): Time lost in the factory. This variable measures the number of minutes lost in the factory due to failures in machinery at the time of grinding the cane. This variable also comes from CONADESUCA and in the months without production it takes the zero value.[147]

145. See: https://www.inegi.org.mx/temas/igae/
146. See: https://datos.gob.mx/busca/dataset/avance-de-la-produccion-de-cana-y-azucar-infocana/resource/343be4f8- 8d98-41e1-8a4c-00afd003b5d9?inner_span=True
147. The PSJEPSC and TP variables appear in the same Excel sheet as the EEF variable downloaded from the mentioned website in the footnote above.

The following figure represents the evolution of the real price of sugar:

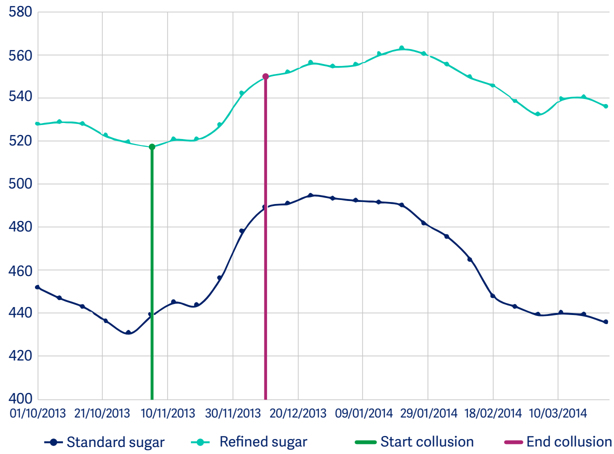
Figure 8.4. Evolution of the weekly prices of standard sugar and refined sugar (at constant prices of July 2018) for a 50-kg package



The turquoise line in the figure above represents the wholesale price of standard sugar and the blue line represents the wholesale price of refined sugar. Unsurprisingly, refined sugar is slightly more expensive than standard sugar. The first vertical line corresponds to the start date of the cartel. The second vertical line corresponds to the date of the end of the cartel. Before the cartel, prices were on a downward trend and there are indications that in the absence of the cartel this negative trend would have run its course.

It is important to highlight that prices did not fall immediately after the dismantling of the cartel. In fact, prices did not return to their pre-cartel level until early March 2014. This is somewhat better illustrated in the figure below:

Figure 8.5. Evolution of sugar prices before, during, and after the cartel. (Price per 50-kg package at constant prices of July 2018)

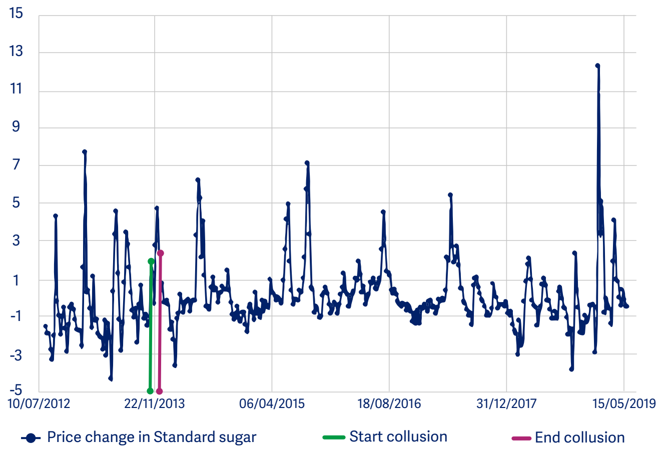


The figure illustrates that the effect of the cartel on wholesale prices lasted until early March 2014. The cartel succeeded to increase the price of standard sugar from 431 pesos in the last week of October to 489 pesos on the second Tuesday of December. The price thereafter remained at that level and only began to fall from the fourth week of January. The reduction in the price, however, was gradual: the price only fell below the barrier of 441 pesos (the average price in October 2013) from the first Tuesday of March. A similar behavior also applies to the price of refined sugar.

It seems intuitive to think that, in the absence of the cartel, prices in the months of December, January and February would also have been lower. In this document, however, we will not calculate any harm that may have existed in these months. That is, after the dismemberment of the cartel we assume that the observed prices are the result of competition between firms and that there is no longer any harm to the market. That hypothesis is consistent with our approach – explained in the section 8.5 – of estimating a lower bound on the harm caused by the cartel to the market.

The following figure represents the evolution of the percentage change in the price of standard sugar.

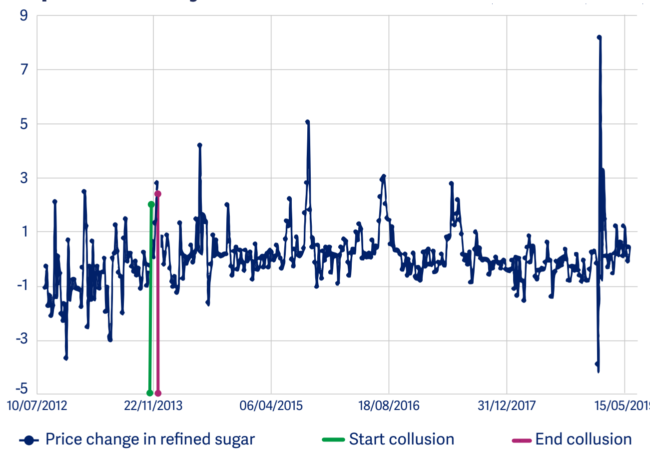
Figure 8.6. Weekly evolution of the percentage change in the price of standard sugar (August 2012—June 2019) per package of 50 kg (constant prices of July 2018)



The figure above shows the relatively high volatility of the price of standard sugar in the wholesale market. Excluding the weeks when the cartel was in force, our database has a record of 351 weeks. In 135 of them (38%) the absolute value of the percentage change is greater than one, which is high considering that it is a change in price from one week to the next. It can also be seen that in some weeks the price increases considerably: for example, in the last week of January 2019 the price increased by more than 12%, compared to the price that prevailed in the penultimate week.

The following figure shows the percentage changes in the wholesale price of the refined sugar price.

Figure 8.7. Weekly evolution of the percentage change in the price of refined sugar (August 2012—June 2019) per 50-kg package (constant prices of July 2018)



As expected, the evolution of the percentage change – from one week to the next – in the wholesale price of refined sugar is very similar to that of standard sugar. It can be observed, however, that the changes have a slightly smaller magnitude: the standard deviation of the percentage change is equal to 1.08% (in the previous case that standard deviation is equal to 1.76%) and in 22% of the weeks,[148] the absolute value of the change is greater than one.

8.7. Estimation of empirical models

As explained in section 8.5, to estimate harm, we need to answer the following two questions:

1. What prices would have prevailed in the absence of the cartel?
2. How many units would have been sold at these estimated prices?

In the next subsection we give an answer to the first question. In the "Demand Estimate" subsection of section 8.7 we estimate the quantities sold based on price.

148. Remember that in the case of standard sugar that percentage is equal to 38%.

8.7.1. Estimation of counterfactual prices

To estimate the prices that would have prevailed in the absence of the cartel, an autoregressive model was estimated for the two-price series. To illustrate our procedure, consider the evolution of the price of standard sugar illustrated in Figure 8.4. The dynamics of that series before the cartel are very different from the one that prevails after the dismemberment of the cartel. Before the cartel, prices had a downward trend, while after the cartel that trend was completely reversed. The same observation also applies to the price of refined sugar. Therefore, to estimate counterfactual prices, we work only with the price series that prevailed before the cartel. That series contains 65 observations – from the first week of August 2012 to the last week of October 2013. The procedure we follow consists of the following steps:

1. We calculate the DPEST variable that is defined as

   $$DPEST_t = Price\_standard\_sugar_t - Price\_standard\_sugar_{t-1}$$

   where $Price\_standard\_sugar_t$ represents the price for a 50 kg package of sugar in the weekt. Similarly, the variable *"DPREF"* is calculated which represents the difference between the price of refined sugar in this week compared to the previous week.

2. We ran a *DPEST* regression on a constant, a linear trend, and a quadratic trend. A Fisher test was performed that allowed us to accept the null hypothesis that the coefficients associated with the last two variables are jointly equal to zero; that is, the *DPEST* series is stationary. This test was repeated with the *DPREF* series and, also, we accept the null hypothesis that the *DPREF* series is stationary.

3. We ran a regression with $DPEST_t$ as an endogenous variable and with $DPEST_{t-1}$, $DPEST_{t-2}$, $DPEST_{t-3}$, $DPEST_{t-4}$ *y* $DPEST_{t-5}$ as explanatory variables. A Fisher test allows us to accept the null hypothesis that the coefficients of the variables $DPEST_{t-2}$, $DPEST_{t-3}$, $DPEST_{t-4}$ *y* $DPEST_{t-5}$ are, together, equal to zero. The coefficient associated with the variable $DPEST_{t-1}$, However, it is significantly different from zero. The following table summarizes the estimated model that will be used to estimate counterfactual prices for standard sugar.

Table 8.2. Results of an AR(1) model with DPEST as the endogenous variable[149]

Endogenous variable: *Price standard sugar$_t$ – Price standard sugar $_{t-1}$ (DPEST$_t$)*		
Explanatory variable	**Coefficient**	**P-Value**
DPESTt-1	0.4405	0
Constant	-1.8528	0.139

The coefficients in the table are measured in weights and remember that we work with the price of standard sugar for a package of 50 kg. The R^2 of the regression is equal to 19.5%.

Subsequently, a symmetrical procedure was performed, but with the price data for refined sugar. The entire procedure was repeated with the DPREF variable as an endogenous variable. A Fisher test allows us to accept the null hypothesis that the coefficients associated with the variables $DPREF_{t-1}$, $DPREF_{t-2}$, $DPREF_{t-3}$, $DPREF_{t-4}$ *and* $DPREF_{t-5}$, together, are equal to zero. In other words, no lagged change in prices of refined sugar serves to predict change in period *t*. In our regression the only significant "explanatory" variable is the constant whose value is summarized in our following table.

Table 8.3. Results of a regression with DPREF as an endogenous variable

Endogenous variable: *Price standard sugar$_t$ – Price standard sugar$_{t-1}$ (DPEST$_t$)*		
Explanatory variable	**Coefficient**	**P-Value**
Constant	-4.9359	0

Based on these two regressions we can calculate the prices for standard and refined sugar that would have prevailed in the month of November and in the first week of December 2013[150] in the absence of the cartel. The following table compares prices during the cartel and counterfactual prices for standard sugar.

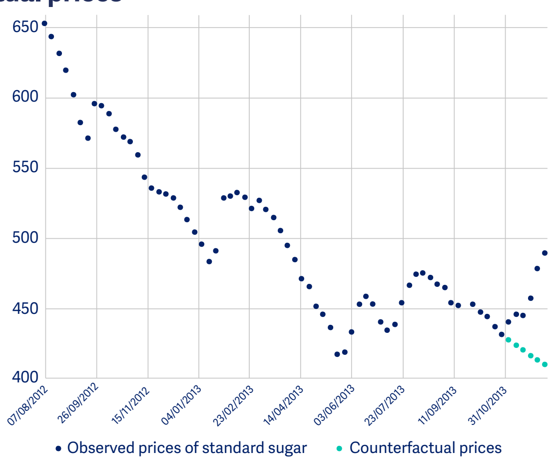
149. STATA does not allow us to estimate an ARIMA model(1,1,1). This model is estimated by means of non-linear least squares, and this technique requires estimating initial values of the parameters and then obtaining the final values by means of an algorithm. Unfortunately, there are not enough observations to estimate these initial values. Remember that we have only 65 observations which is too little to estimate this type of model. The model presented in this table is an ARIMA(1,1,0); that is, the part of the average mobile is omitted.
150. We decided to estimate autoregressive models using weekly data in order to also estimate the harm that the market had in the first week of December.

Table 8.4. Standard sugar prices during the cartel and counterfactual prices. (Price per 50-kg package at constant prices of July 2018)

Week	Weekly prices (pesos)	Counterfactual prices
Nov 2013 (1)	**439.11**	426.46
Nov 2013 (2)	**445.06**	422.7
Nov 2013 (3)	**443.7**	419.19
Nov 2013 (4)	**456.14**	415.79
Dic 2013 (1)	**477.78**	412.44
Dic 2013 (2)	**488.94**	409.12

We will use these prices to estimate harm in section 8.8. The following figure better illustrates the divergence between cartel prices and counterfactual prices.

Figure 8.8. Evolution of the price of standard sugar and counterfactual prices



Note: These are constant prices as of July 2018. The series runs from the first week of August 2012 to the second week of December 2013 and shows prices per package of 50kg.

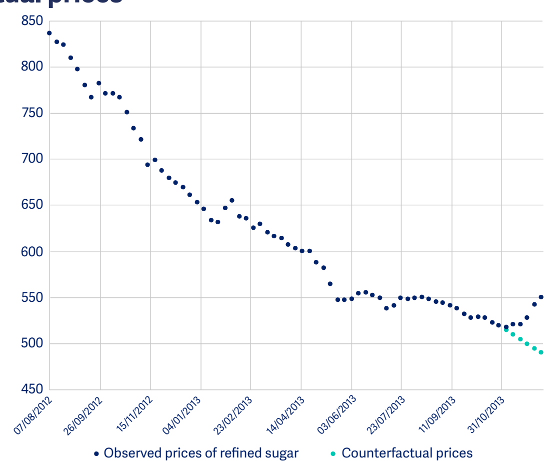
The following table is similar to the previous table except that it is about the prices of refined sugar.

Table 8.5. Prices of refined sugar during the cartel and counterfactual prices. (Price per 50-kg package at constant prices of July 2018)

Week	Weekly prices (pesos)	Counterfactual prices
Nov 2013 (1)	**517.62**	514.22
Nov 2013 (2)	**520.65**	509.29
Nov 2013 (3)	**520.64**	504.35
Nov 2013 (4)	**527.36**	499.41
Dic 2013 (1)	**542.01**	494.48
Dic 2013 (2)	**549.6**	489.54

The following figure illustrates the divergence between these two prices.

Figure 8.9. Evolution of the price of standard sugar and counterfactual prices



Note: At constant July 2018 prices. The series runs from the first week of August 2012 to the second week of December 2013 and shows prices per package of 50kg.

8.7.2. Demand estimation

Recall from our previous section that our database contains three variables that affect the production costs of sugar mills and that could serve as instrumental variables:

- Factory efficiency (*EEF*): Ratio of sucrose content (*Pol*) in sugar to *Pol* in cane. The higher the ratio, the higher the cane quality. One would expect that the higher the EEF, the lower the sugar price.
- *PSJEPSC*: Weight of sucrose in juice divided by the weight of sucrose in cane. That variable also measures the quality of sugarcane. It is expected that the higher the quality of cane (or the higher the weight of sucrose in cane), the lower the price of sugar.
- *TP*: Time lost in the factory. This variable measures the number of minutes lost in the factory due to failures in machinery at the time of grinding the cane. One would expect that, the more time lost, the higher the price of sugar.

There are only monthly data on total sugar sales; that is, the sum of the number of tons of standard sugar and refined sugar in a given month.[151] Therefore, in our estimation of demand, we do not distinguish between those two sugar variants.

Remember that we have weekly data on the price of standard sugar and the price of refined sugar for a 50-kg package. (This data is at constant prices of July 2018.) To calculate the variable P (monthly price of "sugar" per ton), the following procedure was followed:

- The market share of standard sugar was calculated: In the period August 2012 to September 2014, sales of standard sugar represented, on average, 77.4% of total sales.
- Using these data, the price of the good "sugar" in a certain week t was calculated using the following formula:

  $P_t = 0.774 \bullet \text{Price standard sugar}_t + 0.226 \bullet \text{Price refined sugar}_t$
- An average of P_t was calculated in each month and that average was multiplied by twenty to obtain the price of "sugar" per ton per month.

151. In the period August 2012-September 2014, however, we do have disaggregated data, but there is too little data to be able to use it.

Demand was estimated using a two-stage least squares estimation (see Annex 1 for more details on this methodology). In the first stage of this estimation, the *EEF* and *TP* variables were discarded as they were not significant. The variable *PSJEPSC*, however, had the correct sign and was highly significant (see Annex 2 for details). The following table summarizes the results of the demand estimation (for full results, see the second annex to this document):

Table 8.6. Estimation of demand for sugar

Endogenous variable: Demand (in tons)		
Explanatory variable	**Coefficient**	**P-Value**
Constant	-260,616	45.5%
P (in pesos)	-19.66	7.3%
IGAE	8,373	6.6%

The coefficients of the interest variables have the correct sign and are significant at 10%. It can be seen that an increase in the price of sugar of 100 pesos reduces the monthly demand of 1,966 tons.

The model we estimate assumes a linear relationship between quantities Q and price. In Annex 3, we defend that functional form and present a figure that shows that the relationship between the variables is quite linear and that demand should not be estimated by means of a log-log model.

The elasticity of demand ε is calculated using the following formula:

$$\varepsilon = \frac{\partial Q}{\partial P} \bullet \frac{P}{Q}$$

From the regression equation we know that $\frac{\partial Q}{\partial P} = 19.66$. The following table summarizes various elasticities of demand as a function of various prices.

Table 8.7. Elasticity of demand as a function of several values of the price *P*

Percentile	Price (per ton)	Estimated Q[152] (Tons)	ε
10%	9,686	399,436	-0.477
25%	11,231	369,061	-0.598
50%	14,989	295,179	-0.998
75%	16,485	265,767	-1.219
90%	18,202	232,011	-1.542

The above table reveals that in 10% of the observations, the price per ton is less than 9,686 pesos, in 25% of the observations, the price per ton is less than 11,231 pesos, and so on. The third column estimates quantities sold—in tons—based on our demand function. The fourth column calculates the elasticity based on the price P and the estimated quantities. It can be seen that the elasticity, evaluated in the median price (14,989 pesos), is almost unitary.

8.8. Estimation of the impact of the intervention on welfare

The following table summarizes the calculations needed to estimate the harm for standard sugar caused by the cartel:

Table 8.8. Estimation of the harm for standard sugar

Month	# Tuesday of the month	P (per ton)	Counterfactual price (per ton)	Q	Rectangle estimation	Counterfactual DQ	Triangle estimation
November	1	8,782	8,529	48,121	12,174,676	1,243	157,302
November	2	8,901	8,454	48,121	21,519,823	2,198	491,470
November	3	8,874	8,384	48,121	23,589,037	2,409	590,528
November	4	9,123	8,316	48,121	38,833,849	3,966	1,600,444
December	1	9,556	8,249	51,305	67,045,561	4,894	3,197,514
December	2	9,779	8,182	12,826	20,475,883	1,495	1,192,937
				Total	**183,638,828**		**7,230,196**

The calculation of harm is based on the following assumptions:

- The cartel began operating on October 29, 2013. We assume that the effect of the cartel on prices on the wholesale market was not felt before November; that is, there is no harm to the market on October 29, 30 and 31, 2013.

152. The estimated demand function is used to calculate these quantities. This demand function was calculated assuming that the variable $IGAE = 101.5739$, its average value.

- The third and fourth columns represent prices during the collusive phase and counterfactual prices respectively. Table 8.4 of this document shows these two series per 50kg package. These prices were multiplied by twenty to obtain their value in tons.
- The sale of standard sugar in the month of November 2013 was equal to 192,485 tons. We assume that these sales were made evenly during the month. Therefore, in the first week of the month 192,485/4 ≈ 48,121 tons were sold. This explains the amounts presented in the first four rows of column Q.
- The cartel ended on Monday, December 9. Therefore, there was a harm to the market on December 2, 3, 4, 5 and 6. This month had 21 working days and 269,352 tons were sold. Therefore, on average, 269,352/21 ≈ 12,826 tons per day were sold. The first Tuesday of this month was December 3 and the second on December 10. Note that there are three business days between Tuesday, December 3 and Friday, December 6 and only two business days between Friday, December 6 and Tuesday, December 10. The other days (2, 3, 4 and 5) are closer to Tuesday 3 than to Tuesday 10 December. Therefore, the price of Tuesday, December 3, is used as a reference for sales on December 2, 3, 4 and 5 (4 days). Note that 4 • 12,826 = 51,305 (this explains the amount presented in the fifth row of column Q). The December 10 price is used as a reference for Friday, December 6 sales.
- The "Rectangle estimation" column calculates the harm to the market due to the overprice paid by consumers who continued buying the product. To be more precise, the harm in week t is calculated as:

$$\textit{Harm in week}_t = (\textit{Price in week}_t - \textit{Contrafactual price}_t) \bullet Q_t$$

- The column "Counterfactual DQ" calculates the additional quantities that would have been sold in the absence of the cartel. Remember from our previous subsection that, ceteris paribus, if the price rises by one peso, 19.66 tons less of standard sugar are sold. Therefore, the first row of the "Counterfactual DQ" column is calculated as follows:

$$19.66 \bullet (8{,}782 - 8{,}529) \bullet 0.25 \approx 1{,}243 \textit{ tons}$$

The term 0.25 is assumed given that the increase in price was maintained only during the first week of November.

- The column "Triangle estimate" calculates the harm to the market caused by total or partial loss in consumption of standard sugar during the collusive phase. The first row of this column is calculated as follows:

$$(8{,}782 - 8{,}529) \bullet 1{,}243 \bullet 0.5 = 157{,}302 \text{ pesos}$$

The following table analyzes the case of refined sugar.

Table 8.9. Estimation of the harm for refined sugar

Month	# Tuesday of the month	*P* (per ton)	Counterfactual price (per ton)	*Q*	Rectangle estimation	Counterfactual *DQ*	Triangle estimation
November	1	10,352	10,284	2,281	155,232	335	11,384
November	2	10,413	10,186	2,281	518,018	1,116	126,470
November	3	10,413	10,087	2,281	743,252	1,602	260,982
November	4	10,547	9,988	2,281	1,274,947	2,748	767,932
December	1	10,840	9,890	14,378	13,666,918	3,560	1,691,781
December	2	10,992	9,791	3,594	4,317,382	1,124	675,311
				Total	**20,675,749**		**3,534,163**

The methodology for calculating the numbers shown in the table above is identical to that used for standard sugar. The following table summarizes the four estimated harms in that subsection.

Table 8.10. Summary of the different harms to the market

	Rectangle estimation (pesos)	Triangle estimation (pesos)	Total harm (pesos)
Standard sugar	183,638,828	7,230,196	190,869,024
Azúcar refinado	20,675,749	3,534,163	24,209,913
		Total	215,078,936

According to our estimations, the cartel caused harm equal to 215 million 78 thousand 936 Mexican pesos. This harm is considerable, given that the cartel operated for a little more than a month and a week.

8.9. Conclusions

This document estimates the harm caused to the market by the operation of a cartel on the market of production and distribution of sugar. Harm was calculated as the loss in consumer surplus resulting from the higher market price and fewer quantities being sold than if the cartel had not operated. To calculate harm caused to the consumer, we estimate a counterfactual scenario defined by the prices that would have prevailed in the absence of the cartel and by the units that had been sold at those estimated prices.

The total estimated harm amounts to just over 215 million pesos. This harm is much greater than that obtained by COFECE, which was 106 million pesos, so the advantages of its intervention in ending the cartel were greater in our estimation.

There are two reasons for this discrepancy:

1. Our estimation was made with the prices that took place in the next stage of the value chain, and the price increase registered in supply centers (up to 13.5% in standard sugar) was much greater than the price increase recorded in the resolution of COFECE (6.21%). In our opinion, this fact deserves to be analyzed in more detail because it is not easily supported by economic theory.
2. The first week of December 2013 was included in our calculations. In this week there is a big difference between the observed prices and the counterfactual prices causing great harm to the market. This week was excluded by COFECE in the resolution.

8.10. Bibliography

CEDRSSA. (2019). Determinación del precio de la caña de azúcar al productor. [Determination of the price of sugarcane to the producer] Obtained from: http://www.cedrssa.gob.mx/files/b/9/87nota_precio_ca%C3%B1a.pdf

CONADESUCA. (2019). Balance Nacional de Azúcar [National Balance of Sugar], June 2019. Obtained from http://www.cniaa.mx/Politica

CONADESUCA. (2018). Balance nacional de azúcar Ciclo 2017/2018 [National Balance of Sugar 2017/2018 Cycle]. Obtained from https://www.gob.mx/cms/uploads/attachment/file/348133/Balance_estimado_az_car_y_edulcorantes_Ciclo_2017-18_julio.pdf

Greene, W. H. (2018). Econometric analysis. Prentice Hall.

Kaplow, L., & Shapiro, C. (2007). Antitrust. In A. M. Polinsky, & S. Shavell, Handbook of law and economics. Elsevier.

Santillán Fernández, A., García Chávez, L., Vásquez Bautista, N., Santoyo Cortés, V., Melgar Morales, M., Pereira, W., Merino García, A. (2017). "Impacto de la sustitución del azúcar de caña por edulcorantes de alta intensidad en Mexico."[Impact of the substitution of cane sugar by high-density sweetners in Mexico] Universidad Autónoma Chapingo.

The Comission of the European Communities. (1988). Commission Decision of 18 July 1988 relating to a proceeding under Article 86 of the EEC Treaty (Case No IV/30.178 Napier Brown — British Sugar).

The Comission of the European Communities. (1988). Commission Decision of 14 May 1997 relating to a proceeding pursuant to Article 86 of the EC Treaty (IV/34.621, 35.059/F-3 - Irish Sugar plc).

Vives, X. (2001). Precios y Oligopólio: ideas clásicas y herramientas modernas. [Prices and Oligopoly: classical ideas and modern tolos] Antoni Bosch editor.

APPENDIX 1. METHODOLOGICAL NOTE ON OUR ESTIMATE OF SUGAR DEMAND

To estimate a demand curve, one can simply estimate a variant of the following least squares equation:

$$Q_t = \alpha_0 + \alpha_1 \bullet P_t + \alpha_2 \bullet Y_t + u_t \tag{1}$$

where:

- Q_t represents the quantities sold in the month *t*.
- P_t represents the price of the good in the month *t*.
- Y_t is a variable that displaces the demand curve. In the literature, that variable is called a *demand-shifter*.
- u_t represents an-error term.

Equation *(1)* cannot be estimated by least ordinary squares since the price P_t depends on the quantities that are contributed to the market; that is, the variable P_t is endogenous.

It can be shown (see Greene, 2018[153], for more details) that, to estimate demand, an *instrumental* variable or *cost-shifters* that affects supply without affecting demand is needed.

In the presence of a good instrumental variable, the demand curve is estimated by means of a two-stage least squares estimation. This technique consists of sequentially estimating two equations of regressions by means of least squares. First, the following equation is estimated:

$$P_t = \alpha_0 + \alpha_1 \bullet VINST_t + \alpha_2 \bullet Y_t + u_t$$

where:

- P_t represents the price in the montht.
- α_t represents a constant.

153. Greene, W. (2018), Econometric Analysis, Prentice Hall.

$VINST_t$ Represents the instrumental variable in month t. This is a variable that captures changes in price caused by changes in the supply curve.

Y_t represents the monthly growth of Mexican GDP at the national level in the montht.

u_t represents the error term.

Second, the variable "*Pfit*" is calculated, defined as:

$$Pfit = \hat{\alpha}_0 + \hat{\alpha}_1 \bullet VINST_t + \hat{\alpha}_2 \bullet Y_t$$

where $\hat{\alpha}_0$, $\hat{\alpha}_1$ and $\hat{\alpha}_2$ represent respectively the estimates of the α_0, α_1 and α_2 coefficients.

Third, the following regression is run:

$$Q_t = \beta_0 + \beta_1 \bullet Pfit_t + \beta_2 \bullet Y_t + \varepsilon_t$$

That is, the procedure consists of changing the endogenous variable P by the variable *Pfit*. $\hat{\beta}_1$ from that last regression gives us a consistent estimate of the slope of demand.

It is important to mention that equation 1 does not incorporate the price of any substitute or complement. Suppose that instead of estimating equation *(1)*, we want to estimate the following model:

$$Q_t = \alpha_0 + \alpha_1 \bullet P_t + \alpha_2 \bullet Y_t + \alpha_3 \bullet PS_t + u_t \qquad (2)$$

where:

PS_t represents the price of some substitute in the month t.

To obtain consistent parameter estimators α_0, α_1, α_2 and α_3 we have also to estimate equation *(2)* by means of least squares in two stages. There is, however, a subtle difference between the instrumental variable needed to estimate equation *(1)* and the one needed to estimate the second equation. In our last equation, it is necessary to work with a variable that affects the costs of the good under study without that variable affecting the demand for the good and *without that variable affecting the costs of the substitute good*. Unfortunately, it is difficult to find such an instrumental variable. The second reason that makes this estimation difficult, even if we found the required instrumental variables, is that there are no wholesale price data for aspartame, sucralose, saccharin or acesulfame K, which would be the most common substitutes for sugar.

APPENDIX 2.
STATA RESULTS

Next, we present the results of the regression with the price as the endogenous variable and with our three instrumental variables and the IGAE as explanatory variables.

```
. regress p eef psjepsc tp igae
      Source |       SS       df       MS              Number of obs =      63
-------------+------------------------------           F(  4,    58) =   30.64
       Model |  322596699     4  80649174.9           Prob > F      =  0.0000
    Residual |  152652907    58  2631946.68           R-squared     =  0.6788
-------------+------------------------------           Adj R-squared =  0.6566
       Total |  475249607    62  7665316.24           Root MSE      =  1622.3

------------------------------------------------------------------------------
           p |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         eef |   2.166399   22.48733     0.10   0.924    -42.84689    47.17969
     psjepsc |    79.2674     26.957     2.94   0.005     25.30711    133.2277
          tp |    .001801   .0028991     0.62   0.537    -.0040023    .0076042
        igae |   397.7112   40.47457     9.83   0.000     316.6925    478.7298
       _cons |  -36549.86   4714.998    -7.75   0.000    -45987.96   -27111.77
```

It can be observed that:

- The instrumental variable *EEF* has the expected sign (the lower the quality of the cane, the higher the value of the *EEF* variable and the higher the price *P*) but it is not significant (the *P*-value of the coefficient is equal to 92.4%).
- The variable *PSJEPSC* has the correct sign: the higher the weight of sucrose in the cane, the lower the value of the variable *PSJEPSC* and the lower the price *P*. (The coefficient is significant at 1%.)
- The variable *TP* also has the correct sign: the greater the failures of machinery during the grinding of the cane, the higher the price *P*. The coefficient, however, is not significant (the *P*-value of the coefficient is equal to 53.7%).
- With these results, it was decided to work only with the *PSJEPSC* variable as an instrumental variable. Below, we present the results of the first stage of the estimation:

```
. regress p psjepsc igae
      Source |       SS       df       MS              Number of obs =      63
-------------+------------------------------           F(  2,    60) =   62.76
       Model |   321551838     2   160775919           Prob > F      =  0.0000
    Residual |   153697769    60  2561629.48           R-squared     =  0.6766
-------------+------------------------------           Adj R-squared =  0.6658
       Total |   475249607    62  7665316.24           Root MSE      =  1600.5

------------------------------------------------------------------------------
           p |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     psjepsc |   82.69358   21.51571     3.84   0.000     39.65574    125.7314
        igae |   391.7292   36.97292    10.60   0.000     317.7723     465.686
       _cons |  -35822.95   4415.062    -8.11   0.000    -44654.39   -26991.51
------------------------------------------------------------------------------
. predict pfit
(option xb assumed; fitted values)
(65 missing values generated)
```

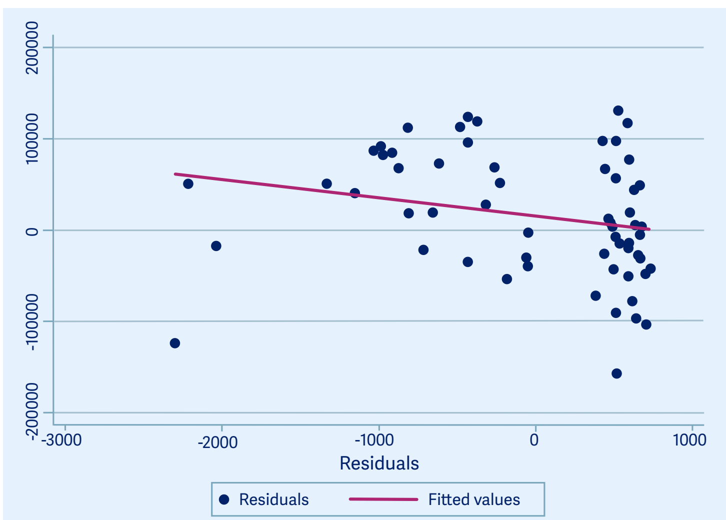
Next, we present the results of the second stage of the estimation:

```
. regress q pfit igae

      Source |       SS       df       MS              Number of obs =      63
-------------+------------------------------           F(  2,    60) =    1.77
       Model |  1.5608e+10     2  7.8042e+09           Prob > F      =  0.1787
    Residual |  2.6419e+11    60  4.4031e+09           R-squared     =  0.0558
-------------+------------------------------           Adj R-squared =  0.0243
       Total |  2.7980e+11    62  4.5128e+09           Root MSE      =   66356

------------------------------------------------------------------------------
           q |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pfit |  -19.65875   10.78713    -1.82   0.073    -41.23622    1.918719
        igae |   8372.641   4467.646     1.87   0.066    -563.9817    17309.26
       _cons |  -260615.6   346592.6    -0.75   0.455      -953904    432672.8
------------------------------------------------------------------------------
```

APPENDIX 3.
FUNCTIONAL FORM OF THE DEMAND FUNCTION

The following figure presents the functional form between the variables *Q* (apparent national consumption) and *PFIT*.

The *X* axis represents variations in *PFIT* that cannot be explained by variations in the global index of economic activity. The *Y* axis represents variations in *Q* that cannot be explained by variations in the *IGAE* variable either. As can be seen in the figure, the relationship between the variables *Q* and *PFIT* does not seem to be convex.



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