Market Power and Social Welfare

Competition Advocacy Studies

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Market Power and Social Welfare

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INTRODUCTION

By *Alejandra Palacios Prieto*

In the economic realm, the problems of inequality, poverty, limited purchasing power and restricted access to goods and services have two faces: how many resources are available (disposable income) and how much things cost. Generally, the former receives the most attention as a public policy problem and has historically interventions have aimed at increasing the welfare of Mexicans. Some of the mechanisms that have been implemented to improve the situation of Mexican families include increasing wages, expanding access to credit, creating educational and job opportunities aimed at obtaining higher income or making direct money transfers. Relevant policies when considering that, according to the National Council for the Evaluation of Social Development Policy (CONEVAL as per its acronym in Spanish), 39% of the country's population lacks sufficient resources to acquire the basic food basket products.[1] However, the other side, - how much things cost and how much should they cost-, has been largely neglected, although it is a fundamental part of the equation to ensure a better quality of life for households. As will be seen further on, the strengthening of competition policy is vital to improve purchasing power, expand the range of goods and services and combat inequality.

In competed markets, social welfare is maximized to the extent that companies compete to offer better products at the lowest possible prices. The logic is that if there are several companies

1. National Council for the Evaluation of Social Development Policy (CONEVAL per its acronym in Spanish), Índice Nacional de la tendencia laboral de la pobreza, December 2017, p. 3. Available at: https://goo.gl/EBZhiN

that offer the same product, there will be competition between these to win customers' preference by producing goods or services of the highest quality at the lowest possible price. In contrast, if only one company offers a product or a group of companies agrees not to compete, these companies would have the market power to determine the price that suits them, aimed at increasing their profits without improving quality. In other words, companies that operate in low competition environments affect consumers, who are left with no other option to satisfy their needs: paying more for the same or simply cease purchasing the product.

The existence of higher prices for certain goods or services in the market, - compared to prices in schemes with greater competitive pressure- may be due to multiple factors, not only the exercise of market power by some economic agent. Increases in production costs or problems in production processes (for instance, a drought leading to poor harvest) are some of the causes associated with higher prices. These increases are generally justified when they respond to the movement of national and international markets, as well as to changes in the supply curves of goods and services. Nevertheless, when the existence of higher prices is a direct consequence of the exercise of market power by suppliers with the aim of increasing their profits, the effective intervention of the State as a regulator becomes essential.

The Federal Economic Competition Commission (COFECE or Commission) is the autonomous constitutional body of the Mexican State responsible for guaranteeing competition and free market access and, in this sense, for contributing to improve the economic welfare of Mexican families. To meet this objective, the Commission has different tools aimed at the proper functioning of the markets.

On one hand, COFECE ensures the enforcement of the Federal Economic Competition Law (LFCE as per its acronym in Spanish) through the analysis of concentrations to prevent the creation of which affect competition, and investigates and sanctions anticompetitive conducts. On the other hand, it promotes the culture of competition by issuing opinions on legislation, draft laws and design of public and the dissemination among consumers of both the work of the Commission, as well as the concrete benefits of competition on their welfare.

By carrying out this dissemination work, that is, making visible the actual cost (in pesos and cents) in the pockets of families in Mexico due to the lack of competition in fundamental markets, we seek to sensitize society on the importance of tearing down barriers that prevent the efficient functioning of markets, because without competition we all lose to the extent that the purchasing power of households is harmed.

In particular, one of the benefits of competition that is not generally taken into account (or is not sufficiently disseminated) is that it can be part of a comprehensive strategy to combat one of the most discussed problems in the world: inequality. This document falls within the efforts of the Commission to disseminate this other face of competition policy, that is, the relationship between competition, inequality and welfare in Mexico.

Inequality and economic competition

In recent years, economic inequality has become a central issue in public discussion and political discourse around the world. Besides the surge of social movements and organizations devoted to combating the problem, several studies and analyses on inequality by influential economists have been published. For example, prominent economists such as Paul Krugman and Joseph Stiglitz have pointed out the importance – and severity – of this problem as a public policy issue. The book *Capital in the Twenty-First Century* by Thomas Piketty, published in 2014, and the heated discussion on his findings have placed inequality at the center of the economic science discussions and in areas beyond academia. As a consequence, academics, politicians, activists and public officials have begun to recognize inequality as a priority in the public agenda and to propose solutions such as the redesign of taxes or the regulation of the financial sector.[2] Mexico is not the exception.

According to data from the World Bank and the Organisation for Cooperation and Economic Development (OECD), our country currently registers a setback in the fight against inequality levels.

2. Anthony Atkinson, *Inequality: What can be done*, Cambridge, Harvard University Press, 2015.

After fifteen years of progress from the mid-nineties to 2010,[3] today we observe similar levels of unequal distribution of wealth to those registered during the eighties, which has negative effects on economic growth: an unequal country tends to grow less.[4] Specifically, according to the OECD, an increase of three points in the Gini coefficient -which is the increase that has been registered during the last two decades among member countries- would slow-down joint economic growth by 0.35% per year for 25 years.[5] In the case of Mexico, it is estimated that between 1985 and 2005 the increase in inequality limited GDP growth by more than 10%.[6]

Faced with this scenario and exercising its powers, the Commission decides to join the efforts to solve the problem of unequal distribution of wealth in Mexico, not only because it is a hindrance to social prosperity, but also because, as mentioned, it limits the potential for economic growth.

Until recently there was relatively little discussion regarding the contribution that economic competition can have in reducing inequality gaps in societies. Although Krugman and Stiglitz have shown the damaging effects of the exercise of market power on the levels of inequality, arguments generally focus on the accumulation of wealth by the highest income deciles: how much people at the top have compared to those at the bottom. In his book, The Price of Inequality, Stiglitz presents the problem under these terms:

> *To put it baldly, there are two ways to become wealthy: to create wealth or to take wealth away from others. The former adds to society. The latter typically subtracts from it, for in the process, for in the process of taking it away, wealth gets destroyed. A monopolist who overcharges for his product takes money from those whom he is overcharging and at the same time destroys value.*[7]

3. OECD, "Focus on Inequality and Growth", *Directorate for Employment, Labour and Social Affairs*, OECD, 2014, p. 1.

4. Gerardo Esquivel Hernández, *Desigualdad extrema en México. Concentración del poder económico y político*, México, Oxfam, 2015, p. 12.

5. Ibid., p. 2.

6. Federico Cingano, "Trends in Income Inequality and its Impact on Economic Growth", *OECD Social, Employment and Migration Working Papers*, no. 163, OECD, p. 14.

7. Stiglitz, Joseph, *op. cit.*, p. 40.

Since monopolistic practices can be understood as one of the causes of wealth concentration among higher-income sectors, competition emerges as an effective way to combat inequality; even more so if we consider it as a criterion neutral to ideologies, political factions or party programs: competition is about ensuring that all citizens have access to goods and services of their choice, according to their income levels, without restrictions produced by the exercise of market power by certain economic agents.

Since for the ordinary citizen the direct relationship between the role of competition and economic welfare may be diffuse, it is essential to encourage the development of studies that, on the one hand, show the costs families face for being captive of concentrated markets (what percentage of their money is lost due to lack of competition in markets) and, on the other, function as guides on the areas of opportunity to guarantee competition with the aim of reducing inequality and poverty gaps.

The need to convey these ideas in our country moved COFECE to ask Andrés Aradillas, PhD to carry out an investigation that estimated the loss of welfare of Mexicans as a consequence of the exercise of market power, that is, a study estimating how much money households lose when companies exert their market power and raise prices in markets of primary-need products. On the issue, only one previous the analysis *Evaluación de los Efectos Distributivos y Espaciales de las Empresas con Poder de Mercado en México* (Evaluation of the Distributive and Spatial Effects of Companies with Market Power in Mexico), carried out by PhD Carlos M. Urzúa in 2008 which, existed. Although widely debated in the academic field since its publication (especially its methodology and results), it played a fundamental role as an argumentative element in favor of the reforms to the *Federal Economic Competition Law* in 2011 and 2014.

A decade later, with a renewed methodology that takes into account the observations made in recent years to Dr. Urzúa's study, Dr. Aradillas presents in the third section of this document his *Estudio sobre el impacto que tiene el poder de mercado en el bienestar de los hogares* (Study on the impact of market power on household welfare), which is a valuable contribution to this new line of research and whose conclusions are a warning that force us

to intensify institutional efforts to reverse high costs due to the lack of competition.

Among other relevant findings, Dr. Aradillas points out, in the first place, that Mexican families pay 98.2% more than they should as a result of being subject to the market power of companies that participate in expenditure categories studied. This has serious repercussions, because, in the absence of market power, families would see an automatic increase of 15.7% in their purchasing power of their salaries.

Second, the Aradillas' study shows that the distribution of the loss of welfare as a consequence of the exercise of market power is *regressive*; that is, it affects with greater intensity the welfare of the poorest sectors of the country, because the lower the income, the greater the relative loss. Specifically, the study presents empirical evidence of how households in the lowest income decile (I) lose 4.42 times the income lost by households in the highest income decile (X) and points out that regional conditions aggravate the impact: the country's southwestern states suffer a 47% greater loss of welfare than entities located in the northwest.

It should be noted that the twelve expenditure categories used in the analysis are the most essential to people's daily lives, such as the consumption of: corn *tortillas*, bread, chicken and eggs, beef, processed meats, nonalcoholic beverages, fruits, vegetables, dairy products, construction materials, interurban passenger transportation and air transportation, and medicines, which intensifies the concern and need to combat this problem by strengthening policies in favor of economic competition.

In this sense, the deployment of effective solutions requires the co-responsibility of authorities and legislators of the three levels of government to establish pro-competitive regulation, repeal or reform regulatory frameworks that guarantee privileges of one group of producers over another(or others), or to avoid political decisions that benefit a few companies to the detriment of most Mexicans. COFECE, of course, is obliged to effectively pursue its legal mandate and prosecute and sanction companies that agree to manipulate prices or restrict supply to the detriment of consumer's pockets in Mexico.

The document you are holding is divided into two parts. In the first, an account of the main studies published in social sciences literature dedicated to measuring the effect of the exercise of market power on consumer welfare is provided and, consequently, the possible impact of competition policy interventions on markets and social welfare in general. This section concludes with an analysis of the main studies on market power in Mexico and positions Dr. Aradillas' study within the framework of the literature on the subject. In the second part, said study is presented.

Undoubtedly, Aradillas' analysis stands out for presenting an innovative and robust research methodology which, as previously mentioned, addresses and overcomes many of the questions raised regarding the first analysis published on the subject in Mexico. COFECE hopes this document will enrich the public debate on the importance of guaranteeing competition in markets as a means to alleviate poverty, close economic inequality gaps and improve the quality of life of Mexicans.

A better Mexico is everyone's Competency.

Alejandra Palacios
Chairwoman, COFECE

INTRODUCTORY STUDY ON THE EVOLUTION OF MARKET POWER AND ITS IMPACT ON WELFARE

By *José Nery Pérez Trujillo*

Economic competition is a strategic ally of the consumer, because it helps to boost economic growth and facilitates access to the benefits of productive activity for a greater number of people. Lower prices, greater quantity, variety, and quality of products, higher productivity and innovation in firms and in markets under competition conditions.[8] For this reason, competition is an instrument that furthers favorable performance of social variables that concern Mexicans, such as inequality, economic privilege concentrated in the hands of few and the loss of purchasing power. Hence, the primary purpose of competition policy is to eliminate structural, behavioral or regulatory restrictions that limit the intensity of competition in markets and hinder their efficiency.

In general terms, restrictions on competition can be classified into three groups: i) regulatory frameworks; ii) market structures; and iii) monopolistic practices or anticompetitive conducts. The first group consists of the regulatory frameworks that prevent the entry of new competitors to a market or that limit or cancel the intensity with which participants compete in the same market. The second is formed by markets with few

8. A compendium of the macroeconomic effects of competition policy are available at: OECD (2014) Available at: https://goo.gl/rZf6XN and in Davies et al. (2004). Available at: https://goo.gl/zPPUDT .

competitors or some that have a large market share, so that the incentives to compete are substantially reduced.

The third refers to the two types of conduct typified by the Federal Economic Competition Law (LFCE) as illegal: a) absolute monopolistic practices and b) relative monopolistic practices. The first, also known as "cartels", are the agreements and exchanges of information among competitors to fix prices, restrict production, segment markets or manipulate tenders. The second are the behaviors carried out by dominant economic agents to unduly displace current or potential competitors to hinder market access or establish competitive advantages.

Competition authorities from different jurisdictions have tools to identify restrictions on competition. Based on their analysis they can sanction, eliminate or correct anticompetitive behavior, or where appropriate, advocate to reform the rules that generate lack of competition and/or market structures that are harmful to consumers.

In this regard, in recent years a major concern has arisen about the growing market power held by some companies.[9] Its existence is worrisome because it facilitates the lobbying power of these companies with public authorities to impose barriers to the entry of potential competing companies, in order to ensure advantages for themselves, which harms consumers, competitors and the efficiency of the economy, with the pernicious effects that this situation entails on the welfare of society.

The analysis presented below consists of three sections. The first reviews five selected articles that contribute to the study of market power and its effect in other jurisdictions. The second, analyzes five articles that identify market power in specific industries in Mexico and discuss both their effects and the methodologies to estimate it. Finally, the third section presents the results of the most recent study commissioned by the Federal Economic Competition Commission (COFECE) to an external expert (Andrés Aradillas) to carry out and analysis on the existence of market power in priority industries and their effects on the welfare of Mexican families.

9. Market power is defined as the capacity of a company to increase prices above a certain competitive or level, or of reference, in a profitable manner: Motta (2018; p. 70)

1. Recent studies on market power in the world

In recent times, various specialists have identified a generalized behavior in most industries since 1980, where markets have become more concentrated and the profit margins of companies already participating in the market have grown substantially, which, in turn is accompanied by the imposition of barriers to entry for potential competitors.

The following is an analysis of the results of five studies on the evolution of market power around the world and its consequences.

a) Market power as a generator of inequality

Piketty (2014) conducted an analysis related to the dynamics of wealth and income distribution since the XVIII century.[10] He found that the rate of return on capital (r) grows at more accelerated rates than the growth rate of income and of the national product (g), which he considers as the main cause of inequality. In his argument, the relation "$r > g$" implies that accumulated wealth in the hands of a few grows faster compared to production and wages, which means that businessowners who have been in the market longest people tend to acquire market power and become dominant economic agents in their industries.

In other words, the dynamics of a market in the long term are strongly determined by the size of the companies already established, when considering that the growth rate of capital (previously accumulated) is higher than of the other production factors, which provides an important advantage for older companies. As evidence, he shows the evolution of the share of capital in national income in selected countries (Germany, Australia, Canada, the United States, France, Great Britain, Italy and Japan) between 1975 and 2010, observing that share of capital represented between 15% and 25% in the seventies and increased in a range between 25% and 30% between 2000 and 2010.

With this increase in capital participation, labor participation decreased because the rate of return of the latter is lower than that of the former. This market power gives economic agents the capacity to set higher prices than those set under competition conditions

10. Piketty, T. (2014) *Capital in the Twenty-first Century*. Cambridge, MA: Belknap Press.

and, therefore, there is a greater transfer of consumer surplus to producers' profit.

In other words, when interpreting the conclusions of Piketty (2014), the exercise of market power is one of the main generators of inequality in economies.

b) Evolution of market power in recent decades

The presence of market power has implications on welfare and resource allocation. Companies with market power can set prices above their marginal costs. Hence, consumers either purchase fewer goods or need to increase their spending to acquire the same quantity, compared to the exchange in an industry where companies lack market power. Furthermore, companies with market power, by having a higher profit margin obtain higher returns, which affects the allocation of capital and labor.[11] When faced with low or null competition, a firm with market power has less incentives to invest in innovation and development so efficiency and quality of the processes advance at a lower rate than in a competed industry, in such a way that efficiency is lost in the allocation of resources .

De Loecker & Eeckout (2017) document the evolution of profit margins in the United States economy from 1950 to 2014.[12] Their analysis finds that the average profit margins remained approximately constant between 1960 and 1980 at around 20% (within an 18% and 20% range), although in 1980 there was a drastic increase that reached 2014 with average margins of 67%. That is, in 35 years the margin was multiplied by 3.6. The growth rate of the average profit margin accelerated after the economic crises of 2000 and 2008. However, margin growth was not homogenous, as higher-return companies saw their profit margins grow in a more accelerated manner, by going from 40% in 1980 to 160% in 2014.

The authors identified two trends that coincide with the increase of market power: i) a decline in the entry of new companies due to

11. Profit margin is defined as the difference between sale price and cost of production of a good or service. Companies with market power increase the sale price because they know the consumer will have to purchase a similar amount of the good or service to satisfy their needs, which increases their profit margin.

12. De Loecker, J. & J. Eeckout. (2017). "The Rise of Market Power and the Macroeconomic Implications". National Bureau of Economic Research. Working paper. Available at: https://goo.gl/nUHze1.

greater barriers imposed by economic agents with market power; and ii) an increase in wage inequality due to the decrease in unskilled wages.

Among the causes that explain this increase in market power are: the increase in the number of mergers and acquisitions, regulations that favor established companies, the growth of network markets, the increase in wholesale transactions, better product differentiation, and greater vertical and financial integration of companies with market power.

c) Drop in labor and capital as a consequence of market power

Recently Barkai (2017) identified that in the last 30 years there has been a pronounced drop in labor participation in the value of production.[13] Some of the suggested explanations argue that this phenomenon is due to technological change, mechanization of production, the accumulation of capital or the change in the relative price of capital when substituting labor. In these explanations, it stands out that the fall in labor share is explained by an increase in participation of capital, measured as the ratio of the cost of capital to gross value added, which can be seen as an efficient result.

To test the hypothesis, Barkai (2017) analyzes various data series of capital costs for non-financial sectors during the last three decades (1984-2014). As a result he found that the decline in the participation of labor as a factor of production was not due to an increase, and therefore displacement, of capital, but that both factors experienced sharp declines. Even the decrease in the share of capital (30%) is more dramatic than the decrease in labor (10%). The foregoing contrasts with an increase in company profits, which grew more than 12 percentage points. The results suggest that decreases in labor and capital participation are due to a fall in competition in markets. To test this hypothesis, the author developed a standard general equilibrium model with imperfect competition. The model identified a decrease in competition and an increase in profit margins as an explanation of the simultaneous decreases.

Likewise, based on the model, he built two counterfactuals. The first tries to identify how labor, capital and investment would have

13. Barkai, S. (2017), "Declining labor and capital shares". Working paper. Available at: https://goo.gl/sLj1T3.

evolved in the period of analysis (1984-2014) in response to less competition in the markets. The second analyzes how the level of production, wages and investment would have evolved from 2014 onwards if the level of competition observed in the markets increased to the level of 1984.[14]

Regarding the first counterfactual, the model predicted drops in labor and capital participations very similar to those observed, due to less competition in markets. With respect to the second counterfactual, the model finds that production grows 10%, wages 24% and investment 19% as competition in the markets increases.

Industries with high concentration levels invest less and have higher profit margins, high (abnormal) equity returns and more mergers and acquisitions transactions that increase their profits. The simultaneous drops in the demand for labor and capital is a distinctive feature of less competition in the industry.

In summary, those industries that had marked increases in their level of concentration also experienced significant drops in labor participation, which increases inequality.

d) Market power effect on the level of wages

According to Marinescu & Hovenkamp (2018), the lack of competition in the labor market generates a loss in the welfare of workers and drops in employment levels.[15] When labor markets operate under conditions of perfect competition, there are many employers whose market participation is small, so they can hire as many workers as they wish, as long as the market wage is equal to the productivity of the worker. In labor markets where there is a high degree of concentration, workers have few options to be employed and are willing to accept a lower wage.

When there are one or few employers in a market, the probability of them establishing agreements between them so as not to compete for the other's workers increases, leaving employees without labor mobility options, disincentives them to

14. To determine the changes in the levels of competition in the observed and counterfactual scenarios, the author uses the elasticity of substitution between labor and capital, which in turn impacts the profit margin in both competed and monopolistic markets.

15. Marinescu, I.E. and Hovenkamp, H. (2018), "Anticompetitive Mergers in Labor Markets" (February 20, 2018). University of Pennsylvania, Institute for Law & Economics, Research Paper Num. 18-8. Available at: https://goo.gl/qPjdq1.

improve their productivity and forces them to accept wages and labor conditions lower than those that would exist if the market was not concentrated. Additionally, because the monopsonist - the only buyer or contractor in the market - has incentives to increase profits, he will seek to reduce the number of personnel hired. Thus, just as a monopoly decreases production in the goods market, a monopsony diminishes the level of employment, placing it below the level that would exist under perfect competition. This reduction in the level of employment and productivity could affect production in the goods market.

In this sense, concentration in labor markets affects people's welfare by limiting their purchasing power, derived from low wages; it has effects on the level of employment and the level of production, and accentuates poverty levels in a country.

Azar *et al*. (2017) quantified the level of labor market concentration in a wide range of professions and trades for more than 8,000 labor markets in the United States.[16] Using quarterly panel data from 2010 to 2013 they concluded that increasing the concentration level from the 25th percentile to the 75th percentile reduces published wages up to 17%, so they conclude that a higher market concentration is associated with significantly lower wages.

e) Market power and political power

Shapiro (2017) analyzes the empirical evidence on market concentration in the United States during the last 40 years.[17] His purpose was to prove that, during that period, the markets increased their levels of concentration, which can be interpreted as a decline in levels of economic competition.

In his analysis he finds that there are several press and public policy reports warning of an increase in the level of market concentration in the United States economy. The evidence indicates that large companies increased their market share in a systematic way in relation to smaller companies. On average, the market share of the four largest companies in each sector grew from 26% to 32% in the period analyzed. Additionally, based on the data from the

16. Azar, J., I. Marinescu & M. Steinbaum. (2017). "Labor market concentration". *National Bureau of Economic Research*. Working paper 24147. Pp. 33. Available at: https://goo.gl/F58Dbk.

17. Shapiro, C. (2017). "Antitrust in a Time of Populism". *International Journal of industrial Organization. Forthcoming*. Available at: https://goo.gl/PcvZdo.

Economic Census, he finds increases in the levels of concentration, which could reflect greater market power during the last 40 years, which is also consistent with a relaxation of the merger control policy by competition authorities in that country as of 1982.

Two questions arise from the above: Has greater concentration resulted in less competition? Why has competition not been effective enough to prevent profits from growing beyond the economy´s growth?

According to Shapiro (2017), there is great concern about the current state of the institutional system, specifically about the political power of large corporations, and points out that monopoly is the great enemy of democracy. The incursion of large corporations that hold market power in the design of public policy could dangerously bias the enforcement of antitrust legislation.

Shapiro (2017) suggests that competition policy must play a fundamental role in the face of the dramatic growth in the levels of concentration and the consequent decrease in the intensity of economic competition. The actions he suggests to the competition authorities are: a) increase efforts to sanction economic cartels; b) maintain a stricter control in the analysis of concentrations; c) be stricter with the displacement conducts exercised by dominant companies; d) promote policies that reduce barriers to entry; e) divest dominant firms in concentrated markets into several smaller companies; and f) regulate the conducts of companies with substantial market power.

2. Studies on market power in Mexico

In our country, the study of market power and its effects on the welfare of families is relatively recent. The first study was carried out by Carlos Urzúa in 2008 on basic consumer goods. Later, in 2009, Urzúa himself published another study on services. His methodology was criticized and improved in some aspects in two research studies done by Luis Alberto Ibarra and by José Alberro and Rainer Schwabe. Finally, Andrés Aradillas prepared a study that takes up the most significant elements of his predecessors improving various technical aspects. The following explains each of these.

a) Market power in basic consumer goods

In 2008, Carlos Urzúa presented the first study on the effects of market power on social welfare in Mexico.[18] This study was carried out at the request of the Organisation for Economic Co-operation and Development (OECD) and the former Federal Competition Commission (CFC). The exercise was novel because it characterized overprices by market and made inferences from a comparative analysis by population segments by income decile and type of locality -urban and rural.

In his 2008 study, Urzúa presents a basic theoretical model to estimate the distributive consequences of market power. To this end, he assumes that the social cost of market power is proportional to the loss of consumer surplus. With the proposed model, to estimate this loss the price-elasticity of demand, the expenditure on each good and an estimate of the relative increase in prices are required. This last element is based on conjectural variations based on a Cournot model.

Subsequently, the author shows the consumption patterns of Mexican households, with data from the National Household Income and Expenditure Survey (ENIGH) 2006, and selects the goods to be analyzed. For the selection, he uses two criteria: i) the presumed existence of market power of the supplier, and ii) the existence of ENIGH data on amounts and unit values. The selected goods are: 1) corn tortilla; 2) processed meats; 3) chicken and eggs; 4) cow's milk; 5) soft drinks, juices and water; 6) beer; and 7) medicines.

Next, he describes Deaton's econometric model of spatial variations (1987, 1988 and 1990), which he uses to indirectly estimate price elasticities of the demand for the chosen goods. He mentions that he has no evidence of third-order discrimination between the urban and rural sectors, therefore it is possible to identify the elasticity of demands in each case.

As part of his conclusions, Urzúa (2008) finds that in the urban sector the negative impact of companies with market power grows as households become poorer (see Table 1). At the limit, the lowest

18. Urzúa, C. (2008), "Evaluación de los efectos distributivos y espaciales de las empresas con poder de mercado en México", Working Paper, Tecnológico de Monterrey, Mexico City Campus. Available at: https://goo.gl/Zmdgou.

income decile has a relative loss almost 20% higher compared to that of the highest decile. This is equivalent to the poorest families paying a hypothetical consumption tax of 20%, which is not paid by the wealthiest families.

Something similar happens in the case of the rural sector, with exception of a more significant distributive impact: the relative loss of the lowest decile is 22.7% greater than that of the highest decile. In regional terms, the southern states, many of the poorest in Mexico, have the most losses in social welfare. In fact, households in Chiapas, the state with the greatest losses, have a relative loss more than double of that suffered by households in Baja California, the state with the lowest losses, due to market power of companies.

Table 1. Household loss due to market power

Urban Households			Rural Households		
Decile	Welfare Loss	Relative Loss	Decile	Welfare Loss	Relative Loss
I	0.394	1.198	I	0.460	1.227
II	0.387	1.176	II	0.444	1.184
III	0.381	1.158	III	0.450	1.2
IV	0.373	1.134	IV	0.442	1.179
V	0.371	1.128	V	0.441	1.176
VI	0.365	1.109	VI	0.419	1.117
VII	0.353	1.073	VII	0.418	1.115
VIII	0.346	1.052	VIII	0.380	1.013
IX	0.341	1.036	IX	0.364	0.971
X	0.329	1.000	X	0.375	1.000

Source: Urzúa (2008)

b) Market power in services

A year later, Carlos Urzúa published a second work which shows that in the case of the hiring of transportation, education, communications, energy, health and financial services, the loss of welfare due to the exercise of market power in these industries is greater in relative terms for the strata with higher income.[19] However, once these results are combined with those obtained in the study carried out in 2008, for the case of consumer goods where significant market power is also presumed, the total losses in welfare becomes relatively greater in the case of the strata with lower income, as well as in the case of the states that are most lagging.

19. Urzúa, C. (2009), "Efectos sobre el bienestar social de las empresas con poder de mercado en México", *Finanzas públicas*, vol. 1, num. 1, pp. 79-118. Available at: https://goo.gl/ngh1ia

Based on the services registered in ENIGH for which he identifies a high market power by the suppliers, Urzúa (2008) develops a model to calculate the losses, which assumes an industrial structure, which, as in Urzúa's (2008) model for consumer goods, presumes all companies as identical and estimates that the other competing companies will not respond to changes in their individual production. He also assumes that the hiring of services by households is determined by maximizing a linear expenditure system, for which he establishes an indirect welfare function dependent on income and sets a parameter of social aversion to inequality.

Given the lack of information, Urzúa (2009) uses the indirect Frisch method to calculate the demand-price elasticities from the income elasticities assuming an additive utility function. Based on these assumptions and estimates, he calculates the negative impacts of market power in the services sector on social welfare, which as previously mentioned, are greater in the two highest income deciles, which is not surprising given that the services considered in the model are hired mostly by households with higher income.

By combining the results obtained for services case (2009) with those of consumer goods (2008), monotonicity is maintained in the case of welfare losses in Urzúa (2008): the lower the income, the greater the relative loss of welfare (see Table 2). Similarly, in geographical terms, in both studies the greatest impacts on social welfare due to the exercise of market power occur in the southern states, the poorest.

Table 2. Distribution of total loss due to market power in goods and services

	Relative Loss	
Decile	Urban Households	Rural Households
I	1.154	1.175
II	1.141	1.143
III	1.127	1.162
IV	1.107	1.146
V	1.104	1.145
VI	1.089	1.093
VII	1.056	1.094
VIII	1.039	0.999
IX	1.028	0.962
X	1.000	1.000

Source: Urzúa (2009).

c) First critique to Urzúa

Ibarra (2016) presents the first methodological critique to the evaluations carried out by Urzúa (2008 and 2009).[20] He identifies three main defects in his analysis:[21]

1. Consideration of only seven types of consumer goods, instead of considering all goods and services where a lack of competition may exist.
2. Use of simplifying assumptions, which facilitate calculation, but generate contradictions.
3. Use of arbitrary assumptions concerning the analyzed market structures.

According to Ibarra (2016), these three problems stem from the use of simplifying and arbitrary assumptions and, therefore, may invalidate or overestimate the conclusions. Assuming that all companies are identical in both technology and behavior, in addition to assuming that the conjectural variation fits the Cournot hypothesis, simplifies the calculations, but omits factors or behaviors that may be relevant.[22]

However, for Ibarra (2016) the most serious problems are the assumptions that Urzúa uses to characterize the structure of each market, since he does not use any empirical estimates of the existing overprice in a monopolistic market, but rather makes a numerical simulation exercise that takes as a basis the price-elasticities. Given the above, Ibarra (2016) proposes a simulation exercise based on the elasticities in the Urzúa study (2008), in which he attempts to separate the impact of the existence of an oligopoly and the impact of a collusive conduct. That is, going from non-cooperative oligopoly competition to cooperative oligopoly competition, where:

20. Ibarra, L. A. (2016), "Concentración de mercados, colusión y bienestar social en México. Una revisión metodológica". *El Trimestre Económico*, vol. LXXXIII (3), num. 331, July - September 2016, pp. 493-523. Available: https://goo.gl/ATcuGM.

21. The main conclusion derived from this review is that, despite there is a theoretical framework to evaluate the impact on social welfare of realization of monopolistic practices, which is relatively simple and well known, the empirical contrasting works are scarce (especially in Mexico) and highly complex due to their information requirements.

22. Each company will assume that each time its production level changes the rest will not react.

1. **Non cooperative oligopoly:** Based on the Cournot model, each company's price-cost margin will be equal to its participation divided by the price elasticity of demand. The weighted average price-cost margin per share will equal the Herfindahl-Hirschman Index (HHI) on the price elasticity of demand. Given the above, it will be possible to estimate the weighted average price-cost margin of a market based on data such as elasticities and the HHI. This is just a mechanical application of the Cournot model.
2. **Cooperative oligopoly:** Collusion will result in an increase in market concentration, and the difference between the cooperative and non-cooperative cases will make it possible to calculate consumer welfare cost resulting from the collusion.

Based on this estimation, the net social loss as a percentage of expenditure for the consumer goods markets adjusted by Ibarra (2016) is 12.6% for urban households and 10.8% for rural households (see Table 3). That is, if there were competition in the markets considered, urban households would have on average resources equivalent to an additional 12.6% of the expenditure made in these markets -for rural households the available resources would increase by an average of 10.8% of their spending in the same markets. These estimates, although more modest, may be more accurate insofar as they start from market structures more closely linked to reality.

Table 3. Overprices and effect on welfare derived from collusion (percentage)

Set of Goods	Overprices		Social Loss (% of expenditure)	
	Urban households	Rural Households	Urban households	Rural Households
Corn *Tortillas*	3.7	16.4	1.8	8.2
Corn flour	28.3	126.2	14.1	63.1
Beef	8.1	9.0	4.1	4.5
Pork	8.1	9.0	4.1	4.5
Chicken	21.3	14.8	10.6	7.4
Eggs	4.1	2.9	2.1	1.4
Milk	76.6	63.6	38.3	31.8
Soft drinks	20.9	18.7	10.4	9.3
Juices	32.7	29.3	16.3	14.6
Water	40.3	36.1	20.1	18.0
Beer	43.9	32.5	22.0	16.2
Distribution of medicines	14.0	23.0	7.0	11.5
Production of medicines	2.8	4.6	1.4	2.3

Source: Ibarra (2016).

d) Second Critique to Urzúa

In parallel Alberro & Schwabe (2016) critique six methodological details used by Urzúa (2018).[23] The critique refers to the following elements: i) treatment of unit values for households without purchase of a good, by assigning them zero; ii) the selection (sic) of a dependent variable, to define proportion of expenditure that is allocated to purchases of a good within a considered group of goods; iii) inclusion of medicines within the group of goods considered, as it is a very category of diverse goods;[24] iv) the inclusion of subsidized goods and observations with irregular prices, not considering that these characteristics, along with the conventions used in the methodology of validation of the survey, may eliminate the relationship between the value of a good and unit value, used in the estimation; v) definition of rural areas, because of inconsistencies presented between the value reported in the document and material provided by the author, in which rural locality was defined with up to 15,000 inhabitants; and vi) the decision on the use of expansion factors, for not using them.

Alberro & Schwabe (2016) propose a solution to each methodological consideration and contribute with the estimation of the corrected model.[25] Furthermore, they present a model defined from the results obtained, without considering the distinction by the size of the locality. Another contribution made by Alberro & Schwabe (2016) is the extension of the period considered by using ENIGH data for the years 2006, 2008, 2010 and 2012, since the estimation in Urzúa 2008 only uses 2006 ENIGH data.

Alberro & Schwabe's (2016) contribution may be considered at two levels. On the first, the model is estimated with the six adjustments

23. Alberro, J. y R. Schwabe. (2016) "Reconsiderando la evaluación de los efectos distributivos del ejercicio de poder de mercado en México". El Trimestre Económico, vol. LXXXIII (3), num. 331, July-September 2016, pp. 459-492. Available in Spanish at: https://goo.gl/b8ovT7. (Reconsidering the evaluation of the distributive effects of the exercise of market power in Mexico, t.n.)

24. The seven goods considered by Urzúa (2008) are: corn tortillas; processed meats; chicken and eggs; milk, soft drinks, juice and water; beer; and prescription and over-the-counter medicines.

25. The proposals to improve each of the above elements, correspondingly are: i) unit values for goods that do not record at least one purchase are treated as missing values (not zeros); ii) the definition of the dependent variable considers the share of expenditure on each good within the total expenditure (not within the expenditure of the goods considered); iii) the estimation excludes the group of goods categorized as medicines; iv) observations with extreme values or corresponding to subsidized purchases are excluded; v) the definition of rural area is extended to locations with less than 15,000 inhabitants; vi) the expansion factors of the survey are used.

proposed to the Urzúa (2008) method for the same 2006 ENIGH data set. On the second, the estimation period is extended in two ways: an estimation for each year with the information made available by ENIGH up to 2012 and an estimation for data from the four surveys (see Table 4).

Table 4. Loss in consumer surplus by income decile, urban zones

Decile	Urzúa (2008) result		With Adjustments		Alternative Measurement
	Reported	Replication	Without Algebraic Error	Own-price elasticity	Share of total expenditure
I	-0.394	-0.385	-0.270	-0.182	-0.021
II	-0.387	-0.381	-0.262	-0.178	-0.019
III	-0.381	-0.366	-0.245	-0.174	-0.018
IV	-0.373	-0.363	-0.245	-0.173	-0.015
V	-0.371	-0.359	-0.239	-0.172	-0.015
VI	-0.365	-0.355	-0.234	-0.170	-0.014
VII	-0.353	-0.343	-0.229	-0.169	-0.014
VIII	-0.346	-0.333	-0.218	-0.168	-0.012
IX	-0.341	-0.332	-0.214	-0.165	-0.011
X	-0.329	-0.302	-0.204	-0.159	-0.008

Source: Alberro & Schwabe (2016).

The results do not rule out equality among the elasticities estimated for rural and urban localities. Therefore, estimations are presented for the six groups of goods, without distinguishing the size of the locality.

Despite criticizing Urzúa's assumptions (2008) on competition structures in the analyzed markets, Alberro & Schwabe (2016) do not put forth a counterproposal; however, they perform loss of welfare calculations, so these calculations have the same problems. From the presented estimates they conclude:

> *"Although it is argued [...] that lower-income households are more affected by the exercise of market power in the food industries, the relative loss between rural and urban areas depends on the level of household income".*

e) Urzúa's response to his critics

The criticisms of Ibarra (2016), and Alberro & Schwabe's (2016) were published in the same edition of the journal El Trimestre Económico which also included Carlos Urzúa's response to the critique received.[26] In general terms, in said response, Urzúa's (2016) recognizes some

26. Urzúa, C. (2016). "Los efectos distributivos del poder de mercado. De vuelta a las andadas." *El Trimestre Económico*, vol. LXXXIII (3), num. 331, July-September 2016, pp. 525-534. Available in Spanish at: https://goo.gl/vLqt8X.

errors in the estimates, justifies the use of certain assumptions that are criticized and recognizes his critics' theoretical and empirical contributions.

3. Aradillas (2018) and his contributions

In order to have a more recent analysis, COFECE decided to carry out an update on the study prepared by Urzúa in 2008. To this end, it commissioned said study to the academic Andrés Aradillas López, associate professor of the Department of Economics at the Pennsylvania State University. The study was carried out with complete independence and contains the author's point of view without prejudging any conduct or circumstance that could be subject of a procedure by COFECE in terms of the LFCE.[27]

The study, presented in the following section, identified the impact that market power has on Mexican households. Market power is defined as the persistence of price levels above the levels that should be observed in a competed environment (a condition where prices are the result of cost considerations). Market power would provide companies with the ability to extract greater rent from consumers, which directly affects the welfare of Mexican households. Thus, market power is associated with a lack of competition.

A company with market power can raise its prices and retain its customers because it has few or no competitors. If a customer cannot obtain the goods or services needed from any other source than from a certain company, there are two alternatives: pay the overprice charged by this company or do without the required good. Barriers to entry that grant market power to a company may be due to: control of scarce resources or essential inputs, increasing returns to scale, technological superiority and regulatory barriers created by the government.

In Aradillas (2018) 12 categories of expenditure were analyzed in 46 Mexican cities distributed in eight geographic regions: 1) corn *tortilla*, 2) bread, 3) chicken and eggs, 4) beef, 5) processed meats, 6) dairy products, 7) fruits, 8) vegetables, 9) soft drinks,

27. Aradillas, A. (2018). "Estudio del impacto que tiene el poder de mercado en el bienestar de los hogares mexicanos."

10) medicines, 11) interurban passenger transportation and 12) construction materials. They were chosen based on five criteria: i) they are final consumer goods; ii) the existence of separate price series from the National Consumer Price Index; iii) they have a relevant contribution to national GDP, in relative terms; iv) they deal with generalized consumer goods and services nationwide; and v) they are goods and services in high demand in lower income households. INEGI data from the 2014 ENIGH and from Economic Censuses were used for the estimates.[28]

The study confirms that market power threatens the welfare of households because it imposes overprices on them. Aradillas (2018) identifies price deviations not associated with the cost functions of industries which statistically suggest the presence of market power in one or several links of the production or commercialization chain of the goods and services studied.

Overprices were identified in nine of the 12 analyzed sectors, with a statistical confidence level greater than 95%, although two of the sectors (soft drinks and medicines) showed overprices with statistical confidence level greater than 90%. The average national overprice for all households was 98.23%.

The average welfare loss of households was 15.7%, which means that to acquire the goods considered in the study households had to allocate 15.7% of additional income to what they would have had to disburse if there were competition in these markets. The loss of welfare in the decile of households with the lowest income (decile I) was of 30.9%, 4.42 times greater than decile X (households with higher incomes). The southeast region (Chiapas, Guerrero and Oaxaca) had the greatest loss of welfare in relative terms, as welfare was reduced by a proportion greater by 47% compared to the less affected region (northwest: Baja California, Baja California Sur, Chihuahua, Durango, Sinaloa and Sonora). Lastly, overprices resulting from market power increased income inequality in the country by 7.3% - calculated through the Gini Coefficient.

28. Aradillas (2018) considers a model that estimates the demand functions based on Lewbel and Pendakur (2009), which incorporates diverse advantages over the Deaton and Muellbauer (1980) model among which the estimation of demand functions with greater functional flexibility stands out.

In sum, the work of Aradillas (2018) contributes to economic theory and competition policy in five important ways: its technical approach, data analysis, the mechanism through which he selects the study categories, the variable of interest to estimate the impact on consumer welfare, and the use of additional variables to analyze the impact of market power.

The first relevant contribution is based on the use of cutting-edge econometric techniques. There are diverse methodologies to model demand functions; this study uses the implicit Marshallian demand system, also known as the Exact Affine Stone Index Demand System (EASI). The demand system belongs to same family as the Almost Ideal Demand System (AIDS) by Deaton and Muellbauer (1980),[29] which are commonly used. However, the EASI systems are less restrictive in their assumptions and more flexible in the use of functional forms. Furthermore, the study makes use of the New Empirical Industrial Organization (NEIO) to model intra-industry competition and identify the presence of market power.

The second, consists on the analysis of the large volume of information and how it was processed to understand the behavior of consumers and producers. On the consumer side, the use of information from the 15,586 households that met consumption criteria, which represents 80% of the 2014 ENIGH sample. Also price indices at the household level were constructed and more than 900 consumer behavior parameters were estimated. Regarding the behavior of producers, production functions were constructed for the 46 geographic markets using value-added variables at branch, sub-branch and economic unit levels, number of economic units, gross production, number of employees, total remunerations, intermediate consumption and fixed assets. Having such vast information and integrating it efficiently and usefully is, without a doubt, an important contribution.

The third contribution is that, unlike in previous studies, the selection of industries analyzed was not arbitrarily determined: it was sought that all markets met the requirements to be considered by COFECE as priority sectors. The criteria are as follows: 1) goods and services are of final consumption, so the impact of price changes

29. Deaton, A. y J. Muellbauer (1980). "An Almost Ideal Demand System". *American Economic Review*, num. 70, pp. 312–326. Available at: https://goo.gl/fH7wSb.

on consumer welfare is direct and not indirect, as is the case with intermediate goods; 2) price series were reported separately from the National Consumer Price Index (INPC as per its initials in Spanish) published by INEGI; 3) the production of goods and services have a relevant contribution to the national Gross Domestic Product, in relative terms; 4) the market under analysis produces goods or services for general consumption by the population at the national level, that is, they are not demanded exclusively by a specific geographical or socio-economic sector or segment; and 5) the goods and services are in high demand by lower income households. With these criteria, 78 categories of ENIGH expenditure were analyzed, which represent on average 66% of household expenditure and 75% in the case of the poorest households.

The fourth is that the study uses an alternative measure to estimate the impact on consumer welfare which is the equivalent variation, rather than using consumer surplus. The equivalent variation is defined as the monetary amount that households would be willing to pay so that prices of goods and services they purchase do not increase, thus measuring the loss of income derived from the presence of overprices. The equivalent variation is a more accurate measure of welfare than the change in consumer surplus.

The fifth and last contribution of Aradillas (2018) is presenting results comprehensively and completely for the benefit of the reader. First, he shows the estimates of elasticities for the analyzed markets, which have robust empirical support. Subsequently, he identifies the overprices by sector and statistical intervals that suggest a reliable range of estimation. Then he indicates the loss of welfare by income decile in monetary and percentage terms, and performs a regional analysis of the impact on loss of welfare and finally translates it into the measure of inequality most used by specialists, the Gini coefficient. In sum, he shows sufficient elements of discussion to provoke further analysis and studies.

The most evident limitation of Aradillas (2018) is the difficulty involved in analyzing 12 economic sectors simultaneously without modeling the particularities specific to each one and the restrictions this imposes on drawing conclusions that may invariably apply to

all sectors. However, this may be interpreted not as a bias particular to the study but as a motivation to trigger greater and more specific studies for each sector and market.

Lastly, I would like to invite readers to examine the S*tudy on the impact of market power on the welfare of Mexican households*, which is presented below.

REFERENCES

Alberro, J. y R. Schwabe. (2016) "Reconsiderando la evaluación de los efectos distributivos del ejercicio de poder de mercado en México". *El Trimestre Económico* , vol. LXXXIII (3), núm. 331, July-September 2016, pp. 459-492. Available in Spanish at: http://www.eltrimestreeconomico.com.mx/index.php/te/article/view/207/205

Azar, J., I. Marinescu & M. Steinbaum. (2017). "Labor market concentration". *National Bureau of Economic Research*. Working paper 24147. P. 33. Available in Spanish at: http://www.marinescu.eu/AzarMarinescuSteinbaum.pdf

Barkai, S. (2017), "Declining labor and capital shares". Working paper. Available at: http://home.uchicago.edu/~barkai/doc/BarkaiDecliningLaborCapital.pdf

Davies, S. W., Coles, H., Olczak, M., Pike, C. & Wilson, C. (2004). "The Benefits from Competition: some Illustrative UK Cases" . DTI Economics Paper No. 9. Available at: http://publications.aston.ac.uk/18473/1/Benefits_from_competition.pdf

Deaton, A. (1987). "Estimation of Own- and Cross-Price Elasticities from Household. Survey Data." *Journal of Econometrics*, núm 36, pp. 7-30. Available at: http://www.princeton.edu/~deaton/downloads/Estimation_of_Own_and_Cross_Price_Elasticities.pdf

Deaton, A. (1988). "Quality, Quantity and Spatial Variation of Price." *American. Economic Review*, núm 78, pp. 418-430. Available at: http://www.princeton.edu/~deaton/downloads/Quality_Quantity_and_Spatial_Variation_in_Price.pdf

Deaton, A. (1990). "Price Elasticities from Survey Data: Extensions and Indonesian. Results." *Journal of Econometrics*, núm 44, pp. 281-309. Available at: http://www.princeton.edu/~deaton/downloads/Price_Elasticities_from_Survey_Data.pdf

Deaton, A. y J. Muellbauer (1980). "An Almost Ideal Demand System." *American Economic Review,* núm 70, pp. 312–326. Available at: http://www.princeton.edu/~deaton/downloads/An_Almost_Ideal_Demand_System.pdf

De Loecker, J. y J. Eeckout. (2017). "The Rise of Market Power and the Macroeconomic Implications". *National Bureau of Economic Research*. Working paper. Available at: http://www.janeeckhout.com/wp-content/uploads/RMP.pdf

Ibarra, L. A. (2016), "Concentración de mercados, colusión y bienestar social en México. Una revisión metodológica." *El Trimestre Económico*, vol. LXXXIII (3), núm. 331, July-September 2016, pp. 493-523. Available in Spanish at: http://www.eltrimestreeconomico.com.mx/index.php/te/article/view/208/206

Lewbel, A. & K. Pendakur (2009). "Tricks with Hicks: The EASI Demand System". *American Economic Review* núm. 99, pp. 827–863. Available at: https://pdfs.semanticscholar.org/f838/df8ba234602d5c885febf5b9207f1b2577a2.pdf

Marinescu, I.E. and Hovenkamp, H. (2018), "Anticompetitive Mergers in Labor Markets" (February 20, 2018). U of Penn, Inst for Law & Econ Research Paper No. 18-8. Available at: https://ssrn.com/abstract=3124483

Motta, M. (2018), *Política de competencia. Teoría y Práctica*; translated by de Carmen Praget; translation review by Alexander Elbittar; technical review of translation by Javier Núñez Melgoza. México: FCE, UNAM, Cofece, CIDE, 2018. 713 pp.

OCDE. (2014). Ficha informativa sobre los efectos macroeconómicos de la política de competencia. Organización para la Cooperación y el Desarrollo Económicos. P. 38. Available in Spanish at: http://www.oecd.org/daf/competition/2014-competition-factsheet-iv-es.pdf

Piketty, T. (2014) *Capital in the Twenty-first Century*. Cambridge, MA: Belknap Press.

Shapiro, C. (2017). "Antitrust in a Time of Populism." *International Journal of Industrial Organization*. Forthcoming. Available at: https://faculty.haas.berkeley.edu/shapiro/antitrustpopulism.pdf

Urzúa, C. (2008), "Evaluación de los efectos distributivos y espaciales de las empresas con poder de mercado en México", Working paper, Tecnológico de Monterrey, Campus Ciudad de México. Available in Spanish at: https://www.oecd.org/daf/competition/45047597.pdf

_____ (2009), "Efectos sobre el bienestar social de las empresas con poder de mercado en México", *Finanzas públicas*, vol. 1, núm. 1, pp. 79-118. Available in Spanish at: http://alejandria.ccm.itesm.mx/egap/documentos/EGAP-2009-05.pdf

_____ (2016). "Los efectos distributivos del poder de mercado. De vuelta a las andadas." *El Trimestre Económico*, vol. LXXXIII (3), núm. 331, July-September 2016, pp. 525-534. Available in Spanish at: http://www.eltrimestreeconomico.com.mx/index.php/te/article/view/209/207

Study on the impact of market power on the welfare of Mexican households

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Andrés Aradillas López*

Summary

Economic theory identifies market power as the persistence of price levels above the competitive levels dictated by cost considerations, and predicts an inverse relationship between this discrepancy and elasticity of demand for the market at issue. This study aims to identify the presence of market power in the expenditure categories and selected markets and to quantify its impact on the loss of welfare in Mexican households. The results suggest the presence of market power in the selected expenditure categories resulted in the payment of an average overprice of 98.2%. This represented a loss of welfare in Mexican households of 15.7% of their average income, with regressive effects, by reducing the budget of the poorest households by 30.9%- that is, 4.42 times more than what households with the highest income levels lose. The results show a greater impact in the geographic regions of the country with lower income. This increases inequality among households, and acts as a burden on economic growth.

Keywords: Demand analysis, market power, welfare loss, inequality.

Palabras clave: Análisis de demanda, poder de mercado, pérdida de bienestar, desigualdad.

JEL Classification (Journal of Economic Literature): C30, D12, D43.

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1. INTRODUCTION

Market power is identified as the persistence of price levels above levels that should be observed in a competitive environment, within which prices only respond to cost considerations. Specifically, the presence of market power is identified when, even controlling for factors that determine costs, there is a systematic relationship between price levels and the elasticity of demand in the corresponding market. The fundamental microeconomic models of the Industrial Organization theory predict that, in the presence of market power there is an inverse relationship between overprices (the discrepancy between the price levels observed and their competitive benchmarks) and the elasticity of demand. In the absence of market power, once cost determining factors are controlled for, there should be no systematic relationship between prices and demand elasticities.

A company with market power can raise its prices and retain its customers because it has few or no competitors. If a customer cannot obtain the goods and services needed but from one determined company, he has two alternatives: pay the overprice or dispense with the required good. That is market power and it is important because it imposes barriers to entry into the market that prevent competition. Barriers to entry that grant market power to a company may be due to: control over scarce resources or essential inputs, increasing returns to scale, technical superiority and regulatory barriers created by the government.

Price distortions derived from the presence of market power have a direct impact on household welfare. Therefore, identifying sectors where there is evidence of market power and measuring the loss of welfare in households associated with it, are relevant actions for competition policy, since its objectives include preventing and investigating anticompetitive practices and eliminating barriers to competition. The analysis described in this study is based on microeconomic theory and uses modern methods of statistical and econometric analysis. The main sources of information are the National Survey of Household Incomes and Expenditures (ENIGH as per its acronym in Spanish), the economic censuses and the series of price indices published by the National Institute of Statistics and Geography (INEGI as per its acronym in Spanish).

The analysis begins with the description of the methodology used to estimate the household demand system. The methods used are based on functional forms that are on the frontier of knowledge in the analysis of demand systems. Subsequently, the categories of expenditure analyzed, the geographic markets and methodology used to obtain price indices at the household level are defined. Derived from the estimation of the demands systems, price elasticities of demands of the expenditure categories are obtained (Section 2).

Subsequently, the study focuses on industrial behavior, and comparing the relationship between prices, cost determinants and demand elasticities, the sectors where there is evidence of the presence of market power are identified and the resulting overprice paid by consumers in the acquisition of the goods and services under analysis are estimated. With the estimated overprice, equivalent variation is used as a monetary measure of the loss in household welfare, to estimate how much household income is reduced as a consequence of paying higher prices due to the presence of market power (Section 3).

The welfare loss analysis is deepened by quantifying the impact on households classified by income decile and by differentiating the impact on the economic regions of the country. Finally, the impact of the persistence of market power on income inequality among Mexican households and on the country's economic growth is estimated (Section 4).

2. DETERMINANTS OF HOUSEHOLD DEMAND

Measurement of the loss in household welfare derived from the presence of market power requires a rigorous analysis of household expenditure decisions,[1] as measures of welfare loss are constructed from these decisions. This section of the study presents the theoretical bases of the analysis, the econometric estimation method and the results using 2014 ENIGH data.

2.1. EXPENDITURE AND DEMAND FUNCTIONS

A formal quantitative analysis requires an abstract behavior model. In this case, the model to be used should describe the decisions of household expenditure and allow for the analysis of counterfactual scenarios. The model used comes from the microeconomic theory of optimal consumption choice and its main components are:

1. Households utility function
2. Households expenditure function
3. Households demand functions

The core part of the study consists in econometrically inferring or estimating said components from the decisions of household expenditure contained in ENIGH. The microeconomic theory that describes and serves as a basis for characterizing the specific definitions of these functions is presented below.[2]

1. Expenditure decisions may be studied at the individual or household level. This study considers Mexican households as the unit of analysis.

2. A detailed theoretical analysis of the concepts presented in this study can be found in Mas-Collel, Whinston, and Green (1995, Chapter 3)

2.1.1. Expenditure function specification

Consumer theory describes optimal consumer behavior and decision-making of individuals (in this case households). In particular, the household expenditure function describes the minimum quantity required by households to achieve a certain level of utility, given their preferences and the price levels they face. This section presents the basic concepts to specify the expenditure function used.

Utility function

The utility function summarizes all the relevant properties of household consumption preferences. This is a function whose arguments constitute a *basket of consumption* (a particular combination of goods consumed). If the household utility function h is identified as $U_h(\cdot)$, then $U_h(A)$ aassigns a numerical value to the consumption basket A. The relevant property of the utility function is not the specific numeric value that it assigns to a basket, but rather the property of comparing different baskets of consumption in a way that reflect the preferences of the household. This means that $U_h(\cdot)$ must satisfy the following property for any pair of baskets of consumption A and B:

i. Household h prefers basket A over basket B if and only if $U_h(A) > U_h(B)$.

ii. Household h is indifferent between basket A and basket B if and only if $U_h(A) = U_h(B)$.

Thus, the only requirement of the utility function is that it must completely summarize the ordinal properties of the preferences of the households.

The complete basket of products consumed by households in Mexico is very extensive and includes hundreds of goods. To make the analysis manageable, the products were classified into a smaller number of expenditure categories (see Section 2.2.1). This has the advantage of diminishing measurement errors and producing more robust and stable estimation results. Classifying goods in expenditure categories is a universal practice in estimating household demand systems based on expenditure surveys (Lewbel and Pendakur (2009), Deaton (1997)). Based on this classification,

presented below, are some useful definitions to characterize the properties assumed in the utility function considered in the study:

h = index to denote households.

J = total number of categories of expenditure (goods).

n_j = number of goods that comprise the expenditure category j.

q_{jih} = quantity consumed (by household h) of good i in expenditure category j.

q_{jh} = vector of quantities consumed by household h in expenditure category j.

p_{ji} = market price of good i within expenditure category j.

p_j = vector of market prices of expenditure catego j.

x_h = total expenditure of household h.

x_{jh} = total expenditure of household h allocated to expenditure category j.

$w_{jh} = x_{jh}/x_h$ = proportion of expenditure allocated to category j in household h.

$w_{jih} = p_{ji}q_{jih}/x_{jh}$ = proportion of expenditure allocated to good i within expenditure category j in household h.

This study follows the fundamental assumption in Lewbel (1989), which assumes that the household utility function is separable in such a way that it may be expressed as:

$$U_h\,(u_{1h}(q_{1h}, z_h), \ldots, u_{Jh}(q_{Jh}, z_h)),$$

(1)

Where z_h is a vector of socioeconomic characteristics observable in household h and each of the functions $u_{jh}(q_{jh}, z_h)$ measure the global utility of household h. This property of separability allows for greater flexibility for the analysis as there are no restrictions between the functional form of global utility U_h and the functional forms of utilities u_{jh} within each category. For example, it is possible to assume that the utility functions $u_{jh}(q_{jh}, z_h)$ within each category are of the "Cobb Douglas" type

without having to specify the functional form of the global utility U_h. It is worth noting that this separability assumption is assumed in practically all the demand estimation literature.[3]

The following is a precise formalization of the assumption of separability of utility functions that will serve as a theoretical support of the results.

Assumption of Separability of utility functions

CAs in Lewbel (1989), household utility functions are assumed to be weakly separable as described in equation (1). In this way, households consumption choices occur in two separate stages: first, each household h decides how to allocate its expenditure among diverse categories $j = 1, \ldots, J$. Once this distribution is determined, each household decides the proportion of expenditure w_{jih} within each category. Assuming that, once controlling for the characteristics of the households included in vector z_h, the proportions of expenditure w_{jih} within each category are statistically independent of the determinants of expenditure decisions between the different categories. In other words, once controlled by z_h, expenditure proportions (w_{jih}) within each category are independent from the expenditure proportions (w_{jh}) within the different categories.

Price indices at the household level

The estimation of expenditure functions based on the ENIGH requires the construction of price indices at the household level for each expenditure category which best approximates the price disbursed in each household, (see section 2.2.3). Following the methodology in Lewbel (1989) whose fundamental assumption is that the utility function of households (individuals) is weakly separable in the way described in equation (1). Based on this generic expression, the objective is to construct price indices $\mathcal{P}_{jh}$ for each expenditure category $j = 1, \ldots, J$ for a household h with

3. The assumption of separability of the utility function is fundamental in the Deaton (1988) method.

characteristics z_h. Lewbel (1989) demonstrates that if preferences are homothetic, $\mathcal{P}_{jh}$ may be calculated by:

$$\log\left(\mathcal{P}_{jh}\right) = p_{ji}\int h_{ji}(p_j, z_h)dp_{ji}, \quad \text{for each} \quad i = 1, \ldots, n_j,$$

where h_{ji} refers to the Hicksian demand of a good *i* within category *j*. In particular, if the utility functions $u_{jh}(q_{jh}, z_h)$ within the category j are Cobb Douglas, a very simple expression for Pjh is obtained, $\mathcal{P}_{jh}$,

$$\mathcal{P}_{jh} = \frac{1}{k_j}\prod_{i=1}^{n_j}\left(\frac{p_{ji}}{w_{jih}}\right)^{w_{jih}},$$

(2)

where k_j is a factor of scale defined as:

$$k_j = \prod_{i=1}^{n_j}\overline{w}_{ji}^{-\overline{w}_{ji}},$$

where $\overline{w}_{ji}$ is the proportion of expenditure allocated to good *i* within category *j* by the "household of reference". Said household of reference may be taken, for example, as the hypothetical household for which the expenditure proportions correspond to the average proportions observed in the data (ENIGH).

Expenditure function

The proposed expenditure function is based on the concept of implicit Marshallian demands introduced and developed by Lewbel and Pendakur (2009). These are the Hicksian demand functions where indirect utility is approximated through an affine transformation (lineal) of the total level of household expenditure. The result is an implicit Marshallian demands system, referred to by authors as *Exact Affine Stone Index (*EASI*) Implicit Marshallian Demand system*.

EASI demand systems are generated by expenditure functions (in logarithm) with functional forms of the type:

$$C(\mathbf{p}_h, u_h, \mathbf{z}_h, \boldsymbol{\varepsilon}_h) = u_h + \mathbf{p}_h' m(u_h, \mathbf{z}_h) + T(\mathbf{p}_h, \mathbf{z}_h) + S(\mathbf{p}_h, \mathbf{z}_h)\cdot u_h + \mathbf{p}_h'\boldsymbol{\varepsilon}_h.$$

Where u_h is the utility level of household h, z_h is a vector of the socioeconomic characteristics of household h, x_h is the logarithm of the total expenditures of household h, $\mathfrak{p}_h=(\log(\mathcal{P}\ j_h\ )^l{}_{J=1}$ is the vector of price indices (in logarithms) for household h (where $\mathcal{P}_{jh}$ is constructed as described in (2)) and $\varepsilon_h(J\ x\ 1)$ is a vector of non-observable characteristics (random parameters) of household h. Also, and following Lewbel and Pendakur (2009), the functions $T(\mathfrak{p}_h, z_h)$ y $S(\mathfrak{p}_h, z_h)$ are defined as:

$$T(\mathfrak{p}_h, z_h) = \frac{1}{2}\sum_{\ell=0}^{L} z_{\ell h}\mathfrak{p}_h' A_\ell \mathfrak{p}_h, \quad S(\mathfrak{p}_h, z_h) = \frac{1}{2}\mathfrak{p}_h' B \mathfrak{p}_h,$$

$$m(u_h, z_h) = \left(\sum_{r=0}^{R} b_r u_h^r\right) + Cz_h + Dz_h u_h.$$

(4)

where

$$z_{0h} \equiv 1, \underbrace{A_\ell}_{J\times J} \text{ (for } \ell = 1, \ldots, L) \text{ y } \underbrace{B}_{J\times J}$$

are symmetrical matrixes of parameters,

$$\underbrace{C}_{J\times L} \text{ and } \underbrace{D}_{J\times L}$$

are matrixes of parameters and each b_r (for $r = 0, \ldots, R$) is in turn a vector of parameters.

The expenditure functions must satisfy a series of restrictions imposed by the microeconomic consumer theory. Said restrictions are detailed, for example in, Mas-Collel, Whinston and Green (1995, Chapter 3) and impose conditions directly on parameters of the system defined in equation (4).

In this sense, the first theoretical restriction is that the matrixes of parameters Al and B should be symmetrical. The second restriction is the property of homogeneity of degree one in prices of the expenditure function. Basically, said property establishes that if the prices of all goods consumed increase by a factor of t, the expenditure function also increases by a factor of t. This

property has direct implications on the parameters of the demand system, which must satisfy the following conditions,

$$1_J' A_\ell = 1_J' B = 0_J' \ (\text{ for each } \ \ell = 1, \ldots, L), \quad 1_J' C = 1_J' D = 0_L,$$

$$1_J' b_0 = 1, \quad 1_J' b_r = 0 \ (\text{ for each } \ r \neq 0)$$

where 1_J denotes a column vector of J ones, 0_J and 0_L are column vectors of J and L zeros respectively.[4] These restrictions have the advantage of reducing the number of parameters to estimate.

2.1.2. Characterization of the demand functions

The demand functions describe the optimal consumption baskets (that is, the consumption baskets that maximize the level of household welfare) as functions of prices and of the total monetary budget destined for consumption by the household. For household h, with a monetary budget x_h for expenses, the demand functions describe the quantities to be consumed, for each of the components of the basket of goods, such that these maximize the level of utility (welfare) of the household.

The demand functions are directly obtained from the expenditure functions through the so-called Shephard's lemma (Mas-Collel, Whinston and Green (1995)), the Hicksian demands (expressed in terms of expenditure proportions) given by:

$$\omega(\mathbf{p}_h, u_h, \mathbf{z}_h, \boldsymbol{\varepsilon}_h) = \nabla_p C(\mathbf{p}_h, u_h, \mathbf{z}_h, \boldsymbol{\varepsilon}_h) = m(u_h, \mathbf{z}_h) + \nabla_p T(\mathbf{p}_h, \mathbf{z}_h) + \nabla_p S(\mathbf{p}_h, \mathbf{z}_h) u_h + \boldsymbol{\varepsilon}_h. \tag{5}$$

Like all empirical analysis, the object of interest is not the Hicksian demand but the Marshallian demand, which describes the optimal behavior of consumers as a function of price and income. The assumption maintained (as in all literature) is that the demands observed in the data correspond to Marshallian, not Hicksian demands.[5] To obtain the Marshallian demands, the following step

4. Also, ε_h must satisfy $\varepsilon'_h 1_J = 0$.

5. The Hicksian demand refers to the optimal consumption quantity when the objective of the consumer is to minimize expenditure under the restriction of maintaining a minimum level of utility uh. The Marshallian demand refers to the optimum consumption quantity when the objective of the consumer is to maximize utility, subject to budgetary restrictions (see Mas-Collel, Whinston and Green (1995)).

would be to solve numerically (in u_h) the equality:

$$x_h = C(\mathfrak{p}_h, u_h, \mathbf{z}_h, \boldsymbol{\varepsilon}_h).$$

The solution is the so-called "indirect utility" given by $V(\mathfrak{p}_h, x_h, \mathbf{z}_h, \varepsilon_h) = C^{-1}(\mathfrak{p}_h, \cdot, \mathbf{z}_h, \varepsilon_h)$. From here, the Marshallian demands are obtained by replacing u_h in the Hicksian demand expression (above) with indirect utility. The resulting demand system (expressed as proportions of expenditure) is:

$$\mathbf{w}_h = m(V(\mathfrak{p}_h, x_h, \mathbf{z}_h, \boldsymbol{\varepsilon}_h), \mathbf{z}_h) + \nabla_p T(\mathfrak{p}_h, \mathbf{z}_h) + \nabla_p S(\mathfrak{p}_h, \mathbf{z}_h) V(\mathfrak{p}_h, x_h, \mathbf{z}_h, \boldsymbol{\varepsilon}_h) + \boldsymbol{\varepsilon}_h.$$

If the function $m(u_h, \mathbf{z}_h)$ is a polynomial in u_h, solving numerically the indirect utility function $V(\mathfrak{p}_h, x_h, \mathbf{z}_h, \varepsilon_h)$ is computationally costly and potentially inviable. The contribution of Lewbel and Pendakur (2009) demonstrates that, if the expenditure function has the description given in (3), then the indirect utility is *ordinally equivalent* to the following affine transformation of $x_h - \mathfrak{p}_h' \mathbf{w}_h$:

$$y_h = \frac{x_h - \mathfrak{p}_h' \mathbf{w}_h - T(\mathfrak{p}_h, \mathbf{z}_h) + \mathfrak{p}_h' \left[\nabla_p T(\mathfrak{p}_h, \mathbf{z}_h)\right]}{1 + S(\mathfrak{p}_h, \mathbf{z}_h) - \mathfrak{p}_h' \left[\nabla_p S(\mathfrak{p}_h, \mathbf{z}_h)\right]}.$$

(6)

Given the ordinal equivalence, the proposal of Lewbel and Pendakur (2009) is to substitute u_h for y_h in (5), obtaining the implicit Marshallian demand system:

$$\mathbf{w}_h = m(y_h, \mathbf{z}_h) + \nabla_p T(\mathfrak{p}_h, \mathbf{z}_h) + \nabla_p S(\mathfrak{p}_h, \mathbf{z}_h) y_h + \boldsymbol{\varepsilon}_h.$$

(7)

This construction allows for greater flexibility in the functional forms used for $m(u_h, \mathbf{z}_h)$, $T(\mathfrak{p}_h, \mathbf{z}_h)$ and $S(\mathfrak{p}_h, \mathbf{z}_h)$, especially ordinally *vis-à-vis* the AIDs systems by Deaton and Muellbauer (1980). Denoting the vector of observable characteristics $\mathbf{z}_h$ as $\mathbf{z}_h = (z_{1h}, z_{2h} \ldots, z_{Lh})$, the system of implicit Marshallian demands (in terms of expenditure proportions) is reduced to:

$$\mathbf{w}_h = \sum_{r=0}^{R} b_r y_h^r + \mathbf{C}\mathbf{z}_h + \mathbf{D}\mathbf{z}_h y_h + \sum_{\ell=0}^{L} z_{\ell h} A_\ell \mathfrak{p}_h + \mathbf{B}\mathfrak{p}_h y_h + \boldsymbol{\varepsilon}_h,$$

$$\text{where} \quad y_h = \frac{x_h - \mathfrak{p}_h' \mathbf{w}_h + \frac{1}{2}\sum_{\ell=0}^{L} z_{\ell h} \mathfrak{p}_h' A_\ell \mathfrak{p}_h}{1 - \frac{1}{2}\mathfrak{p}_h' \mathbf{B}\mathfrak{p}_h}$$

(8)

The system of implicit Marshallian functions "EASI" described in (8) has the following advantages – among others:

i. Conditional in y_h, the demand system is linear in all the parameters of interest, which computationally simplifies the estimation.

ii. Parameters *D* and *B* allow for the flexible integration between y_h and z_h, as well as between y_h and p_h. This degree of flexibility is much greater than, for instance, that allowed by an AIDs demand system by Deaton and Muellbauer's (1980) AIDs.

iii. Banks, Blundell and Lewbel (1997); Blundell, Chen and Kristensen (2007)) suggest that the Engel curves of certain types of goods have complicated shapes, including 'S' shaped curves (*S-shaped Engel curves*) and inverted 'S' (*inverted S-shaped Engel curves*). The coefficients b_r , $r = 0, \ldots R$ imply that the Engel curves derived from the system are polynomials of the R order. This great flexibility allows to approximate very complicated shapes, much more than other existing specifications allow (for example the AIDs system of Deaton and Muellbauer (1980)).

iv. The specifications of the function $m(y_h, z_h)$ is not restricted only to be polynomial. It may be generalized to functions of the type $m(y_h, z_h) = \Gamma g(y_h, z_h)$, where Γ is a matrix of $(J \times K)$ parameters and $g(y_h, z_h)$ is a vector of R functions. In the specification described above, functions $g(y_h, z_h)$ are of the type $y^r{}_h z_{\ell h}$. This can be generalized to include non-polynomial functions.

v. The demand system (8) is entirely compatible with expression (2) utilized to generate price indices at the household level. This is due to the assumption of weak separability of preferences and to the fact that (2) is derived from the utility functions within each expenditure category $(u_{jh}(q_{jh}, z_h)^l{}_{J=1}$, while the demand system (8) is derived from global utility $U_h(u_{1h}, \ldots, u_{Jh})$ through which household h decides how much expenditure to allocate to each category.

2.1.3. Exact Marshallian Demands and construction of the aggregated demands

The implicit Marshallian demands, described in (8), use y_h as an approximation of the function of implicit utility. From the expenditure functions it is possible to construct the exact Marshallian demands, as follows.

Step 1.- For household h and a given vector of prices $\mathfrak{p}$, numerically solve (in u) the equality

$$x_h = u + \mathfrak{p}' m(u, \boldsymbol{z}_h) + T(\mathfrak{p}, \boldsymbol{z}_h) + S(\mathfrak{p}, \boldsymbol{z}_h) \cdot u + \mathfrak{p}' \boldsymbol{\varepsilon}_h$$

The solution is the estimated indirect utility $V(\mathfrak{p}, x_h, \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h)$.

Step 2.- The system of exact Marshallian demands (expressed in terms of expenditure proportions) is given as,

$$\boldsymbol{\omega}_h^M(\mathfrak{p}, x_h, \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h) =$$
$$m\left(V(\mathfrak{p}, x_h, \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h), \boldsymbol{z}_h\right) + \nabla_p T(\mathfrak{p}, \boldsymbol{z}_h) + \nabla_p S(\mathfrak{p}, \boldsymbol{z}_h) \cdot V(\mathfrak{p}, x_h, \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h) + \boldsymbol{\varepsilon}_h$$

From here, the system of Marshallian demands (in quantities demanded) can be obtained as:

$$q_h^M(\mathfrak{p}, x_h, \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h) = \operatorname{diag}(\mathfrak{p}) \cdot \boldsymbol{\omega}_h^M(\mathfrak{p}, x_h, \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h) \cdot x_h,$$

$$\text{where} \quad \underbrace{\operatorname{diag}(\mathfrak{p})}_{J \times J} = \begin{pmatrix} \mathfrak{p}_1 & 0 & \cdots & 0 \\ 0 & \mathfrak{p}_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \mathfrak{p}_J \end{pmatrix}$$

Once the exact Marshallian demands have been calculated, it is possible to construct a measure of aggregated demand. It should be noted that the ENIGH is comprised by a representative sample of households in Mexico, while an adequate measure of aggregated demand should include the sum of the demands of all *households*. From the ENIGH sample, this can be approximated as follows:

$$Q_h^M(\mathfrak{p}) = \sum_{h=1}^{N} q_h^M(\mathfrak{p}, x_h, \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h) \cdot \pi_h,$$

where π_h is a weighting factor that measures the representativeness of household h within the population of total households. This study utilizes π_h as the so-called *household expansion factor* included in the

ENIGH for each household in the sample.[6] The demand elasticities reported in this study are calculated based on this construction of aggregated demands.

2.1.4. COMPENSATING VARIATION AND EQUIVALENT VARIATION

By definition, the expenditure function $C_h(\cdot)$ may provide monetary measures, with theoretical foundation, of the impact derived from changes in prices on households' welfare. Taking household h and assuming two alternative level of prices, p_0 y p_1, and denoting the maximum utility that said household can reach under these scenarios as u_0 y u_1 respectively, there are two formal measures of the impact on the welfare of household h derived from the change in prices from p_0 a p_1 (see Hicks (1939)).[7] These are called *compensating variation and equivalent variation*.

Compensating variation *(VC)*.– is defined as the monetary amount with which household h would have to be compensated or that would have to be taken from household h) to reach the original level of utility u_0 under the new prices p_1. In terms of the expenditure function, this is:

$$VC = C_h(\boldsymbol{p}_1, u_1) - C_h(\boldsymbol{p}_1, u_0).$$

Equivalent variation *(VE)*.– is defined as the monetary amount equivalent to the change in prices from p_0 to p_1. In terms of the expenditure function, this is:

$$VE = C_h(\boldsymbol{p}_0, u_1) - C_h(\boldsymbol{p}_0, u_0).$$

Derived from the functional forms, a precise expression is obtained for compensating (VC) and equivalent (VE) variation. Assuming that the objective is to measure the impact of a change in the vector of prices from $\mathbf{p}^0_h$ a $\mathbf{p}^1_h$ p for household h, we have:

6. The household expansion factor published by the ENIGH is a weighting factor that measures, for each household in the ENIGH, the quantity of total households in the population that represents the household at issue.

7. Contrary to what is sometimes assumed, the so-called "consumer surplus" is not a formal measure of the impact on welfare but only an approximation.

$$VC_h(\mathbf{p}_h^0, \mathbf{p}_h^1, \mathbf{z}_h, \boldsymbol{\varepsilon}_h) = \exp\left\{C\left(\mathbf{p}_h^1, y_h(\mathbf{p}_h^1), \mathbf{z}_h, \boldsymbol{\varepsilon}_h\right)\right\} - \exp\left\{C\left(\mathbf{p}_h^1, y_h(\mathbf{p}_h^0), \mathbf{z}_h, \boldsymbol{\varepsilon}_h\right)\right\},$$

$$VE_h(\mathbf{p}_h^0, \mathbf{p}_h^1, \mathbf{z}_h, \boldsymbol{\varepsilon}_h) = \exp\left\{C\left(\mathbf{p}_h^0, y_h(\mathbf{p}_h^1), \mathbf{z}_h, \boldsymbol{\varepsilon}_h\right)\right\} - \exp\left\{C\left(\mathbf{p}_h^0, y_h(\mathbf{p}_h^0), \mathbf{z}_h, \boldsymbol{\varepsilon}_h\right)\right\},$$

where:

$$C(\mathbf{p}_h, u_h, \mathbf{z}_h, \boldsymbol{\varepsilon}_h) = u_h + \mathbf{p}_h' m(u_h, \mathbf{z}_h) + T(\mathbf{p}_h, \mathbf{z}_h) + S(\mathbf{p}_h, \mathbf{z}_h) \cdot u_h + \mathbf{p}_h' \boldsymbol{\varepsilon}_h,$$

$$y_h(\mathbf{p}_h) = \frac{x_h - \mathbf{p}_h' \mathbf{w}_h + \frac{1}{2}\sum_{\ell=0}^{L} z_{\ell h} \mathbf{p}_h' \mathbf{A}_\ell \mathbf{p}_h}{1 - \frac{1}{2}\mathbf{p}_h' \mathbf{B} \mathbf{p}_h'},$$

$$T(\mathbf{p}_h, \mathbf{z}_h) = \frac{1}{2}\sum_{\ell=0}^{L} z_{\ell h} \mathbf{p}_h' \mathbf{A}_\ell \mathbf{p}_h,$$

$$S(\mathbf{p}_h, \mathbf{z}_h) = \frac{1}{2}\mathbf{p}_h' \mathbf{B} \mathbf{p}_h,$$

$$m(u_h, \mathbf{z}_h) = \left(\sum_{r=0}^{R} \mathbf{b}_r u_h^r\right) + \mathbf{C}\mathbf{z}_h + \mathbf{D}\mathbf{z}_h u_h,$$

$$\boldsymbol{\varepsilon}_h = \mathbf{w}_h - \left[\sum_{r=0}^{R} \mathbf{b}_r y_h^r + \mathbf{C}\mathbf{z}_h + \mathbf{D}\mathbf{z}_h y_h(\mathbf{p}_h) + \sum_{\ell=0}^{L} z_{\ell h} \mathbf{A}_\ell \mathbf{p}_h y_h(\mathbf{p}_h) + \mathbf{B}\mathbf{p}_h y_h(\mathbf{p}_h)\right]$$

2.2. Data

The source of information for the study is ENIGH prepared by INEGI. This survey has a probabilistic, stratified, two-stage and by conglomerates sampling scheme. The ultimate sampling unit is the dwelling and the unit observed is the household; consequently, the results obtained from the survey are generalizable to the entire population.

2.2.1. Expenditure categories

The variety of markets for goods and services, which can be analyzed to determine the impact of the presence of market power on consumers, is very broad. However, the resources, time and information for its analysis are limited. Therefore, it is necessary to select the categories of expenditure to be analyzed based on criteria of interest for competition policy.

For the selection of the expenditure categories, five criteria were established in this study. The first is that the goods and services under analysis are of final consumption, so that the impact of the change in prices on the welfare of consumers is direct, and not indirect as is the case with intermediate goods.

The second is that goods and services correspond to the price series of the National Consumer Price Index (INPC) published by INEGI. The third considers the size of production, that is, that the production of said goods and services has a relevant contribution to the national Gross Domestic Product in relative terms. The fourth is that the sector produces goods or services for general consumption among the population at the national level, that is, that these are not only demanded by a specific sector or geographic or socioeconomic segment. Finally, the fifth, is that these are goods and services of high demand in lower-income households.

After applying these criteria, 12 categories of expenditure were selected for this study. These categories of expenditure are shown in Box 1.

Box 1. Analyzed Expenditure Categories. [a/]

1.- *Tortillas*		2.- Bread		3.- Chicken and eggs	
Corn *Tortillas*	(A004)	White bread	(A012)	Whole Chiken	(A057,A058)
		Sweet bread	(A013,A014)	Pieced Chiken	(A059)
				Egg	(A093)
4.- Beef		**5.- Processed meats**		**6.- Non- alcoholic beverages**	
Steak	(A025)	*Chorizo*	(A049)	Juices and nectars	(A218)
Ground beef	(A034)	Ham	(A052)	Soft drinks	(A220)
Beef viscera	(A037)	Sausages	(A055)	Bottled water	(A215)
		Bacon	(A054)		
7.- Fruits		**8.- Vegetables**		**9.- Dairy**	
Apple	(A158)	Avocado	(A108)	Pasteurized milk	(A075)
Banana	(A065 - A067)	Tomato	(A124)	Powdered milk	(A078)
Papaya	(A161)	Potato	(A102)	Fromula milk	(A079)
Orange	(A160)	Onion	(A112)	Condensed milk	(A076)
Lemon	(A154)	Green tomato	(A129)	Fresh cheese	(A085)
Mellon	(A159)	Cabbage	(A120)	Oaxaca cheese	(A087)
Grapes	(A169)	Lettuce	(A125)	Yellow cheese	(A082)
Pear	(A162)	Zucchini	(A111)	Dairy cream	(A089)
Guava	(A152)	Carrot	(A130)	Butter	(A090)
Watermelon	(A168)	Serrano chile pepper	(A117)		
Pineapple	(A163)	Cactus	(A126)		
		Mirliton squash	(A113)		
		Poblano chile peppeer	(A116)		
		Cucumber	(A127)		
		Green beans	(A121)		
		Peas	(A114)		
		Beans	(A137)		
10.- Construction Materials		**11.- Interurban transport**		**12.- Medicines**	
Cosntruction materials	(K044)	Interurban bus	(M001)	Antibiotics	(J028, J052)
		Air transport	(M003)	Cardiovascular	(J056, J031)
				Analgesics	(J029, J030, J053, J054)
				Nutritional supplements	(J033, J055)
				Gastrointestinal	(J020, J044)
				Anti-influenza	(J021, J045)
				Cough medicine	(J024, J048)
				Dermatologic	(J022, J046)

Source: Author's work.
[a/]. The number in parenthesis corresponds to the identification code in the ENIGH of the products selected in each category.

On average, households in the sample allocate approximately two-thirds of their total monetary expenditure to the categories included in the study, and this proportion is higher (reaching levels higher than 75%) for households with lower incomes.

2.2.2. Geographic markets

As of 2011, INEGI publishes average prices at product level for 46 cities within the Mexican Republic. This study takes advantage of the availability of these prices. For this reason, these 46 cities were chosen as the geographic markets in the study.

For each household in the ENIGH, the nearest market was found and the prices of that market were used to construct the price indices for each household in the manner described in Section 2.2.3. Households located more than 400 kilometers from the nearest market were removed from the sample. Likewise, to have reliable statistical results only for households for which expenditure categories used were minimally relevant are considered. To this end, the study focuses on those households that reported monetary expenditure in at least one of the food categories and at least one of the remaining categories. Applying these criteria, the study universe includes 15,586 households (these represent approximately 80% of the households in the 2014 ENIGH).

Box 2 presents a comparison between the average quarterly income of households in the sample with respect to households in the ENIGH, by income decile. In this regard, the average percentage variation between the samples is 5.7% so that no significant differences of the households considered in the study are identified with respect to the original sample. That is, the study sample continues to be considered representative at the national level.

Box 2. Total quarterly income of households by decile in the 2014 ENIGH sample and the study sample.

Income Decile	ENIGH	Study
I	$6,902	$7,981
II	$12,035	$13,523
III	$16,058	$16,899
IV	$20,282	$20,655
V	$24,439	$25,051
VI	$29,532	$30,618
VII	$36,094	$38,636
VIII	$45,593	$47,227
IX	$62,840	$65,033
X	$143,850	$147,522
All households	$39,742	$41,293

Source: Author's work.

The geographic markets, in turn, were grouped into eight regions; in this way differentiated effects between households can be identified, according to the region in which these are located. The regions used are: Northwest (Baja California, Baja California Sur, Chihuahua, Durango, Sinaloa and Sonora), Northeast (Coahuila, Nuevo León and Tamaulipas), North Central (Aguascalientes, Guanajuato, Querétaro, San Luis Potosí and Zacatecas), South Central (Mexico City, State of Mexico and Morelos), Southwest (Chiapas, Guerrero and Oaxaca), Southeast (Campeche, Quintana Roo, Tabasco and Yucatan), West (Colima, Jalisco, Michoacán and Nayarit) and East (Hidalgo, Puebla , Tlaxcala and Veracruz). Box 3 shows the geographic markets and the regions to which they belong.

Box 3. Geographic Markets.

Northwest	Northeast	West	East
Mexicali, B.C.	Ciudad Acuña, Coah.	Colima, Col.	Tulancingo, Hgo.
Tijuana, B.C.	Monclova, Coah.	Guadalajara, Jal.	Puebla, Pue.
La Paz, B.C.S.	Torreón, Coah.	Tepatitlán, Jal.	Tlaxcala, Tlax.
Chihuahua, Chih.	Monterrey, N.L.	Jacona, Mich.	Córdoba, Ver.
Ciudad Juárez, Chih.	Matamoros, Tamps.	Morelia, Mich.	San Andrés Tuxtla, Ver.
Jiménez, Chih.	Tampico, Tamps.	Tepic, Nay.	Veracruz, Ver.
Durango, Dgo.			
Culiacán, Sin.			
Hermosillo, Son.			
Huatabampo, Son.			
North Central	**South Central**	**Southwest**	**Southeast**
Aguascalientes, Ags.	Ciudad de México.	Tapachula, Chis.	Campeche, Camp.
Cortázar, Gto.	Toluca, Mex.	Acapulco, Gro.	Chetumal, Q.R.
León, Gto.	Cuernavaca, Mor.	Iguala, Gro.	Mérida, Yuc.
Querétaro, Qro.		Oaxaca, Oax.	Villahermosa, Tab.
San Luis Potosí, S.L.P.		Tehuantepec, Oax.	
Fresnillo, Zac.			

Source: Author's work.

2.2.3. Construction of price indices at the household level

The first challenge to estimate expenditure and demand functions of households based on the ENIGH (or based on *expenditure surveys* similar to the ENIGH) is the fact that different households consume different baskets of goods within each category, whose exact composition is not typically available in these surveys. For instance, within the expenditure category "meats" there are different types of meat cuts of different quality, so that the unit price disbursed by household h will generally be different from the unit price disbursed in household h' if both households consumed different meat cuts. Therefore, the first step is to try to reconstruct a price index at the household level for each expenditure category that best approximates the unit price spent on each household. Even for the same cut of meat, the same location and the same date of purchase there may be heterogeneity in price observed by household h and household h', depending on the place these made the purchase.

One possibility to build price indices at the household level is through the use of the so-called "unit values", which are constructed from the information of monetary expenditure and units or quantities consumed. Methods based on unit values have been outlined mainly in Deaton (1987, 1988 and 1997). The disadvantage of the use unit values is that said methodology can only be applied

if there is information on quantities consumed, and the ENIGH does not include such information for several of the expenditure categories analyzed in the present study.

Instead of using a method based on unit values, the proposal is to use the results of Lewbel (1989), who demonstrates how a price index can be retrieved at the individual level (or at the household level in this case) if the utility function satisfies homotheticity. This property is very general, so this method has great applicability. Above all - crucially for the objectives of the study - all components needed to retrieve these price indices are available in the ENIGH for all expenditure categories. The detail of the methodology is presented in Section 2.1.1.

Previous studies (Slesnick (2005), S. Hoderlein (2008)) have shown that demand estimates based on the price indices at the household level described in (2) have excellent properties compared to demand estimates that use unit values or estimates of demand that directly use price indices at the market level.

2.3. Estimation

The estimation method used is guided by the methodology proposed in Lewbel and Pendakur (2009). The objective is to estimate the parameters of the demand system described in (8),

$$\left((\boldsymbol{b}_r)_{r=0}^{R}, C, (\boldsymbol{A}_\ell)_{\ell=0}^{L}, D, B\right)$$

According to the authors mentioned above, this study uses an expenditure function that depends on indirect utility through a polynomial of degree 3 (that is, $R = 3$), in order to provide flexibility to the functional forms. Prior to the estimation, the space of parameters is also restricted to those values that are consistent with the conditions described in Section 2.1.1, which are derived from microeconomic theory. In this sense, the following restrictions are imposed on the parameters:

1. Symmetry of the matrixes A_ℓ and B.
2. Degree of homogeneity 1 in prices- We impose the restrictions described in section 2.1.1.

In addition to obtaining expenditure functions compatible with consumer theory, these restrictions have the great advantage of reducing the number of parameters to be estimated.

2.3.1. Exact demand systems

The system of implicit Marshallian demands (Equation (8), Section 2.1.2) can be re-expressed as

$$\mathbf{w}_h = \sum_{r=0}^{R} \mathbf{b}_r y\left(x_h, \mathbf{p}_h, \mathbf{w}_h, (\mathbf{A}_\ell)_{\ell=0}^{L}, \mathbf{B}\right)^r + \mathbf{C}\mathbf{z}_h + \sum_{\ell=0}^{L} z_{\ell h}\mathbf{A}_\ell \mathbf{p}_h + \left(\mathbf{D}\mathbf{z}_h + \mathbf{B}\mathbf{p}_h\right) \cdot y\left(x_h, \mathbf{p}_h, \mathbf{w}_h, (\mathbf{A}_\ell)_{\ell=0}^{L}, \mathbf{B}\right) + \boldsymbol{\varepsilon}_h. \quad (9)$$

Therefore, the estimation proceeds in two steps:

1. Estimation of an approximate system of demand, based on a simple approximation of indirect utility y_h in (6).
2. Using the parameters estimated in the first step as initial values, we proceed to estimate the exact system of demands described in (9) using estimation methods for nonlinear models.

Before describing the steps of the procedure, emphasis is made in two important implications of the assumption of the separability of the utility functions (Section 2):

1. Assuming that each household takes market prices as exogenous (a reasonable assumption if it is assumed that households do not individually have market power to influence prices) and that, consequently, there is no systematic relationship between market prices and the characteristics of households, then the statistical independence (conditional on $\mathbf{z}_h$) between the proportions of expenditure (w_{jih}) and the proportions of expenditure (w_{jh}) between the different categories implies that price indices of Lewbel described in equation (2) are statistically independent from $\boldsymbol{\varepsilon}_h$. In other words, price indices can be taken as exogenous in the estimation of the system of demands described in (8).
2. There are statistical tests to explore the validity of this exogeneity of the price indices of households. Annex A presents the results of said tests.

2.3.2. Estimation of an approximate demand system

The expression of y_h described in (6) is a nonlinear transformation of the parameters of the demand system. Lewbel and Pendakur (2009) analyze replacing y_h cwith an approximation of the following type:

$$\tilde{y}_h = x_h - \mathbf{p}_h' \overline{\boldsymbol{w}}_h,$$

Where $\overline{w}_h$ is a given vector of expenditure shares. The purpose for using $\tilde{y}_h$ as an approximation is to simplify the computational cost involved in the estimation of the parameters. The authors refer to the resulting demand system as an *approximate demand system*, which is simply of the type:

$$\boldsymbol{w}_h = \sum_{r=0}^{R} b_r \tilde{y}_h^r + \boldsymbol{C}\boldsymbol{z}_h + \sum_{\ell=0}^{L} z_{\ell h} \boldsymbol{A}_\ell \mathbf{p}_h + \left(\boldsymbol{D}\boldsymbol{z}_h + \boldsymbol{B}\mathbf{p}_h\right) \cdot \tilde{y}_h + \tilde{\boldsymbol{\varepsilon}}_h.$$

(10)

The authors suggest different options for $\overline{w}_h$. Following one of their recommendations, this study uses average expenditure shares among households,

$$\overline{\boldsymbol{w}}_h = \frac{1}{N} \sum_{h=1}^{N} \boldsymbol{w}_h.$$

The estimation of the approximate demand system (10) is relatively simple, since it represents a system of linear equations in the parameters of interest. Derived from the assumption of separability of the utility functions and the resulting exogeneity of prices, if it is assumed that x_h y $\boldsymbol{z}_h$ are not systematically correlated with the residual $\tilde{\boldsymbol{\varepsilon}}_h$ (in other words, if x_h y $\boldsymbol{z}_h$ are considered as exogenous), the estimation of (10) may be done using least squares. Otherwise, if x_h and/or some of the element(s) in $\boldsymbol{z}_h$ are suspect of endogeneity, the estimation of (10) may be done using the method of instrumental variables for which "instruments" are needed for the endogenous elements in $\boldsymbol{z}_h$ or x_h (see Davidson and MacKinnon (1993, Chapter 7)). In this specific study, x_h and the characteristics included in $\boldsymbol{z}_h$ will be treated as exogenous and testing is done to corroborate the validity of such an assumption (in Annex A).

The system (10) is only an approximation of the exact demands system (9). However, among the main findings of Lewbel and Pendakur (2009), the authors find evidence that the results of

estimating the approximate system (10) in most cases, are remarkably similar to those obtained by the exact system estimation (9), with the advantage that the approximate demand system is relatively simpler to estimate computationally. Therefore, this study estimates the exact demands system (9) in a second step, using the estimated values of the parameters of the approximate demand system only as initial values of the final estimation.

2.3.3. Estimation of the Exact Demand System

Denoting the estimators obtained from the first stage (derived from the approximate demand system) as:

$$\left(\left(\tilde{A}_\ell\right)_{\ell=0}^{L}, \tilde{B}, \tilde{C}, \tilde{D}, \left(\tilde{b}_r\right)_{r=0}^{R}\right)$$

In the second stage of the procedure, the exact demand system described in (9) (which is nonlinear in the parameters of interest) is resumed and it is estimated by using the first-stage estimators as the initial values. As usual in the estimation of nonlinear models, the estimation proceeds using the so-called *Generalized Method of Moments* (see Davidson and MacKinnon (1993, Chapter 17)). It is defined as:

$$g_h = \frac{x_h - \mathbf{p}_h' \mathbf{w}_h + \frac{1}{2}\sum_{\ell=0}^{L} z_{\ell h} \mathbf{p}_h' \tilde{A}_\ell \mathbf{p}_h}{1 - \frac{1}{2}\mathbf{p}_h' \tilde{B} \mathbf{p}_h'},$$

$$s_h = \left(1, \left(g_h^r\right)_{r=1}^{R}, \mathbf{z}_h, \left(z_\ell h \cdot \mathbf{p}_h\right)_{\ell=1}^{L}, \mathbf{z}_h \cdot g_h, \mathbf{p}_h \cdot g_h\right)'$$

It should be noted that g_h is the indirect utility while y_h is that estimated using the estimators from the approximate model obtained in the first step. The exogeneity of prices that results from the assumption or separability of household utility, combined with the assumption that both x_h and the characteristics of the households $\mathbf{z}_h$ are not systematically correlated with ε_h, produces the following *conditions or restrictions of moments*,

$$E\left[\begin{pmatrix} \mathbf{w}_h - \sum_{r=0}^{R} b_r y\left(x_h, \mathbf{p}_h, \mathbf{w}_h, (A_\ell)_{\ell=0}^{L}, B\right)^r + C\mathbf{z}_h \\ + \sum_{\ell=0}^{L} z_{\ell h} A_\ell \mathbf{p}_h + \left(D\mathbf{z}_h + B\mathbf{p}_h\right) \cdot y\left(x_h, \mathbf{p}_h, \mathbf{w}_h, (A_\ell)_{\ell=0}^{L}, B\right) \end{pmatrix} \cdot s_h \right] = 0. \quad (11)$$

The estimation made of the exact demand system is based on said restrictions.

Household characteristics

Based on the type of variables included in empirical work on demand systems, the following household characteristics were included as determinants of the demands:

1. EDUC: Education of the head of the household.
2. INTEGRANTES: Total number of household members.
3. MENORES: Number of household members under 12 years of age.
4. INGR80: Indicator variable (1 if the household is above the 80th income decile).
5. LOC2500: Indicator variable (1 if household is in a locality with fewer than 2,500 inhabitants).
6. AUTOLAV: Indicator variable (1 if the household has a washing machine and a car).

In order to have a flexible and rich demand system in its specification, interaction terms between the variables described above were included. Specifically, the variables included in the demand systems were the following:

EDUC, INTEGRANTES, MENORES, EDUCxINTEGRANTES, EDUCxMENORES, $EDUC^2$, INGR80, LOC2500, AUTOLAV

Number of Parameters to be estimated

The demand system considered is unusually rich and complex relative to the systems that have been estimated in previous literature. It covers 12 expenditure categories and includes a rich collection of household characteristics as controls. Once the conditions of symmetry and the other restrictions described above have been imposed, the total number of parameters to be estimated in the demand systems is 902. However, interest is focused not on the individual parameters but on more specific measures that are relevant to the economic policy, specifically demand elasticities

(that is, measures of sensibility to changes in prices), and measures of loss of welfare described above.

Disaggregation of results for the transport category

Within each expenditure category, the methodology allows to isolate the effect of changes in prices of specific *products* or *subcategories*, keeping the prices of the other products or subcategories constant. In this case, for some results those for the category of expenditure *national transportation* has been disaggregated into its two components: air transport and interurban buses. Eventually, this allows to identify the properties separately and the possible presence of market power in these two subcategories. The reason why these are grouped into a same category is that there are many households that reported zero total expenditure in one of these two. Derived from this, analyzing these as separate categories produces some instability in the estimation results (derived from our construction of price indices at the household level). Such instability disappears once grouped into a single category: "interurban passenger transportation".

2.4. Results

The results of the estimation of the demand system are summarized below. Appendixes A and B include different robustness tests where the possibility of endogeneity is analyzed as well as the goodness-of-fit.

2.4.1. Demand elasticities: results at the national level

The estimated demand system allows to estimate elasticities for a specific market or at the national aggregate level. The construction proceeds as described in Section 2.1.3, using the estimated results. Box 4 includes the results of the aggregated (national) demand for each category.

The price elasticity of a good defines how dispensable it is for consumers who demand it, given an increase in price. Thus, an elastic good sees its demand reduced in a greater proportion than the increase in price (elasticity greater than one in absolute value). On the contrary, an inelastic good sees its demand reduced in a

smaller proportion compared to the increase in the price (elasticity less than one).

According to the result of the estimates, the four most inelastic expenditure categories are: beef, ground interurban passenger transportation, construction materials and medicines. The five most elastic expenditure categories are: bread, fruit, dairy products and chicken-eggs. This is a reflection of the substitution patterns among food products of Mexican households. It is obvious that the beef category presents the least elasticity, revealing in turn that given the preferences of Mexican households, beef is in particular a good that is difficult to substitute. The results also reveal that three of the four non-food expenditure categories included in the study present inelastic demands (less than one in absolute value). This elasticity close to the unit can be interpreted as a "red flag", as it is indicative of the vulnerability of households to increases in prices derived from the presence of market power in these markets.

Box 4. Estimations of demand elasticity (absolute value).

Category	Elasticity	Standard error
Beef	0.735 **	0.366
Interurban passenger transportation	0.847 ***	0.269
Construction materials	0.934 ***	0.099
Medicines	0.943 ***	0.096
Processed meat	0.968 ***	0.276
Tortillas	1.054 ***	0.046
Non-alcoholic beverages	1.110 ***	0.241
Air transportation	1.246 ***	0.363
Chicken and egg	1.261 ***	0.169
Dairy	1.289 ***	0.105
Vegetables	1.389 ***	0.164
Fruit	1.415 ***	0.127
Bread	1.462 ***	0.139

Source: Author' work. Results of our estimation.
Notes:
***Statistically significant at 99%.
**Statistically significant at 95%.
Standard errors estimated through the method of subsampling bootstrap (Politis and Romano (1994)).

2.4.2. Demand elasticities: results by region

Box 5 disaggregates the results for each of the geographic regions analyzed. In general, the geographical comparison does not reveal significant structural differences on the elasticity of demand between regions, although it stands out that the Southwest region

(Chiapas, Guerrero and Oaxaca) presents the most inelastic demands on average. In the food sector, households in the southeast (Chiapas, Guerrero and Oaxaca) and South-Central regions (Mexico City, State of Mexico and Morelos), present the lowest elasticities of demand. Considering the weighted average of elasticities by region, the proximity of that average to the unit elasticity within each region, is identified, which shows that the relative vulnerability of households to increases in prices derived from the presence of market power is a result that extends to each of the regions of the country.

Box 5. Estimations of demand elasticities: absolute value with standard errors in parentheses. Regional breakdown.

	Northwest	Northeast	West	East
Food and beverages †	1.232 *** (0.092)	1.171 *** (0.094)	1.240 *** (0.093)	1.237 *** (0.088)
Medicines	0.938 *** (0.099)	0.936 *** (0.105)	0.943 *** (0.106)	0.946 *** (0.100)
Interurban passenger transportation	1.030 *** (0.186)	1.041 *** (0.181)	1.068 *** (0.194)	1.025 *** (0.192)
Construction material	0.924 *** (0.110)	0.940 *** (0.140)	0.924 *** (0.1 09)	0.927 *** (0.106)

	North Central	South Central	Southwest	Southeast
Food and beverages †	1.209 *** (0.094)	1.168 *** (0.107)	1.179 *** (0.093)	1.165 *** (0.092)
Medicines	0.951 *** (0.124)	1.076 *** (0.114)	0.939 *** (0.081)	1.056 *** (0.083)
Interurban passenger transportation	1.038 *** (0.177)	1.013 *** (0.198)	1.028 *** (0.164)	1.034 *** (0.171)
Construction material	0.926 *** (0.130)	0.929 *** (0.137)	0.926 *** (0.160)	0.972 *** (0.141)

Source: Author's work.
(†) Average elasticity of all our food and beverage subcategories.
Standard error in parentheses. Standard errors estimated through the method of subsampling bootstrap (Politis and Romano (1994)).
*** Statistically significant at 99%.

3. IDENTIFYING THE PRESENCE OF MARKET POWER AND ESTIMATION OF OVERPRICES

Microeconomic theory for industrial organization identifies market power through the persistence of price levels above the levels that should be observed in a competitive environment where prices are only due to cost considerations. The fundamental models of market power predict an inverse relationship between the overprice (discrepancy between the observed price levels and their competitive reference), and elasticity of demand. In the absence of market power, once cost-determining factors are controlled, no systematic relationship between prices and demand elasticities should exist. Consequently, the presence of market power is identified when, once controlling for cost-determining factors, there still is a systematic relationship between the price levels and demand elasticity in the corresponding market.

Using the results of the demand system estimation from previous sections, this section identifies the sectors (expenditure categories) where the evidence of market power is statistically significant, and quantifies the corresponding overprices. For this purpose, a methodological strategy consistent with the so-called *new empirical industrial organization* ("NEIO") approach, used in modern literature on industrial organization to identify the presence of market power, is employed.

The NEIO methodological approach has been described in detail by Bresnahan (1989). Generically, NEIO studies use structural models where the relationship between prices, costs and characteristics of demand (specifically, the elasticity of demand) are econometrically estimated. The level of detail in our demand system provides us with a unique opportunity to have elasticity measurements that take into account patterns of cross-elasticity and expenditure substitution. While the existing NEIO models focus on estimating demand of a single good (not a system of demands as is the case in

this study), the character of general equilibrium of our system of demand produces much more realistic elasticity measures.

This section of the study analyzes, for each sector, whether after controlling for the cost determinants of firms, there is evidence of a systematic relationship between price levels and demand elasticities. Based on economic theory, such relationship would constitute evidence of market power.

3.1. Methodology for the identification of market power and estimation of overprices

The fundamental model of industrial organization that formally describes how market power arises as a discrepancy between observed prices and prices that would exist under perfect competition, as well as the role played by the elasticity of demand is described below.

Microeconomic theory (see Tirole (1988), Varian (1988)), indicates that in a competition environment where firms accept prices, these are determined only by cost considerations, and that there should not be a systematic relationship between observed prices and the elasticity of demand. In contrast, when firms set their prices making use of their market power, they do so by extracting the highest amount of consumer surplus, resulting in a systematic relationship between observed prices and the elasticity of demand. That is, *ceteris paribus*, markets with lower elasticities where there are firms with market power are more likely to observe higher prices than those markets with large elasticities or where there are no firms with market power.

Specifically, the fundamental theoretical model of pricing can be described as follows. Considering item ℓ (for example, construction materials), and denoting the quantity demanded (and produced) in market m as Q^{ℓ}_{m}. Furthermore, defining $Q^{\ell}_{d,m}(p)$ as the demand function in market m and $CM^{\ell}_{m}(Q^{\ell}_{m})$ as the marginal cost of production in market m. In perfect competition, the prices must be set to cover the marginal cost (the cost of producing an additional unit of the good in question). This is:

$$p^{\ell}_{m}{}^{*} = CM^{\ell}_{m}(Q^{\ell}_{m}) \tag{12}$$

By contrast, in an environment where market power does exist costs are not the only determinant of prices, defining

$$\eta_m^\ell = -\left(\frac{\partial Q_{d,m}^\ell(p_m^\ell)}{\partial p^\ell} \cdot Q_m^\ell\right)^{-1} = -\frac{p_m^\ell}{\epsilon_{d,m}^\ell},$$

(13)

Where $\varepsilon_{d,m}$ is elasticity of the demand:

$$\epsilon_{d,m}^\ell = \frac{\partial Q_{d,m}^\ell(p_m^\ell)}{\partial p^\ell} \cdot \frac{Q_m^\ell}{p_m^\ell},$$

By contrast, in an environment where market power does exist, the basic overprice model predicts that these would be given by the following equation (see Tirole (1988, Chapter 6), Varian (1988, Chapter 14), Pindyck and Rubinfeld (2009, Chapter 10)),

$$p_m^\ell = CM_m^\ell(Q_m^\ell) + \eta_m^\ell.$$

(14)

From (14) and (12) it can be deduced that prices are above the prices of perfect competition by a margin that depends on the elasticity of demand: expenditure categories with lower elasticity will observe higher prices. The *markup* or *overprice* is given by:[8]

$$Markup_m^\ell = \frac{p_m^\ell}{CM_m^\ell(Q_m^\ell)} = \frac{p_m^\ell}{p_m^\ell - \eta_m^\ell}.$$

(15)

8. By definition of η^ℓ_m, this expression is equivalent to

$$Markup_m^\ell = \frac{1}{1 + \frac{1}{\epsilon_{d,m}^\ell}}.$$

We used this expression (14) because it is more convenient for presenting the analysis.

This equation describes the so-called *markup pricing rule* (see Pindyck and Rubinfeld (2009, equation 10.1-10.2)). The proposed method to detect overprices is based on the following generalization of the equation (12):

$$p_m^\ell = CM_m^\ell(Q_m^\ell) + \beta_\eta^\ell \cdot \eta_m^\ell.$$

(16)

The coefficient $\beta_\eta^\ell \geq 0$ is a *parameter of market power* that captures the magnitude of the deviation between observed prices and competitive prices. The markup (overprice) in (15) is then generalized as:

$$Markup_m^\ell = \frac{p_m^\ell}{p_m^\ell - \beta_\eta^\ell \cdot \eta_m^\ell}.$$

(15')

The results of the demand estimation directly produce estimators for η^ℓ_m. The only missing component is an estimator for the market power parameter β^ℓ_η. The estimation procedure is described below.

The estimated systems of demand immediately allow to estimate the factor η^ℓ_m for each geographic market $m = 1, \ldots, 46$ and each expenditure category, $\ell = 1, \ldots, 12$. Thus, to estimate (16) it is enough to assume a functional form for the marginal cost function $CM^\ell_m(Q^\ell_m)$. For this purpose, a specification in the following form is used,

$$p_m^\ell = \underbrace{X_m^{c\ell\prime}\gamma^\ell + \varepsilon_m^\ell}_{=CM_m^\ell(Q_m^\ell)} + \beta_\eta^\ell \cdot \eta_m^\ell.$$

(17)

Where, for each expenditure category ℓ, vector $X^{c^\ell}_m$ is a collection of observable variables indicative of costs in market m and ε^ℓ_m captures all cost-indicative factors that are not observable in market m. The relationship described in (17) is a special case of the type of market power analysis analyzed in Bresnahan (1989).

3.2. Data

For the estimations based on (17) to have credibility it is important to include in XC^{ℓ}_{m} the most important cost variables that are observable in the data. In an effort to achieve this, two categories of variables were included in vector XC^{ℓ}_{m}:

1. General measures of operating cost and productivity aggregated at each market *m*.
2. Specific cost measures for each category ℓ in each market *m*.

Box 6 accurately lists the variables included in XC^{ℓ}_{m}. The estimation includes a total of eleven variables, whose configuration has the objective of capturing, on the one hand, productivity measures and total operating costs at the market level, and on the other hand, variables of input costs by company specific to those branches of the economic activity related to each of the twelve expenditure categories in the study. The source of information for each variable was the 2014 Economic Censuses by INEGI.

Box 6. Cost variables included in XC^{ℓ}_{m} in the estimation of the model.

1. Variables at the market level aggregated for all branches of the manufacturing and commercial activity	
GASTOS UE m	: Total expenditure per economic unit for the total set of manufacturing and commercial branches in market m.
VA UE m	: Value added per economic unit for the total set of manufacturing and commercial branches in market m.
VA EMPL m	Value added by number of employees for the total set of manufacturing and commercial branches in market m.
VA ACTIV m	: Value added per unit of fixed assets for the total consumption of manufacturing and commercial branches in market m.
2. Variables at the market level for branches of economic activity [a/] specifically related to each category $\ell = 1, \ldots, 12$.	
UE $^{\ell}_{m}$	Number of economic units for the total set of branches of economic activity related to category ℓ in market m.
PROD UE $^{\ell}_{m}$	: Total gross production per economic unit for the total set of branches of economic activity related to category ℓ in market m.
EMPL UE $^{\ell}_{m}$	: Number of employees per economic unit for the total set of branches of economic activity related to category ℓ in market m.
REMUN UE $^{\ell}_{m}$	: Total remunerations per economic unit for the total set of branches of economic activity related to category ℓ in market m.

$INTERM\ UE_{m}^{\ell}$: Total intermediate consumption per economic unit for the total set of branches of economic activity related to category ℓ in market m.

$ACTIV\ UE_{m}^{\ell}$: Total fixed assets per economic unit for the total set of branches of economic activity related to category ℓ in market m.

$DEPREC\ UE_{m}^{\ell}$: Fixed assets depreciation per economic unit for the total set of branches of economic activity related to category ℓ in market m.

[a/] Box 7 describes in detail the branches of economic activity considered for each one of the expenditure categories.

Box 7. Breakdown of Branches, Sub-branches and Classes of Economic Activity included in the cost variables in the estimation of the model (17)[a/]

1.- *Tortillas*	
Sub-branch 31183:	*tortilla* manufacturing and grinding nixtamal

2.- Bread	
Class 311811:	Industrial baking
Class 311812:	Traditional baking

3. Chicken and eggs	
Class 311612:	Cutting and packaging of meat from cattle, poultry and other edible animals
Sub-branch 43111:	Wholesale of groceries
Class 431122:	Wholesale of poultry meat
Sub-branch 43114:	Wholesale of egg
Class 461122:	Retail of poultry meat
Sub-branch 46211:	Retail trade in self-service stores

4. Beef	
Sub-branch 311612:	Cutting and packaging of meat from cattle, poultry and other edible animals
Sub-branch 431121:	Wholesale of red meats
Class 461121:	Retail of red meats
Sub-branch 46211:	Retail trade in self-service stores

5. Processed meats	
Class 311613:	Preparation of sausages and other canned meat from cattle, poultry and other edible animals
Sub-branch 43111:	Wholesale of groceries
Sub-branch 43117:	Wholesale of sausages
Sub-branch 46115:	Wholesale of milk, other dairy products and sausages
Sub-branch 46211:	Retail trade in self-service stores

6. Non-alcoholic beverages	
Sub-branch 31192:	Coffee and tea industries
Sub-branch 31211:	Manufacture of soft drinks, ice and other non-alcoholic beverages and purification and bottling of water
Sub-branch 43111:	Wholesale of groceries
Class 431211:	Wholesale of non-alcoholic beverages and ice
Sub-branch 46111:	Retail trade in small local stores
Class 461213:	Retail trade of non-alcoholic beverages and ice
Sub-branch 46211:	Retail trade in self-service stores

7. Fruits	
Branch 3114:	Preservation of fruits, vegetables, stews and other prepared foods
Sub-branch 43111:	Wholesale of groceries
Sub-branch 43113:	Wholesale of fresh fruits and vegetables
Sub-branch 46111:	Retail trade in small local stores
Sub-branch 46113:	Retail trade of fresh fruits and vegetables
Sub-branch 46211:	Retail trade in self-service stores

8. Vegetables	
Branch 3114:	Preservation of fruits, vegetables, stews and other prepared foods
Sub-branch 43111:	Wholesale of groceries
Sub-branch 43113:	Wholesale of fresh fruits and vegetables
Sub-branch 46111:	Retail trade in small local stores
Sub-branch 46113:	Retail trade of fresh fruits and vegetables
Sub-branch 46211:	Retail trade in self-service stores

9. Dairy	
Sub-branch 31151:	Manufacture of milk and dairy derivatives
Sub-branch 43111:	Wholesale of groceries
Sub-branch 43116:	Wholesale of milk and other dairy products
Sub-branch 46115:	Wholesale of milk, other dairy products and sausages
Sub-branch 46211:	Retail trade in self-service stores

10. Construction materials	
Branch 3273:	Manufacturing of cement and concrete products
Branch 3274:	Manufacturing of lime, gypsum and gypsum products
Sub-branch 33122:	Manufacturing of other iron and steel products
Branch 4671:	Retail trade of hardware, hardware products and glass items

11. Interurban passenger transportation	
Branch 4852:	Interurban fixed route passenger transportation
Subsector 481:	Air transportation

12. Medicines	
Branch 3254:	Manufacturing of pharmaceutical and naturopathic products
Branch 4331:	Wholesale of pharmaceutical products
Sub-branch 46411:	Retail trade of pharmaceutical and naturopathic products

Source: Author's work.
a/. The numerical codes correspond to that of INEGI's code for North American Industry Classification System (NAICS).

The aggregated variables at the market level capture, on the one hand, the general cost of doing business in that market and on the other the general productivity of the firms and that of production factors. The purpose of including these is to be able to capture the variation in the quality of productive inputs and ease of doing business in each market. The cost variables specific for each expenditure category capture input costs per firm (labor, capital and intermediate goods) as well as the scale of production (total number of business units and its gross production). These are typically the determinants of costs, both theoretical and used in models and empirical estimations. Box 7 describes in detail the branches of economic activity considered for each of the expenditure categories. Additionally, an intercept was included in $X^{C^{\ell}}_{m}$. As described in equation (17), the vector of parameters is specific for each category ℓ, which combined with a model that includes eleven cost variables, seven of which are specific for each category ℓ, results

in a functional form and highly flexible econometric specification tailored to each expenditure category.

The parameters of the specification (17) were estimated assuming that the non-observable cost factors are not systematically correlated neither with XC^{ℓ}_{m} or the demand factor η^{ℓ}_{m}. Equation (17) was estimated separately for each category $\ell = 1, \ldots, 12$. The information source for all variables in XC^{ℓ}_{m} was the 2014 INEGI Economic Censuses. The price p^{ℓ}_{m} in (17) refers to the observed price index for the category ℓ in the market $m = 1, \ldots, 46$. The estimated markup then is given by:[9]

$$\widehat{Markup}^{\ell}_{m} = \frac{p^{\ell}_{m}}{p^{\ell}_{m} - \hat{\beta}^{\ell}_{\eta} \cdot \hat{\eta}^{\ell}_{m}}.$$

(18)

Holding all else constant, an inelastic demand increases the discrepancy between observed prices and their competitive counterparts in the presence of market power.

The parameters of equation (17) are estimated under the assumption that there is no systematic correlation between explanatory variables and non-observable factors that determine prices. Annex B includes statistical tests to assess this condition of exogeneity, and tests for the rejection of the model are also presented. The analysis in said annex finds that the model is not rejected and that the assumption of exogeneity is also supported statistically.

3.3. Results

Next, Box 8 shows the results of the estimation of the model of market power described in (17). The estimation method used was least squares. Standard errors were obtained using the variance-

9. Since the theoretical model of market power model described in (14) assumes that $\beta^{\ell}_{\eta} = 1$, in the *markup* estimation described in (18), the minimum between $\hat{\beta}^{\ell}_{\eta}$ and 1 was taken. Thus, our estimated markups are never greater than those predicted by the theoretical model described in (14). We emphasize that our estimated *markup* measures are conservative in relation to the theoretical *markup*.

covariance matrix estimator described in White (1980). Said estimator is robust to the presence of heteroscedasticity. Robustness tests of the model are included in Appendix B. Said tests analyze the properties of exogeneity and goodness-of-fit of the model. As can be observed in these results, the model (17) constitutes a statistically robust approximation of the variation in prices and its relationship with costs and demand elasticity.

Box 8. Estimation of market power parameters β^{e}_{η}

Category	β^{e}_{η}	Statistic -t[a/,b/]
Tortillas	0.183 ***	3.223
Bread	1.477 ***	16.268
Chicken and eggs	0.139 **	1.796
Beef	0.047***	2.851
Processed meats	0.017	0.906
Dairy	0.626***	3.933
Fruits	1.120 ***	12.033
Vegetables	0.328 ***	3.249
Non-alcoholic beverages	0.047	1.531
Medicines	0.026	1.566
Air passenger transportation	0.196 ***	4.368
Interurban bus transport	0.081 ***	2.718
Construction materials	0.493***	5.535

Source: Author's work
Notes: a. The estimation method used was least squares. Standard errors were obtained using the variance-covariance matrix estimator described in White (1980). The estimator is robust in the presence of heteroscedasticity.
b. Since the theory predicts that the price can never be less than the marginal cost, the sign β^{e}_{η} in equation (18) is less than or equal to 0. Therefore, the critical values for levels of statistical confidence level at 95% and 99% are 1.645 and 2.326, respectively.
c. The medicines category is statistically significant at 94.1% and non-alcoholic beverages at 93.7%. Though it is true that is common for different studies to establish the threshold of statistical significance at 90%, in this study a level of 95% is chosen with the aim of obtaining more conservative estimations when identifying the impact on household welfare.
++ Statistically significant at 95%.
+++ Statistically significant at 99%.

The estimated parameters of market power are described in Box 8. The model described in (17) was satisfactorily adjusted to the data in practically all expenditure categories analyzed. Specifically, the theory predicts that the coefficient β^{e}_{η} must have a positive sign (or zero), which was consistent with the findings: each of the estimated parameters was statistically significant and positive, or statistically equal to zero. None of them were negative and statistically significant.

Box 9. Overprice estimations by expenditure category.

Expenditure category	Value [a/]	Lower limit	Upper limit
Fruits	238.52 % ***	228.89 %	248.16 %
Bread	199.95 % ***	182.14 %	217.76 %
Construction materials	113.25 % ***	109.83 %	116.67 %
Dairy	95.43 % ***	92.97 %	97.88 %
Vegetables	30.47 % ***	28.64 %	32.31 %
Air passenger transportation	27.40 % ***	22.88 %	31.92 %
Tortillas	26.19 % ***	23.84 %	28.54 %
Interurban bus transport	14.54 % ***	11.04 %	18.04 %
Beef	8.13 % ***	7.38 %	8.88 %
Chicken and eggs	14.02 % **	12.67 %	15.37 %
Non-alcoholic beverages	4.85 % *	4.30 %	5.40 %
Medicines	4.36 % *	3.20 %	5.51 %
Processed meats	1.86 %	1.67 %	2.06 %

Source: Author's work.
Note [a/]. Statistically significant at 90 % level of confidence.
Statistically significant at 95 % level of confidence.
Statistically significant at 99 % level of confidence.
Upper and lower limits were approximated using the *subsampling bootstrap* technique (Politis and Romano (1994)) for the elasticities, setting the value of each β coefficient at its estimated value in Box 8 confidence.

Box 9 shows overprices for each expenditure category, calculated from the estimated parameters of market power. As can be observed, there is evidence that warns of the existence of markups in 2014. The result indicates that on average Mexicans pay an overprice of 98.23% when buying goods and services offered on the analyzed markets due to the presence of market power. This overprice is statistically significant at 95%.

3.4. About the scope of the concept of market power

As has been repeatedly mentioned, market power is associated with observation of prices levels above competitive prices that would be determined only by cost considerations over sustained periods. Specifically, the theoretical concept of market power exists if the discrepancy depends in a systemic way on the elasticity of demand. Accordingly, the purpose of the model in (17) is to identify and estimate the presence of market power through the coefficient β^{ℓ}_{η}.

In particular, said model (and the general concept of market power) do not intend to identify the mechanisms through which market power is "exercised", as well as the stage(s) of the productive chain where price distortions are generated. Following the concept

of market power, the purpose of the analysis herein is merely to identify those sectors where the variation in market prices, and its relationship with cost determinants and with demand elasticity, are consistent with the behavior that would exist in the presence of market power.

4. IMPACT OF MARKET POWER ON HOUSEHOLD WELFARE

This section combines previous results to measure the loss in household welfare derived from the discrepancy between the observed prices and prices that would have prevailed in perfect competition. Said discrepancy is given by the markups described in the previous section. To produce a conservative estimate of loss of welfare, the focus is only on the sectors for which evidence of the presence of market power was found at a statistical confidence level of 95%. This includes the categories: tortillas, bread, chicken and eggs, beef, dairy products, fruit, vegetables, air passenger transportation, interurban passenger transportation and construction materials. Annex D contains the results if only the sectors where statistical confidence level was of 99% are considered (this excludes only chicken and eggs in relation to sectors significant at 95%). As can be seen in the said annex, the conclusions of the study do not change substantially if a criterion of 95% or 99% of confidence of market power is used.

4.1. Measures of household welfare

The theoretical framework for measuring loss in welfare was discussed in Section 2.1.4. The question is the following: which is the loss the income of households that is equivalent to the distortion in prices in the sectors where the presence of market power was identified in Box 9. The appropriate measure for said loss is the equivalent variation (VE), whose concept was defined in Section 2.1.4. Defining:

$\mathbf{p}^0_h$ = Vector of counterfactual prices that would have existed in the absence of overprices.

$\mathbf{p}^1_h$ = Vector of observed prices.

To construct a conservative measure of loss in welfare, it is assumed that there are price distortions derived from the presence

of market power only in the sectors where the coefficient of market power was statistically significant with a 95% level of confidence (see Box 9).[10] This includes the categories: *tortillas*, bread, chicken and eggs, beef, dairy products, fruit, vegetables, air passenger transport, interurban transportation and construction materials.

For household h inhabiting in market m, the vector of counterfactual prices $\mathbf{p}^0_h$ was obtained by recalculating $\mathbf{p}^1_h$, subtracting the estimated *markups* in market m from the expenditure categories described. The *markups* of the other categories were taken as 1; that is, it is assumed that there are no price distortions derived from the presence of market power in the other categories. The objective is to estimate, for each household, the loss in welfare equivalent to an increase in the level of prices from $\mathbf{p}^0_h$ to $\mathbf{p}^1_h$. The exact expression of the VE that is obtained from the expenditure function described in Section 2.1.4. is given by:

$$VE_h(\mathbf{p}^0_h, \mathbf{p}^1_h, \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h) = \exp\left\{C\left(\mathbf{p}^0_h, y_h(\mathbf{p}^1_h), \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h\right)\right\} - \exp\left\{C\left(\mathbf{p}^0_h, y_h(\mathbf{p}^0_h), \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h\right)\right\},$$

where

$$C(\mathbf{p}_h, u_h, \boldsymbol{z}_h, \boldsymbol{\varepsilon}_h) = u_h + \mathbf{p}_h' m(u_h, \boldsymbol{z}_h) + T(\mathbf{p}_h, \boldsymbol{z}_h) + S(\mathbf{p}_h, \boldsymbol{z}_h) \cdot u_h + \mathbf{p}_h' \boldsymbol{\varepsilon}_h,$$

$$y_h(\mathbf{p}_h) = \frac{x_h - \mathbf{p}_h' \boldsymbol{w}_h + \frac{1}{2}\sum_{\ell=0}^{L} z_{\ell h} \mathbf{p}_h' \boldsymbol{A}_\ell \mathbf{p}_h}{1 - \frac{1}{2}\mathbf{p}_h' \boldsymbol{B} \mathbf{p}_h'},$$

$$T(\mathbf{p}_h, \boldsymbol{z}_h) = \frac{1}{2}\sum_{\ell=0}^{L} z_{\ell h} \mathbf{p}_h' \boldsymbol{A}_\ell \mathbf{p}_h,$$

$$S(\mathbf{p}_h, \boldsymbol{z}_h) = \frac{1}{2}\mathbf{p}_h' \boldsymbol{B} \mathbf{p}_h,$$

$$m(u_h, \boldsymbol{z}_h) = \left(\sum_{r=0}^{R} \boldsymbol{b}_r u_h^r\right) + \boldsymbol{C}\boldsymbol{z}_h + \boldsymbol{D}\boldsymbol{z}_h u_h,$$

$$\boldsymbol{\varepsilon}_h = \boldsymbol{w}_h - \left[\sum_{r=0}^{R} \boldsymbol{b}_r y_h^r + \boldsymbol{C}\boldsymbol{z}_h + \boldsymbol{D}\boldsymbol{z}_h y_h(\mathbf{p}_h) + \sum_{\ell=0}^{L} z_{\ell h} \boldsymbol{A}_\ell \mathbf{p}_h y_h(\mathbf{p}_h) + \boldsymbol{B}\mathbf{p}_h y_h(\mathbf{p}_h)\right]$$

10. In Annex D the results are presented if only the sectors where statistical level of confidence was 99% for the presence of market power were considered. this excludes only chicken and eggs in with respect to sectors significant at 95%. As demonstrated there, the estimated loss of welfare is on average approximately 7% lower if we only consider categories where market power was significant at a 99% level of confidence. The difference varies by income deciles and by regions, but it is approximately in that order of magnitude.

The estimation of loss of welfare adheres completely to the expressions described above, replacing the parameters with their estimators. Therefore, we have that:

$$\widehat{VE}_h(\mathbf{p}_h^0, \mathbf{p}_h^1, \mathbf{z}_h, \boldsymbol{\varepsilon}_h) = \exp\left\{\widehat{C}\left(\mathbf{p}_h^0, \widehat{y}_h(\mathbf{p}_h^1), \mathbf{z}_h, \widehat{\boldsymbol{\varepsilon}}_h\right)\right\} - \exp\left\{\widehat{C}\left(\mathbf{p}_h^0, \widehat{y}_h(\mathbf{p}_h^0), \mathbf{z}_h, \widehat{\boldsymbol{\varepsilon}}_h\right)\right\},$$

where

$$\widehat{C}(\mathbf{p}_h, u_h, \mathbf{z}_h, \widehat{\boldsymbol{\varepsilon}}_h) = u_h + \mathbf{p}_h'\widehat{m}(u_h, \mathbf{z}_h) + \widehat{T}(\mathbf{p}_h, \mathbf{z}_h) + \widehat{S}(\mathbf{p}_h, \mathbf{z}_h)\cdot u_h + \mathbf{p}_h'\widehat{\boldsymbol{\varepsilon}}_h,$$

$$\widehat{y}_h(\mathbf{p}_h) = \frac{x_h - \mathbf{p}_h'\mathbf{w}_h + \frac{1}{2}\sum_{\ell=0}^{L} z_{\ell h}\mathbf{p}_h'\widehat{\mathbf{A}}_\ell\mathbf{p}_h}{1 - \frac{1}{2}\mathbf{p}_h'\widehat{\mathbf{B}}\mathbf{p}_h'},$$

$$\widehat{T}(\mathbf{p}_h, \mathbf{z}_h) = \frac{1}{2}\sum_{\ell=0}^{L} z_{\ell h}\mathbf{p}_h'\widehat{\mathbf{A}}_\ell\mathbf{p}_h,$$

$$\widehat{S}(\mathbf{p}_h, \mathbf{z}_h) = \frac{1}{2}\mathbf{p}_h'\widehat{\mathbf{B}}\mathbf{p}_h,$$

$$\widehat{m}(u_h, \mathbf{z}_h) = \left(\sum_{r=0}^{R}\widehat{\mathbf{b}}_r u_h^r\right) + \widehat{\mathbf{C}}\mathbf{z}_h + \widehat{\mathbf{D}}\mathbf{z}_h u_h,$$

$$\widehat{\boldsymbol{\varepsilon}}_h = \mathbf{w}_h - \left[\sum_{r=0}^{R}\widehat{\mathbf{b}}_r y_h^r + \widehat{\mathbf{C}}\mathbf{z}_h + \widehat{\mathbf{D}}\mathbf{z}_h y_h(\mathbf{p}_h) + \sum_{\ell=0}^{L} z_{\ell h}\widehat{\mathbf{A}}_\ell\mathbf{p}_h y_h(\mathbf{p}_h) + \widehat{\mathbf{B}}\mathbf{p}_h y_h(\mathbf{p}_h)\right]$$

4.2. Results

The loss of household welfare as a consequence of the overprice paid due to the presence of market power can be interpreted as a "tax".

Below are the results of the average amount of "tax" paid by households at the national level, by income decile and by region.

4.2.1. Loss of household welfare at the national level

The cost in monthly welfare for households, calculated in pesos as of October 2015, on average for households was $1, 497 pesos, which represents an average of 15.7% of household income. At a 95% confidence level, those effects lie within an interval of [$1, 196, $1, 798] and [14.7%, 16.7%], respectively.[11]

11. These intervals can be constructed taking ±1.96 times the standard errors included in Table 10.

4.2.2. Loss of household welfare by income decile

In order to examine in greater depth the regressive potential of price distortions derived from the presence of market power, Box 10 shows disaggregated results by income deciles. The results confirm the hypothesis that households in lower income deciles are more vulnerable to the presence of market power. The presence of multiple categories of food expenditure within the items where significant evidence of the presence of market power was found is the most plausible explanation. As can be observed, the "tax" derived from the presence of market power represents on average 15.7% of household income, its maximum impact being for decile I with 30.9% and its minimum impact for decile X with 5.7%. Alarmingly, a 95% confidence interval reveals that the impact on households in decile I can represent up to 33% of their income.

4.2.3. Loss of household welfare by region

The results allow disaggregating the impact of the presence of market power by regions, with the purpose of investigating whether there are significant differences.[12] Box 15 included in Annex C shows the detailed results, by regions and by income deciles. Comparing a 95% confidence interval with the estimated national average of the impact on welfare as a proportion of income (estimated as 15.7 %), we found that the regions where the impact was statistically higher than the national average were: East (Hidalgo, Puebla, Tlaxcala and Veracruz), Southwest (Chiapas, Guerrero and Oaxaca), and South Central (Mexico City, State of Mexico and Morelos).

12. The regional results of this study are representative of each region to the extent that the households selected in the ENIGH sample constitute representative samples of the households in each region.

Box 10. Harm to consumer welfare by income decile.
Standard errors in parentheses

Income decile	Amount [a/]	Percentage [b/]
I	$841 ($92.9)	30.9 (1.08)
II	$1,097 ($117 .7)	23.6 (0.80)
III	$1,286 ($137.7)	21.4 (0.73)
IV	$1, 410 ($146.3)	18.9 (0.63)
V	$1,487 ($147.8)	16.7 (0.54)
VI	$1,613 ($158.3)	15.1 (0.46)
VII	$1,738 ($158.4)	13.6 (0.40)
VIII	$1,907 ($187.7)	11 .9 (0.39)
IX	$2,052 ($202.5)	9.5 (0.33)
X	$2,237 ($257.3)	5.7 (0.22)
All households	$1, 497 ($153.5)	15.7 (0.49)

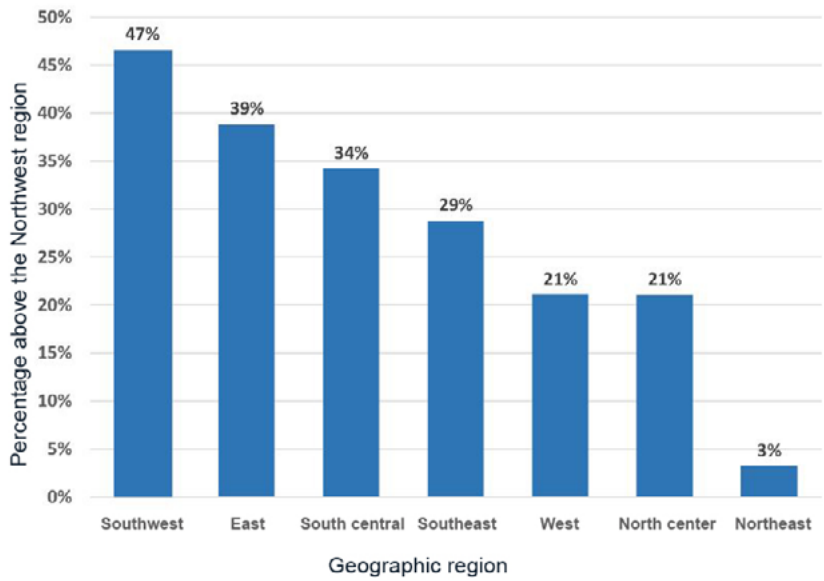
.

Source: Author's work.
Notes: a,b. Values shown correspond to the mean of the households.
b. The total income of households in this study includes the sum total of current income and total earnings. This includes: remuneration for work, income from a business, transfers, non-monetary expenditures (remuneration in kind), and other incomes. Standard errors obtained via the method *subsampling bootstrap* (Politis and Romano (1994)).

The regions where the impact was statistically similar to the national average were: West (Colima, Jalisco, Michoacán and Nayarit), North Central (Aguascalientes, Guanajuato, Querétaro, San Luis Potosí and Zacatecas) and Southeast (Campeche, Quintana Roo, Tabasco and Yucatán). Finally, the regions where the impact was statistically lower than the national average: Northwest (Baja California, Baja California Sur, Chihuahua, Durango, Sinaloa and Sonora) and Northeast (Coahuila, Nuevo León and Tamaulipas). Graph 1 disaggregates the impact (as proportion of income) among the regions in relation to the northwest region, where the lowest impact was recorded. It shows, for instance, that the loss of welfare in the Southwest region (Chiapas, Guerrero and Oaxaca) was 47% greater than that of the Northwest region (Baja California, Baja California Sur, Chihuahua, Durango, Sinaloa and Sonora). The

reasons for this differentiated effect are due to the fact that in the regions with greater loss of welfare: i) there are fewer substitutes for goods in the markets; ii) incumbent companies can charge higher overprices to their consumers without the risk of losing market share, and iii) these have a greater proportion of low-income households than the national average.

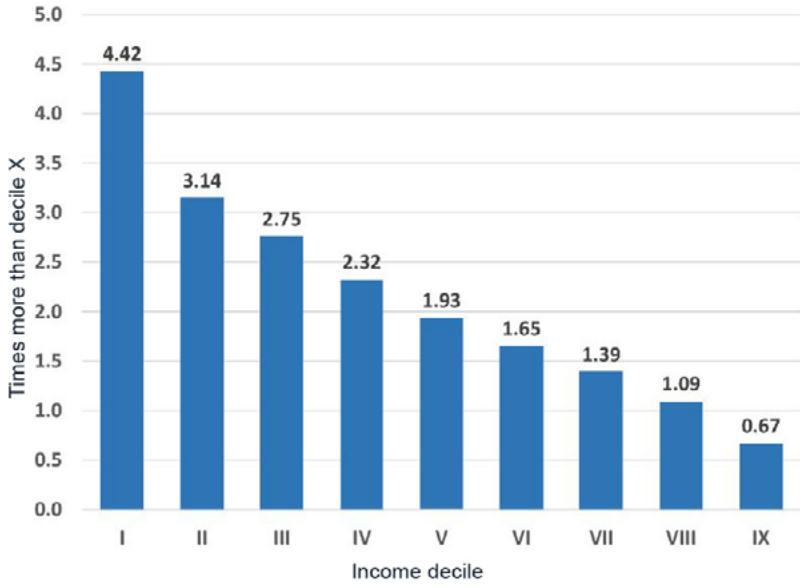
Graph 1. Relative loss in the welfare of households (as proportion of income) by region, in relation to the northwest region.



4.2.4. Impact of market power on inequality

Graph 2 shows the regressive impact of market power through overpricing more clearly. By dividing the loss of welfare of each decile by the loss of welfare of the higher-income decile (decile X), a relative measure of the impact of the exercise of market power exercise is obtained. Thus, the relative loss of welfare in lower-income households – decile I – in relation to the loss caused to higher income households, is 4.42 times greater in 2014. The foregoing implies that overprices derived from the exercise of market power not only harms all households but also harms the poorest families the most, in other words, it contributes significantly to accentuate inequality in the country.

Graph 2. Relative loss in the welfare of households (as proportion of income) compared to income decile X.



The above results suggest that the "tax" from the distortions in prices derived from the presence of market power present regressive characteristics, since it is higher for lower-income deciles. This section formally quantifies the effect of this tax derived from market power on inequality, by comparing the calculation of the Gini Coefficient observed with that which would have existed in the absence of market power (that is, in the absence of the "tax" derived from market power). The Gini Coefficient is the best-known and most used measure to calculate inequality in income distribution (see Deaton (1997), Foster, Seth, Lokshin, and Sajaia (2013)). Originally proposed in Gini (1912), this coefficient measures the discrepancy between the observed income distribution and that which would exist if all households had the same income (total equality). The range of values for this measure is [0, 1], with 0 representing total income equality and 1 representing total income inequality (an individual or household holds the entire income and the rest of households hold zero). The Gini Coefficient can be calculated as follows (see Sen (1997, Chapter 2)), denoting the income of households income in the sample as $(M_h)^N_h = 1$. The first

step consists of ordering all observations, from smallest to largest: $M_{(1)} \leq M_{(2)} \leq M_{(3)} \leq \ldots M_{(N)}$. The formula of the Gini Coefficient is given by,

$$G = \frac{N-1}{N} - 2 \cdot \frac{\sum_{h=1}^{N} (N+1-h) M_{(h)}}{N \sum_{h=1}^{N} M_{(h)}}$$

(19)

Now, assuming that each household is compensated with the loss of welfare derived from the distortions in prices created by market power, according to the results previously obtained. This is equivalent to eliminating the "tax" derived from market power. Denoting the counterfactual income of household as in that case as $(M^*_h)^N_{h=1}$, the resulting Gini Coefficient would be given by

$$G^* = \frac{N-1}{N} - 2 \cdot \frac{\sum_{h=1}^{N} (N+1-h) M^*_{(h)}}{N \sum_{h=1}^{N} M^*_{(h)}}$$

(19')

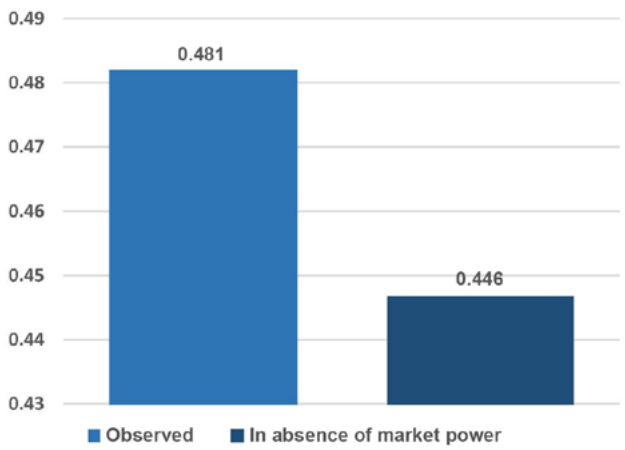
Thus, G^* represents the measure of income inequality that would exist in the absence of market power. Graph 3 compares the inequality observed in the data (measured by G) and that which would have existed in perfect competition (measured by G^*).

The observed Gini Coefficient, obtained in the ENIGH, is very close to the figure of 0.481 published for Mexico by the World Bank with 2012 data. (See World Bank (2015, Chart 2.9)). The results reveal that income inequality would be lower in the absence of market power distortions detected in this study. In comparison, the coefficient would be 0.446 in the absence of distortions produced by the presence of market power. Proportionally, the Gini Coefficient would be 7.3% lower. In other words, the measurement of income inequality in Mexico would be approximately 7.3% lower if there were no evidence of market power in any of the markets selected in this study.

5. CONCLUSIONS

Market power is identified as a persistence of price levels above the levels that should be observed in a competitive environment, where prices are due solely to cost considerations. Specifically, the presence of market power is identified when, even controlling cost determinant factors, there is a systematic relationship between levels of prices and demand elasticity in the corresponding market. In the presence of market power, there is an inverse relationship between the overprice (the discrepancy between level of prices and their competitive benchmarks) and demand elasticity. In the absence of market power, once cost-determining factors are controlled for, no systematic relationship between prices and demand elasticities should exist.

Graph 3. Comparison of the observed and counterfactual Gini Coefficient.



In the present study the impact of market power on the welfare of Mexican households was analyzed. The analysis included 12 expenditure categories in 46 cities: corn *tortillas*, bread, chicken and eggs, beef, processed meats, dairy products, fruit, vegetables, non-alcoholic beverages, medicines, interurban passenger transportation, and construction materials. With information

from the ENIGH and INPC, implicit Marshallian demands systems were constructed for households, which derived in obtaining market elasticities.

Subsequently, the price actually paid by households was compared to the counterfactual that would have existed in the absence of market power. This difference was identified as the overprice generated by the presence of market power. The estimation showed that on average, Mexican households pay an overprice of 98.23% because of the existence of market power.

Similarly, the impact of the overprice on consumer welfare was estimated through the equivalent variation. It was found that on average Mexican households allocate 15.7% of their income to pay overprices due to the presence of market power the analyzed markets. This economic loss of Mexican households can be interpreted as a "tax", since it reduces the disposable income of households.

Furthermore, the "tax" is regressive, since it harms more households with lower incomes. Evidence of this is that households in decile I lose 4.42 times the percentage of income that households in decile X lose. The regressivity of this "tax" can also be identified regionally, since the southwest region of the country sees its welfare reduced 47% more than the northeast region.

Finally, this regressive effect accentuates inequality in the country, since it is estimated that in the absence of price distortions generated by the presence of market power in the selected markets, the Gini Coefficient, and therefore income inequality in the country, would be reduced by around 7.3%.

REFERENCES

Aghion, P., E. Caroli, and C. Garcia-Penalosa (1999). "Inequality and Economic Growth: the Perspective of the new Growth Theories." *Journal of Economic literature*, núm. 37, pp. 1615-1660.

Banks, J., R. Blundell, and A. Lewbel (1997). "Quadratic Engel Curves and Consumer Demand." *Review of Economics and Statistics*, núm. 79, pp. 527–539.

Blundell, R., X. Chen, and D. Kristensen (2007). "Semi-Nonparametric IV Estimation of Shape-Invariant Engel Curves." *Econometrica*, núm. 75, pp. 1613–1669.

Bresnahan, T. (1989). "Empirical Studies of Industries with Market Power." In R. Schmalensee and R. Willig (Eds.), *The Handbook of Industrial Organization*, Volume 2, Chapter 17, pp. 1011–1057. Amsterdam: Elsevier.

Davidson, R. and J. MacKinnon (1993). *Estimation and Inference in Econometrics*. Oxford University Press. Oxford.

Deaton, A. (1987). "Estimation of Own-and Cross-Price Elasticities from Household Survey Data." *Journal of Econometrics*, núm. 36, pp. 7–30.

Deaton, A. (1988). "Quality, Quantity and Spatial Variation of Price." *American Economic Review*, núm. 78, pp. 418–430.

Deaton, A. (1997). *The Analysis of Household Surveys: a Microeconometric Approach to Development Policy*. Washington: World Bank.

Deaton, A. and J. Muellbauer (1980). "An Almost Ideal Demand System." *American Economic Review,* núm. 70, pp. 312–326.

Engle, R. (1983). "Wald, Likelihood Ratio, and Lagrange Multiplier Tests in Econometrics." En M. Intriligator and Z. Griliches (Eds.), *The Handbook of Econometrics*, Volume 2, Chapter 13, pp. 776–826. Amsterdam: Elsevier.

Foster, J., S. Seth, M. Lokshin, and Z. Sajaia (2013). *A Unified Approach to Measuring Poverty and Inequality*. The World Bank. Washington, D. C.

Gini, C. (1912). "Variabilità e mutabilità." In E. Pizetti and T. Salvemini (Eds.), *Memorie di Metodologica Statistica*. Libreria Eredi Virgilio Veschi.

Hausman, J., J. Powell, and W. Newey (1995). "Nonlinear Errors in Variables: Estimation of some Engel Curves." *Journal of Econometrics,* núm. 65, pp. 205–253.

Hausman, J. A. (1978). "Specification Tests in Econometrics." *Econometrica*, núm. 46, pp. 1251–1271.

Hicks, J. (1939). *Value and Capital*. Clarendon Press. Oxford.

Lewbel, A. (1989). "Identification and Estimation of Equivalence Scales under Weak Separability." *Review of Economic Studies,* núm. 56, pp. 311–316.

Lewbel, A. and K. Pendakur (2009). "Tricks with Hicks: The EASI Demand System." *American Economic Review,* núm. 99, pp. 827–863.

Mas-Collel, A., M. Whinston, and J. Green (1995). *Microeconomic Theory*. Oxford University Press. Oxford.

Nakamura, A. and M. Nakamura (1981). “On the Relationships among Several Specification Error Tests Presented by Durbin, Wu, and Hausman.” *Econometrica,* núm. 49, pp. 1583–1588.

Pindyck, R. and D. Rubinfeld (2009). *Microeconomics*, 7th Edition. Prentice Hall. Cambridge.

Politis, D. and J. Romano (1994). “Large Sample Confidence Regions Based on Subsamples under Minimal Assumptions.” *Annals of Statistics,* núm. 22, pp. 2031–2050.

Hoderlein, Mihaleva, S. (2008). “Increasing the Price Variation in a Repeated Cross Section.” *Journal of Econometrics,* núm. 147, pp. 316–325.

Sen, A. (1997). *On Economic Inequality* (Radcliffe Lectures). Clarendon Press.

Slesnick, D. (2005). “Prices and Demand: New Evidence from Micro Data". *Economics Letters,* núm. 89, pp. 269–274.

Tirole, J. (1988). *The Theory of Industrial Organization*. MIT Press. Cambridge.

Todaro, M. P. (1997). “Urbanization Unemployment and Migration in Africa: Theory and Policy.” *Population Council, Policy Research Division Working Papers,* núm. 104, 50 pp.

Varian, H. (1988). *The Theory of Industrial Organization*. MIT Press. Cambridge.

White, H. (1980). “A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity.” *Econometrica,* núm. 48, pp. 817–838.

WorldBank (2015). 2015 *World Development Indicators*. The World Bank. Washington, D. C.

Wu, D. (1973). Alternative Tests of Independence between Stochastic Regressors and Disturbances. *Econometrica,* núm. 41, pp. 733–750.

A. ROBUSTNESS TESTS IN THE ESTIMATION OF THE DEMANDS SYSTEM

It is important to verify the following with respect to the results presented in the document:

1. Check that the estimated expenditure functions satisfy the basic requirements of rationality of the consumer theory.
2. Check the validity of the assumption of separability of utility functions (through a price exogeneity test).
3. Check the validity of the assumption of exogeneity of the characteristics of the households included in the analysis

In this section we conduct such tests and find that our results are statistically consistent with the validity of these assumptions.

A.1. Conformity of the results with the predictions of economic theory

By the design of the parameters space, the results were automatically consistent with two basic theoretical constraints of the expenditure functions:

1. Symmetry of matrixes A_ℓ y B.
2. Degree 1 homogeneity in prices of the expenditure function.

In addition, the results were verified to be consistent with two additional properties essential to expenditure functions:

3. Monotonicity of expenditure functions with respect to prices. –The estimated expenditure functions are (increasingly) monotonic with respect to prices

4. Monotonicity of expenditure functions with respect to utility. – The estimated expenditure functions are also increasing transformations of y_h, the measure of indirect utility.

The compatibility between the estimators and the theoretical properties that every expenditure function must satisfy is a very important element that will provide theoretical support to the validity of the results obtained, especially to the construction of the measures of loss in the welfare of households.

A.2. Validity of the assumption of separability of utility

The property of separability in the functions of utility of households implies that prices can be taken as exogenous in the estimation. Therefore, a statistical test of price exogeneity is an indirect way of testing the validity of the assumption of separability. There is no definite test of exogeneity in the literature, and all existing procedures focus on testing necessary conditions that must be satisfied in the presence of exogeneity. In our context, the existing procedures (see, for example, Wu (1973), Hausman (1978), Nakamura and Nakamura (1981)) are based on the following idea. Without loss of generality, for each expenditure category, we can express

$$\log\left(\mathcal{P}_{jh}\right) = E\left[\mathcal{P}_{jh}\middle| z_h, x_h, M_h\right] + \nu_{jh},$$

where z_h is the vector of socioeconomic characteristics of the household included in our demands system, x_h is the logarithm of total expenditures of the household, and M_h stands for the market to which household h belongs (it is important to include M_h to control by market prices, which are determining of the price index $\mathcal{P}_{jh}$ of the household). By definition, the residual ν_{jh} groups all the factors that explain the variation in log ($\mathcal{P}_{jh}$) *which cannot be explained by the variables included in the model*. Now, let us take ε_{eh}, the non-observable shock of preferences for the

category of expenditure ℓ and denote $\mathcal{E}_{-\ell h}$ as a subset of *shocks* in vector $\mathcal{E}_h$ that excludes $\mathcal{E}_{\ell h}$. [13] Maintaining the hypothesis that z_h, x_h and M_h are exogenous, a necessary condition of exogeneity for the price index $\mathcal{P}_{jh}$ is that

$$E\left[\varepsilon_{\ell h}\middle|\varepsilon_{-\ell h},\ \nu_{jh}\right] = E\left[\varepsilon_{\ell h}\middle|\varepsilon_{-\ell h}\right] \quad \forall\ \ell = 1, \ldots, 12. \tag{20}$$

That is, controlled by the variation in the rest of the vector of non-observable variables $\mathcal{E}_{-\ell h}$, the residual ν_{jh} should not contain additional information that can explain the variation in $\mathcal{E}_{\ell h}$, and this must be true for each category ℓ.

The previous discussion is of nonparametric nature. In our case, to perform the test of the hypothesis described in (20) we approximated the conditional expectations described above as follows,

$$E\left[\mathcal{P}_{jh}|z_h, x_h, M_h\right] = \lambda_j'\phi_j(z_h, x_h, M_h), \text{ and } E\left[\varepsilon_{\ell h}|\varepsilon_{-\ell h},\ \nu_{jh}\right] = \delta_\ell'\psi_\ell(\varepsilon_{-\ell h}) + \alpha_{\ell,j}\cdot\nu_{jh},$$

where $\Psi_\ell(\cdot)$ y $\Phi_\ell(\cdot)$ are polynomial functions of up to degree 6. Thus, the price index $\mathcal{P}_{jh}$ is exogenous only if $\alpha_{\ell,j}=0$ for each ℓ. The steps of our analysis were as follows:

1. For each expenditure category $j = 1, \ldots, 12$ the estimated model was:

$$\log\left(\mathcal{P}_{jh}\right) = \lambda_j'\phi_j(z_h, x_h, M_h) + \nu_{jh},$$

where $\Phi_j(\cdot)$ is a vector of polynomial functions of up to degree 6. The estimated residuals $\hat{\nu}_{jh}$ were collected.

2. For each pair of expenditure categories (j, ℓ), a model described as

$$\hat{\varepsilon}_{\ell h} = \delta_j'\psi_j(\hat{\varepsilon}_{-\ell h}) + \alpha_{\ell,j}\cdot\hat{\nu}_{jh}. \tag{21}$$

was estimated.

13. As noted in footnote 4, the restriction of degree 1 homogeneity in the expenditure function implies that $\sum_{\ell=1}^{12}\varepsilon_{\ell h} = 0$.

Therefore, in the construction of $\mathcal{E}_{-\ell h}$ we excluded $\mathcal{E}_{\ell h}$ and excluded another additional element in $\mathcal{E}_h$; otherwise, if we only exclude $\mathcal{E}_{\ell h}$, we would have $E[\mathcal{E}_{\ell h}|\mathcal{E}_{-\ell h}]= \mathcal{E}_{\ell h}$.

The equation described in (21) is our parametric approximation to (20). $\mathcal{P}_{jh}$ is exogenous only if $\alpha_{\ell,j}=0$ for each ℓ.

3. Based on the parametric approximation described in (21), $\mathcal{P}_{jh}$ is exogenous only if each coefficient $\hat{\alpha}_{\ell,j}$ (for each $\ell= 1,\ldots,12$) is statistically significant. This was evaluated through the corresponding *t*-statistics. For the construction of standard errors reflected in the *t*-statistics the variance-covariance matrix of the model described in Step 2 was estimated using the estimator robust to the presence of heteroscedasticity described in White (1980).

Our analysis then consists of 144 regressions where we individually analyzed the statistical significance of each coefficient $\hat{\alpha}_{\ell,j}$ according to the procedure described above. The purpose is to have a comprehensive and individualized analysis of the likelihood of endogeneity of each of the twelve indices of prices of the households. The results are shown in Boxes 11A and 11B. It is possible to see that in none of the cases the coefficient $\alpha_{\ell,j}$ was statistically significant with confidence level greater than 95%. In fact, none of the p-values were less than 10%. Even though there is no definite manner to reject endogeneity, the fact that none of the 144 regressions violated the necessary conditions of price exogeneity is, undoubtedly, a mitigating factor with respect to the suspicion of endogeneity.

Box 11A. Price endogeneity tests: Absolute value of the *t*-statistic - coefficient $\alpha_{\varepsilon,j}$ in the equation (21), with the corresponding p-value in parentheses.

	Price ($\mathcal{P}_{jh}$)					
Expenditure category ($\mathcal{E}_{\ell h}$)	*Tortillas*	Bread	Chicken and egg	Beef	Processed meats	Dairy products
Tortillas	1.1977 (0.2310)	1.2586 (0.2081)	1.1754 (0.2398)	1.1893 (0.2343)	1.1776 (0.2389)	1.1614 (0.2454)
Bread	0.8892 (0.3738)	0.9818 (0.3261)	0.8625 (0.3884)	0.1051 (0.9162)	0.8587 (0.3905)	0.8479 (0.3964)
Chicken and egg	1.4877 (0.1368)	1.5509 (0.1209)	1.4768 (0.1397)	1.4835 (0.1379)	1.4748 (0.1402)	0.7047 (0.4809)
Beef	0.2105 (0.8332)	0.2153 (0.8294)	0.2185 (0.8269)	0.2023 (0.8396)	0.2094 (0.8341)	0.2176 (0.8277)
Processed meats	0.5290 (0.5967)	0.5313 (0.5951)	0.5431 (0.5870)	0.5259 (0.5989)	0.5305 (0.5957)	0.5388 (0.5900)
Dairy products	0.9178 (0.3587)	0.9715 (0.3312)	0.8967 (0.3698)	0.9073 (0.3642)	0.8990 (0.3686)	0.8782 (0.3797)
Fruits	0.6522 (0.5142)	0.6975 (0.4854)	0.6378 (0.5235)	0.6458 (0.5183)	0.6418 (0.5209)	0.6184 (0.5362)
Vegetables	1.4373 (0.1506)	1.5306 (0.1258)	1.4151 (0.1570)	1.4197 (0.1556)	1.4075 (0.1592)	1.3844 (0.1662)
Non-alcoholic beverages	0.4724 (0.6366)	1.0868 (0.2771)	0.4405 (0.6595)	1.1750 (0.2399)	0.0775 (0.9381)	0.1007 (0.9197)
Medicines	0.8348 (0.4038)	0.7955 (0.4262)	0.8536 (0.3933)	0.8402 (0.4007)	0.8454 (0.3978)	0.8563 (0.3918)
Interurban passenger transport	0.9721 (0.3309)	0.9254 (0.3547)	0.9921 (0.3211)	0.9772 (0.3284)	0.9834 (0.3253)	0.9952 (0.3196)
Construction materials	0.5410 (0.5884)	1.2988 (0.1939)	0.5479 (0.5837)	0.5352 (0.5924)	0.5363 (0.5917)	0.5979 (0.5498)

The *p*-values correspond to the null hypothesis that $\alpha_{\varepsilon,j}=0$ (the condition of exogeneity). In no case, coefficient $\alpha_{\varepsilon,j}$ was statistically significant at 95% confidence level.

Box 11B. Price endogeneity test (continued): Absolute Value of the *t*-statistic of coefficient $\alpha_{\ell,j}$ in equation (21), with the corresponding *p*-value in parentheses.

Expenditure category	Price					
	Fruits	Vegetables	Non-alcoholic beverages	Medicines	Interurban passenger transport	Construction materials
Tortillas	1.2093 (0.2265)	1.1328 (0.2572)	1.1717 (0.2412)	1.1701 (0.2419)	1.1791 (0.2383)	1.1798 (0.2380)
Bread	0.9149 (0.3602)	0.8134 (0.4159)	0.8558 (0.3920)	0.8564 (0.3917)	0.8642 (0.3874)	0.8651 (0.3869)
Chicken and egg	1.4938 (0.1352)	1.4346 (0.1513)	1.4732 (0.1406)	1.4665 (0.1425)	1.4751 (0.1401)	1.4749 (0.1402)
Beef	0.2048 (0.8376)	0.2386 (0.8113)	0.2178 (0.8275)	0.2183 (0.8271)	0.2176 (0.8277)	0.2149 (0.8298)
Processed meats	0.5197 (0.6032)	0.5564 (0.5779)	0.5359 (0.5919)	0.5377 (0.5907)	0.5378 (0.5906)	0.5344 (0.5930)
Dairy products	0.9242 (0.3553)	0.8606 (0.3894)	0.8988 (0.3687)	0.8918 (0.3724)	0.9048 (0.3655)	0.9028 (0.3665)
Fruits	0.6723 (0.5013)	0.6193 (0.5357)	0.6387 (0.5229)	0.6364 (0.5244)	0.6414 (0.5212)	0.6409 (0.5215)
Vegetables	1.4360 (0.1509)	1.3722 (0.1699)	1.4007 (0.1613)	1.4032 (0.1605)	1.4137 (0.1574)	1.4133 (0.1576)
Non-alcoholic beverages	0.4320 (0.6657)	0.9491 (0.3425)	0.9539 (0.3401)	0.9329 (0.3508)	0.9531 (0.3405)	0.9487 (0.3427)
Medicines	0.8106 (0.4175)	0.8290 (0.4070)	0.8353 (0.4035)	0.8565 (0.3916)	0.8359 (0.4031)	0.8390 (0.4014)
Interurban passenger transport	0.9449 (0.3447)	0.9685 (0.3327)	0.9738 (0.3301)	0.9947 (0.3198)	0.9747 (0.3297)	0.9775 (0.3282)
Construction materials	0.5696 (0.5688)	0.5785 (0.5629)	0.5430 (0.5870)	0.5614 (0.5745)	0.5364 (0.5916)	0.5376 (0.5908)

The *p*-values correspond to the null hypothesis that $\alpha_{\ell,j}=0$ (the condition of exogeneity). In no case, coefficient $\alpha_{\ell,j}$ was statistically significant at 95% confidence level.

A.3. Other endogeneity tests

The estimation was also based on the assumption that all the characteristics included in z_h ((described in Section 2.3.3) satisfy a condition of exogeneity, which means no systematic relationship exists between z_h and $\mathcal{E}_h$ that cannot be captured by the variables included in the model. It is necessary to evaluate whether the statistical evidence is consistent with said assumption. z_h includes some cross-terms; our analysis focuses on the basic components of that vector:

EDUC, INTEGRANTES, MENORES, INGR80, LOC2500, AUTOLAV

Similar to the analysis of exogeneity of prices, the strategy is the following. Without loss of generality, we can express each component z^k_h in vector z_h as

$$z^k_h = E\left[z^k_h \middle| z^{-k}_h, x_h\right] + \xi^k_h,$$

where z^{-k}_h refers to the rest of the elements in z_h. Following the rest of the literature x_h (logarithm for total household expenditures) is considered exogenous throughout the analysis. The socioeconomic characteristic z^k_h is exogenous only if

$$E\left[\varepsilon_{\ell h} \middle| \varepsilon_{-\ell h}, \xi^k_h\right] = E\left[\varepsilon_{\ell h} \middle| \varepsilon_{-\ell h}\right] \quad \forall\, \ell = 1, \ldots, 12.$$

As it was done in the study of price exogeneity, the conditional expectations are approximated using polynomial functions. We used the approximations,

$$E\left[z^k_h \middle| z^{-k}_h, x_h\right] = \lambda'_k \varphi_k(z^{-k}_h, x_h), \text{ and } E\left[\varepsilon_{\ell h} \middle| \varepsilon_{-\ell h}, \nu_{jh}\right] = \delta'_\ell \omega_\ell(\varepsilon_{-\ell h}) + \gamma_{\ell,k} \cdot \xi^k_h,$$

where, once again, $\varphi_k(\cdot)$ and $\omega_\ell(\cdot)$ are vectors of polynomial functions of up to order 6. The steps of our analysis were:

1. For each z^k_h the model estimated was

$$z^k_h = \lambda'_k \varphi_k(z^{-k}_h, x_h) + \xi^k_h,$$

where $\varphi_k(\cdot)$ is a vector of polynomial functions of up to grade 6. Estimated residuals ξ^k_h. were collected.

2. For each expenditure category $\ell = 1, \ldots, 12$, we estimated a model described as

$$\widehat{\varepsilon}_{\ell h} = \delta'_\ell \psi_\ell(\widehat{\varepsilon}_{-\ell h}) + \gamma_{\ell,k} \cdot \widehat{\xi}^k_h.$$

(22)

where z^k_h is exogenous only if $Y_{\ell,k} = 0$ for each ℓ.

3. Based on the parametric approximation described in (22), z^k_h is exogenous only if each coefficient $Y_{\ell,k}$ (for each $\ell = 1,\ldots,12$) is statistically significant. This was evaluated using the corresponding *t*-statistics. For the construction of standard

errors reflected in the *t*-statistics, the variance-covariance matrix of the model described in Step 2 was estimated using the robust estimator to the presence of heteroscedasticity described in White (1980).

Our analysis consists in this case of 48 regressions, for each of which that statistical significance of coefficient $Y_{\ell,k}$ was evaluated. The results are included in Box 12. Compared to the results of the exogeneity tests of price indices in Boxes 11A and 11B, lower *p*-values are observed in some cases. In particular, *p*-values under 5% were observed for EDUC (education of head of the household) and for INGR80 (indicator of the households that are above income decile 8). However, in none of the 48 cases there were *p*-values below 2%, so the hypothesis of exogeneity cannot be rejected with a statistical confidence greater than 99% in any case. This is notable due to the great heterogeneity of households included in our sample and the large number of expenditure categories analyzed. It is also worth noting that the analysis of endogeneity included herein is much more detailed and exhaustive than the discussions included in the vast majority of demand studies, since the possibility of endogeneity was examined for each characteristic included in z_h individually, within each of the expenditure categories used; this level of analysis typically cannot be found in demand estimation works.

Box 12. Test of endogeneity of the socioeconomic characteristics included in the demand analysis: Absolute value of the *t*-statistic of coefficient $Y_{\ell,k}$ in equation (22), with the *p*-value in parentheses.

	Price ($\mathcal{P}_{jh}$)					
Expenditure category ($\mathcal{E}_{\ell h}$)	*Tortillas*	Bread	Chicken and egg	Beef	Processed meats	Dairy products
Tortillas	1.1977 (0.2310)	1.2586 (0.2081)	1.1754 (0.2398)	1.1893 (0.2343)	1.1776 (0.2389)	1.1614 (0.2454)
Bread	0.8892 (0.3738)	0.9818 (0.3261)	0.8625 (0.3884)	0.1051 (0.9162)	0.8587 (0.3905)	0.8479 (0.3964)
Chicken and egg	1.4877 (0.1368)	1.5509 (0.1209)	1.4768 (0.1397)	1.4835 (0.1379)	1.4748 (0.1402)	0.7047 (0.4809)
Beef	0.2105 (0.8332)	0.2153 (0.8294)	0.2185 (0.8269)	0.2023 (0.8396)	0.2094 (0.8341)	0.2176 (0.8277)
Processed meats	0.5290 (0.5967)	0.5313 (0.5951)	0.5431 (0.5870)	0.5259 (0.5989)	0.5305 (0.5957)	0.5388 (0.5900)
Dairy products	0.9178 (0.3587)	0.9715 (0.3312)	0.8967 (0.3698)	0.9073 (0.3642)	0.8990 (0.3686)	0.8782 (0.3797)
Fruits	0.6522 (0.5142)	0.6975 (0.4854)	0.6378 (0.5235)	0.6458 (0.5183)	0.6418 (0.5209)	0.6184 (0.5362)
Vegetables	1.4373 (0.1506)	1.5306 (0.1258)	1.4151 (0.1570)	1.4197 (0.1556)	1.4075 (0.1592)	1.3844 (0.1662)
Non-alcoholic beverages	0.4724 (0.6366)	1.0868 (0.2771)	0.4405 (0.6595)	1.1750 (0.2399)	0.0775 (0.9381)	0.1007 (0.9197)
Medicines	0.8348 (0.4038)	0.7955 (0.4262)	0.8536 (0.3933)	0.8402 (0.4007)	0.8454 (0.3978)	0.8563 (0.3918)
Interurban passenger transport	0.9721 (0.3309)	0.9254 (0.3547)	0.9921 (0.3211)	0.9772 (0.3284)	0.9834 (0.3253)	0.9952 (0.3196)
Construction materials	0.5410 (0.5884)	1.2988 (0.1939)	0.5479 (0.5837)	0.5352 (0.5924)	0.5363 (0.5917)	0.5979 (0.5498)

The *p*-values correspond to the null hypothesis that $\alpha_{\ell,j}=0$ (the condition of exogeneity). In no case, coefficient $\alpha_{\ell,j}$ was statistically significant at 98% confidence level.

B. ROBUSTNESS TESTS OF THE MARKUP MODEL

Model (17) is an *approximation of the markup price* theoretical equation described in (16). It is important to evaluate whether (17) constitutes a suitable econometric approximation. First, the theory predicts that coefficient β^{e}_{η} must have a positive sign (or zero), which was consistent with the results obtained: each of the estimated parameters was statistically significant and positive, or statistically equal to zero. None of them was negative and statistically significant. Additionally, the sign of each β^{e}_{η} was as expected, which is essential for the robustness of approximation. The analysis is complemented below by conducting statistical tests of rejection to model (17) and statistical tests of endogeneity to those presented in Annex A.

B.1. CAPABILITY OF THE MODEL TO EXPLAIN PRICE VARIATION

Our first objective is to determine whether the model described in (17) is able to explain the observed variation in prices. This can be determined by testing the null hypothesis that all regressors included in (17) are statistically insignificant. Since our estimation of (17) admits the possibility of heteroscedasticity (we use the estimator of variance-covariance robust to heteroscedasticity proposed by White (1980)), the appropriate statistic[14] for this hypothesis test is the Wald statistic (see Engle (1983)), which is used to test hypothesis of the type

$$H_0 : R\theta = c,$$

where θ is a vector of k parameters, R is a matrix of dimensions q x k and c is a vector of dimension q. The Wald statistic is constructed thus,

$$\mathcal{J} = \sqrt{n} \cdot \left(R\hat{\theta} - c\right)' \left(R\widehat{V}(\hat{\theta})R'\right)^{-1} \left(R\hat{\theta} - c\right),$$

14. The so-called F-statistic of the regression is appropriate only if the hypothesis of homoscedasticity is maintained, but this is a very restrictive assumption in our case.

where $V(\theta)$ is the estimator of the variance-covariance matrix of θ. In our case we use the estimator of variance-covariance proposed by White (1980), which is robust to the presence of heteroscedasticity. Under the null hypothesis H_0, statistic J thas an asymptotic distribution x^2_q (Chi-square with q degrees of freedom). The null hypothesis is rejected with a degree of significance α if and only if $J > z_{1-\alpha}(q)$, where the critical value $z_{1-\alpha}(q)$ is the percentile $1-\alpha$ corresponding to a random variable with distribution x^2_q.

Model (17) includes twelve regressors (eleven cost variables, plus the demand elasticity factor), plus an intercept. Therefore, the Wald statistic for the hypothesis that all regressors have coefficients equal to zero has a x^2_{12} (Chi-square with 12 degrees of freedom) distribution, under the null hypothesis. Therefore, the critical value for a significance level of 1% is 26.2165. The results are summarized in Box 13. With 99% statistical confidence, we cannot reject the hypothesis that the model has explanatory power for the variations in prices for eleven of our categories, and with 95% statistical confidence, this was true for all categories. The fact that the model has explanatory power in the vast majority of the cases is not surprising given that in the regression (17) it includes a vast collection of relevant measures of cost for each market.

Box 13. Wald statistic of the regressions (17) for the null hypothesis that all explanatory variables have a coefficient equal to zero.[a]/

Category	Wald statistic for $H_0 : \gamma^\ell = 0, \theta^\ell_\eta = 0$ in (17)	p-value
Tortillas	96.226	<0.01
Chicken and egg	53.213	<0.01
Processed meats	77.337	<0.01
Fruits	285.623	<0.01
Non-alcoholic beverages	21.242	0.046
Air passenger transportation	206.107	<0.01
Interurban passenger transport	113.225	<0.01
Bread	1209.61	<0.01
Beef	63.420	<0.01
Dairy products	200.445	<0.01
Vegetables	22.201	0.035
Medicines	56.720	<0.01
Construction materials	54.450	<0.01

[a]/ The *p*-values correspond to the null hypothesis that all coefficients in (17) are equal to zero.

B.2. Endogeneity Tests

Let us remember that the model of overprices is given by the equation (17), described as:

$$p^{\ell}_{m} = X^{c\ell\prime}_{m}\gamma^{\ell} + \beta^{\ell}_{\eta}\cdot\eta^{\ell}_{m} + \varepsilon^{\ell}_{m},$$

where $\mathcal{E}^{\ell}_{m}$ includes the non-observable determinants of costs in the market m for the category ℓ. The estimation of parameters Y^{ℓ} and β^{ℓ}_{η} was made under the assumption that a systematic correlation between $\mathcal{E}^{\ell}_{m}$ and the explanatory variables $X^{c\ell}_{m}$ (observable determinants of costs) and η^{ℓ}_{m} (demand elasticity) does not exist. In the analysis presented below the hypothesis that there is no systematic relationship between η^{ℓ}_{m} and $\mathcal{E}^{\ell}_{m}$. Eis maintained. This is a reasonable assumption, since the demand elasticity is a characteristic of the preferences of households, therefore it is enough to assume that there is no systematic relationship between these preferences and the determinants of costs at the market level. Therefore, the analysis of endogeneity focuses exclusively on the cost variables included in $X^{c\ell}_{m}$. The list includes eleven variables detailed in Box 6. Let us denote generically each of the eleven variables included in vector $X^{c\ell}_{m}$ as $X^{c\ell}_{m}(j)$, with $j = 1, \ldots, 11$. For each element, we can express

$$X^{c\ell}_{m}(j) = E\left[X^{c\ell}_{m}(j)\middle|\eta^{\ell}_{m}\right] + \nu_{m,\ell}(j).$$

$\nu_{m\ell}(j)$ captures the variation of $X^{c\ell}_{m}(j)$ that cannot be explained by η^{ℓ}_{m} (the only variable that is considered as exogenous throughout this exercise). Let us group $\nu_{m}=(\nu_{m\ell}(j))^{11}_{j=1}$. Under the assumption of exogeneity of $X^{c\ell}_{m}$ in equation (17), we should have

$$E\left[\varepsilon^{\ell}_{m}\middle|\nu_{m}\right] = E[\varepsilon^{\ell}_{m}].$$

(23)

The conditional expectations described above are approximated here as follows,

$$E\left[X^{c\ell}_{m}(j)\middle|\eta^{\ell}_{m}\right] = \rho^{j}_{0} + \sum_{r=1}^{6}\rho^{j}_{r}\cdot(\eta^{\ell}_{m})^{r}, \text{ and } E\left[\varepsilon^{\ell}_{m}\middle|\nu_{m}\right] = \gamma^{\ell}_{0} + \alpha^{\ell\prime}\nu_{m}.$$

Thus, the conditional expectation $E[X^{c\ell}_{m}(j)|\eta^{\ell}_{m}]$ is approximated as a sixth-order polynomial function (sixth-order polynomials

were also used to approximate the nonparametric conditional expectations in Annex A). The variables in $X^{c^{\ell}}_{m}$ are exogenous only if $\alpha^{\ell}=0$. The steps were as follows:

1. For each of the eleven cost variables $X^{c^{\ell}}_{m}(j)$, $j = 1, \ldots, 11$ included in equation (17), the model was estimated

$$X^{c^{\ell}}_{m}(j) = \rho^{j}_{0} + \sum_{r=1}^{6} \rho^{j}_{r} \cdot (\hat{\eta}^{\ell}_{m})^{r} + \nu_{m,\ell}(j).$$

(24)

From this, the estimated residual vector $\nu_{m}=(\nu_{m\ell}(j))^{11}_{j=1}$ was obtained.

2. For each expenditure category for which we estimated the regression:

$$\hat{\varepsilon}^{\ell}_{m} = \gamma^{\ell}_{0} + \alpha'_{\ell}\hat{\nu}_{m} + \xi^{\ell}_{m}$$

(25)

The cost variable vector $X^{c^{\ell}}_{m}$ is exogenous only if $\alpha^{\ell}=0$.

3. The hypothesis test $H_0 : \alpha^{\ell}=0$ was conducted by using the Wald statistic (see Engle (1983)). In this case, said statistic is given by

$$\mathcal{J} = \sqrt{n} \cdot (I_{11}\hat{\alpha}_{\ell})' \left(I_{11}\hat{V}(\alpha_{\ell})I_{11}\right)^{-1} (I_{11}\hat{\alpha}_{\ell}),$$

where $I11$ is the identity matrix of dimension $11x11$ and $\hat{\nu}(\alpha^{\ell})$ is our estimator of the variance-covariance matrix of $\hat{\alpha}^{\ell}$. As in all previous cases in the present study, the variance-covariance estimator is of the form proposed in White (1980) and it is robust to the presence of heteroscedasticity. Under the null hypothesis of exogeneity (that is, under the null hypothesis $H_0 : \alpha^{\ell}=0$), the Wald $\mathcal{J}$ statistic has an asymptotic distribution x^{2}_{11} (Chi-square with 11 degrees of freedom). Consequently, the critical value for our test of hypothesis is 19.6751 for 5% significance, and 24.7249 for 1% significance.

The results of the endogeneity tests are summarized in Box 14. If a 99% of statistical level of confidence is set (that is, if the aim is to reduce the probability of rejecting exogeneity erroneously at no more than 1%), the conjecture of exogeneity cannot be rejected[15].

15. More precisely, the lowest *p*-value was 43.16%.

Box 14. Tests of endogeneity in the regression (17): Wald statistic for hypothesis $H_o: \alpha_\ell = 0$ in model (25)[a/].

Category	Wald statistic for $H_0 : \gamma^\ell = 0, \beta^\ell_\eta = 0$ in (17)	p-value
Tortillas	96.226	< 0.01
Chicken and egg	53.213	< 0.01
Processed meats	77.337	< 0.01
Fruits	285.623	< 0.01
Non-alcoholic beverages	21.242	0.046
Air passenger transportation	206.107	< 0.01
Interurban passenger transport	113.225	< 0.01
Bread	1209.61	< 0.01
Beef	63.420	< 0.01
Dairy products	200.445	< 0.01
Vegetables	22.201	0.035
Medicines	56.720	< 0.01
Construction materials	54.450	< 0.01

Under the null hypothesis of exogeneity ($\alpha_\ell = 0$), the statistic J thas an asymptotic distribution χ^2 (Chi-square with 11 degrees of freedom). Consequently, for a 5% of statistical significance 5 %, the test's critical value is 19.6751 and for a 1% significance level the critical value is 24.7249.

C. RESULTS OF REGIONAL IMPACT DISAGGREGATED BY INCOME DECILES

Box 15. Impact of market power on the welfare of households.
Breakdown by income decile and by regions.[a/]
Standard errors in parentheses.

Income Decile	Northwest		Northeast		West		East	
	Amount	Percentage	Amount	Percentage	Amount	Percentage	Amount	Percentage
I	$876	21.6	$777	25.9	$898	30.5	$735	33.0
	($97.7)	(0.85)	($103.8)	(1.12)	($98.8)	(1.19)	($83.5)	(1.22)
II	$1, 235	20.2	$1, 173	21.7	$1, 208	23.6	$860	25.6
	($143.9)	(0.75)	($145.6)	(0.85)	($147.5)	(0.94)	($99.9)	(0.92)
III	$1, 308	16.4	$1, 259	17.6	$1, 251	20.3	$1, 036	21.8
	($156.3)	(0.65)	($144.2)	(0.64)	($137.4)	(0.74)	($107.5)	(0.75)
IV	$1, 385	15.4	$1, 348	14.9	$1, 326	16.7	$1, 260	20.8
	($146.6)	(0.58)	($193.4)	(0.69)	($161 .8)	(0.64)	($138.1)	(0.71)
V	$1, 596	14.3	$1, 441	13.9	$1, 617	18.2	$1, 343	18.8
	($169.5)	(0.47)	($179.1)	(0.56)	($167.7)	(0.55)	($128.7)	(0.57)
VI	$1, 551	12.1	$1, 584	12.3	$1, 694	14.4	$1, 510	17.8
	($153.2)	(0.40)	($175.2)	(0.43)	($197.9)	(0.54)	($184.4)	(0.69)
VII	$1, 744	11 .9	$1, 591	11 .2	$1, 897	13.4	$1, 457	14.8
	($200.5)	(0.49)	($164.8)	(0.39)	($220.3)	(0.45)	($137.3)	(0.44)
VII	$1, 728	8.8	$1, 614	9.2	$1, 941	10.7	$1, 705	14.1
	($232.3)	(0.37)	($197.4)	(0.37)	($224.7)	(0.43)	($171 .6)	(0.43)
IX	$1, 801	7.4	$1, 809	7.6	$2, 431	9.6	$1, 965	12.4
	($178.6)	(0.26)	($243.1)	(0.34)	($289.9)	(0.38)	($164.8)	(0.34)
X	$2, 134	5.4	$2, 323	4.7	$2, 285	5.7	$2, 270	8.3
	($287.6)	(0.25)	($332.7)	(0.21)	($271.4)	(0.23)	($241.4)	(0.33)
All households	$1, 461	12.9	$1, 477	13.3	$1, 610	15.6	$1, 376	17.9
	($151 .9)	(0.42)	($168.9)	(0.49)	($168.9)	(0.48)	($134.0)	(0.54)

Income Decile	North Central		South Central		Southwest		Southeast	
	Amount	Percentage	Amount	Percentage	Amount	Percentage	Amount	Percentage
I	$1, 001	31.8	$1, 182	33.9	$621	35.4	$757	28.9
	($110 .0)	(0.97)	($133.1)	(1.30)	($96.9)	(1.55)	($105.0)	(1.32)
II	$1, 170	24.7	$1, 543	27.2	$1, 033	33.0	$1, 093	26.1
	($110 .6)	(0.78)	($171 .0)	(0.99)	($127.3)	(1.31)	($137.5)	(1.04)
III	$1, 335	21.0	$1, 551	21.4	$1, 086	26.9	$1, 134	20.7
	($157.8)	(0.80)	($136.5)	(0.63)	($103.5)	(0.84)	($145.2)	(0.85)
IV	$1, 581	20.6	$1, 664	19.4	$1, 108	22.6	$1, 256	19.6
	($148.7)	(0.70)	($161 .3)	(0.62)	($123.2)	(0.79)	($176.3)	(0.89)
V	$1, 407	16.4	$1, 794	17.9	$1, 223	20.7	$1, 433	17.8
	($168.9)	(0.59)	($181 .6)	(0.61)	($136.2)	(0.68)	($181 .6)	(0.74)
VI	$1, 726	16.2	$1, 649	14.9	$1, 339	19.1	$1, 678	16.5
	($170.3)	(0.55)	($163.6)	(0.47)	($228.5)	(1.05)	($188.9)	(0.59)
VII	$1, 623	13.1	$2, 091	15.7	$1, 443	17.5	$1, 912	16.1
	($175.6)	(0.44)	($189.1)	(0.49)	($151 .7)	(0.58)	($218.5)	(0.62)
VII	$2, 041	13.0	$2, 147	12.9	$1, 472	14.0	$1, 929	12.8
	($199.7)	(0.39)	($242.5)	(0.47)	($160.5)	(0.46)	($237.9)	(0.52)
IX	$2, 115	10.1	$2, 194	9.9	$1, 781	12.1	$2, 045	9.9
	($213.5)	(0.33)	($249.4)	(0.37)	($190.6)	(0.45)	($241.4)	(0.39)
X	$2, 162	5.3	$2, 523	5.9	$2, 655	9.3	$2, 170	5.8
	($269.5)	(0.22)	($320.9)	(0.33)	($328.3)	(0.38)	($277.9)	(0.25)
All households	$1, 564	15.6	$1, 796	17.3	$1, 286	18.9	$1, 439	16.6
	($147.3)	(0.44)	($166.2)	(0.54)	($122.2)	(0.58)	($176.8)	(0.63)

a. The total income of households includes the sum total of current income and total earnings. This includes: remuneration from work, income from a business, transfers, non-monetary expenditures (remuneration in kind), and other income. Standard errors obtained via the method *subsampling bootstrap* (Politis and Romano (1994)).

D. RESULTS OF IMPACT ON WELFARE FOR SECTORS WHERE THE STATISTICAL CONFIDENCE LEVEL OF MARKET POWER WAS 99 %

Results of the impact on welfare included in Section 4 take into account the overprice in expenditure categories where the coefficient of market power in equation (17) was statistically significant at 95% confidence level in Box 9. This includes the categories: tortillas, bread, chicken and eggs, beef, dairy products, fruit, vegetables, air passenger transportation, interurban passenger transportation, and construction materials. This annex only includes results from categories where the coefficient of market power was significant at 99% confidence level. This excludes only the expenditure category chicken and eggs from the previous list.

Comparing the results from Boxes 10 and 15 with that of Boxes 16 and 17, respectively, it can be observed that the order of magnitude of the estimated loss in welfare is very similar if the items where market power was significant at 95% are considered, or if the analysis is restricted only to items where the statistical level of confidence was 99%. For example, the estimated average impact for all households is $1,497 in the first case and $1,414 in the second case (a proportional difference of 6% approximately).

As proportion of income, the estimates are 15.7% and 14.4% respectively (a proportional difference at 9%).

Comparing confidence intervals it can be clearly verified that the conclusions of the study do not change substantially if a criterion of 95% or 99% level of confidence of market power is used. To illustrate this, 95% confidence intervals are compared

below, constructed by taking the estimated values and adding ±1.96 times the corresponding standard error.

	95% statistical confidence interval for the estimated harm in welfare	
	Including sectors where market power is significant at 95%	Including sectors where market power is significant at 99%
Amount	[$1, 196, $1, 798]	[$1, 112, $1, 716]
Percentage	[14.7%, 16.7%]	[13.4%, 15.4%]

Box 16. Harm in the consumer welfare by income decile, including only categories where the statistical confidence level of market power was at 99%. Standard errors in parentheses.

Income Decile	Amount [a/]	Percentage
I	$765 ($89.2)	27.2 (0.96)
II	$1, 034 ($118 .9)	22.2 (0.82)
III	$1, 236 ($142 .6)	20.7 (0.76)
IV	$1, 328 ($147 .9)	17 .8 (0.62)
V	$1, 418 ($151 .0)	16 .2 (0.56)
VI	$1, 557 ($163 .6)	14 .5 (0.41)
VII	$1, 683 ($163 .0)	13 .1 (0.41)
VIII	$1, 793 ($181 .4)	11 .3 (0.39)
IX	$1, 850 ($191 .1)	8.7 (0.31)
X	$2, 104 ($247.3)	5.2 (0.20)
All households	$1 , 414 ($154 .1)	14 .4 (0.49)

Source: Author's work.
a,b. Values shown correspond to the mean of households.
a. The total household income in this study includes the total sum of current income and total earnings. This includes: remuneration from work, income from a business, transfers, non-monetary expenditures (remuneration in kind), and other income.
Standard errors obtained via the method subsampling bootstrap (Politis and Romano (1994)).

Box 17. Impact of market power on welfare of households including only the categories where the statistical level of confidence of market power was at 99%. Breakdown by income decile and by regions.[a/]
Standard errors in parentheses.

Income Decile	Northwest		Northeast		West		East	
	Amount	Percentage	Amount	Percentage	Amount	Percentage	Amount	Percentage
I	$737	20.4	$668	24.0	$867	26.8	$672	28.4
	($94.6)	(0.82)	($91.2)	(1.03)	($84.9)	(1.00)	($82.5)	(1.04)
II	$1, 115	17.9	$971	18.1	$1, 131	22.1	$835	23.6
	($131 .1)	(0.68)	($117 .9)	(0.67)	($145.8)	(0.92)	($93.2)	(0.81)
III	$1, 071	14.2	$1, 234	16.8	$1, 233	20.1	$992	21.4
	($142.8)	(0.62)	($137.3)	(0.62)	($144.3)	(0.77)	($100.3)	(0.69)
IV	$1, 170	13.2	$1, 275	14.6	$1, 370	17.9	$1, 175	20.8
	($153.3)	(0.39)	($174.6)	(0.44)	($184.1)	(0.49)	($178.5)	(0.66)
V	$1, 328	12.4	$1, 410	13.2	$1, 577	17.0	$1, 314	18.2
	($169.8)	(0.41)	($167.7)	(0.39)	($218.3)	(0.45)	($126.1)	(0.41)
VI	$1, 397	11 .3	$1, 508	12.3	$1, 614	14.1	$1, 479	17.2
	($204.7)	(0.33)	($210.9)	(0.40)	($213.3)	(0.41)	($176.9)	(0.44)
VII	$1, 518	10.1	$1, 530	10.8	$1, 883	13.3	$1, 399	14.5
	($169.9)	(0.40)	($167.7)	(0.39)	($218.3)	(0.45)	($126.1)	(0.41)
VII	$1, 430	7.7	$1, 582	9.2	$1, 825	9.6	$1, 683	13.7
	($204.7)	(0.33)	($210.9)	(0.40)	($213.3)	(0.41)	($176.9)	(0.44)
IX	$1, 559	6.4	$1, 661	7.0	$2, 277	9.4	$1, 779	11 .6
	($168.7)	(0.25)	($234.5)	(0.34)	($258.6)	(0.32)	($154.7)	(0.33)
X	$1, 963	4.6	$1, 933	4.0	$2, 259	5.6	$2, 215	7.9
	($257.9)	(0.21)	($262.2)	(0.19)	($228.0)	(0.19)	($240.0)	(0.28)
All households	$1, 295	10.8	$1, 379	12.1	$1, 555	14.5	$1, 304	17.1
	($145.1)	(0.38)	($169.1)	(0.47)	($161 .8)	(0.49)	($131 .7)	(0.55)

Income Decile	North Central		South Central		Southwest		Southeast	
	Amount	Percentage	Amount	Percentage	Amount	Percentage	Amount	Percentage
I	$875	29.2	$1, 018	30.1	$618	26.3	$732	27.1
	($94.8)	(0.93)	($107.9)	(1.05)	($73.1)	(0.97)	($108.8)	(1.27)
II	$1, 114	23.3	$1, 555	27.2	$990	31.5	$1, 045	24.8
	($124 .0)	(0.85)	($177 .8)	(1.04)	($126.3)	(1.32)	($144.7)	(1.08)
III	$1, 298	20.7	$1, 483	21.0	$964	23.9	$1, 096	20.1
	($140.1)	(0.71)	($151 .5)	(0.70)	($95.7)	(0.80)	($154.0)	(0.90)
IV	$1, 443	19.7	$1, 642	19.1	$1, 084	21.7	$1, 211	18.7
	($128.1)	(0.61)	($167.1)	(0.63)	($128.5)	(0.83)	($176.5)	(0.90)
V	$1, 442	16.9	$1, 708	17.2	$1, 225	20.9	$1, 397	16.9
	($163.3)	(0.58)	($187.7)	(0.63)	($148.9)	(0.74)	($186.7)	(0.74)
VI	$1, 673	15.6	$1, 660	15.1	$1, 177	16.4	$1, 589	16.1
	($173.4)	(0.55)	($163.9)	(0.47)	($186.9)	(0.85)	($195.6)	(0.63)
VII	$1, 622	13.1	$2, 036	15.1	$1, 422	16.8	$1, 792	15.3
	($145.9)	(0.38)	($200.1)	(0.51)	($143.9)	(0.54)	($222.5)	(0.65)
VII	$1, 888	12.1	$2, 177	12.9	$1, 473	14.5	$1, 846	12.2
	($188.3)	(0.38)	($240.6)	(0.45)	($165.7)	(0.44)	($235.5)	(0.52)
IX	$2, 074	9.1	$2, 099	9.7	$1, 735	11 .7	$1, 838	8.9
	($211 .4)	(0.30)	($249.7)	(0.39)	($191 .1)	(0.45)	($220.9)	(0.39)
X	$2, 126	5.3	$2, 300	4.3	$2, 640	9.1	$1, 979	5.2
	($238.7)	(0.22)	($263.9)	(0.20)	($307.1)	(0.34)	($282.0)	(0.24)
All households	$1, 472	14.9	$1, 760	16.2	$1, 237	18.2	$1, 387	15.1
	($136.6)	(0.42)	($172.9)	(0.56)	($125 .9)	(0.58)	($182 .1)	(0.63)

a/ The total household income in this study includes the total sum of current income and total earnings.
It includes: remuneration from work, income from a business, transfers, non-monetary expenditures (remuneration in kind), and other income.
Standard errors obtained using the method subsampling bootstrap (Politis and Romano (1994)).

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A better Mexico is everyone's responsibility