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CASE STUDY OF THE PORK MEAT MARKET

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Foreword

This report was prepared by Francisco Javier Nuñez Melgoza, consultant to the OECD, under the direction of Sean Ennis, OECD Senior Economist and reviewed by Niccolò Comini, Competition Expert at the OECD, at the request of the Ministry of Economy of Mexico (Secretaría de Economía – SE). Its objective is to identify situations that could indicate inefficiencies in the pork meat market in Mexico. It is also motivated by the interest of the SE for a better understanding of this and related markets. The study is part of the SE's work programme; one of its priorities is to contribute to the efficient functioning of markets for the benefit of consumers and companies.

The methodology of "Market Examinations in Mexico: A Manual by the OECD Secretariat" was applied to carry out the research.[1] According to this document, market reviews can have different purposes, among which are to:

- Identify market distortions that may be caused by the structure of the market, regulations or conduct of companies or competitors, to propose remedial actions.
- Improve market knowledge, the ability to respond to unusual events in markets, and identify potential risks to consumers.
- Provide elements for the intervention of the authorities in different areas of public policy, such as: aspects related to consumer protection, recommendations to market participants, recommendations to different levels of government to modify laws and regulatory framework, as well as promoting better regulatory practices.

In general terms, the report contains the following elements:

- A description of the production, distribution and marketing of pork meat, as well as a review of international experience;
- The delineation of the markets that constitute the value chain, as well as revision of the characteristics of these, which determine relationships between participants, including: the identification of the latter in the links of the chain, their market presence, multi-market contacts, the nature and characteristics of the products, as well as their possible substitutes and complements, and the description of common practices in the industry.
- The structural aspects that characterise the value chain, including the level of market concentration, participation in the market by different participants, the degree of product differentiation, cost structures, vertical integration, business strategies, market transparency, stability of market conditions, information asymmetries, exchange costs and purchasing power, among other elements.

[1] Available at www.oecd.org/daf/competition/Examenes-de-mercado-en-Mexico-Manual-2016.pdf

- Conditions of entry, exit and expansion, including economies of scale and scope, access to inputs, installed capacity and access to imports.
- Aspects related to the behaviour and performance of the markets, such as prices, profitability, quality, innovation, contractual relationships and practices of market participants.
- Regulatory aspects that could impose entry restrictions or distort incentives for market participants, affect their ability to compete and limit or distort decisions and the information available to consumers.

The pork market is important since it is one of the main sources of protein for the population of Mexico. In 2016, the per capita consumption for pork was approximately 12 kilogrammes (kg).[2] Expenditure on pork meat represented 4.1% of food expenditure in the basket of goods of the National Consumer Price Index. In addition to its importance in consumption, the pork meat production chain contributes to the generation of jobs and income.

The survey is integrated as follows: Chapter 1 presents an introduction, which contextualises the development of the industry based on industry experience in other countries; Chapter 2 presents the general elements of the international context; Chapter 3 gives the general characteristics of the industry in Mexico; Chapter 4 describes the swine livestock industry; Chapter 5 presents a description of meat processing; Chapter 6 describes the distribution and commercialisation of pork meat; Chapter 7 analyses business practices; Chapter 8 exposes elements of industry performance. Finally, Chapter 9 presents final conclusions Chapter 10 gives recommendations.

We appreciate the collaboration of the former Under Secretary of Competitiveness and Normativity, María del Rocío Ruiz Chávez; former Head of the Competitiveness and Public Policies for Market Efficiency Unit, David López Victoriano, as well as several public officials who have collaborated in that Unit, among them Gustavo Rodrigo Pérez Valdespín, Alín Martínez Morales, Aurelio Limón Cruz and Víctor Fabián Coca Reyes. All made valuable contributions, supported and made comments at different stages of the project. In addition, interviews with officials from SAGARPA, SENASICA and FIRA were conducted, as well as with representatives of companies and associations related to the industry. Thanks to this, it was possible to obtain valuable information for the preparation of this report. It is also important to highlight the collaboration of Sean Ennis, Michael Saller and Niccoló Comini, high-level experts from the Competition Division, the OECD Directorate of Financial and Business Affairs and the OECD Centre in Mexico, respectively, who contributed significantly to the direction and review of the survey.

[2] In this study, figures from the OECD-FAO database are used for two reasons. First, the database allows analysis of the time trajectory since the 1990s and provides forecasts to 2025 and in some cases to 2030. Second, it allows comparison between different countries. The OECD-FAO database converts production data on the carcass-to-retail channel using a rate of 0.78. In carcass units, the industry estimates that per capita consumption is around 16 kg a year. The figures used in this study can be consulted in the OECD-FAO, Agricultural Outlook 2016-2025 and 2017-2026.

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Glossary

Animal offal: Animal tissue, which is not intended for human consumption, according to the The Manual of Good Farming Practices in the Production of Swine Farms (MBPPGP).

Animal welfare: Level of health, comfort, food and safety, which allows an animal to manifest innate forms of behaviour; not suffering from unpleasant sensations of pain, fear or restlessness.

Balanced meal: The MBPPGP points out that this is the result of mixing two or more ingredients in a food formula to obtain animal feed, for the farm's own consumption or for commercialisation.

Biosecurity: The essential zoosanitary provisions and actions that minimise risks of introduction, transmission or dissemination of disease or pests (MBPPGP).

Carcass: Refers to the body of the animal devoid of skin, bristles, head, viscera and legs.

Dark, Firm and Dry (DFD) meat: A quality problem in meat that is characterised by a high pH (6.0 to 6.4) and is generated by chronic stress in the animal in the long term.

Establishment of Federal Inspection Type (TIF): The Federal Law on Animal Health (LFSA) defines these as the facilities where animals are slaughtered or where goods of animal origin are processed, packed, refrigerated or industrialised, subject to regulation by the Secretariat of Agriculture and Rural Development (SAGARPA), in co-ordination with the Ministry of Health.

Evisceration: Extraction of viscera of the species of animals considered suitable for human consumption.

Food safety: The guarantee that a food will not cause harm to the consumer when it is prepared or ingested according to the use for which it is destined (MBPPGP).

Good Livestock Practices: The LFSA defines a set of procedures, activities, conditions and controls that are applied in the units of production of animals and TIF establishments, to reduce the hazards associated with physical, chemical or biological agents, as well as the zoosanitary risks in goods of animal origin for animal consumption.

Hazard Analysis and Critical Control Points (HACCP): A systematic preventive process to ensure food safety, which is applied in industries that are related to food production.

Inspection: Verification of compliance with the LFSA and derived provisions by the SAGARPA.

Moral hazard: Situation of information asymmetry, in which an individual has private information about the consequences of their own actions, but other people bear the consequences of the risks assumed.

Official Mexican Standards (Norma Oficial Mexicana, NOM): Mandatory technical regulations issued by the agencies responsible, in accordance with the purposes set out in article 40 of the Federal Law on Metrology and Standardization. These official standards establish rules, specifications, attributes, guidelines, features or requirements applicable to a product, process, installation, system, activity, service or method of production or operation, as well as those related to terminology, symbology, packaging, marketing or labelling and those that refer to its compliance or application.

Official Veterinarian: A professional of veterinary medicine whose salary is paid by SAGARPA (LFSA).

Pale, Soft and Exudative (PSE) meat: A problem of quality in meat, characterised by a very fast drop in pH (below 6 in the first 45 minutes after slaughter), generated by intense stress in the animal in the short term and usually associated with high temperatures in the muscle tissue.

Processing: The set of activities that are carried out in a TIF establishment in the production of a good of animal origin that makes it suitable for human consumption (LFSA).

Product System: Set of elements and concurrent agents of the productive processes of agricultural products, including the supply of technical equipment, inputs and services of primary production, collection, transformation, distribution and commercialisation.

Responsible Authorised Veterinarian: A professional authorised by SAGARPA, to provide its services of help and emission of documents in production units; establishments that industrialise or commercialise biological, chemical, pharmaceutical, pesticides or food products for use in animals or consumption by them; authorised laboratories; TIF establishments for slaughter and processing; or others determined by SAGARPA (LFSA).

Scalding: Procedure of introduction of the slaughtered animal in hot water to facilitate hair removal.

Sharecropping: A situation where a person gives several animals to another to care for and feed with distribution of yields in the proportion that suits them.

Slaughterhouse: Establishment dedicated to the slaughter and dressing of animals for supply.

Slaughtering: The process in which an animal is killed, under sanitary orders, in order to obtain its meat in optimal conditions for human consumption.

Stress: The reaction of living organisms to various adverse stimuli, internal or external, that tend to alter the psychological and physiological balance of an animal, through its exposure to extreme conditions (MBPPGP).

Supply-side substitution: In competition policy, it refers to the possibility of a company being subject to competitive restrictions when, because of a rise in prices, producers of other goods can modify their production processes to produce products competing with those supplied by the first.

Traceability: The series of systematised technical and administrative activities which register the processes of birth, breeding, fattening, reproduction, slaughtering and processing of an animal, the goods of animal origin, as well as chemical, pharmaceutical, biological and food products for use in animals or consumption by them until their final consumption, identifying at each stage their spatial location and, where appropriate, animal

health and contamination risk factors that may be present in each one of the activities (MBPPGP).

Value chain: From an economic point of view, a set of activities necessary to conduct a product or service through the different phases of its production, and delivery to final consumers and waste. Participants in the chain include suppliers of raw materials, farmers, traders, processors, transporters, wholesalers, retailers and end consumers. In terms of the LFSA, it is a set of elements and agents involved in the production processes of the goods regulated by law, including the supply of technical equipment, productive inputs, financial resources, primary production, stockpiling, processing, distribution and marketing.

Verification: The ocular verification, review of documents or verification by sampling and analysis of the official laboratory, approved or authorised, that verifies compliance with the provisions of the LFSA and related provisions (MBPPGP).

Vertical integration: Situation, in which a single entity takes control of different stages of the process of production or distribution of a product or service.

Vertical relationships: Relationships, upstream or downstream, which refer to the stages of the production process in an industry. The upstream stage is related to obtaining the necessary inputs for a productive process. The downstream stage involves the sale or distribution of the good or services produced.

Viscera: Organs contained in the thoracic, abdominal, pelvic and cranial cavities.

Acronyms and abbreviations

ANETIF	National Association of TIF Sites (Asociación Nacional de Establecimientos TIF)
CGT	Gene transfer centre
CIMMYT	International Maize and Wheat Improvement Center (*Centre international d'amélioration du maïs et du blé*)
COFECE	Comisión Federal de Competencia Económica
CONAFAB	Consejo Nacional de Fabricantes de Alimentos Balanceados y de la Nutrición Animal, A.C.
DOJ	US Department of Justice
ENIGH	National Survey of Household Income and Expenditure (*Encuesta Nacional de Ingresos y Gastos de los Hogares)*
FAO	Food and Agriculture Organization
FIRA	Trust Funds for Ruran Development (*Fideicomisos Instituidos en Relación con la Agricultura*)
FTC	US Federal Trade Commission
HACCP	Hazard Analysis and Critical Control Points
INEGI	National Institute of Statistics and Geography (*Instituto Nacional de Estadística y Geografía*)
LFSA	Federal La won Animal Health (*Ley Federal de Sanidad Animal*)
MBPPGP	Manual of Good Farming Practices in the Production of Swine Farms (*Manual de Buenas Prácticas Pecuarias en la Producción de Granjas Porcícolas*)
NOM	Official Mexican Standard (Norma Oficial Mexicana)
OCETIF	Certification Organism for TIF Establishments (*Organismo de Certificatión de Establecimientos TIF*)
OECD	Organisation for Economic Co-operation and Development
PORCIMEX	Association of Mexican Pork Producers (*Confederación de Porcicultores Mexicanos, A.C.)*
PROGAN	Sustainable Livestock Production and Beekeeping Regulation Program (*Programa Producción pecuaria sustentable y ordenamiento ganadero y apícola*)
SAGARPA	Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (*Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación*)
SE	Ministry of Economy (*Secretaría de Economía*)
SENASICA	National Service of Health, Food Safety and Food Quality (*Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria*)
SIAP	Agrifood and Fisheries Information Service (*Servicio de Información Agroalimentaria y Pesquera*)
SIAVI	Harmonized Tariff System (Sistema de Información Arancelaria Vía Internet)
SNICE	National Service of Information on Foreign Trade (*Servicio Nacional de Información de Comercio Exterior*)
SNIIM	National Information System anad Market Integration (*Sistema Nacional de Información e Integración de Mercados*)
USDA	US Department of Agriculture
TIF	Federal Inspection Sites (Establecimientos Tipo Inspección Federal)

Executive summary

Objective of the study

This survey analyses the functioning of the value chain of pork production using the methodology indicated in "Market Examinations in Mexico: A Manual by the OECD Secretariat" prepared by the Secretariat of Economy (SE) and the OECD.

The pork industry is important, representing 4.1% of food expenditure in the basket of goods of the National Consumer Price Index (CPI). Despite being third in importance, after chicken and beef, pork has an important growth potential, due to a better perception of its quality and the favourable performance of its prices. According to figures from the Agrifood and Fisheries Information Service (SIAP), pork meat production represented 4.5% of agri-food GDP value in 2017.

Overview

The relationship between production links in agri-food chains is an issue that concerns the authorities of different jurisdictions, particularly due to the increase in food prices since the mid-2000s. One important point, mainly in the United States, is the possibility of an increase in bargaining power in the processing link, in relation to pork producers. This is the result of an increase in the levels of market concentration over the past 20 years, as a result of economic phenomena such as the 2008 crisis and the need to increase the scale of production of the industry, to meet technological, cost and security needs.

Another important aspect is vertical integration and relations between competitors. As will be shown, there are different models of organisation for the industry. In some countries (such as Denmark), practically all the production comes from vertically integrated producers. There are outstanding examples of collaboration between competitors, such as Denmark and Germany. In other cases, the industry develops around contractual relationships such as in the United States.

These cases are characterised by the existence of regulatory frameworks that exempt agricultural industries from the application of competition laws for certain purposes.

International context

Growth in population and the improvement in income levels have stimulated an increase in meat consumption. Pork is the most consumed meat in the world, despite the religious and cultural restrictions that exist in some countries. Although forecasts indicate that the consumption of chicken meat will exceed the consumption of pork in the coming years, pork will continue its expansion, probably at a rate of around 2.5% per year.

Production is concentrated in three jurisdictions: 75% of production is in China, the European Union and the United States. Mexico is a medium producer, represents 1.1% of

world production and has a deficit. Mexico is the second largest importer, since its purchases represent 9% of total international trade in pork.

Relative to other types of meat, the price of pork has evolved favourably for consumers in relative terms. Pork prices have risen less than those of chicken and beef.

General characteristics of the pork industry in Mexico

In volume, pork meat represents one fifth of meat production. In recent years the industry has performed well, with an average annual growth of 2.1%. However, consumption has increased faster, which has meant a significant increase in imports that represent about 45% of apparent consumption. The United States is the main exporter to Mexico; the most import products are fresh, chilled or frozen meats.

Tariffs fluctuate between 10% and 20%, applicable to imports from countries with which there are no commercial agreements. In June 2018, the Mexican government decided to suspend preferential tariff treatment for various pork products from the United States. It also established a quota to import up to 350 000 tonnes (t) tariff free. As of November 2018, only about 1.5% of the quota had been used.

Production is highly concentrated in six Mexican states, which represent almost 76% of supply. Per capita consumption has increased almost 50% since the 1990s. It is feasible that this growth will continue over the next few years, due to population growth and rising incomes.

The swine industry

In Mexico there are two systems for producing swine: traditional and modern. The modern system is characterised by a high degree of specialisation in the production stages, a wide use of technology and vertical integration.

The production of swine includes the stages of gestation, weaning, pre-fattening and fattening. In the modern system, some farms carry out the different stages in three separate and clearly differentiated sites to guarantee better feeding efficiency and better sanitary control.

The most important inputs of the process are breeder sows and animal feed. The latter represents 67% of the total cost of production.

The indicators of productivity in the different stages are unfavourable for Mexico. In recent years, the country has worked on programmes that seek to improve production and productivity. Voluntary certification mechanisms also allow export to countries that require compliance with sanitary regulations.

Processing

Slaughtering is carried out in different types of establishments. These are Federal Inspection Sites (TIF), municipal and other non-identified facilities. There is federal supervision over slaughterhouses; however, market participants indicate that the degree of monitoring between TIF and municipal facilities differs.

The government has encouraged the expansion of TIF slaughtering, supporting campaigns and granting subsidies. In particular, the Ministry of Agriculture and Rural Development (SAGARPA) supports campaigns carried out by the National Association of TIF Sites

(ANETIF) to increase the level of identification of TIF establishments and has a TIF slaughter support programme. This type represents around 60% of slaughtering in establishments.

The entrance to the processing market in TIF slaughterhouses requires large investment and regulation requires a large number of veterinarians. This can make the operation of the installation costly. The management of land use by municipal authorities can constitute another barrier to entering the pork processing market.

Distribution and marketing

Pork steak is the most consumed cut, representing approximately 27% of pork consumption, followed by rib and chop which represents 26.3%. The consumption of cuts varies among states of the republic and deciles of income.

Butcher shops sell 55% of the total product and are the main point of sale of pork. Public markets are the second most important channel, and they represent 21% of sales. The modern channel is not very relevant as supermarkets represent only 11% of commercialisation.

Consumption is highly concentrated in a few states. The State of Mexico, Mexico City, Veracruz, Jalisco and Puebla account for 51.3% of consumption. In per capita terms, there is great heterogeneity in consumption by state. Citizens of the south-eastern states of Mexico spend the most on pork, followed by the inhabitants of Colima, Tlaxcala and the State of Mexico. The states with lower consumption are in northern Mexico.

There is no evidence to conclude that there is a high concentration in the distribution of pork (especially in the retail sector). There are few economies of scale to increase the purchasing power of clients.

No information is available on the investment required to establish a distribution centre, although it is known that the amounts will depend on the volume and whether the distribution establishments are multi-product.

For butcher shops, the investment is smaller. However, there may be local restrictions established by municipal authorities.

Commercial practices

SAGARPA has favoured the creation of gene transfer centres, which influences the supply of good quality animals. The most important producers have made investments in this activity.

The interviewees pointed out the existence of areas of opportunity in the organisation of primary producers to make purchases that could reduce the costs of acquiring inputs such as medicines and animal feed.

Some companies use sharecropping contracts mainly for the fattening stage of swine. Sharecropping contracts provide comparative advantages, reducing the capital, labour and sanitary control costs of swine producing companies. This model has been implemented in some regions. Trust Funds for Rural Development (FIRA) has stimulated the development of such relations and has encouraged the operation of *Parafinancieras*, financial institutions that provide support to producers who do not have access to traditional credit sources.

Performance

The study concludes with a statistical analysis of prices. It demonstrates that there are no changes in the relative prices between the different links in the chain (animal feed inputs, balanced feed, swine, carcass, cuts, and final consumer). However, there are indications of an increase in the gross margin of carcass producers, but there are no elements to indicate that this has affected final prices.

Prices seem to be differentiated in regions, although it is not possible to identify any one or several regions that can exercise leadership over the others.

There is also a relationship between import prices and domestic prices. This is explained by the high imported component of apparent consumption and reflects the importance of maintaining the market open to imports.

Chapter 1. Overview

This chapter presents the pork market in general terms. It describes the origins of the industry and contextualises it in relation to food chains. A general presentation of the characteristics of the industry in Mexico includes some peculiarities in other jurisdictions and identifies certain problems at the international level.

1.1. Origins of the industry

Several studies show that the pig descends from two artiodactyl mammals, one of European origin (*Sus scrofa*) and another Asian (*Sus vittatus*). For thousands of years, the pig was domesticated in several places, including Europe, China and the Middle East.[3] Recently, Italy, Burma, Thailand, India and New Guinea are identified as the original centres of domestication.[4] The pig was introduced to America in the 16th century with the colonisation of the Spanish and was one of the animals that managed to adapt to the territory most successfully. Creole pigs evolved from crosses between European and Asian races.

The acceptance of the pig comes from its ease of domestication; its high fertility rate, which produces up to 15 young per year per breeding sow; and its rapid growth – it grows to maturity in 6 months. It also has the advantage of being omnivorous, capable of feeding on various types of organic components, which historically means that the pig is perceived as an animal that feeds on waste.[5]

Production was mechanised after the Second World War and pigs became a standardised product of massive production facilities. The industry bases its production on mixtures of several races, the main ones being the so-called Duroc, Hampshire and Yorkshire, which have been selected for intensive production.

Until the 1940s, exploitation in Mexico had backyard or rustic characteristics. In that decade pork became the second most important source of meat supply in the country. However, it was not until the 1970s that pork meat became the most important meat production system in the country and mechanised swine farming was developed, mainly in the north of the country. Nevertheless, Mexico still has an important backyard production sector.

3 Studies indicate that the pig may have been domesticated about 11 000 years ago. The pig is considered to be one of the animals most closely linked with the development of humanity.

4 Information available at www.elmundo.es/elmundo/2005/03/11/ciencia/1110563044.html

5 There are cultural and religious restrictions to pork consumption, which are derived from historical circumstances. For example, the sacred writings of Hebrews prohibited its consumption because it is an animal that spent its life in filth and is not hygienic. A similar situation is reflected in Islamic cultures.

1.2. Pork and the food industry

For more than a decade there has been a concern about the price of food internationally. This has been manifested in various studies prepared by organisations such as the OECD and the American Antitrust Institute.[6]

The studies identify an increase in food prices in practically all the links of the value chain. The increases have been higher than those shown by merchandise in general. In the case of meat, the rise has been accompanied by higher prices of cereals, particularly corns, which are the main inputs for the feed of cattle, swine and poultry. In turn, animal feed is the main production cost of meat chains.[7]

In addition to the usual determinants of productive conditions, the emphasis has been on the relationship between links. In sum, the relative evolution of prices between the stages of the value chain has to do with the length of these chains, the contractual relations and the vertical integration between the links and the particular conditions of demand in each one of them.

This report analyses the value chain of pork production in Mexico to identify distortions and inefficiencies that, if addressed, could improve price, access to and quality of the products. This analysis used "Market Examinations in Mexico: A Manual by the OECD Secretariat" prepared by Secretariat of the Economy (SE) and the OECD.

1.3. Country experience

United States

In the United States the industry has given rise to greater concentration. Between 1992 and 2004, the number of farms decreased by 70% and the average size of these farms increased almost five-fold.[8] The trend continued and between 2007 and 2012 the number of farms again decreased by 25%.

The industry has gone from a model that integrated all stages of production to a model specialised in specific phases of production. Thus, there are several types of producers: independent producers operate in the reproduction and completion stages; contract producers are responsible for finalising the product provided (but that is owned by someone else); and contractors who, in addition to producing, hire these latter producers.

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6 See OECD (2014), *Competition Issues in the Food Chain Industry*, DAF/COMP(2014)16, available at www.oecd.org/daf/competition/CompetitionIssuesintheFoodChainIndustry.pdf, and American Antitrust Institute (2008), "Fighting Food Inflation through Competition", in *The Next Antitrust Agenda: The American Antitrust Institute´s Transition Report on Competition Policy to the 44th President of the United States*, available at https://antitrustinstitute.org/files/Food%20Chapter%20from%20%20AAI%20Transition%20Report_100520082051.pdf.

7 The international price of corn was affected during recent years by US policy to stimulate the production of biofuels.

8 Key, N. y W. Mcbride, (2007), *The Changing Economics of U.S. Hog Production*, USDA, Economic Research Report Number 52, December 2007, available at www.ers.usda.gov/publications/pub-details/?pubid=45938.

In 2012, independent producers operated 85% of the farms but only produced 46% of the animals. The contract producers represented 44% of production. The contractors produced the remaining 10%, but they owned the production obtained by contract.[9]

Concentration can also be seen in the processing stage.[10] In 2008 it was estimated that the five largest producers represented 65% of processing. This has happened due to various mergers. For example, Smithfield Foods acquired several competing companies, concentrating the main processors in some areas.[11]

Concentration on processing activities has generated concern. As with other products, such as chicken farms, swine producers found it is expensive to move animals over long distances, so there are price differentials paid to producers depending on their location and local processing alternatives. The purchasing power of the processors who acquire swine for slaughter gives them the benefit of lower prices.[12]

A significant number of producers participate in contractual schemes with processors, though proportionately less than in the chicken industry. The contracts guarantee a destination for swine produced on the farms, but the price is usually defined in terms of spot markets, which could be subject to manipulation by some companies.

The US market is controlled by a small number of producers. Efforts have been made to limit their purchasing power, for example through initiatives in Congress to avoid vertical control of production and proposals to force processors to acquire at least 25% of the swine they slaughter from spot markets.

Large producers are identified as contractors or integrators, who contract with independent breeders for pork production. There are also producers who own farms, which are managed by independent managers. It is estimated that more than 40% of the animals slaughtered by large producers come from own or controlled farms.[13]

European Union

Meat represents the product that takes up the largest share of food expenditure in European Union countries. Pork is the most consumed meat.

The industry has different levels of concentration in its different activities. In general terms, breeding is the least concentrated activity. Slaughtering is carried out by a smaller group of companies. At the retail level, there has been diversification.

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9 USDA (2012), *Census of Agriculture Highlights*, available at www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/Hog_and_Pig_Farming/

10 A review of the structure of the industry in the US is found in *United States International Trade Commission* (2014), Pork and Swine, Industry and Trade Summary, available at www.usitc.gov/publications/332/pork_and_swine_summary_its_11.pdf

11 In turn, Smithfield Foods was acquired in 2013 by the main shareholder of China's largest meat processor, Shuanghui International Holdings.

12 American Antitrust Institute (2008), pp. 292-293.

13 Reimer, J. (2005), *Vertical Integration in the Pork Industry*, available at https://aae.wisc.edu/fsrg/web/FSRG%20papers/10%20Reimer.pdf

Breeding is considered a less mechanised phase. Overcapacity has led to a consolidation in slaughtering and cutting, in which large transnational companies participate. Concentration has been stimulated by increasing requirements of animal welfare and hygiene.

In some countries, such as Poland, studies have been carried out on the supply of live animals. Likewise, there have been investigations into collusion among producers, particularly in the stage of primary production.[14]

Germany is the main European producer and consumer. The market is considered mature, due to its high level of per capita consumption and the stagnation of population growth. The industry has focused on export markets, such as Russia and China.

Breeding is carried out by 28 000 producers, of whom 42% are affiliated to Germany's national association of pork producers.[15] The model is of low vertical and contractual integration. Swine are commercialised through some 3 000 intermediaries, which represent more than 40% of sales. About 100 co-operatives represent approximately 25% of sales. Another 25% is made up of some 60 associations that in turn are part of the union of associations of meat and livestock producers. Direct sales to processors, specialised marketers and consumers represent 8%. Processing is carried out by larger companies.[16]

Prices are defined in two stages. The first involves farmers and processors. There is a market mechanism in which the union of associations participates. This organisation publishes a consensus price based on the production of the co-operatives on a weekly basis. This is the result of a telephone conference call between its associates, with the consensus price the reference for the establishment of the prices paid by the processors. In the second stage, the price is established between processors and marketers through periodic negotiations.

The market operates based on low vertical integration between producers and processors and spot market operations between them and long-term informal relationships. However, there is a high level of co-ordination between processors and marketers, as well as among competitors, through associations and co-operatives.

Unlike the German model, Denmark has a vertical integrated model. In 2014 there were 3 638 farms in the country, reduced from 2004, when there were 8 514 farms. This means an average annual reduction of 8% during the period. The reasons for the decline are associated with the crisis in 2008 and low profit margins. Of the total farms, 18% participate

14 For example, Slovak authorities investigated 47 breeders, due to collusion in the prices of animals for slaughter. For more details on the structure of the industry, see European Competition Network (2012), *Report on Competition Law Enforcement and Market Monitoring Activities by European Competition Authorities in the Food Sector,* available at http://ec.europa.eu/competition/ecn/food_report_en.pdf

15 Farm production has been concentrated. Between 2000 and 2013, the number of farms was reduced from more than 120 000 to 28 000. See Ver European Commission (2014), *The Economic Impact of Modern Retail on Choice and Innovation in the EU Food Sector,* available at http://ec.europa.eu/competition/sectors/agriculture/cases_retail_study.pdf, pp. 28-37.

16 At the processing level, concentration has also increased. In 2004, the 10 largest companies represented 60% of production; in 2012 the percentage had increased to 75%. In the same years, the participation of the three largest producers changed from 45% to 55%. Ibid.

in reproduction; 31% integrate reproduction and finalisation, and more then 50% participate only in finalisation.[17]

The country exports around 90% of its production to more than 140 countries; 70% of exports go to other European countries. Exports of pork account for 5% of export revenues.

Denmark produces almost 30 million pigs a year; 31% are exported as piglets to conclude their growing process in other countries, mainly Germany. Denmark also exports half a million breeding sows.

Almost 20 million pigs are slaughtered every year with 90% of slaughtering carried out in establishments belonging to two co-operatives, Danish Crown and Tican. The remaining 10% is slaughtered in private establishments.

The industry is characterised by producers who own the entire production chain, in a total vertical integration that allows the control of all stages, from the selection of genetic material to processing. In addition, the companies operate as co-operatives.

Denmark has one of the highest productivities in the world. On average, almost 31 weaned pigs are obtained per breeding sow every year. The most productive farms reach up to 33.[18] The industry has achieved productive improvements while it has implemented measures to protect animal welfare, maintaining low rates of antibiotics use and applying sustainable production methods.

1.4. Collaboration between competitors

The examples presented above show that there is diversity in the way the industry is organised. The differences in structure provide the possibility of collaboration between producers.

In the European Union, Article 101 of the Treaty on the Functioning of the European Union establishes exemptions in the application of competition provisions in the agricultural sector. The development of this sector is considered a priority, for which specific regulations have been established that allow producers to strengthen their negotiating power with the buyers of their products.[19] In the cases of Germany and Denmark, these provisions allow for and motivate the operation of co-operatives and producer associations.

In the United States there are provisions, such as the Capper-Volstead Act, which exempt agricultural co-operatives from antitrust laws. In the case of pork, no recent cases were identified in the application of these provisions in the industry that had an effect on the configuration of its structure.

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17 See Danish Agriculture & Food Council (s.f.), *Danish Pig Production Fact File*, available at https://agricultureandfood.co.uk/knowledge-bank/publications

18 See SEGES Pig Research Centre (2016), *Annual Report 2015*, available at https://agricultureandfood.co.uk/knowledge-bank/publications

19 See *Reglamento (UE) No 1308/2013 del Parlamento Europeo y del Consejo de 17 de diciembre de 2013 por el que se crea la organización común de mercados de los productos agrarios y por el que se derogan los Reglamentos (CEE) No 922/72, (CEE) No 234/79, (CE) No 1037/2001 y (CE) No 1234/2007*, available at https://eur-lex.europa.eu/legal-content/ES/TXT/?uri=uriserv:OJ.L_.2013.347.01.0671.01.SPA

1.5. Conclusions

The pig has been present in the history of mankind since ancient times. However, it is not always accepted by different cultures and suffers from prejudices regarding its quality.

Like many agricultural products, the value chain of the industry is made up of different links and there are various models of vertical integration and collaboration among economic agents. For example, in United States, the contracting model between farms and processors in which the farms provide pig growth services and which are owned by the processors has been expanded.

In Germany, there is a low degree of vertical integration. Marketing through intermediaries prevails but associations of producers have a significant influence that has an impact on the setting of reference prices between producers and processors. Contractual schemes have given place to informal long-term relationships. In Denmark, a vertically integrated model prevails in which producers control the processing phase, whereas production is carried out by co-operatives.

A common element of these countries is the increase in concentration in the various links. In some cases, such as in the United States, this has raised concerns about the creation of situations of asymmetry of bargaining power.

Chapter 2. International context

This chapter describes general aspects of the international pork meat market, its production, consumption and prices.

2.1. Meat production

The production of meat has improved since the end of the 1960s due to population growth and a rise in incomes. The production of poultry and pork meat has been distinguished from that of other types of meat, such as beef and sheep.

Table 2.1 shows the evolution of international meat production and how the production of red meat and poultry has increased from 92 million tonnes (Mt) at the end of the 1960s to 323 Mt in 2017. Total production has increased at a rate of 2.6% per year. By type, the production of poultry and pork together reached 239 Mt in 2017. The remaining production of meat from cattle and sheep was 84 Mt.

Food and Agriculture Organization (FAO) projections indicate that meat production will increase to reach 376.3 Mt in 2030. In the same way, it is expected that the production of poultry and pork meat will continue to grow with respect to cattle and sheep production.

Table 2.1. World meat production, 1967-2030

Million tonnes

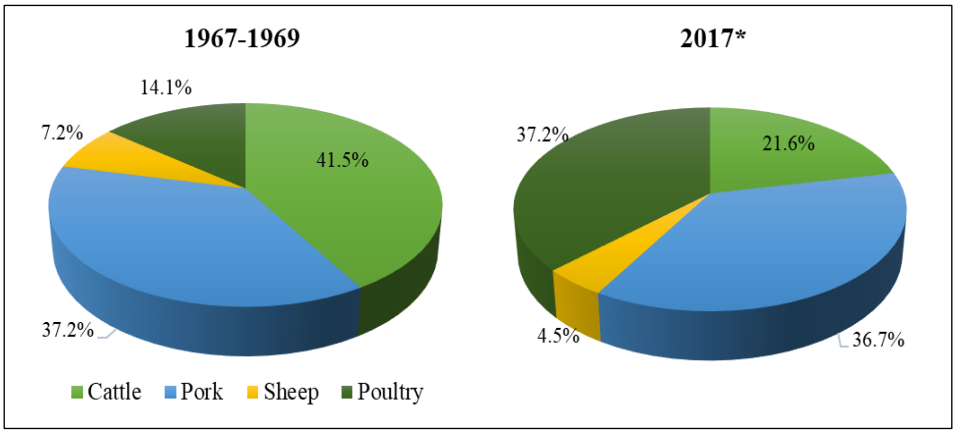
Period	1967/69*	1987/89*	1997/99*	2017**	2025***/	2030***/	Growth rate 1967-2017
Cattle	38.0	53.7	58.7	69.8	77.5	88.4	1.2%
Pork	34.1	66.3	86.5	118.6	128.8	124.5	2.5%
Sheep	6.6	9.1	10.8	14.6	16.8	20.1	1.6%
Poultry	12.9	37.2	61.8	120.1	135.8	143.3	4.6%
Total	91.6	166.3	217.8	323.2	358.9	376.3	2.6%

Note: */ Annual average, **/ Estimate., ***/ Forecast.
Source: FAO, World Agriculture: Towards 2015/2030 an FAO Perspective and OECD-FAO Agricultural Outlook 2018-2027.

In percentage terms, Figure 2.1. shows a comparison between the world production of meat in 1967-1969 and 2017. The production of pork has maintained a share of 37.2% of the total. Poultry meat increased its share in 2017, up from 14.1% in 1967-1969 to 37.2% of the total. In contrast, the share of beef decreased from 41.5% of the total in 1967-1969 to 21.6% in 2017. This behaviour is similar for sheep meat, which went from 7.2% in 1967-1969 to 4.5% in 2017.

Figure 2.1. World production of meat

(Percentage share)



Note: * Estimate
Source: FAO, World Agriculture: Towards 2015/2030 A FAO Perspective and OECD-FAO Agricultural Outlook 2018-2027.

2.2. Consumer trends

In 2017, the per capital world consumption of meat was estimated at 34.3 kg. Consumption increased 24.8% between 1995 and 2017. By 2026, a per capita consumption of 34.6 kg is expected. Table 2.2 shows that pork represented 38.6% of the total in 1995 and 35.6% of the total in 2017. This decrease was also reflected in the per capita consumption of beef, which went from 24.6% to 18.7% between 1995 and 2017. In contrast, per capita consumption of poultry increased from 31% to 40.7% between 1995 and 2017. Pork was the second most important meat, after chicken in 2017, as shown in the following table.[20]

Table 2.2. World consumption of meat per capita, 1995-2026

(Kilogrammes per capita)

	1995	% total	2017*	% total	2026**	% total
Cattle	6.8	24.6%	6.4	18.7%	6.5	18.7%
Pork	10.6	38.6%	12.2	35.6%	12.1	35.0%
Sheep	1.6	5.8%	1.7	5.0%	1.9	5.4%
Poultry	8.5	31.0%	14.0	40.7%	14.1	40.8%
Total	27.5		34.3		34.6	

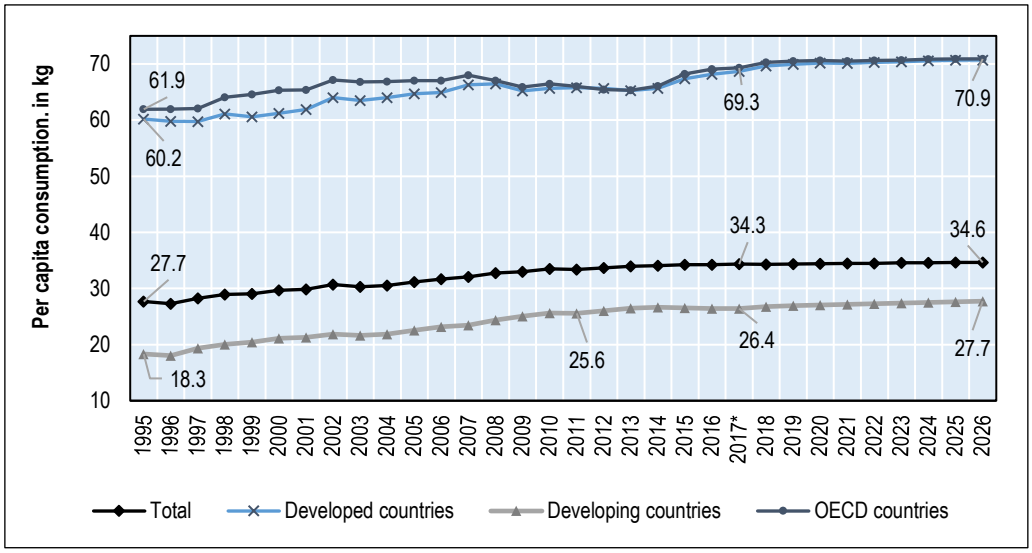
Note: *Estimate, **Forecast
Source: OECD-FAO Agricultural Outlook 2016-2025, 2017-2026 and 2018-2027.

Projections indicate that the shares by type of meat will change little by the year 2026.

[20] There is a difference between the figures reported in the OECD-FAO database and the results according to the National Household Income and Expenditure Survey of INEGI, because the first one transforms the equivalent weight at the retail level, which implies a conversion factor of 0.78 applicable to the weight in carcass.

Figure 2.2 shows the trend of per capita consumption of meat in the world. Consumption in developed countries registered a maximum of 68.7 kg in 1995 and a minimum of 59.8 kg in 2017. OECD member countries consumed 61.9 kg in 1995 and 69.3 kg at the end of 2017. Developing countries had the lowest level of consumption with 18.3 kg in 1995; an expected consumption of 27.2 kg is forecast for 2026. Total world consumption stood at 34.3 kg in 2017. As of 2026, world per capita consumption could reach 34.6 kg.

Figure 2.2. World consumption of meat per capita, 1995-2026



Note: *Estimate. Bovine meat data from 1995 to 1999 was obtained from the publication: OECD-FAO Agricultural Outlook 2016-2025.
Source: OECD-FAO Agricultural Outlook 2016-2025, 2017-2016 and 2018-2027.

Table 2.3 shows worldwide per capita consumption of pork among the different groups of countries in 1995, 2017 and its forecast to 2026. The percentage of pork consumed in developed countries represented 32.9% of total meat consumption in 2017. This percentage is lower than that registered in 1995 and higher than that forecast for 2026. This behaviour is similar to that reported in developing countries. In OECD member countries, in 2017 the percentage corresponding to pork consumption was 33.5%, practically equal to 1995 and greater than 2026.

Table 2.3. World consumption of meat and pork per capita, 1995, 2017 and 2026

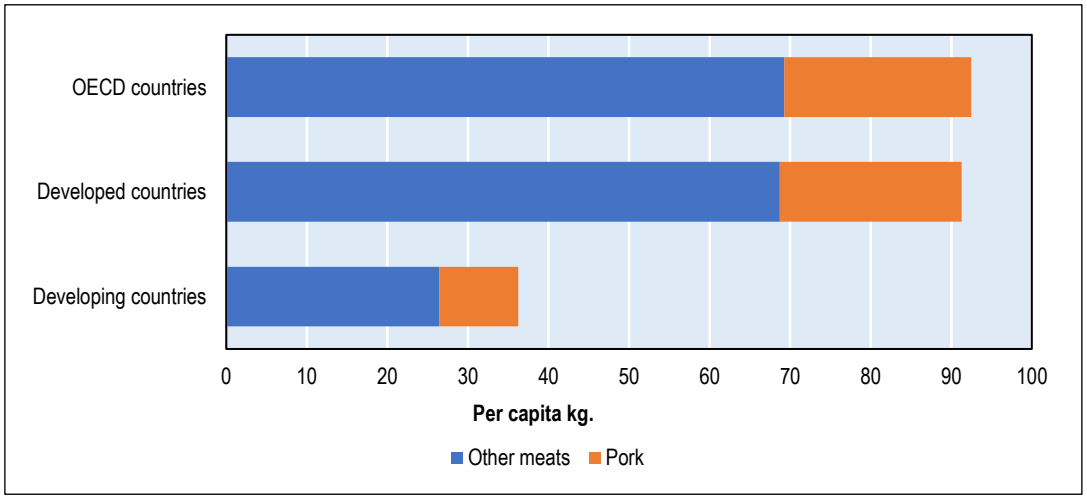
In kilogrammes

	1995	2017*	2026**
Developed countries			
Total meat consumption	59.1	68.7	70.7
Pork consumption	21.7	22.6	22.9
Pork/total %	36.7%	32.9%	32.3%
Developing countries			
Total meat consumption	18.3	26.4	27.7
Pork consumption	7.4	9.8	10.0
Pork/total %	40.3%	37.3%	36.0%
OECD countries			
Total meat consumption	61.1	69.3	70.9
Pork consumption	20.5	23.2	23.2
Pork/total %	33.6%	33.5%	32.8%

Note: *Estimate, **Forecast
Source: OECD-FAO Agricultural Outlook 2016-2025, 2017-2026 and 2018-2027.

Figure 2.3 illustrates per capita consumption of meat and pork per kg and the level of development of the countries. The total per capita consumption of meat in developed countries and OECD member countries was close to 70 kg in 2017. The consumption of pork in this group of countries was around 23 kg. The developing countries consume less than 30 kg of meat per capita and less than 10 kg of pork per capita.

Figure 2.3. Per capita consumption of meat and pork, by level of development, 2017*



Note: *Estimate
Source: OECD-FAO Agricultural Outlook 2018-2027.

When analysing per capita consumption of meat per country, the differences in consumption are remarkable. Table 2.4 presents this information in 2017. Among the sample of countries, the United States has the highest per capita consumption of meat, at 98.4 kg, followed by Brazil with 75.2 kg and Canada with 69.9 kg. Per capita consumption in Mexico is less than half that of the United States at 49.3 kg. By type of meat, the European Union, China and Vietnam have a per capita consumption of more than 30 kg of pork. The countries that consume less pork are Mexico, with 12.3 kg per capita and Brazil with 11.4 kg.

Table 2.4. Per capita consumption of meat, selected countries, 2017*

Kilogrammes

	US	Brazil	Canada	European Union	Korea	Vietnam	China	Mexico	OECD countries
Cattle	25.9	25.9	17.3	10.9	10.3	9.9	3.9	8.8	14.5
Pork	23.1	11.4	16.5	32.1	29.8	30.4	30.3	12.3	23.2
Sheep	0.4	0.5	0.9	1.8	0.3	0.1	3.1	0.5	1.4
Poultry	48.9	37.4	35.1	24.2	17.2	13.0	11.9	27.7	30.2
Total	98.4	75.2	69.9	69.0	57.5	53.3	49.2	49.3	69.3

Note: *Estimate
Source: OECD-FAO Agricultural Outlook 2018-2027.

2.3. Production of pork by country

China, the European Union and the United States concentrated 74.6% of world production in 2017. Mexico is a medium producer, representing 1.1% of world production and has a deficit. Table 2.5 shows the corresponding information for the most relevant countries in this area.

Table 2.5. World pork meat production, selected countries, 1995-2017

Millions of tonnes

Period	1995	1996	2000	2001	2005	2006	2010	2011	2015	2017*	% total
China	36.7	31.8	40.5	41.8	45.7	46.6	51.2	49.6	54.6	53.4	45.0%
European Union	21.0	21.0	21.8	21.8	21.9	22.2	22.8	23.1	23.4	23.5	19.8%
US	8.0	7.5	8.4	8.5	9.1	9.2	10.0	10.1	11.0	11.5	9.7%
Brazil	1.4	1.6	2.6	2.7	2.7	2.9	3.2	3.4	3.5	3.7	3.1%
Canada	1.3	1.3	1.7	1.8	2.1	2.1	1.9	2.0	2.0	2.0	1.7%
Mexico	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.1%
Others	14.0	14.3	14.4	14.7	16.5	17.2	19.3	19.7	21.5	23.0	19.4%
OECD countries	34.2	33.8	36.1	36.3	37.5	38.1	39.6	39.8	41.5	42.4	35.7%
Total	83.2	78.5	90.3	92.3	99.0	101.4	109.6	109.1	117.2	118.6	

Note: *Estimate
Source: OECD-FAO Agricultural Outlook 2017-2026 and 2018-2027.

Table 2.5 shows how China has increased its presence in pork production. In 1995 it produced 36.7 Mt of world production and in 2017 it produced 53.4 Mt, due to the sustained increase in per capita consumption over the last decades. The United States has also increased its presence. It went from 8 Mt to 11.5 Mt in the same period. Brazil has managed to expand its production, from 1.4 Mt to 3.7 Mt, particularly in the 1990s, due to an increase in consumption and exports. This was possible because of the existence of natural resources, particularly animal feed.

2.4. International pork trade, exporters and importers

At the end of 2017, international trade in pork meat stood at 8.1 Mt. It highlights that imports from China and Japan amounted 2.8 Mt, which accounted for 35% of total world trade. Mexico represents 10% of imports. In terms of exports, OECD countries account for 84% of the total. Within this context, Mexico had a share of 1.5%.

Table 2.6. Imports, exports and trade balance of pork meat, selected countries, 2017*

Thousand tonnes

Country	Imports	Exports	Trade balance
China	1,580.0	231.9	-1,348.1
Japan	1,265.4	3.7	-1,261.7
Mexico	816.8	124.0	-692.8
US	647.3	2,554.1	1,906.8
Korea	650.2	2.2	-648.0
Canada	220.5	1,492.2	1,271.7
Brazil	20.2	688.0	667.8
European Union	13.8	2,565.7	2,551.9
OCDE countries	4,074.3	6,969.3	2,896.2
Total	8,120.1	8,295.6	176.7

Note: *Estimate
Source: OECD-FAO Agricultural Outlook 2018-2027.

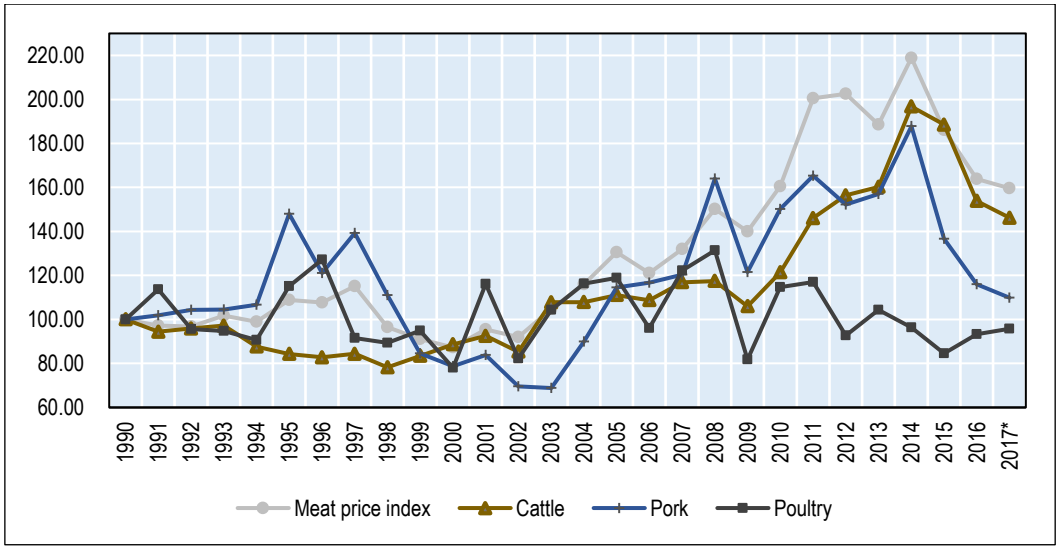
In terms of trade balance, China has the largest deficit in the pork trade, close to 1.4 Mt, followed by Japan, with 1.2 Mt and Mexico, with 0.7 Mt. In contrast, the OECD countries have, overall, a surplus of 2.9 Mt; the United States have 1.9 Mt and Canada has 1.3 Mt.

2.5. Evolution of prices

Figure 2.4 shows the evolution of international meat prices between 1990 and 2017, at the aggregate level and by type of meat. In 2017, this meat index showed an increase of 59% compared to 1990. The maximum level was registered in 2014, when it was 118.9% and its minimum level of -13% was in 2000. On the other hand, the pork index price closed with an increase of 10% with respect to 1990, although it was lower than that calculated for poultry meat and higher for cattle.

Figure 2.4. Evolution of international prices by meat, 1990-2017

1990=100



Note: *Provisional
Source: OECD-FAO Agricultural Outlook 2017-2026.

Table 2.7 shows the world average prices by type of meat between 1990 and 2017. The price of cattle, pork, sheep and poultry increased, with a particularly significant increase in the case of cattle. In 1990, the price of pork was 65% of the price of cattle; this ratio was 49% in 2017.

Table 2.7. Prices of different types of meat, world average, 1990 and 2017

Current USD per tonne

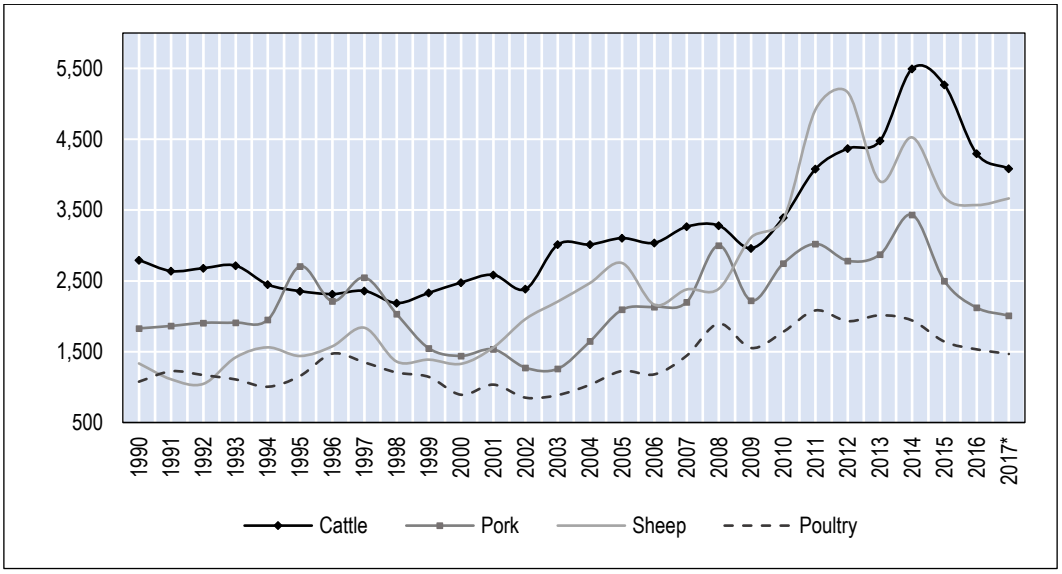
	1990	2017*
Cattle	2,793.5	4,084.8
Pork	1,828.6	2,008.6
Sheep	1,334.1	3,663.8
Poultry	1,076.7	1,467.6

Note: *Provisional
Source: OECD-FAO Agricultural Outlook 2017-2026.

The competitiveness of pork in relation to chicken has improved. In 1990, on average per kilogramme, pork cost almost 70% more than chicken. In 2017, the price difference was only 36%. The following figure shows the evolution of the prices of the three types of meats, in USD (United States dollars).

Figure 2.5. Prices of different types of meat, world average, 1990-2017

Current USD per tonne



Note: *Provisional
Source: OECD-FAO Agricultural Outlook 2017-2026.

All meat prices have increased significantly since the mid-2000s, which is attributed to the growth in the price of grain used as animal feed, but prices dropped significantly since 2014 back to the mid-2000s levels.

2.6. Conclusions

There has been a significant increase in meat consumption over the past 50 years, the result of both an increase in population and a rise in levels of improvement in income. Experience shows that, with the improvement of purchasing power, the population adopts diets in which there is greater meat consumption.

Currently the most consumed meat in the world is pork. However, in the next few years it will probably be overtaken by chicken, due to the dynamism shown by that industry. Chicken meat has advantages because of its lower cost; its shorter growth process; its more efficient use of resources such as land, water and food; its favourable perception among consumers; and its lack of cultural restrictions for consumption. However, the pork industry will continue its expansion, at a rate of around 2.5% per year.

Swine production is highly concentrated, since 75% of it is carried out in three jurisdictions. China, accounts for 45% of total production; the European Union represents just over 20%; and the United States, has a share of 9.6%. Mexico represents 1.1% of production and has a deficit. China and Japan shared 35% of total imports in 2016. Mexico's imports are equivalent to 10% of total international trade in pork. On the other hand, the United States and Canada exported 48.7% of the total. Mexico´s share in exports was 1.5%.

The price of pork has favoured consumers; it is the meat product with the lowest price increases. In relative terms, pork meat has now become significantly cheaper in relation to beef and chicken meats.

Chapter 3. The pork industry in Mexico

3.1. Meat production

Mexico produced 6.69 million metric tonnes of meat in 2017. Poultry meat represented 47.9%, beef 28.8% and pork 21.5% of total production, as shown in Table 3.1.

Table 3.1. Production of carcass meat, 2016 and 2017

Thousand tonnes

Product	2016	2017*	Share %	Variation %
Cattle	1 879.3	1 925.4	28.8%	2.5%
Pork	1 376.1	1 439.9	21.5%	4.6%
Sheep	60.4	61.6	0.9%	2.1%
Chicken	3 077.9	3 207.3	47.9%	4.2%
Goat	39.5	39.7	0.6%	0.3%
Turkey	16.8	17.0	0.3%	1.3%
Total	6 449.9	6 690.9		3.7%

Note: *Preliminary figures to December 2017.
Source: SIAP

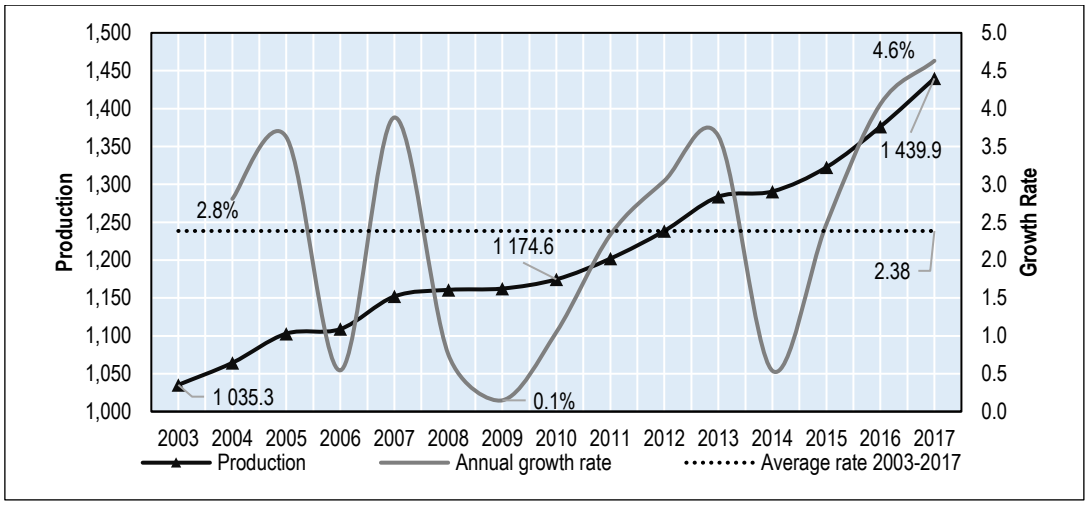
In 2016, production increased 3.7%. Notably, pork production increased 4.6% and chicken production 4.2%.

3.2. Evolution of the production of pork meat

Figure 3.1 shows the evolution of the total production of pork meat in the period 2003-2017. In 2003 production was 1.03 Mt in 2003 and 1.44 Mt in 2017. That is, production grew 39% during the period, at an average annual growth rate of 2.38%.

Figure 3.1. Production of pork meat in Mexico, 2003-2017

Thousand tonnes/growth rate of production

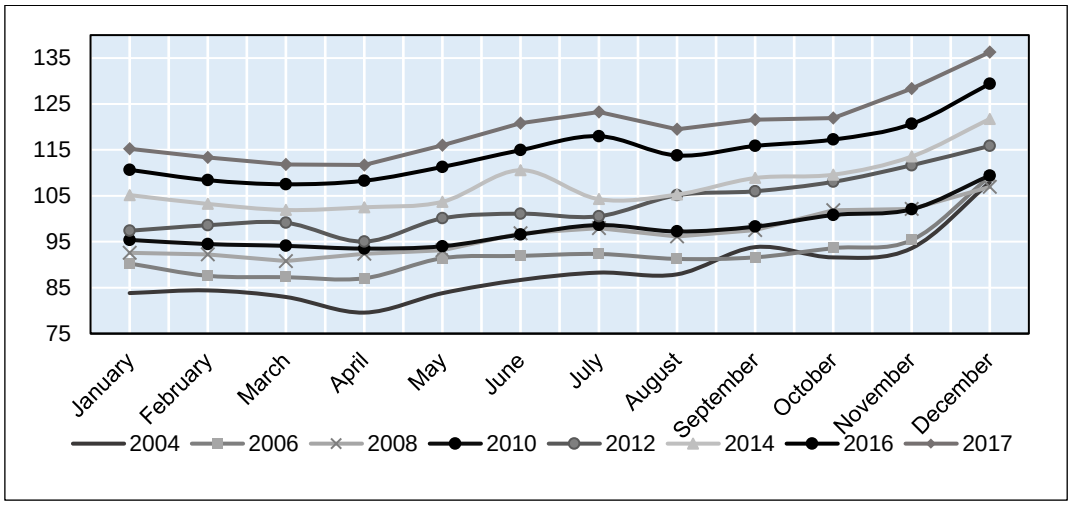


Source: SIAP

Figure 3.2. shows the evolution of monthly production in the period 2004 to 2017. Production has increased steadily. In the middle of each year there is a recovery in production and the last two months generally show the highest levels of production.

Figure 3.2. Monthly production of pork meat, 2004-2017

Thousand tonnes



Source: SIAP

3.3. Apparent consumption

The growth in the national production of pork meat has been insufficient to meet the domestic growth in demand. Imports increased 138% between 2003 and 2017. As a proportion of apparent consumption, imports were equivalent to 31.6% of apparent

consumption in 2003 and increased to 45.6% in 2017.[21] Exports have increased 251% during this period and represented 9.3% of production in 2017.

Table 3.2. Apparent consumption of pork meat, 2003-2017

Thousand tonnes

Year	National production	Imports (a)	Exports	Apparent consumption (b)	a/b
2003	1 035.3	460.1	38.4	1,457.0	31.6%
2004	1 064.4	554.7	41.4	1,577.6	35.2%
2005	1 102.9	510.5	46.5	1,566.9	32.6%
2006	1 108.9	532.2	51.8	1 589.3	33.5%
2007	1 152.0	537.8	62.4	1 627.3	33.0%
2008	1 160.7	613.8	70.4	1 704.1	36.0%
2009	1 162.4	736.4	55.1	1 843.7	39.9%
2010	1 174.6	758.2	60.8	1 872.0	40.5%
2011	1 202.0	679.3	66.8	1 814.4	37.4%
2012	1 238.6	779.8	74.5	1 943.9	40.1%
2013	1 283.7	845.1	86.9	2 041.9	41.4%
2014	1 290.6	900.6	92.4	2 098.8	42.9%
2015	1 322.5	1 022.4	99.8	2 245.1	45.5%
2016	1 376.2	1 026.9	111.4	2 291.7	44.8%
2017*	1 439.9	1 095.1	135.1	2 399.9	45.6%

Note: *Preliminary figures to December 2017.
Source: SIAP y SIAVI.

Processing of products such as sausages, hams and cold meats requires the use of pork. There are no precise statistics on the demand for pork by the processing industry, but according to the National Meat Council (*Consejo Mexicano de la Carne*), the total estimated production of all types of meat in the country was 6.8 Mt in 2017, of which 950 thousand tonnes (tt) were processed products. Of these, 45% come from poultry. The remaining 55% comes from other species, including swine. It is difficult to establish from this percentage how much corresponds to swine-based products and how much pork could be used as an input, since several of the processed products are made by grinding meats of different species and it can include components such as soybeans. In the case of some hams, natural gelatins are used and saline solutions are also injected in undetermined percentages.[22]

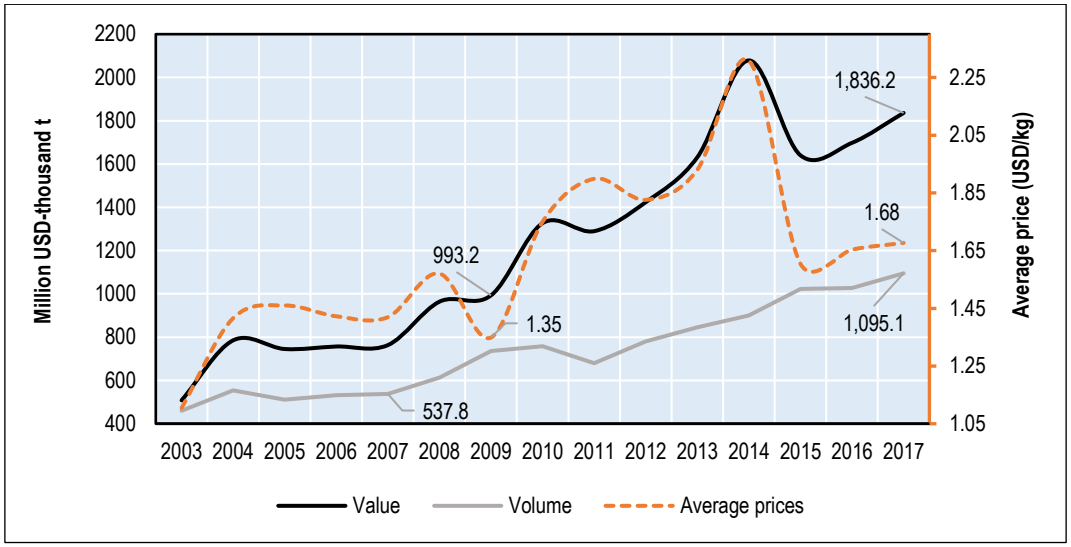
[21] The calculation of imports includes the following tariff codes: i) meats, fresh or chilled products (02031101, 02031201, 02031999); ii) meats, frozen products (02032101, 02032201, 02032999); iii) edible, fresh and chilled and frozen offal (02063001, 02063099, 02064101, 02064901 and 02064999); iv) bacon without lean parts and fats (02090099, 02091001, 02099099); v) meat and edible offal, salted or in brine, dried or smoked edible flour and powder, meat or offal (02101101, 02101201, 02101999); and vi) meat preparations and preserves (16024101, 16024201, 16024901, 16024999).

[22] Consejo Mexicano de la Carne, Compendio estadístico 2017, available at https://comecarne.org/wp-content/uploads/2018/05/Compendio-Estad%C3%ADstico-2017-v7-1-sin-elab.pdf

3.4. Imports

Imports increased between 2003 and 2017. Figure 3.3 indicates that imports increased, from 460 tt in 2003 to 1.95 tt in 2017. In terms of value, they grew from USD 508.2 to USD 1 836.2 million, that is, an increase of 261%. The figure also shows the evolution of the implicit price of imports, from USD 1.1 to USD 1.68 per kg of meat.[23]

Figure 3.3. Imports, value, volume and average price, 2003-2017



Source: SIAVI, www.economia-snci.gob.mx

By type of cut, in 2017 meat products, fresh or chilled, represented 65.3% in terms of value and 64.8% in terms of volume; frozen meat products accounted for 11.2% in terms of value and 8.5% in terms of volume. Other imported products are edible offal, bacon, preparations and preserves, among others.

[23] According to representatives of SENASICA, there are two mechanisms to carry out international trade in pork. On the one hand, the importing country can recognise the TIF system of the exporter. On the other hand, the importer sends a commission to review the producer's plant to ensure that the product complies with the necessary measures for export. Most countries, except China, rely on the TIF system, although they request that the plant be located in an area free of swine fever. The US Department of Agriculture recognised Mexico as a country free of swine fever in 2018.

Table 3.3. Imports of pork, 2017

USD millions (md) and thousand tonnes (tt)

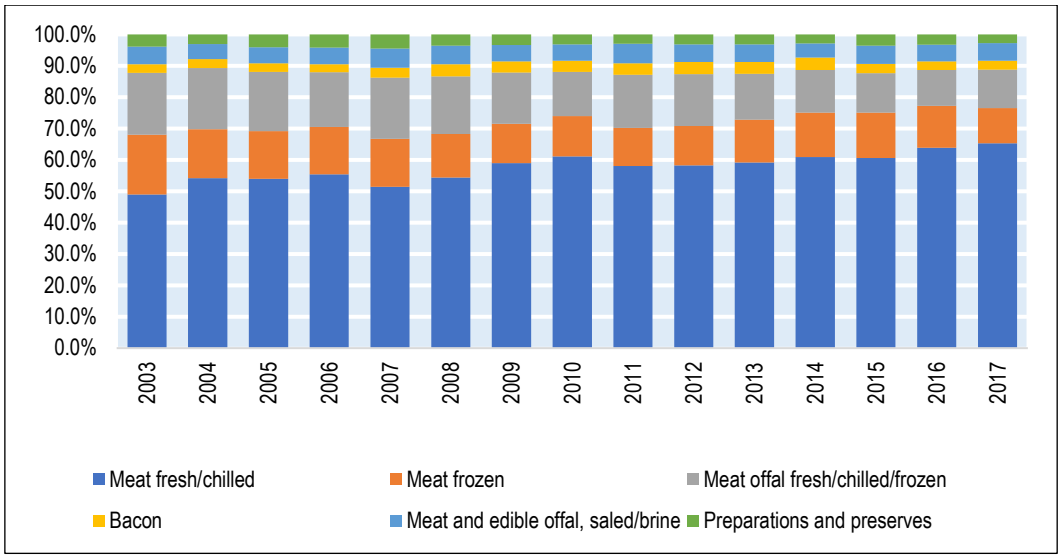
Product	Tariff code	Value (md)	% total	Volume (tt)	% total
Meat					
Fresh or chilled	02031101 02031201 02031999	1,199.7	65.3%	710.1	64.8%
Frozen	02032101 02032201 02032999	205.6	11.2%	93.3	8.5%
Edible offal					
Fresh or chilled	02063001 02063099	110.9	6.0%	113.3	10.3%
Frozen	02064101 02064901 02064999	113.0	6.2%	83.5	7.6%
Bacon without lean parts and fats*					
	02091001 02099099	52.3	2.9%	65.0	5.9%
Meat and edible offal, salted or in brine, dried or smoked edible flour and powder, meat or offal					
	02101101 02101201 02101999	104.1	5.7%	21.1	1.9%
Preparations and preserves					
	16024101 16024201 16024901 16024999	50.5	2.8%	8.7	0.8%
Total		1,836.2		1,095.1	

Note: *Tariff code 2090099 deleted July 1, 2012. The goods are classified in 02091001 and 02099099.
Source: SIAVI, www.economia-snci.gob.mx

Figure 3.4. shows that the proportion of imported fresh, refrigerated and frozen meat increased between 2003 and 2016.

Figure 3.4. Imports of pork, 2003-2017

Percentage, distribution, value of imports



Source: SIAVI, www.economia-snci.gob.mx

In 2017, meat products, fresh or chilled, were imported mainly from the United States and Canada. Imports of frozen products from these countries represented 99% in terms of value and volume. Likewise, Spain is a supplier of edible, salted or brined, dried or smoked offal flour and edible dust, meat or offal, with 20% in terms of value; Canada has 10% of the same in terms of volume. Table 3.4 shows the percentage distribution of imports of the remaining pork products.

Table 3.4. Imports of pork meat, 2017

Percentage share

Product	Tariff code	Country	Value %	Volume %
Meat				
Fresh or chilled	02031101	US	88.7%	88.6%
	02031201			
	02031999	Canada	11.3%	11.4%
Frozen	02032101	US	90.7%	90.3%
	02032201			
	02032999	Canada	8.7%	9.3%
Edible offal				
Fresh or chilled	02063001	US	81.2%	81.2%
	02063099	Canada	18.8%	18.8%
Frozen	02064101	US	73.8%	67.5%
	02064901			
	02064999	Canada	20.5%	22.8%
Bacon without lean parts and fats*				
	02091001	Canada	55.6%	58.2%
	02099099	US	40.5%	37.1%
Meat and edible offal, salted or in brine, dried or smoked edible flour and powder, meat or offal				
	02101101	US	74.4%	81.8%
	02101201	Spain	19.9%	-
	02101999	Canada	-	10.5%
Preparations and preserves				
	16024101	US	97.2%	98.2%
	16024201			
	16024901			
	16024999			
Total			100%	100%

Note: *Tariff code 2090099 deleted July 1, 2012. The goods are classified in 02091001 and 02099099.
Source: SIAVI, www.economia-snci.gob.mx

Table 3.5. shows the tariffs for imported pork products. Exports are exempt from tariffs.

Table 3.5. Import tariffs, 2017

Product	Tariff code	Tariff	Date of entry into force
Meat			
Fresh or chilled	02031101	20%	22 September 1992
	02031201	20%	2 January 2009
	02031999	20%	22 September 1992
Frozen	02032101	20%	22 September 1992
	02032201	20%	2 January 2009
	02032999	20%	22 September 1992
Edible offal			
Fresh or chilled	02063001	10%	12 January 1989
	02063099	20%	5 October 1989
Frozen	02064101	10%	12 January 1989
	02064901	Ex.	1 January 1996
	02064999	10%	12 January 1989
Bacon without lean parts and fats*			
	02090099		1 July 2012
	02091001	15%	1 January 2017
	02099099	15%	1 January 2017
Meat and edible offal, salted or in brine, dried or smoked edible flour and powder, meat or offal			
	02101101	10%	2 January 2009
	02101201	10%	1 January 1996
	02101999	10%	1 January 1996
Preparations and preserves			
	16024101	20%	31 December 2004
	16024201	20%	31 December 2004
	16024901	20%	1 July 2007
	16024999	20%	1 July 2007

Note: *Tariff code 2090099 deleted 1 July 2012. The goods are classified in 02091001 and 02099099.
Source: SIAVI, www.economia-snci.gob.mx

As noted, the applicable tariff for countries with which there is no free trade agreement varies between 10% and 20%.

In June 2018, the US federal government suspended the preferential tariff treatment of pork, granted to various products, among them:[24]

- legs, shoulders and their pieces, without bone (tariff code 02031201)
- others (tariff code 02031999)
- legs, shoulders, and their pieces, without bone (tariff code 02032201)
- others (tariff code 02032999)
- of the porcine species (tariff code 16010002)
- hams and pieces of ham (tariff code 16024101)
- palettes and pieces of palette (tariff code 16024201).

[24] "Decree by which the Tariff of the Law of General Import and Export Taxes is modified, the Decree establishing the Applicable Rate during 2003, of the General Import Tax, for goods coming from North America and the Decree establishing various Sectoral Promotion Programs," Official Gazette of the Federation, June 5, 2018.

To avoid affecting prices, the Mexican government opened a quota to import up to 350 000 tonnes of pork products from other countries with a 0% tariff. The tariff codes of the products that can be imported under the quota represent 60% of total pork meat imports.

According to SNICE, in November 2018, only about 5.2 tt were imported using this mechanism, that is, 1.5% of the quota. Of the quota allocated (314.2 tt), 98.3% has not been used.[25]

It should be noted that 97% of the quota was allocated to agents established in the market, as producers and importers. The rules of the quota determine that only 3% of it can be granted to new competitors. It is also important to mention that three groups used 46% of the allocated quota and they had only used 2.4% of what was granted.

The above indicates that imports are addressed primarily from the North American region, since before the elimination of tariffs, through the quota, imports from other regions practically did not increase. This means, tariff protection for countries that are not trading partners is probably unnecessary, because the possibility of importing without tariffs has not led to an increase in trade.

The imports of live animals are relatively minor. In 2017 they represented USD 12.6 million, and 52% of them were pure-bred breeding animals with a pedigree or high registration certificate.[26]

3.5. Exports

In 2017, the value of exports was USD 563.3 million. Of these, fresh or refrigerated products represented 17.5% and frozen meat products accounted for 76.2%. Table 3.6 shows the detail by type of product.

[25] Available on SNICE website, www.snice.gob.mx/cs/avi/snice/cuposinfosensibles.html

[26] Imports of semen and embryos are lower. Imports of semen represented USD 326 000 (of various species, except bovine) in 2017. Imports of embryos of various species (cattle, horses, pigs, sheep and goats) amounted to USD 452 000 in 2017. See SIAVI.

Table 3.6. Exports of pork meat, 2017

USD millions (md) and thousands of tones (tt)

Product	Tariff code	Value (md)	% total	Volume (tt)	% total
Meat					
Fresh or chilled	02031101 02031201 02031999	98.5	17.5%	22.4	16.5%
Frozen	02032101 02032201 02032999	429.1	76.2%	102.3	75.7%
Edible offal					
Fresh or chilled	02063001 02063099	0.1	0.0%	0.0	0.0%
Frozen	02064101 02064901 02064999	7.8	1.4%	4.1	3.0%
Bacon without lean parts and fats*					
	02090099 02091001 02099099	0.4	0.1%	0.3	0.2%
Meat and edible offal, salted or in brine, dried or smoked edible flour and powder, meat or offal					
	02101101 02101201 02101999	15.2	2.7%	4.0	3.0%
Preparations and preserves					
	16024101 16024201 16024901 16024999	12.3	2.2%	2.1	1.6%
Total		563.3		135.1	

Note: *Tariff code 2090099 deleted July 1, 2012. The goods are classified in 02091001 and 02099099.
Source: SIAVI, www.economia-snci.gob.mx

Mexico exported meat products, fresh or chilled, mainly to Japan and South Korea. Japan received 86% of frozen products in terms of value and the United States received 8.7%; 16% was exported to China in terms of volume. Table 3.7 shows the percentage distribution of exports of the remaining pork products.

Table 3.7. Exports of pork meat, by product type and main countries of destination, 2017

Percentage distribution

Product	Tariff code	Country	Value %	Volume %
Meat fresh				
Fresh or chilled	02031101	Japan	47.7%	51.3%
	02031201	Korea	47.5%	43.1%
	02031999			
Frozen	02032101	Japan	86.0%	81.3%
	02032201	US	8.7%	9.3%
	02032999			
Edible offal				
Fresh or chilled	02063001	Japan	97.4%	97.4%
	02063099	Korea	2.6%	2.6%
Frozen	02064101	US	62.1%	71.0%
	02064901	China	16.9%	16.5%
	02064999	Japan	12.5%	5.2%
Bacon without lean parts and fats*				
	02091001	Japan	100.0%	100.0%
	02099099			
Meat and edible offal, salted or in brine, dried or smoked edible flour and powder, meat or offal				
	02101101	Japan	91.6%	95.3%
	02101201			
	02101999			
Preparations and preserves				
	16024101	US	90.0%	86.1%
	16024201			
	16024901	Guatemala	7.6%	10.7%
	16024999			
Total			100%	100%

Note: *Tariff code 2090099 deleted 1 July 2012. The goods are classified in 02091001 and 02099099.
Source: SIAVI, www.economia-snci.gob.mx

3.6. Production of pork meat by state

Six states concentrate national production of pork meat (Jalisco, Sonora, Puebla, Yucatán, Veracruz and Guanajuato). They represent almost 76% of the total. Roughly 90% of production is carried out in only 13 states.[27]

Between 2003 and 2017, production increased 36.2%, that is, 487.7 tt. Average annual growth has been 2.1%. The most prominent states are:

- Jalisco, which represents 20% of national production and grows 2.6% annually
- Sonora, with production equivalent to 18% of the total, although it has only grown at 1.7% per year
- Puebla, which produces 12% of the supply and grows annually at 6.1%
- Yucatán, which represents 9% of production and grows at 4.5% per year
- Veracruz, which produces about 9% and increases 4.3% per year
- Guanajuato is important in volume; it has 8%, but grows only 1.1%

[27] According to FIRA, the states of Sonora, Yucatán and Jalisco are the main exporters to Japan, Korea and other Asian countries.

Table 3.8. Production of pork meat by state, 2003-2017

Thousand tonnes

State	Production 2003	% total	Production 2016	% total	Production 2017	% total	Rate of growth 2003-2017
Jalisco	264.8	19.7%	362.3	20.7%	380.0	20.7%	2.4%
Sonora	254.6	18.9%	296.3	16.9%	323.5	17.7%	1.2%
Puebla	93.8	7.0%	211.4	12.1%	213.6	11.7%	6.4%
Yucatán	101.6	7.6%	167.1	9.5%	173.3	9.5%	3.9%
Veracruz	88.5	6.6%	152.2	8.7%	163.8	8.9%	4.3%
Guanajuato	122.7	9.1%	141.2	8.0%	143.4	7.8%	1.1%
Michoacán	61.2	4.6%	57.4	3.3%	57.6	3.1%	-0.5%
Chiapas	28.0	2.1%	34.5	2.0%	37.3	2.0%	-0.4%
Oaxaca	38.7	2.9%	36.8	2.1%	36.6	2.0%	1.6%
Querétaro	19.1	1.4%	27.5	1.6%	28.8	1.6%	-0.3%
México	35.3	2.6%	28.3	1.6%	28.5	1.6%	-1.7%
Guerrero	30.2	2.2%	28.9	1.6%	28.4	1.5%	2.8%
Nuevo León	23.4	1.7%	27.1	1.5%	26.2	1.4%	1.1%
Sinaloa	21.5	1.6%	23.2	1.3%	26.2	1.4%	0.6%
Aguascalientes	6.6	0.5%	20.0	1.1%	20.3	1.1%	8.9%
Hidalgo	26.3	2.0%	16.2	0.9%	16.3	0.9%	-3.7%
Tlaxcala	13.1	1.0%	15.5	0.9%	15.3	0.8%	1.3%
Tabasco	11.0	0.8%	15.5	0.9%	15.1	0.8%	2.7%
Tamaulipas	21.7	1.6%	14.8	0.8%	14.2	0.8%	-2.9%
Zacatecas	7.6	0.6%	13.0	0.7%	14.0	0.8%	4.2%
San Luis Potosí	10.7	0.8%	8.1	0.5%	10.0	0.5%	-0.8%
Chihuahua	9.9	0.7%	9.0	0.5%	9.4	0.5%	7.5%
Colima	3.4	0.3%	8.8	0.5%	8.7	0.5%	-2.1%
Campeche	7.1	0.5%	7.0	0.4%	7.4	0.4%	-0.2%
Coahuila	10.2	0.8%	5.6	0.3%	6.6	0.4%	4.9%
Morelos	3.4	0.3%	6.4	0.4%	6.5	0.4%	-4.4%
Durango	5.6	0.4%	5.0	0.3%	5.7	0.3%	-6.0%
Quintana Roo	11.4	0.8%	5.1	0.3%	5.4	0.3%	-0.8%
Nayarit	6.3	0.5%	4.8	0.3%	5.0	0.3%	-2.0%
Ciudad de México	3.2	0.2%	2.2	0.1%	2.3	0.1%	-2.8%
Baja California Sur	1.0	0.1%	1.8	0.1%	1.8	0.1%	4.4%
Baja California	2.7	0.2%	1.1	0.1%	1.1	0.1%	-6.9%
Total	1 344.5		1 754.2		1 832.1		2.1%

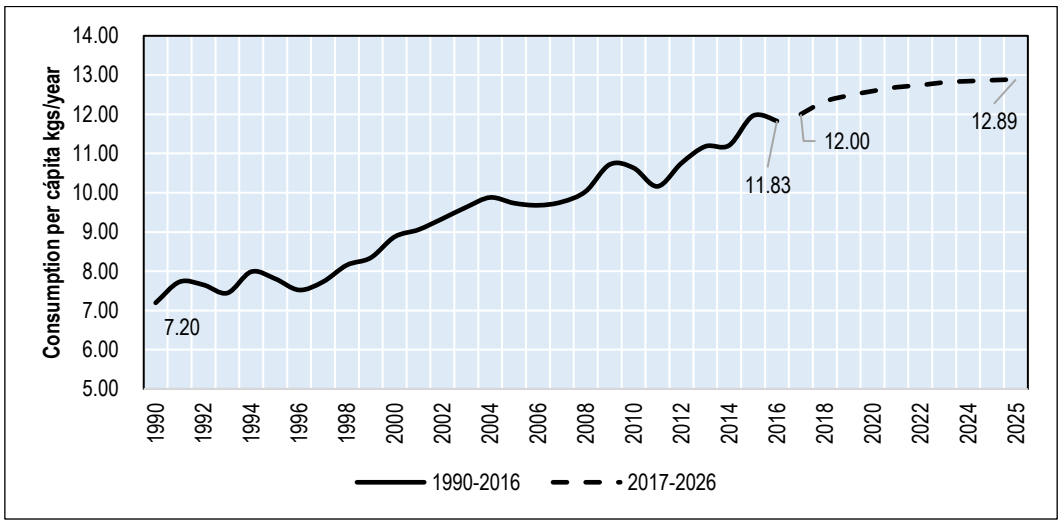
Source: SIAP.

3.7. Per capita consumption

Annual per capita consumption has increased, from 7.2 kg in 1990 to 11.83 kg in 2016, that is, 65% more.[28]

[28] As indicated, the figures in the OECD-FAO database are lower than those resulting from ENIGH, because the first database applies a conversion factor of 0.78 to transform from carcass kilogrammes into kilogrammes in the retail channel. According to the industry, per capita consumption-measured carcass is approximately 16 kilogrammes per year. It was decided to use the figures from the OECD-FAO database, because in this way comparisons can be made between countries and projections can be made.

Figure 3.5. Consumption per capita of meat of pork in Mexico, real and projected, 1990-2026



Source: OECD-FAO Agricultural Outlook 2017-2026.

The projections prepared by the OECD and the FAO indicate that consumption will continue to increase, and that it is likely to be 9% higher in 2025. If we consider that the National Population Council (*Consejo Nacional de Población*) indicates that the population was 122.2 million inhabitants in 2016 and that it will increase by 10.3 million[29] between 2016 and 2025, it is possible that by 2025 the consumption of pork meat will be higher – 262.3 tt at the retail level, as the OECD-FAO base calculates, or 336.3 tt in carcass. The latter equates to 23.3% of national production or 14% of apparent consumption in 2017.

3.8. Conclusions

The production of pork meat represents 21% of the total production of meat in Mexico. Production of pork meat has increased at a rate of 2.1% per year, however; domestic and foreign demand has increased faster, so that imports in terms of volume have increased 138% compared to 2003. In 2003 the share of imports in apparent consumption was 31.6%, and it was 45.6% in 2017. Of this, 73% of imports are fresh or chilled and frozen meat. Almost 90% of the imports of the most important categories come from the United States.

Import tariffs from countries with which there are no commercial agreements fluctuate between 10% and 20%. In June 2018, the federal government suspended preferential tariff treatment for various pork products from the United States. To avoid effects on prices, a quota for imports from other countries was established. In November 2018, only 1.5% of the quota had been used.

By state, Jalisco, Sonora, Puebla, Yucatán, Veracruz and Guanajuato represent the majority of production, and they account for almost 76% of national supply.

Per capita consumption has increased approximately 50% since the 1990s. It is possible that by 2025 per capita consumption will probably grow 9%. If population growth is also considered, apparent consumption will increase by 14%.

[29] Consejo Nacional de Población, available at www.conapo.gob.mx/es/CONAPO/Proyecciones_Datos

Chapter 4. The swine industry

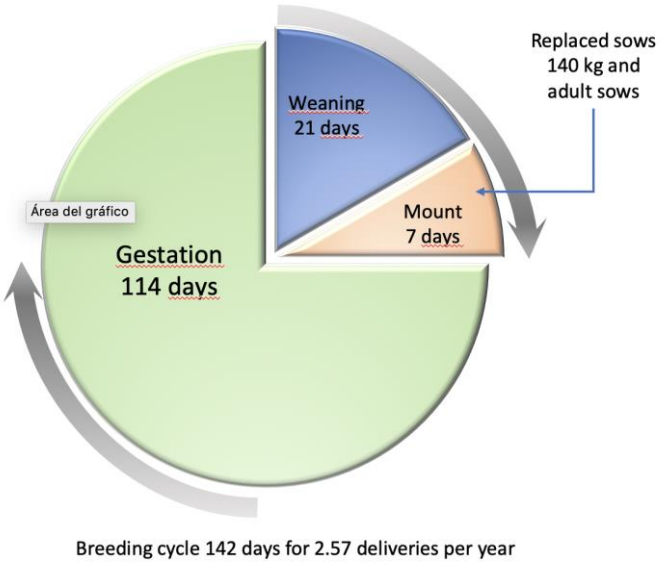
This chapter describes the most important inputs, products and production for swine farming. Markets are defined to examine inputs and products at different stages of production. Subsequently, the most significant aspects are analysed to determine the structure of the markets. Some elements of the agricultural policy and subsidies are also exposed, as well as regulations that could be limiting competition and the efficiency of pork markets in Mexico and the possible barriers to entry or expansion for new competitors.

In Mexico, according to available information, most of the production of swine is related to intensive production. Many of the main companies in the pork industry have farms and facilities where they carry out the reproduction, feeding, rearing and slaughtering of animals. In the production of pork, there is less vertical integration than in the production of chicken meat in terms of ownership, for example, but contracting and collaboration modalities are being extended with effects on vertical contractual integration.

4.1. Stages of swine production

In a swine farm there are two types of pigs. On the one hand, animals for the market and on the other, the breeding herd (consisting of breeding sows and, where appropriate, boars). The production consists of the stages of gestation, weaning, pre-fattening and fattening. The objective of these production phases is to reach the slaughter weight (90-120 kg) in the shortest possible time. The division of swine production in stages allows a better use of animal feed because in each stage the pig needs a different combination of nutrients.

Figure 4.1. Breeding cycle of swine production



Source: PORCIMEX.

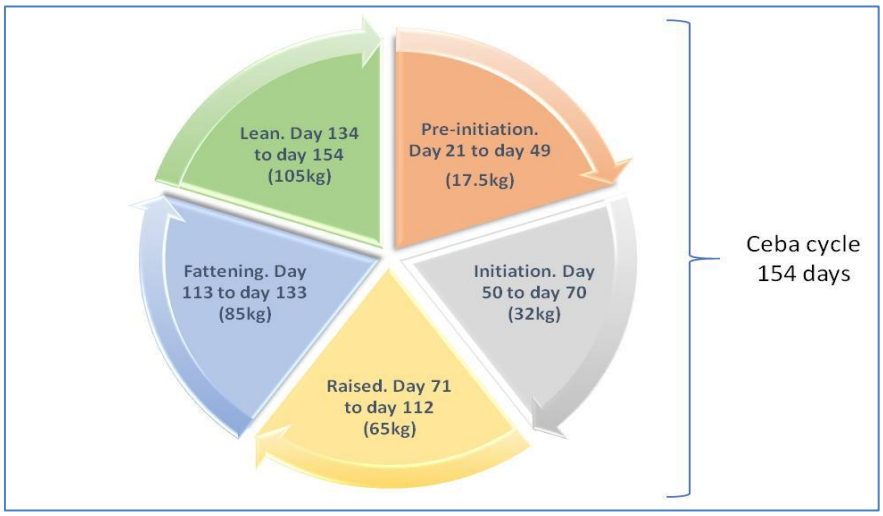
The gestation period lasts around 114 days and is subdivided into three stages: from the mounting until the fifth day of pregnancy; from 5 to 90 days of pregnancy; and from that date to delivery. The litter is usually 8 to 10 piglets for sows at first calving and rises to 10 to 16 piglets for adult sows. The size of the litter increases in a young female and stabilises around six to seven litters.[30] The gestation and weaning cycle is presented in Figure 4.1.

The stage of lactation includes the birth of the piglet until weaning, so its duration depends on the period of weaning which varies from 21 to 28 days. In this period the piglet reaches approximately 6 to 8 kg. The division of the productive phases of swine depends on the weaning period. However, genetics and the final market weight have an important role to play in deciding the timing of each feeding phase. After weaning, the pre-fattening stage begins, and this phase concludes when the pig weighs between 50 and 60 kg (according to specialists, this phase includes several sub-phases in which the type of animal feed given should be different and the gains in weight are diverse).[31] From this phase, the finishing or fattening begins, ending with the sale or slaughtering of the animal when it reaches approximately 110 kg (around five and a half months). This process is represented in Figure 4.2.

[30] Cíntora I, (s.f), Reproducción porcina, available at www.engormix.com/porcicultura/articulos/reproduccion-porcina-t25977.htm

[31] See https://razasporcinas.com/etapas-y-conceptos-importantes-en-la-alimentacion-porcina/

Figure 4.2. The swine production cycle



Source: PORCIMEX.

4.2. Definition of the most relevant inputs, products and production systems

4.2.1. Production systems

In Mexico, there are two swine production systems for fattening: the traditional production system and the modern production system. In the traditional production system, the producer participates at all stages of the production process (gestation, weaning, pre-fattening and fattening or finishing), with little use of technology.

In contrast, the modern system is characterised by a high level of specialisation in the production stages, a wide use of technology and vertical integration (producers such as GENA Agropecuaria, S.A. of C.V. (GENA) and Animal Protein S.A. of C.V. (PROAN) sell live pigs but integration with slaughterhouses is intensifying).

In the modern system the different stages of production are clearly differentiated and are carried out in farms at three separate sites (in part to guarantee better feeding efficiency and to ensure better sanitary control). According to FIRA, several producers concluded that the traditional system was not sustainable. They organised themselves to rethink the production model, creating a project in which the production activities were divided. The first model with these characteristics emerged four to five years ago, to resolve health risks and improve productivity. This model was accepted after a health outbreak occurred and the model allowed mitigation of the negative impact on production. Currently, there are several groups of producers who use this scheme. For example, one the participants is a partner in the production of meat and balanced animal feed. In another company, the owners are entrepreneurs, but trained their suppliers through a sharecropping scheme. The adoption of these models has allowed Mexican producers to go from 17 to 25 piglets per female per year. The weight of the piglet also improved, going from 6 kg to 7.5 kg.

In each stage facilities and specialised personnel are used. All facilities are owned by large companies (although there is a physical separation that reduces health risks). The sites are

classified as:[32] i) gestation, maternity and weaning; ii) pre-fattening or initiation in which initiation feed is provided; and iii) fattening or finishing facilities.

Generally, modern farms follow a system of "continuous production" in which animals are sold and bought continuously. This requires a certain infrastructure, since animals of different ages need different handling.

Site 1 is divided into the gestation and maternity areas. In the area of gestation, the main function is the insemination of the sow. The maternity area lodges the sows that are close to calving and those that carry out lactation of the litter until the moment of weaning. Site 2 is for weaning or growth in which the piglets are separated from their mother after breastfeeding. Piglets remain in this area for seven to nine weeks. During weaning, most of the antibodies are formed. Some production units in Mexico leave out Site 2 and animals go directly from Site 1 to Site 3 for fattening. This is despite the fact that adapting to the different nutritional needs of the animals depending on their age would allow a more efficient use of nutrition and would produce a greater daily weight gain. Since the stage of pre-fattening and fattening have formally similar properties and inputs, in the remainder of the study they will be analysed as one.

Medium and small producers do not have the capacity to operate the separation model and generally follow an operational model called "all in, all out", in which the piglets follow a single process in one place. This system consists of filling the shed with animals of the same age, where they stay for five months until they are all sold at the same time. This model carries biosecurity risks and can affect the productivity of the unit.

According to representatives of SENASICA, the small independent producer scheme tends to disappear in Mexico. One of the reasons is the reaction of producers to health risks. Another has to do with the requirement of the standardised product industry. At the same time the scheme of sharecropping or farm income is expanding. Under this scheme the processors provide piglets and feed to the breeders/sharecroppers, who are paid with the cash from the sale of the meat.

The modern production system tends to produce pigs of a standard size and characteristics (for example the proportion of fat in the meat) to make its processing as automatic as possible. On the other hand, certain pig breeds have better calving standards and others have better carcass yields. This requires that the genetics of the pigs be controlled.

4.2.2. Inputs and products in Stage 1: Production of piglets

Stage 1 consists of the production of piglets. The most important inputs are breeding sows (female pigs that are used for the total cost. The third element corresponds to the sanitary aspects, which takes up 5% of the total cost. The cost associated with genetic factors represents 1.5% of the total cost. The cost for energy and heating is 2.7% of the total cost. On the other hand, the FIRA study distinguishes that the cost of commercialisation is 0.8% and other costs are 11.8% of the total. With a gestation period of 114 days and a lactation period of 21 days, sows that are paired 5 to 10 days after weaning are expected to produce a litter every 5 months or an average of 2.3 to 2.4 litters per year.[33] That would be the

[32] See FIRA (2016).

[33] Cíntora I, (s.f), Reproducción porcina, available at www.engormix.com/porcicultura/articulos/reproduccion-porcina-t25977.htm

potential productivity. A sow is fertile until it is 10 or 12 years old, although according to representatives of SENASICA a breeding sow has about 3 years of reproductive life (which is equivalent to 10 reproduction cycles). Although a young female produces smaller litters, the size of the litter increases and stabilises from a litter of six to seven piglets. As mentioned, an adult female can have up to 16 piglets per litter.[34]

The productivity indicators in this stage are the maternity mortality rate, the weaning weight and the number of weaned piglets.

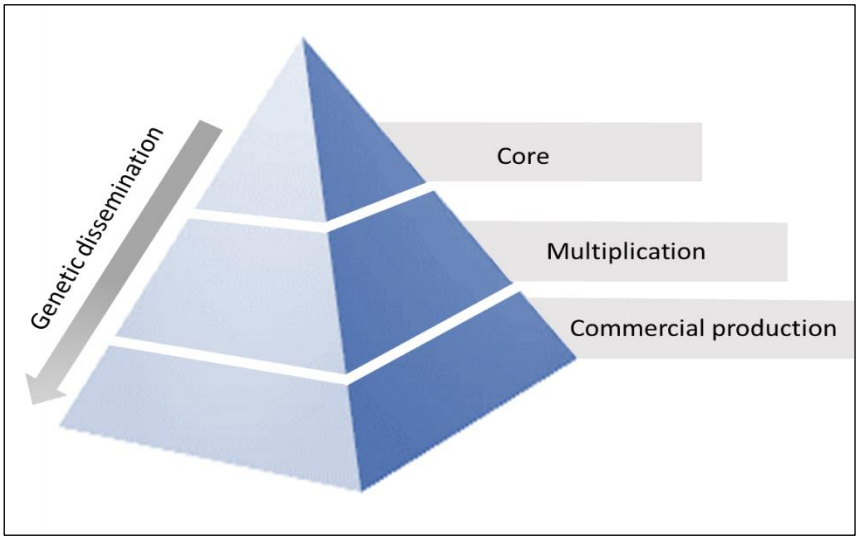
FIRA (2016) makes a comparison of the values of these indicators for nine Latin American countries. Of these, Mexico has the highest maternal mortality rate, and the weaning weight and age are lower than the Latin American averages, as is the number of weaned piglets per female per year. These indicators imply that there are possibilities for improvement in Mexico.

Genetics is very important in the modern production system because it is one of the determinants of weight gain in its various stages and the eventual quality of the carcasses. Different pig breeds have different characteristics in terms of breeding quality, fecundity and crossbreeding capacity, development capacity, temperament, carcass quality, market demand and resistance to disease. The type of race of pig must be chosen in terms of adaptation to the production unit. On the other hand, the control of genetics allows for the production of animals of a standardised size and characteristics. This is very important so that they can be processed in a relatively automated way. The most common races in Mexico are: Yorkshire, Hampshire, Duroc and Landrace.

Traditionally genetics was carried out with mating with suitable boars. Currently the artificial insemination system is the most used. This is carried out through agreements and contracts for the use of genetics. Large transnational genetics companies have patented genetic lines and large producers have breeding farms, usually in collaboration with genetics companies. Genetic products deteriorate so they must be renewed with new inseminations every year. Small pig farmers access genetics through doses of semen. The cost of a dose of semen is approximately MXN 60 (Mexican pesos). Sellers are genetics companies, distributors or producers through gene transfer centres. Figure 4.3 shows the structure of genetics in the industry.

[34] The representatives of FIRA indicate that breeding swine generally do not move and the replacement is developed in the same facilities. The pigs move from 25 to 30 km and are prepared beforehand so that their meat is not affected. Slaughtering facilities are located at strategic points so that they are at the same distance from a group of companies.

Figure 4.3. Pyramid of the genetics of the swine industry



Source: Own elaboration.

Representatives of SAGARPA mentioned an effort by the Mexican State to have alternative sources using Mexican genetic material. In this sense SAGARPA has supported the creation of four gene transfer centres (CTG) (Bajío, Sonora, Yucatán, and Veracruz). However, the latter has been suspended, because the intended company, Smithfield (partner of Carroll and Norson) was recently acquired in the United States by a Chinese company.

The Mexican government has worked with National Council of Science and Technology (CONACyT) to improve genetic material through agreements. This has arisen because of a concern for the low birth rates in traditional pig farming (with pairing). Another concern is that genetic material is expensive for traditional pig farmers. The opinion of the experts of SAGARPA is that currently 99% of the genetic material is imported, although they expect that in two years the CTGs will be consolidated in El Bajío in a collaboration with Danish companies.

The cost of the most recent CTG supported by SAGARPA, which was inaugurated in 2017 in Michoacán, was MXN 18 million, of which, MXN 4 million was contributed by SAGARPA for the acquisition of equipment and software; MXN 700 000, for the National Institute of the Social Economy (INAES), that was used in the purchase of hogs, and MXN 13 million was spent through the producers.[35] In 2017 another CTG was inaugurated in Álamos, Sonora, by a private company, Hyson Genetics, in which the investment was MXN 14 million.[36] It is hoped that these efforts will provide producers with better genetic material and improve productivity.

4.2.3. Inputs and products in Stage 2, fattening and finishing

The product of this phase is the finished pork ready for processing. The pig is usually processed when it weighs 110 kg. According to representatives of SENASICA, the productivity of this phase has increased and it is now possible to slaughter animals

35 See www.sagarpa.gob.mx/Delegaciones/nayarit/boletines/Paginas/B0462016.aspx

36 See http://tribuna.com.mx/nota.php?n=38001

weighing 125 kg that are 25 weeks old (previously, after 25 weeks animals weighed only 100 kg).

The most important inputs in the link of pre-fattening and fattening are piglets, grain (corn, sorghum), protein pastes (soybean, canola), agro-industrial byproducts such as wheat bran, rice polishing, wet brewery grains, distillery dry grains, cane molasses and fibrous forages.

According to representatives of the Association of Mexican Pork Farmers (PORCIMEX),[37] grain represents around 85% of animal feed. Swine farmers alternate corn with sorghum, depending on the prices. Corn gives a higher nutritional yield since a kilogramme of sorghum contains 90% of the protein that is contained in a kilogramme of corn.[38] However, industrial processing can significantly improve the nutritional value of sorghum and in this case the differences in quality with respect to corn can decrease significantly. PORCIMEX considers that sorghum represents 35% and corn 65% of the grains used in the country to feed pigs. In the particular case of Sonora, wheat is used to feed the animals, due to the existence of surplus grain.

As mentioned above, at this stage two processes can be distinguished (although in some production units in Mexico these represent only one). Stage 2 of weaning or initiation and Stage 3 of fattening.[39] The indicators of productivity in both are the age of exit, daily weight gain and mortality rate.

FIRA (2016) makes a comparison of productivity indicators for nine Latin American countries for the two sites. The goal of weaning or initiation (Stage 2) is to separate the piglets from their mother after the lactation period. The animals are in this process between 7 and 9 weeks. Here, FIRA data indicate that Argentina is the country with the best performance, with the exception of a higher than average exit age. The output weight in Argentina is 32.56 kg and the daily weight gain is 0.53 kg. By contrast, Mexico has the highest mortality rate in this group of countries (2.51% when the average is 1.78%); its weight output is 21.8 kg (the average is 24.9 kg) and its daily weight gain is 0.394 kg (the average is 0.44 kg). These values are below average.

In the fattening facility (Stage 3) the goal is for the pig to reach its ideal sale weight. Mexico has a mortality rate above the regional average (4.42% when the average is 2.59%), below the average daily weight gain (0.887 kg when the average is 0.89 kg) and has an above average exit age (169.2 days when the average is 158.5).

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37 PORCIMEX was created in 2002 with the participation of Comisión Nacional de Porcicultores y el Consejo Mexicano de Porcicultura, to promote the development and integration of the national swine sector, through the definition of public agro-food policies.

38 According to FIRA representatives, the feeding depends on the mechanical level – the more the process is mechanised, the more standardized the food. Corn accounts for approximately 80% of the pig's diet.

39 According to FIRA representatives, the cost of installing a standard farm depends on the design of the space. For example, the cost of a new space for a fattening pig in Sonora is USD 280. In Jalisco, a growth facility for 5 000 breeding sows requires an investment of MXN 200 million.

The representatives of SENASICA indicate that for the installation of a farm, land, facilities, food and genetics are generally required. For each female that produces 22 piglets per year, USD 5 000 is invested.

The low value of the productivity indicators in Mexico in both stages in relation to those of other Latin American countries implies that there are possibilities for improvement for Mexico.

4.2.4. Animal feed

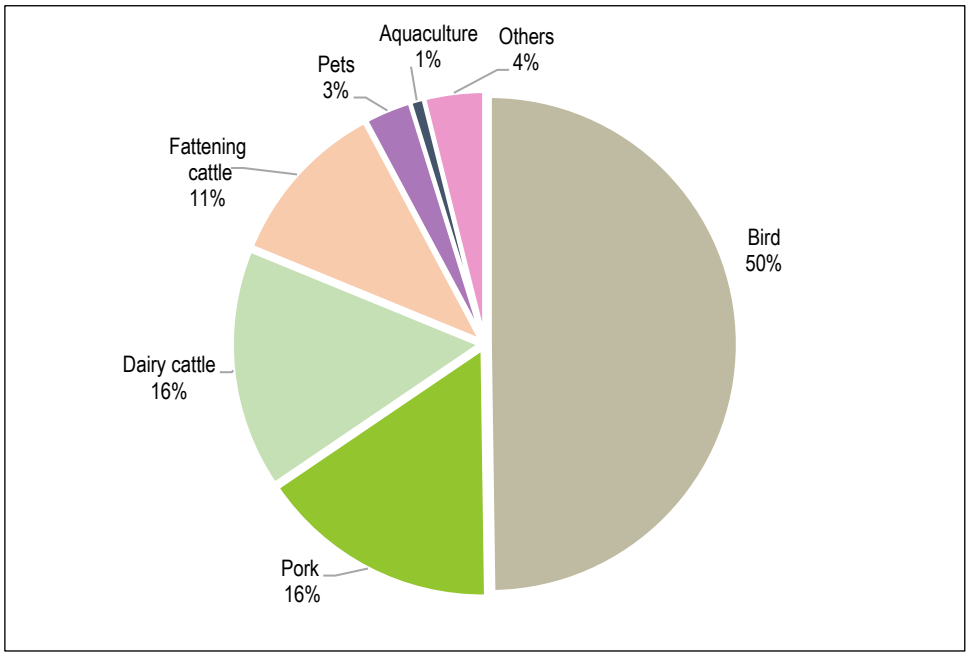
The nutritional needs of pigs vary with age and are affected by the state of their health and development. Before choosing the ingredients that should be included in the food ration given to a pig (a balance between proteins, carbohydrates and minerals), availability, costs, nutritional value and flavour are considered. As a source of carbohydrates, yellow corn is the main ingredient that must be included in a ration and sorghum can be included as a second option. As a source of protein, soy or alfalfa flours which also contain minerals are also often used.[40]

The rations can be prepared by the company itself or purchased already prepared. Commercial feeds are substances or products (including additives) intended for oral feeding of animals. This may have been transformed or not.

There is a balanced animal feed industry in Mexico. Figure 4.4 shows how the production is distributed, according to the type of animal. The production of animal feed for swine production represents 16% of the total of balanced feed.

Figure 4.4. Balanced animal feed production, 2017*

By type of animal



Note: *Estimate. Estimated production of 33 million tonnes.
Source: CONAFAB.

[40] See Secretaría de la Reforma Agraria (2005), *Manual del Participante. Producción de Cerdos*, available at www.ciap.org.ar/Sitio/Archivos/14960672-Manual-de-Produccion-Cerdos.pdf

Balanced animal feed can be produced for domestic consumption or for the external market. According to CONAFAB, for 2016, 61.4% of animal feed for swine was produced by integrated producers, who destined it for their own fattening processes and also had the option of taking it to the market. The remaining 38.6% is prepared by animal feed companies and is not vertically integrated.

4.2.5. Demand-side and supply-side substitution

Demand-side substitution in the piglet production phase is limited. Such substitution occurs when producers substitute piglets for some other type of animal as a result of an increase in the price of the piglets. Potential consumers of piglets are breeders whose infrastructure is specific for pig breeding (manuals of good livestock practices require a different infrastructure by type of animal) and, therefore, facilities are not suitable for breeding other animals. On the other hand, the phases of production and breeding are usually carried out by the same agent, either by themselves or partially through sharecropping agreements, which is why it can be considered an internal relationship for the company.

Consumers in the pre-breeding and breeding phase of pigs are packers or distributors who buy the meat once processed. Demand-side substitution in distribution activities will be analysed in Chapter 6. Many packers are fatteners and in this case an increase in the cost of fattening should not lead to drastic changes in demand because its infrastructure is specific for packaging of pork. An significant number of them have TIF-certified processes. A change of direction (for example, dedicating their infrastructure to the packaging of another type of animal) requires new certification. Therefore, demand-side substitution in fattening activities is also limited.

As for supply-side substitution, companies that currently do not supply the product but which, faced with an increase in prices, could easily offer it, without facing high costs.

Supply-side substitution in production would be represented by other economic agents that, before a change in prices of pigs, buy breeding sows and put them in the system to produce by natural or artificial insemination, using the infrastructure of a farm. Given the gestation periods, the increase in supply is not immediate and the financial cost of entry is not trivial if you want to follow good livestock practices.

In the fattening stage, the entry of new companies or the change of activity of some companies (for example, livestock producers of other animals) increasing the supply of finished cattle is not easy and would involve costs. Compliance with good livestock practices in pig production requires specific and not negligible investments. Therefore, supply-side substitution is also limited.

4.3. Market structure

INEGI indicates that there are 20 000 producers, although SAGARPA indicates the existence of 8 000. It is important to clarify that INEGI also considers backyard production (producers of at least three breeding sows).

The productive capacity of a company is measured by the number of breeding sows that they hold. There are no public data on the number of breeding sows in the largest companies. A notice on the pig industry website[41] considers that Granjas Carroll is the

[41] See www.porcicultura.com/destacado/10-mil-vientres-mas-se-sumaran-a-la-produccion-de-GCM

largest company in Mexico and that it has around 135 000 breeding sows (after an investment in 10 000 breeding sows). Some interviewees point to the existence of around one million breeding sows, which means that Granjas Carroll has just over 13% of the country's productive capacity after its last investment.

The most important producer groups in the country are:[42]

Granjas Carroll de México, S.A. de C.V (Grupo Carroll)[43]

Granjas Carroll was founded in 1993 and breeds, processes and markets pigs. In terms of productive capacity it is the largest company in the country. It is integrated by Agroindustrias Unidas de México (AMSA), with activities in several segments of the agri-food industry and Smithfield Group, which is the main pig producer and processor in the world.

Granjas Carroll has 18 high-tech farms distributed throughout the states of Veracruz and Puebla.

Of their output, 89% of animals produced are sold alive and 11% processed. It is an integrated company from the production of animal feed to the sale of pigs to traders and meat preparers.

According to the information on its website, this company participates with 10.5% of the national production of pigs (more than 1.3 million head).

In total, 100% of Granjas Carroll production is sold in the Mexican market, mainly in Mexico City and the State of Mexico (around 66%).

Grupo Porcícola Mexicano S.A. de C.V. (Grupo Kekén)[44]

Kekén belongs to Grupo Kuo[45] and is located in the Yucatan Peninsula. Kekén is dedicated to the production and marketing of pork. It considers itself the largest producer of pork in the country and the only fully integrated Mexican company, from the creation of genetic material and reproduction of pigs to the retail distribution of pork to final consumers, for which it has developed a chain of Maxicarne stores.

Kekén commercialises live pork, carcasses, fresh meat and vacuum packed and frozen cuts. It operates distribution centres, has routes for direct delivery to businesses, serves industry and self-service stores directly and manages a large number of points of sale through its chain of stores.

The company markets a wide variety of pork products: lard, pork rind, pig's head, quartered head, ears, cheeks, brains, head trimming, crop, *nana*, calibrated gut, pork mask, pork sausage and viscera (liver, heart, pancreas, kidney, lung and spleen).

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42 According to FIRA representatives, three groups, Kowi, Norson and Soles (Grupo Soles, S.A. de C.V.) participate in integration projects. In El Bajío, the main producers are Kekén and Grupo Nu 3, among others.

43 See www.granjascarroll.mx/

44 See www.keken.com.mx/index.php

45 Mexican public company, with activities in the production of pork, synthetic rubber, polystyrene, automotive parts and transmissions and components.

The company participates in export activities to the Asian market, mainly Japan and Korea. To meet the requirements of these markets, it makes tailored cuts.

The integration of operations allows it to guarantee the traceability of its products, as well as food safety.

To carry out its foreign trade operations, this company has a processing plant with TIF certification. The company has the following certifications: Mexico Calidad Suprema, HACCP system, POES (Standard Operating Procedures for Sanitization), BPM (Good Manufacturing Practices). It is authorised by the governments of Japan and South Korea and the USDA of the United States to export to their markets.

Maxicarne operates a chain of stores with a presence in 11 states, primarily in the southeast.[46] Maxicarne sells pork, chicken and beef. Its customers are both businesses and final consumers.

The company accepts supply from third parties, who must prove compliance with quality and processes.

Promotora Comercial Alpro, S. de R.L. de C.V. (Norson) (also known as Agroindustrial del Noroeste).

Norson was founded in 1972, under the name of Alpro, by a group of small pig producers in Hermosillo, Sonora. Initially, the objective was to gather forces to jointly market their production, mainly in Mexico City.[47]

In 1989, Alpro formed a strategic alliance with Smithfield Foods Inc., a US company that is a world leader in pork production and marketing. From this alliance arose Norson, which has been exporting to Japan since 1991. In addition, it exports to South Korea, Hong Kong, China and the United States.

Norson received the national export award in 2008 and has been the main exporting company of the industry for the past three years.

The company's operations are vertically integrated. Its activities include raising, fattening, processing and cutting.

The company serves different distribution channels: wholesalers, supermarkets, retailers, packers and food services.

Smithfield also has a joint venture with Granjas Carroll. As in the case of Norson, Smithfield holds 50% of the shares of this joint venture.

Kowi Foods S.A. de C.V. (Kowi)

Kowi has 50 farms and 35 000 breeding sows. It has an annual capacity to produce 627 000 pigs[48] and is vertically integrated with stores in six states of the country.

46 See www.keken.com.mx/maxicarne.php

47 See www.norson.net/?q=es

48 See https://kowi.com.mx

Kowi was founded in 1984 in Navojoa (Sonora) and is one of the largest processors and marketers of pork. Kowi supplies its products throughout Mexico and also exports to Japan, the United States and Korea, among other countries.

Kowi is vertically integrated in genetics, farms, food, TIF processing plants and final distribution. Kowi has TIF, Mexico Supreme Quality and SQF (Safety Quality Food) certifications.[49]

The company Nutrikowi produces animal feed for pigs and prepares specialised rations for each stage of growth of the animals.

The company GeniKowi is an artificial insemination centre, which works with cutting-edge technology to create the genetic material that is used in the farms of the group. GeniKowi produces complete pigs that reach a weight of 105 k with less than 16 millimetres (mm) of back fat, in a period of less than 155 days.

There is no information on the share of the entire market. The number of breeding sows can be used as an approximation to understand the market structure. PORCIMEX provided information regarding its associates, who represent 645 350 breeding sows in production. According to the data, six companies account for 63.7% of the total capacity reported. The remaining 36.3% is contributed by 18 companies. The data provided by the organisation are reported in Table 4.1.

Table 4.1. Market shares in terms of breeding sows in production, 2018

Percentage share

Company	Number of breeding sows	% Share
A	85 400	13.2%
B	76 000	11.8%
C	75 000	11.6%
D	62 000	9.6%
E	58 000	9.0%
F	55 000	8.5%
G	32 500	5.0%
H	25 500	4.0%
I	22 000	3.4%
J	21 000	3.3%
K	19 000	2.9%
L	18 000	2.8%
M	15 000	2.3%
N	13 650	2.1%
O	10 000	1.5%
P	8 000	1.2%
Q	8 000	1.2%
R	8 000	1.2%
S	6 800	1.1%
T	6 000	0.9%
U	6 000	0.9%
V	5 000	0.8%
W	5 000	0.8%
X	4 500	0.7%
Total	645 350	100.0%

Source: PORCIMEX.

[49] Standard of certification of processes and products, for the control of risks to food safety.

According to the market share, the result of the Herfindahl-Hirschman Index is 796 points,[50] which is indicative of a relatively low concentration.

4.4. Agricultural policy and subsidies, regulation, Official Mexican Standards and government policy

4.4.1. Support programmes

SAGARPA has a livestock development programme that includes five subprogrammes: i) livestock productive capitalisation; ii) comprehensive strategies for the productive chain; iii) livestock research, innovation and technological development; iv) sustainable livestock production and livestock and beekeeping (PROGAN Productivo) and v) livestock sustainability.

In addition, SAGARPA, through SENASICA, supports farmers with campaigns to prevent various diseases.

One of the most important programmes that affect the industry is PROGAN.[51] Its characteristics are briefly described below.

Livestock productive capitalisation programme

The objective is to economically incentivise livestock economic units, for the acquisition of productive assets, infrastructure, machinery and equipment, well-drilling, repopulation and rescue of females, which contributes to the increase of their productivity. For this, they finance individuals or corporations that produce, commercialise or industrialise livestock products. In each of the fields there are absolute limits to support (MXN 500 000 for individuals and MXN 5 million for entities), as well as relative limits (the public contribution will be no greater than 35% of the volume of the project).

Support programme for livestock chains

The objective is to economically incentivise livestock economic units to increase their productivity, through incentives for livestock post-production, livestock breeding, breeding and livestock genetic material, livestock management, food livestock and livestock product systems. It is focused on supporting individuals and corporations dedicated to the production, commercialisation and industrialisation of livestock products.

Likewise, the post-production of livestock and rearing livestock is supported; livestock handling is also supported with infrastructure, machinery and equipment related to the conditioning of the livestock production unit.

In terms of post-production livestock, the maximum amount of federal support for technical services is up to MXN 30 000 for individuals and MXN 260 000 per entity. The federal contribution can be up to 35% of the value of the project. The incentives for the rearing of pubescent pig females is up to MXN 200 per head.

[50] In the analysis of mergers, COFECE considers the existence of risks to competition and free competition to be unlikely when, among other elements, the Herfindahl-Hirschman Index is below 2 000 points. See COFECE (2015b).

[51] See SAGARPA (2016b).

The programme supports the acquisition of boars, semen, embryos of different livestock species and a technological reproductive package. The limits to support are absolute (MXN 500 000 for individuals and MXN 5 million for entities) and also relative (the public contribution will be no greater than 35% of the volume of the project).

The programme also provides incentives for the livestock product systems that would be destined for the following uses:

- Administration payment of professional services, mainly for the facilitator or manager, assistant and accounting services.
- Business services; hiring services for the realisation of studies, diagnostics, analysis of market information, master plan, among others, aimed at strengthening the productive chain.
- Professionalisation and communication: expenses destined for contracting of services for organising congresses, forums, conventions, assemblies, symposia, work tables and workshops, in order to communicate to the links of the chain; advances or decisions of a different order that favour professionalisation and communication; and transmit new knowledge, or to discuss specific problems.
- Expenses inherent to the operation: those derived from the general operation of the Product System Committees, such as tickets, lodging and food, among others.

Research, innovation and livestock technological development

A research and innovation programme to increase productivity encourages the acquisition of assets that allow a substantive technological change in livestock activity. This includes research projects, innovation and livestock technological development. It also considers listing machinery, equipment and innovative facilities, as well as technical support. Part is related to livestock genetic resources in which it finances projects for the conservation, characterisation, evaluation, promotion and use of the genetic resources of the different species and livestock breeds. The support is limited to MXN 10 million per entity and project, and up to MXN one million per individual.

PROGAN: Sustainable Livestock Production and Beekeeping Regulation Program (Programa Producción pecuaria sustentable y ordenamiento ganadero y apícola)

PROGAN has the general objective of contributing to increasing the productivity of livestock economic units through investment in the livestock sector. Focused on individuals and entities dedicated to the production, commercialisation and industrialisation of livestock products, PROGAN provides economic support and services to livestock economic units.

In the particular case of pigs, for producers of between 15 and 105 units, the programme contributes MXN 117 to the producer's costs for each breeding sow. Systems are financed in the form of services, technical assistance, training or technical accompaniment, technical monitoring or patrimony protection, or operation of individualised livestock identification. The cost of technical services is financed through collaboration agreements or concertation.[52]

[52] FIRA supplies preparing, asset rehabilitation and factoring credits. It also provides technical advice to producers to analyse the problems to be addressed and performs an analysis of benefits. This permits guarantee of recovery of the credits and avoids defaults.

Livestock sustainability

The Sustainability Programme supports livestock economic units for the acquisition of support goods to minimise the effects of waste and improve the biological control of farms. It also re-establishes the natural resources of livestock by rehabilitating pastures and improving grazing lands in an ecological manner. It also targets individuals and entities engaged in the production, commercialisation or industrialisation of livestock products that are registered in the National Livestock Register. It supports infrastructure and equipment to cover sanitary aspects and to carry out control, handling and use of animal excreta. The maximum amount of federal support for this concept is up to MXN 500 000 per individual and MXN 5 million per entity.

Another concept supported in this area is the maintenance and reconversion of pastures, with a support of up to MXN 3 000 per hectare (which is limited to an individual with up to 200 hectares and to an entity up to 2 400 hectares).

Campaigns and health programmes

Mexico has been successful in controlling disease and was recently declared free of classical swine fever. This has two very important effects on the development of this industry. On the one hand, it facilitates export and on the other it eliminates the need to establish internal controls (health checkpoints, mobilisation guides) in the interior of the country.[53]

The fundamental programme on which the animal health policy is based is the Agrifood Health and Safety Programme.[54] This programme is based on sanitary campaigns, pest monitoring, health and safety plans and inspection and surveillance measures. The responsible and executing agency is SENASICA through state committees (an alliance between the state, producers and the federal government). The programme has annual work programmes in which resources are provided for good practices and other related food safety issues.

4.4.2. Official standards

For the mobilisation of swine the following standards apply:

- "NOM-051-ZOO-1995 que versa sobre Trato humanitario en la movilización de animales" (which concerns humanitarian treatment in the transport of animals).

FIRA points out that the creation of alternative models has been stimulated, such as the so-called "Parafinancieras", which grant loans to small products that are not traditionally subject to credit by a financial intermediary. The credits are used for the operation of the farms and for their modernisation on a small scale. They are based on the knowledge of the "Parafinancieras" of recipients of the credit. For example, credit unions can operate under this model.

[53] According to FIRA representatives, in regions such as the Yucatan Peninsula, the wild pig can be a trigger for disease and is a latent problem. Therefore, extreme care must be taken with distances and sanitary fences. In the Yucatan a permanent quarantine is maintained from Campeche to the Peninsula. In Sonora and Jalisco a company was created that allows the collection of blood and waste which is moved in specialised vehicles to transform them into flour, compost or other products.

[54] The details of this programme are available in www.sagarpa.gob.mx/SRC/Padron-de-Beneficiarios/Paginas/2017/Programa-de-Sanidad-e-Inocuidad-Agroalimentaria.aspx

- "NOM-024-ZOO-1995 acerca de Transporte de animales, productos y subproductos" (concerning the transport of animals, their products and sub-products).

For feeding and medication of pigs the following standards must be met:

- "Norma Oficial NOM-061-ZOO-1999 Especificaciones zoosanitarias de los productos alimenticios para consumo animal" (Zoosanitary specifications for alimentary products for animal consumption).
- "NOM-012-ZOO-1993 Especificaciones para la regulación de productos farmacéuticos, biológicos y alimenticios para uso en animales o consumo por estos" (Specifications for the regulation of farmaceutical, biological and alimentary products for animal use or for their consumption).
- "NOM-025-ZOO-1995 Características y especificaciones zoosanitarias para las instalaciones, equipo y operación de establecimientos que fabriquen productos alimenticios para uso en animales o consumo por estos" (Zoosanitary characteristics and characteristics for the instalation, equipping and operation of establishments that produce alimentary products for animal use or their consumption).
- "NOM-060-ZOO-1999 Especificaciones para la transformación de despojos animales y su empleo en la alimentación animal" (Specifications for the transformación of animal waste products and their use in animal feed).

There are certain Official Mexican Standards that are not mandatory, such as those for lard and balanced feed in its pre-starter, starter, growth, development and completion varieties.

4.4.3. Voluntary compliance standards

The "Manual of Good Farming Practices in the Production of Pig Farms" (MBPPGP)[55], produced by SAGARPA compiles the necessary actions so that the production of meat in pig farms is safe for human consumption. The manual indicates a series of practices that are considered appropriate and that concern nutrition, health, ranch management, facilities and process control.

Compliance certification of the MBPPGP is required to slaughter animals in TIF establishments. In addition, compliance with the requirements of the manual is a necessary basis to obtain the certification and the Mexico quality supreme seal "México Calidad Suprema", which generates an added value to the products for export or sale through modern channels.

This seal is an official brand that identifies and differentiates the agri-food products of Mexico, giving the distinction of health, safety and quality. The Certification Organism for TIF Establishments (OCETIF), is the body that grants certification throughout the productive chains of beef and pork. This certificate is a guarantee of compliance which is required by supermarket chains.

[55] www.sagarpa.mx/ganaderia/Publicaciones/Lists/Manuales%20de%20Buenas%20Prcticas/Attachments/6/manual_porcino.pdf

According to representatives of SENASICA, 80% of producers comply with good livestock practices. However, there IS no official information to validate this figure. The only element that counts is TIF slaughtering, which represents more than 50% of the total.

4.5. Regulatory and non-regulatory barriers to entry

No regulatory barriers were identified. Although producers must comply with various provisions on animal health, these cannot be considered barriers, as they are measures that apply equally to all producers.

Non-regulatory barriers exist for certain producers. In pig production, scale is important in many ways. For a company, having its own balanced feed plant is viable only for certain volumes of pork production. Producing the feed itself allows for efficiencies, cost reduction and direct import of corn. The volume is also related to the separation of processes, which reduces health risks. The operation of specialised facilities for slaughter requires a significant volume of animals, with standardised characteristics and size, for which the use of genetic material is necessary. Therefore, the scale of production can operate as a barrier to entry.

4.6. Conclusions

In Mexico, there are two pig production systems: traditional production and the modern production system. The modern system is characterised by a high degree of specialisation in the production stages, a wide use of technology and vertical integration.

Pig production has several stages, such as gestation, weaning, pre-fattening and fattening. In the modern system the different stages of production are clearly differentiated and in many farms are carried out in three separate sites, to guarantee greater efficiency in feeding and better sanitary control.

Stage 1 involves the production of piglets. The most important inputs are breeding sows (female pigs that are used for procreation), animal feed, labour, health costs, energy and heating and genetic material, among other variables. Feed is the most important input representing 67.5% of the total cost. The indicators of average productivity of this first phase in Mexico are worse than those of other countries in Latin America, so there is room for improvement.

The product of Stage 2 is the finished pig ready for processing. The most important inputs in the link of pre-fattening and fattening are piglets and animal feed. In this phase, the unfavourable comparison of the productivity indicators for Mexico with those of other Latin American countries allows room for certain improvements. Demand-side and supply-side substitution, both in the production phase of piglets and in the production phase of finished pigs, is limited.

SAGARPA has a livestock development programme that directly affects pork production and includes five subprogrammes. On the other hand, voluntary compliance programmes also have an important impact since compliance grants certificates for slaughter in TIF establishments and that allow sale through modern channel or export. The most important certificate is the MBPPGP.

No regulatory barriers were identified. The scale of production of a pig producer could limit entry into the modern production system. A certain size is necessary to integrate balanced feed production and operate farms through process separation. The use of genetic material is also required on large farms.

Chapter 5. Meat processing

Once the fattening stage is finished and the animal reaches a weight of approximately 110 kg, it is slaughtered, the carcass is removed, cut and, if necessary, packed and prepared for distribution. The main product obtained is pork meat and the main input is the live animal.

The transformation of live pigs into meat involves handling and loading of the animals on the farm and subsequent transfer to the plant for slaughtering and commercialisation.

In Mexico, there are two types of differentiated processing. There is meat that is obtained from its processing in municipal slaughterhouses and meat that is processed in TIF establishments. The regulation of the TIF system is stricter, and consequently compliance with sanitary and animal welfare measures is different from that of the municipal system. There are also other, informal facilities. However, given the lack of information about them, they will not be included in this analysis. In any case, according to information provided by some interviewees, their participation in the market is not large.

According to SENASICA, TIF establishments represent around 65% of swine slaughtering; 30% is obtained from municipal slaughterhouses and 5% is backyard production. According to ANETIF, in Mexico 62% of slaughtering is done in 114 TIF establishments and 38% in 1 200 municipal facilities.[56]

Most TIF slaughterhouses are private; Some municipal facilities have TIF certification. Some TIF facilities are owned by feed producers and in some cases, these slaughterhouses provide subcontracting services to other producers.

5.1. Definition of the most relevant inputs, products and production systems

The transformation of a living animal into meat takes place in a slaughterhouse. The main input is the pig with a weight of around 110 kg. The process begins with the stunning of the animal and its subsequent processing. The first product of the slaughterhouse is the carcass (the body of the animal without head, skin or legs). Within the modern production system, there is a preference for processing pigs of a standard size because the cutting processes are usually semi-automated.

The meat can be marketed as carcasses or cuts. Some of the large pig producing companies market their ready-to-eat meat mainly in pieces.

In principle, regardless of the type of slaughterhouse, the regulation and supervision of the processes that handle live animals and until they are processed is carried out by SENASICA. The regulation and supervision of the processes once the animal is dead and becomes ready-to-eat meat is carried out by COFEPRIS.

[56] See www.anetif.org/pages/view/comparativo_de_sacrificio

5.1.1. TIF establishments

A TIF establishment is an animal slaughtering facility, a refrigerator or an industrialist of meat products and by-products, which undergoes permanent sanitary inspection, verifying that the facilities and processes comply with COFEPRIS regulations for safe food and the provisions required by SENASICA so that the animal arrives in an appropriate way to its slaughtering.

Many TIF establishments obtain products which will be suitable for export. Each process of these establishments undergoes inspections carried out by responsible veterinary doctors authorised by SAGARPA (in the case of authorised facilities for export, with official veterinarians of SENASICA) to reduce the risk of contamination of their products. These establishments, like all other facilities in Mexico, also have the obligation to ensure that slaughtering operations are in accordance with animal welfare rules and they are required to control hygiene and temperature throughout the process.

TIF establishments are obliged to maintain a cold chain. This means keeping meat and its derivatives at a temperature of -1° to 4° C, during slaughter, deboning, packing, distribution and marketing until the point of sale to the final consumer.

A TIF establishment must have ramps for boarding and disembarking the animals, corridors, resting pens, access ramps to the slaughter area, and stunning and bleeding cages. All these facilities must be built to allow proper handling and promote animal welfare. In addition, a TIF establishment requires the appropriate infrastructure to maintain the cold chain throughout the process. TIF establishments are regulated and inspected by SENASICA and COFEPRIS. They operate an animal traceability system and a risk control system. Procedures include reception of animals, numbering and revision and a blood data collection system to detect toxic waste. These samples can be analysed either in the laboratories of SAGARPA or in authorised third parties laboratories.

5.1.2. Municipal slaughterhouses

Municipal slaughterhouses generally have a less solid infrastructure, less strict controls and produce meat destined for sale in local butcher shops, markets and street markets that in some cases lack a refrigeration system.

Article 115(f) of the Constitution stipulates the legal basis for municipalities to operate slaughterhouses and to obtain an income for it. It establishes that one of the public services of municipalities is the operation of such facilities either directly or through their concession to individuals or companies. Municipal facilities have authorisations that are older than those of TIF establishments and are often based on local regulations.

These facilities are generally regulated by COFEPRIS and SENASICA. The rules on animal health and welfare are also applicable. COFEPRIS carries out random inspections (covering about 10% of the facilities). The inspection sheets of COFEPRIS are similar to those of SENASICA.

The cost of operating the municipal facilities is lower than that of the TIF establishments. This is because, although the requirements for animal welfare, cold processing and food safety are similar to those of the TIF system, veterinary surveillance is not permanently required, the required infrastructure is not the same and it is possible to operate with some level of non-compliance (in aspects such as keeping the cold chain or animal welfare procedures).

5.2. Markets to be examined: substitution relations in demand and supply

Slaughtering and processing of swine is carried out in TIF and municipal facilities with pork meat as the resulting product. However, pork is differentiated in the market depending on the type of process applied. Distribution to consumers through modern channels and for export requires TIF certification.

Therefore, the fact that the product emerging from the two types of facilities is still pork in all its different manifestations, having TIF certification or not makes a big difference. TIF meat and meat obtained in municipal facilities is destined for different distribution channels. Therefore, TIF and municipal processes cannot be substituted in the market and fulfil the needs of different segments of the market.

5.3. Market structure

In Mexico, there are 440 TIF facilities which include 114 slaughterhouses and 1 200 municipal facilities.

Concentration and major players

The major pig producers are probably large processors. There is not enough public data to evaluate reliable concentration indicators or to make a link between slaughter establishments and economic groups that produce animals.

Scale economics

An investment in a medium TIF establishment requires a reception area, a slaughtering area, corridors, a carcass cooling infrastructure and a shipping area. To slaughter a certain number of animals per turn, it is necessary to have cooling capacity to preserve twice the number of slaughtered animals (carcasses must be refrigerated for the time necessary to go from 40° to 4° C before cutting, storing and shipping). The cost of refrigeration is high, both for the construction of refrigeration chambers and in terms of the electric energy they use.

A TIF establishment must have a veterinarian for each process and each shift of work. In some cases, they are financed by the facility, which makes the procedure more expensive. The high fixed costs require an important volume of regular slaughtering to guarantee profitability.

Vertical integration

Many big producers have vertically integrated slaughtering with the rest of their activities in the value chain. These producers process and pack their own pigs. In some cases, the companies trade directly with final distributors and some of the companies sell directly to the final consumer through their own stores, such as Kekén or Kowi. There are companies (for example, GENA or PROAN) that sell live pigs, but there is a trend to integrate breeding and slaughtering.

5.4. Regulations, official standards and government policy

General rules applicable to all types of facilities.

The official standard "NOM-033-ZOO-1995: Sacrificio Humanitario en Animales de Abasto*"* (humanitarian slaughter of animals for consumption) pursues the objective of animal welfare. It determines the obligatory nature of the adequate handling of animals during slaughtering.

COFEPRIS regulates food safety in the facilities through the official standard "NOM-194-SSA1-2004, Productos y servicios. Especificaciones sanitarias en los establecimientos dedicados al sacrificio y faenado de animales para abasto, almacenamiento, transporte y expendio. Especificaciones sanitarias de productos" (Products and services. Sanitary specifications for establishments reserved for the slaughter and finishing of domestic animals, their storage, transport and sale).

According to representatives of COMECARNE, no matter how advanced the official standard is, without adequate compliance monitoring, it cannot be put into practice. Monitoring is very complicated given the large number of municipal facilities. The smaller number of TIF establishments makes the application of standards easier.

Official standards applicable in TIF system

Two fundamental official standards regulate the operation of TIF establishments. The first regulates the infrastructure required for the operation of an establishment. The second regulates the treatment of meat:

- "NOM-008-ZOO-1994, Especificaciones zoosanitarias para la construcción y equipamiento de establecimientos para el sacrificio de animales y los dedicados a la industrialización de productos cárnicos, en aquellos puntos que resultaron procedentes." (Zoosanitary specification for the construction and equiping of establishments for the slaughter of animals and those involved in the industrialisation of meat products).
- "NOM-009-ZOO-1994, Proceso sanitario de la carne" (The sanitary processing of meat).

Regulation of TIF establishments is currently being changed. According to representatives of COMECARNE, an official standard will be issued that merges the two previous ones, containing annexes on processing, slaughter and refrigerators. There is no information on when this change is to be implemented.

Government policy

The Mexican government seeks the expansion of slaughtering in TIF establishments. For this, SAGARPA supports campaigns carried out by ANETIF to increase the level of TIF meat recognition. However, according to ANETIF, the level of recognition is still very limited among the population in general.

SAGARPA implements a TIF slaughtering support programme. Its objective is to encourage and support producers and breeders of cattle, pigs, sheep and goats to slaughter their livestock in TIF establishments to expand and consolidate the supply of meat products that are of good quality and safe.

In the case of pigs, the support consists of MXN 100 per slaughtered animal, with a maximum support of 5 000 heads and up to MXN 550 000 per producer per year. The producers can participate individually or in groups.

According to representatives of ANETIF, public policy is having a positive effect on the use of the TIF system, because slaughtering on TIF establishments. Ten years ago it represented around 30% of the total meat produced and currently TIF represents more or less 60%.

5.5. Regulatory and non-regulatory barriers to entry

This section refers to barriers to entry to TIF activities, since municipal facilities are public.

TIF certification is a recognition of the safety and hygiene level granted by SAGARPA to establishments that slaughter, produce, process, store and/or distribute meat and their derivatives by complying with the requirements established in the official standards (in addition to NOM-033-ZOO-1995 and NOM-194-SSA1-2004). To operate a TIF establishment, a proposal must be presented with a manual that includes processing plant diagrams, a description of product movements, personnel, and projects for pest control and water and meat waste. Once this infrastructure is built, if it is approved by the certifiers, the establishment receives a TIF code.

Since 2001, OCETIF has been collaborating with the Mexican Animal Health Directorate to certify establishments that seek to obtain TIF certification.

A TIF establishment can be certified for the slaughter of different species. For each type of animal, specific certification is required. If the owner of a facility wants to include new species, it needs to build a production line and put in a request for the corresponding certificates. Animals of different species cannot be mixed in the same processing line to avoid contamination between species.

An investment in a TIF establishment requires areas of reception, slaughtering areas, corridors and areas for cooling and shipment. In a business plan study for a TIF establishment for beef and pork in northern Sinaloa in 2011, a required investment of MXN 87.5 million was calculated.[57] On the other hand, representatives of FIRA stated that the investment for a slaughtering plant depends on factors such as size, design, technology and the degree of automation; for a slaughtering flow of 43 000 animals per week, the investment would be around USD 120 million. These are large investments that can represent a barrier to entry into this market.

The Federal Law on Animal Health (LFSA) in its articles 107 and 108, requires a large number of veterinarians. Article 107 refers to facilities authorised to export and requires the presence of official veterinarians (who are employees of SENASICA) to carry out the inspection or verification. Article 108 requires all animal slaughtering centres and TIF animal processing establishments to have at least one responsible veterinarian authorised by SAGARPA during working hours. In addition to these veterinarians, TIF establishments need an official veterinarian. The presence of the responsible veterinarian is necessary even if there is an official veterinarian on the facility. This duplication of functions can be an additional burden to these companies, as mentioned in OECD (2018).

57 See Kaplan, J. et. al. (2011).

In countries such as the United States, the supervision of many functions in the facilities are carried out by technicians. In Mexico this supervision is carried out by veterinarians that, in some cases, are financed by the establishment. This high number of veterinarians may require a high scale of production to achieve profitability.

Another possible administrative barrier to entry is the need to obtain land authorisation for building facilities; these are managed by the municipalities.

5.6. Conclusions

The transformation of living pigs into meat takes place in slaughter houses. The main input is pigs for slaughter. The first product that is obtained is pork carcass. In some cases, cutting and packing is also carried out for the distribution of pork in pieces.

Slaughtering of pigs is carried out on TIF establishments, municipal facilities or other types of facility. SENASICA regulates and supervises the management of live animals until they are processed. COFEPRIS is in charge of the regulation and supervision of the processes once the animal is slaughtered and is transformed into ready-to-eat meat.

Although regulation of TIF and municipal establishments is similar, the degree of monitoring and infrastructure required for each type of facility is different. Modern distribution channels and the export market differentiate between the type of facility in which the meat was processed. Therefore, the processes taking place in TIF and municipal establishments are not perceived as substitutes.

The Mexican government seeks the expansion of slaughtering in TIF establishments. To achieve this, SAGARPA supports campaigns carried out by ANETIF to increase the level of identification of TIF establishments and has a programme to support slaughter in TIF facilities. Currently, approximately 60% of total meat production comes from TIF establishments in Mexico.

Entry into the processing market in TIF establishments requires large investment and the regulation that requires the duplication of veterinarians, meaning that the operation of the facility is expensive. The management of land authorisations by municipal authorities can constitute another barrier to entry into the market.

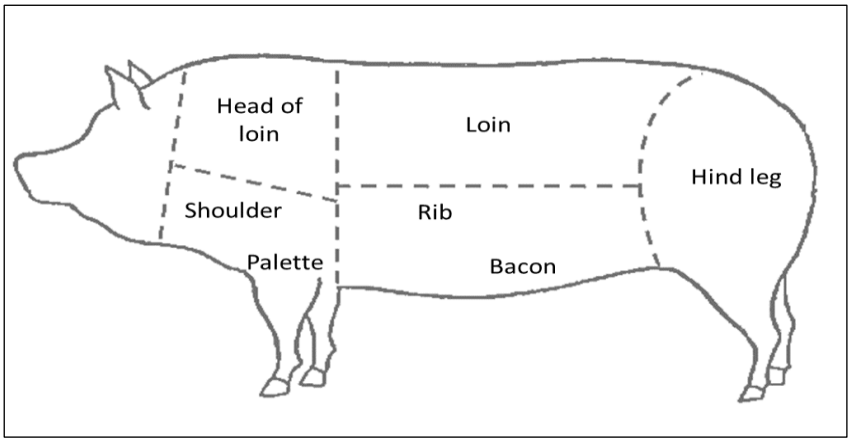
Chapter 6. Distribution and marketing

The distribution and marketing of pork meat begins at the slaughterhouse and the facilities that prepare the meat. Carcasses and specific cuts are prepared to a certain specification. The product is then sent to distribution centres and stores, to reach the final consumer. This process includes logistics, distribution and retailing.

6.1. Products and distribution channels

Once processed, the pork is cut into carcasses, half-carcasses or cuts depending on the link of the chain to which the meat is destined. Distribution centres, butcher shops and supermarkets can buy carcasses; however, final consumers usually buy specific cuts. Final consumers obtain cuts that reach different price levels in the market. Examples of pork cuts are steak, chop or rib. Figure 6.1 shows a pig with its different parts.

Figure 6.1. Parts of the pig



Source: PORCIMEX.

Table 6.1 shows the consumption of different pork cuts considered by the National Survey of Household Income and Expenditure (ENIGH). It shows that the most important product is steak – this represents more than 27% of pork consumption, followed closely by ribs and chops, which represent 26.3%.

Table 6.1. Quarterly consumption of pork by product, 2016

Million MXN

Type	Consumption of pork	% total
Steak	2 155.4	27.6%
Ribs and chops	2 052.2	26.3%
Leg in pieces	1 010.3	12.9%
Meat from other parts	829.1	10.6%
Pulp in chunks	778.6	10.0%
Ground pork	576.9	7.4%
Shoulder	181.5	2.3%
Knuckle	175.7	2.2%
Viscera	54.8	0.7%
Total	7 814.4	100.0%

Source: ENIGH 2016.

Pig meat is acquired by consumers in various establishments or through retail channels. The ENIGH distinguishes the way in which the meat reaches the consumer. Table 6.2 shows the importance of the different sales channels with the most important channel being butcher shops, which represent 55% of sales. Markets are the second most important channel with 21% of sales, with supermarkets in third place with only 11% of sales. The conclusion is that modern channels are unimportant in the sale of pork.

Table 6.2. Consumption of pork by point of sale, 2016

Million MXN

Point of sale	Consumption of pork	% total
Branch stores	4 283.5	54.8%
Markets	1 606.4	20.6%
Supermarkets	896.4	11.5%
Grocery stores	343.8	4.4%
Tianguis (open markets)	277.2	3.5%
Particular persons	253.1	3.2%
Street markets	129.3	1.7%
Membership stores	14.8	0.2%
Diconsa	4.8	0.1%
Convenience stores	2.5	0.0%
Department stores	1.2	0.0%
Shopping outside the country	1.1	0.0%
Total	7 814.4	100.0%

Source: ENIGH 2016.

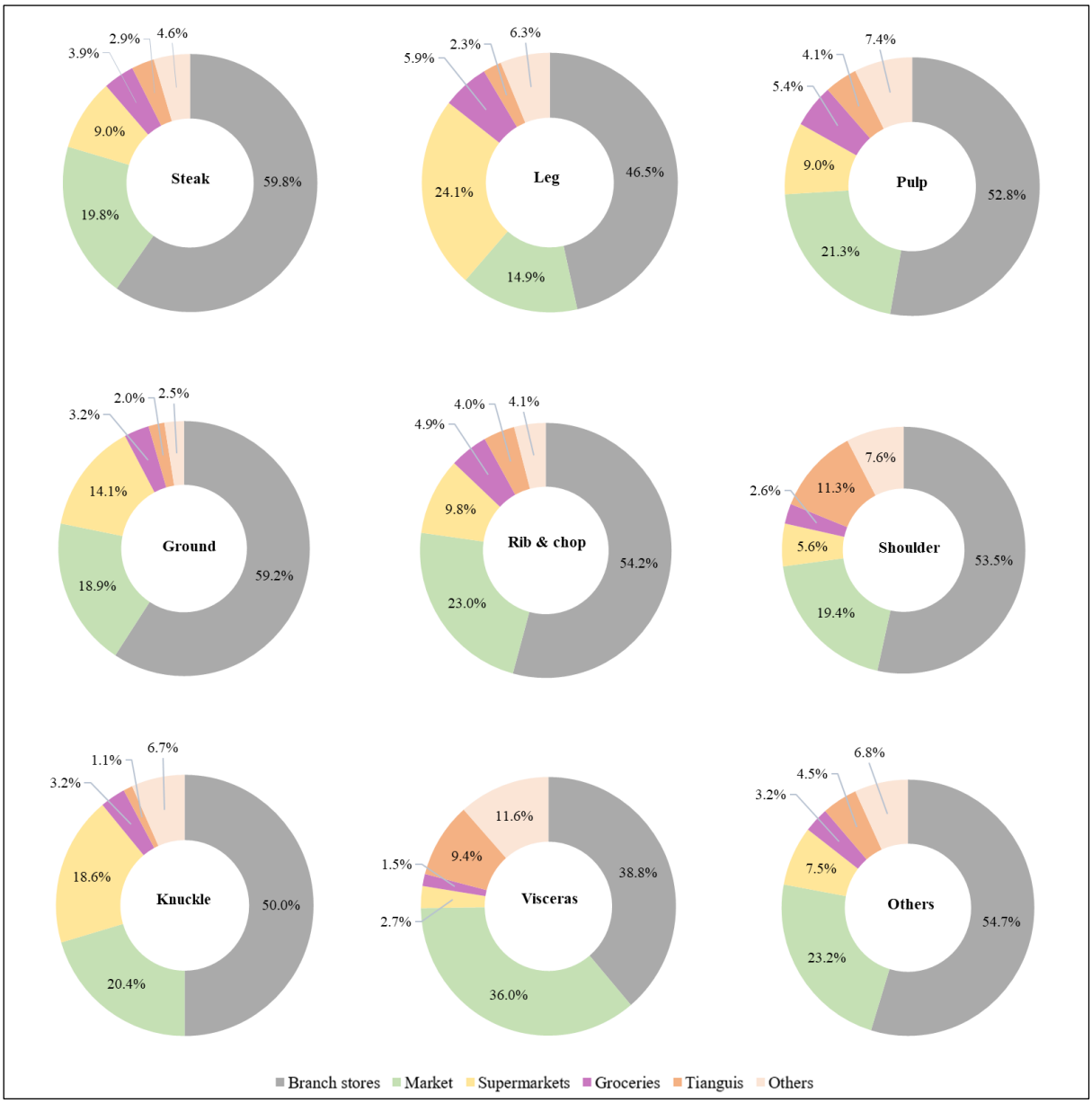
According to the cut of meat, there are differences in the marketing channel through which the meat is acquired by final consumers (see Figure 6.2 for details). Supermarkets are relatively more important in the case of leg meat (24%) and knuckle meat (18.6%). However, in regard to other cuts, the modern channel is relatively unimportant.

Butcher shops have an important share (over 50%) of all cuts, with the exception of viscera (in which they have 38.8%) and leg (in which they have 46%).

Markets have a share of around 20% in all cuts except leg cuts (in which they have a 14.9% share) and viscera (in which they have a participation of 36% that is close to the 38% in which butcher shops participate).

Street markets are relatively more important for the purchase of viscera (9.4% share) and shoulder (with 11.3%) than for other cuts. Grocery stores are more important for the purchase of leg meat (they participate with 5.9%) and pulp (with 5.4%) than for other cuts.

Figure 6.2. Importance of marketing channels by cuts



Source: ENIGH 2016.

6.2. Consumption by state

Consumption of pork is relatively concentrated in a few locations. The states of Mexico, Veracruz, Jalisco, Puebla and Mexico City account for 51.3% of the country's consumption of pork meat. The state of Mexico concentrates about 20% of the total national consumption, as shown in Table 6.3.

Table 6.3. Quarterly consumption of pork in households by state, 2016 (million MXN)

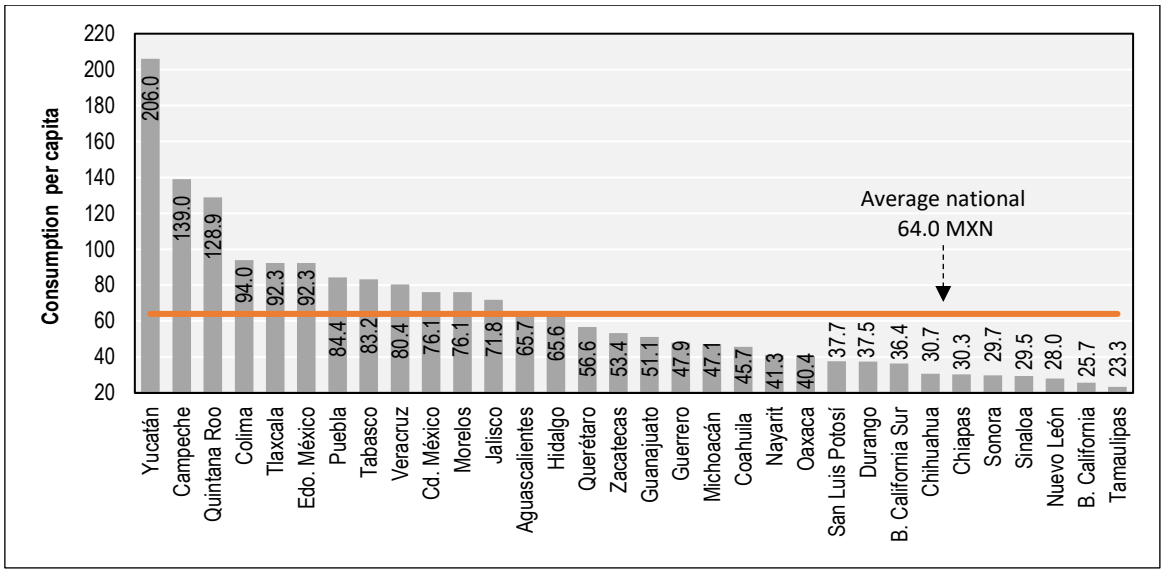
State	Consumption of pork	% total
México	1 579.9	20.22%
México City	672.6	8.61%
Veracruz	652.1	8.34%
Jalisco	576.4	7.38%
Puebla	527.8	6.75%
Yucatán	442.0	5.66%
Guanajuato	299.6	3.83%
Michoacán de Ocampo	217.9	2.79%
Quintana Roo	208.8	2.67%
Tabasco	200.3	2.56%
Hidalgo	191.1	2.45%
Guerrero	171.8	2.20%
Oaxaca	163.2	2.09%
Chiapas	161.1	2.06%
Morelos	147.8	1.89%
Nuevo León	144.6	1.85%
Coahuila de Zaragoza	136.8	1.75%
Campeche	128.0	1.64%
Tlaxcala	119.7	1.53%
Querétaro	115.2	1.47%
Chihuahua	114.9	1.47%
San Luis Potosí	104.6	1.34%
Baja California	90.9	1.16%
Sinaloa	88.8	1.14%
Sonora	88.4	1.13%
Aguascalientes	85.7	1.10%
Zacatecas	84.8	1.09%
Tamaulipas	83.6	1.07%
Colima	69.1	0.88%
Durango	66.8	0.85%
Nayarit	51.4	0.66%
Baja California Sur	28.6	0.37%
Total	7 814.4	100.00%

Source: ENIGH 2016.

Figure 6.3 presents the quarterly spending of households on pork meat, but in per capita terms. The figure shows a great heterogeneity in consumption by state, with citizens of the states of south-eastern Mexico by far those who spend the most on pork meat in the country. Yucatan stands out, where per capita consumption reaches MXN 206 per inhabitant per quarter. The south-eastern states are followed by Colima, Tlaxcala and the state of Mexico with consumption of more than MXN 92 per inhabitant per quarter. The states with the lowest consumption are from the north of the country (Sonora, Sinaloa, Nuevo León, Baja California and Tamaulipas) with consumption below MXN 30 per inhabitant per quarter.

Figure 6.3. Quarterly expenditure per capita by state, 2016

Per capita consumption MXN



Source: ENIGH 2016.[58]

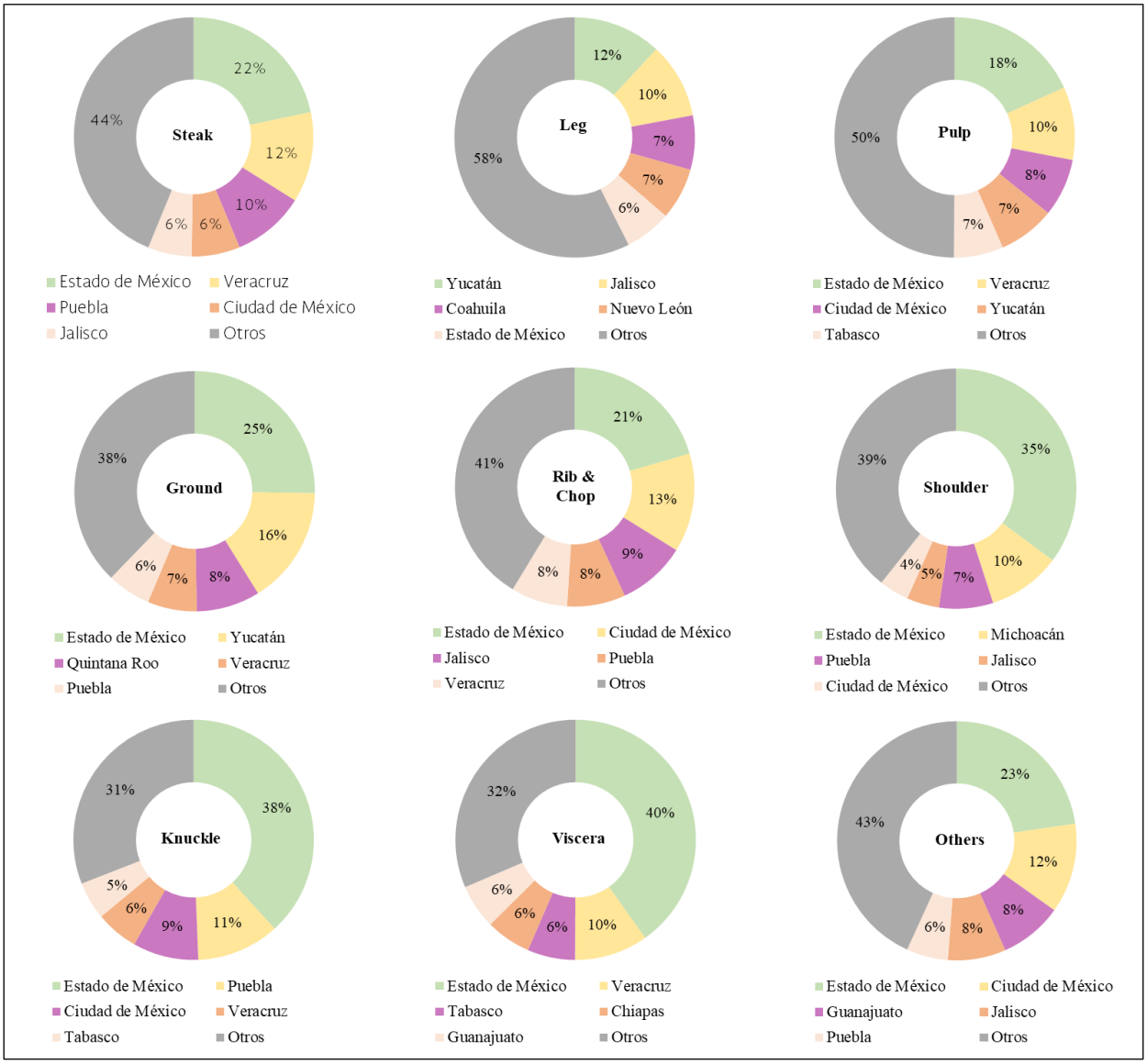
Figure 6.4 presents the five entities with the highest average consumption for a set of cuts. A first observation is that consumption is quite heterogeneous at the state level, because some states proportionally consume more of some parts of the pig than other states. The importance of each state in the total consumption of a particular pork cut reflects different tastes and different preparations in the consumption of this type of meat.

The state of Mexico is the largest consumer in all categories of cuts with the exception of leg pieces. It highlights that in this state 40% of the viscera are consumed, 36% of knuckle and 35% of shoulder, while its share in leg consumption is only 6%.

Mexico City is second in percentage consumption of rib (share of 13%) and chop and in other categories of cuts (12%). Veracruz appears second in steak (12%), pulp (10%) and viscera (10%). Jalisco is second in leg (10%). Yucatan is first in leg (12%) and second in ground meat (16%). Michoacán is second in consumption of shoulder (10%).

[58] Mid-year population estimate by federal entity of CONAPO. Proyecciones de la Población en México, 2010-2030.

Figure 6.4. Quarterly consumption of pork by state and type of product, 2016



Source: ENIGH 2016.

6.3. Consumption by economic segment

Consumption of pork meat is linked to socioeconomic levels as shown in Table 6.4.

Table 6.4. Quarterly consumption of pork by decile of income, 2016

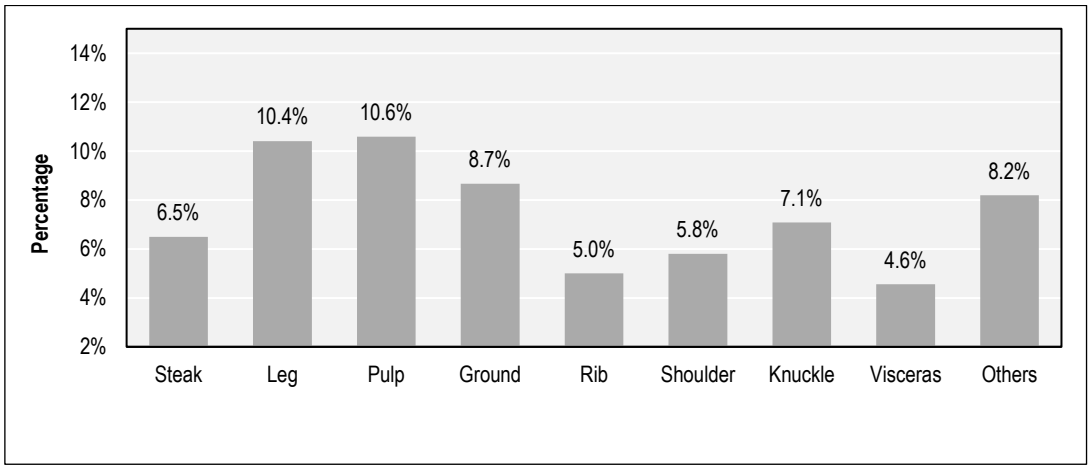
Million MXN

Decile	Consumption of pork meat	% total
I	85.8	1.1%
II	191.7	2.5%
III	296.1	3.8%
IV	371.2	4.7%
V	464.3	5.9%
VI	570.1	7.3%
VII	719.6	9.2%
VIII	885.9	11.3%
IX	1 312.5	16.8%
X	2 917.2	37.3%
Total	7 814.4	100%

Source: ENIGH 2016.

The type of cut that is consumed most also varies depending on the decile of income. For example, Figure 6.5 shows the percentage of quarterly consumption in pork meat by type of pork cut for the lowest deciles. The conclusion is that, for this socioeconomic level, the most consumed cuts are leg, pulp and ground meat.

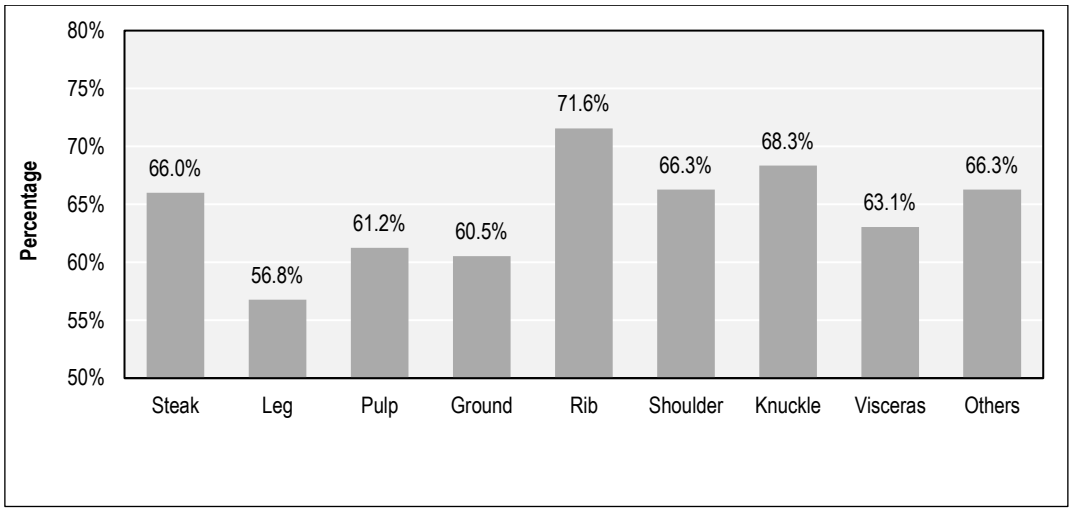
Figure 6.5. Quarterly consumption of pork by lower income decile (I, II and III) and type of product, 2016



Source: ENIGH 2016.

Figure 6.6 shows the percentages of consumption per cut, but for the highest deciles. In this case the most consumed cut is rib, knuckle, shoulder and steak.

Figure 6.6. Quarterly consumption of pork by highest income decile (VIII, IX and X) and type of product, 2016



Source: ENIGH 2016.

6.4. Market analysis: demand-side and supply-side substitution

There are two types of substitution: substitution of the product or substitution of the distribution channel. In the case of pork meat, distribution systems that supply the modern channel generally have TIF certification and distribute meat from TIF establishments. The animals that are processed have been bred following good practices and are subject to certification procedures. Therefore, it must be assumed that among the distribution systems there are limited possibilities for substitution in demand since the retail system differentiates TIF products from those that follow different procedures. Supply-side substitution is also limited because a system has to invest significant resources in order to obtain TIF certification.

In terms of pork products, there are two sources of demand-side substitution. On the one hand, it is possible to change the consumption of a specific type of pork cut (say the loin) for the consumption of another cut, also of pork (the leg). In the pig, as in other animals, there is a great variety of cuts that have different characteristics and command different prices. On the other hand, it is possible to replace pork with meat from another animal.

In distribution, some distributors are specialised in pork products and many others distribute products of other species. For both, it is difficult to do without pork meat, because their operation depends on the demand derived from the products. That means, a distributor of pork will acquire pork meat as an input and later sell it on to customers who are retailers. A distributor who only distributes pork cannot change the product because its customers demand that type of meat. The logistics and customer network are organised around the sale of pork or, where appropriate, a variety of products. On the other hand, many distributors of pork are at the same time vertically integrated producers; they are hardly going to substitute pork with other meats.

For retail establishments there are also no substitution possibilities from the point of view of demand, because their activity is derived from the demand of final consumers.

Regarding supply-side substitution, it is possible for a specialised establishment, such as a butcher shop, to sell meats of different types using the same infrastructure. This takes place mainly in butcher shops that sell beef, pork and other varieties of meat. In the face of an increase in the price of one of the types of meat, the establishment can substitute that meat for others only if the final consumers choose to do so, because butchers shops react to consumer demand.

Supermarkets base their business on supplying a variety of meat products. To eliminate the sale of one type of meat, substituting it for another, would be detrimental to its global operation and its business model. The conclusion of substitution relationships analysed is that the product to be analysed is pork meat.

6.5. Market structure

The information provided by INEGI refers to the category of meat in general. Therefore, there is no specific information on the number of economic agents distributing and marketing pork in Mexico. Table 6.5 below presents information about existing establishments in 2015.

Table 6.5. Wholesale and retail establishments, related to the distribution and marketing of meats, 2015

Number of establishments

State	Wholesale	%	Retail	%	Supermarkets	%	Grocery	%
Aguascalientes	26	2.20%	696	1.00%	66	1.10%	5427	0.90%
Baja California	39	3.20%	314	0.50%	374	6.20%	12 947	2.10%
Baja California Sur	18	1.50%	136	0.20%	85	1.40%	2 836	0.50%
Campeche	14	1.20%	627	0.90%	49	0.80%	5 428	0.90%
Coahuila	42	3.50%	877	1.30%	243	4.00%	14 544	2.30%
Colima	9	0.70%	482	0.70%	48	0.80%	3 571	0.60%
Chiapas	20	1.70%	2 961	4.40%	115	1.90%	32 575	5.20%
Chihuahua	58	4.80%	752	1.10%	238	3.90%	14 415	2.30%
Mexico City	137	11.30%	6 418	9.60%	453	7.50%	41 772	6.60%
Durango	16	1.30%	818	1.20%	68	1.10%	7 633	1.20%
Guanajuato	78	6.50%	3 721	5.50%	218	3.60%	31 380	5.00%
Guerrero	14	1.20%	2 015	3.00%	97	1.60%	22 829	3.60%
Hidalgo	11	0.90%	1 516	2.30%	78	1.30%	14 791	2.40%
Jalisco	93	7.70%	5 163	7.70%	370	6.10%	40 286	6.40%
México	116	9.60%	9 543	14.20%	678	11.20%	85 503	13.60%
Michoacán	24	2.00%	3 316	4.90%	159	2.60%	30 247	4.80%
Morelos	10	0.80%	1 536	2.30%	81	1.30%	12 889	2.00%
Nayarit	8	0.70%	691	1.00%	56	0.90%	5 875	0.90%
Nuevo León	122	10.10%	1 199	1.80%	519	8.60%	18 513	2.90%
Oaxaca	6	0.50%	3 100	4.60%	79	1.30%	30,963	4.90%
Puebla	44	3.60%	4 154	6.20%	169	2.80%	44 866	7.10%
Querétaro	20	1.70%	995	1.50%	101	1.70%	7 840	1.20%
Quintana Roo	22	1.80%	705	1.00%	122	2.00%	5 747	0.90%
San Luis Potosí	29	2.40%	1 461	2.20%	106	1.80%	13 165	2.10%
Sinaloa	51	4.20%	876	1.30%	319	5.30%	13 727	2.20%
Sonora	67	5.50%	540	0.80%	340	5.60%	12 084	1.90%
Tabasco	15	1.20%	1 546	2.30%	91	1.50%	8 487	1.30%
Tamaulipas	41	3.40%	1359	2.00%	225	3.70%	15 535	2.50%
Tlaxcala	2	0.20%	1 097	1.60%	27	0.40%	11 624	1.80%
Veracruz	35	2.90%	5 588	8.30%	288	4.80%	41 328	6.60%
Yucatán	17	1.40%	1 911	2.80%	126	2.10%	11 708	1.90%
Zacatecas	4	0.30%	1 033	1.50%	49	0.80%	8 412	1.30%
Total	1 208		67 146		6 037		628 947	

Source: INEGI.

There are 1 208 wholesale establishments; more than 67 000 retail establishments, presumably butcher shops; more than 6 000 supermarket stores; and almost 630 000 grocery stores, of which an undetermined proportion participates in the commercialisation of pork meat.

There is no conclusive information regarding markets, *tianguis* (open markets) and street markets.

The degree of vertical integration between processors, distributors and marketers is unknown. Some pig producers (for example, Kekén and Kowi) are vertically integrated and participate in distribution and marketing.

The information that is available does not allow for the calculation of reliable concentration indicators, by means of links and distribution channels, since it is not feasible to group the establishments by economic group. The exception is the modern channel, which includes three main supermarket chains.

6.6. Regulations and official standards for pork

Regulation on Sanitary Control of Products and Services (Reglamento de Control Sanitario de Productos y Servicios)

This regulation in force (with a last amendment in the *Diario Oficial de la Federación*, 12 February 2016) regulates activities, services and establishments related to meat and its products. Article 28 states that, during transport, perishable foods must be kept refrigerated at a designated temperature and frozen foods must be kept frozen.

The regulation includes certain provisions related to the operation of establishments, which need to comply with sanitary conditions; such as areas destined for the temporary deposit of waste; conservation and cleaning of facilities; clothing; handling of substances; temperature measurement equipment and the obligation to report any health anomalies to the authorities.[59]

The practice of hygiene for the processing of food, drink and nutritional supplements (NOM-251-SSA1-2009 Prácticas de higiene para el proceso de alimentos, bebidas o suplementos alimenticios)

This official standard establishes the minimum requirements for hygiene practices that must be observed in the processing of food, beverages and food supplements and their raw materials to avoid contamination during their processing. These requirements must be fulfilled by any person or company engaged in the processing of food, beverages and food supplements intended for consumption in Mexico.

The guide gives information on facilities, equipment, utensils, storage of products, packaging, control, maintenance, cleaning, pest control, health and hygiene of personnel, transport and training.[60]

[59] See third title of the regulation.

[60] See COFEPRIS, *Guía de buenas prácticas de higiene en establecimientos de servicio de alimentos y bebidas*, available at www.cofepris.gob.mx/AS/Documents/COMISIÓN%20DE%20OPERACIÓN%20SANITARIA_Documentos%20para%20publicar%20e

It should be mentioned that interviews with market participants identified that, in the case of some meats, companies inject aqueous solutions, of a brine type, and without a clear objective. Other countries also follow this practice but in some, such as the United States, the industry informs the consumer. In Mexico, there are no provisions to regulate the maximum amounts to be injected or to oblige producers to inform consumers.

Specifications and procedures for the verification of imported meat, carcass, viscera and waste at points of zoosanitary verification (NOM-030-ZOO-1995 Especificaciones y procedimientos para la verificación de carne, canales, vísceras y despojos de importación en puntos de verificación zoosanitaria).[61]

This is an official standard of verification within the process of importing meat into the national territory. The objective is to avoid entry of diseases into the country and to ensure that meats comply with quality and hygiene standards.

6.7. Barriers to entry

As discussed in the introduction to this chapter, the distribution and commercialisation of pork meat includes the production of carcasses or cuts, and their delivery from slaughterhouses or meat preparation facilities until the final point of sale to consumers. This process includes logistics, distribution and retail.

Meat that comes from TIF establishments and that is sold in butcher shops or through the modern channel is refrigerated. The cold chain must be maintained until its final destination. This requires specialised equipment for transport that can be expensive.

There is no information about the investment required to establish a distribution centre. However, it must include processes for cold storage and adequate conservation (especially if it follows the TIF standards needed to fulfil the needs of the modern channel or specialised butcher shops). Therefore, it is possible that significant investments are required, depending on the volume and if it is a multi-product distribution establishment.

The investment needed to open a butchery-type retail establishment is not high. This type of establishment only requires refrigeration equipment, counters, scales and cutting and grinding equipment. The shops are generally small and are rented through lease agreements.

In addition to federal regulations, those interested in opening an establishment for the marketing of meat must obtain local authorisation. Occasionally, authorities at the municipal level may establish additional requirements as indicated at the federal level and that may affect conditions of competition.[62]

n%20la%20sección%20de%20MEDICAMENTOS/ALIMENTOS/GUIA%20ALIMENTOS%20FINAL1.3.1.pdf

[61] See presentation of SAGARPA, available at www.comecarne.org/wp-content/uploads/2015/06/SENASICA.-Procedimiento-de-Inspección-de-productos-cárnicos.pdf.

[62] See, for example, article 8 of the Regulation for the sale of meat and poultry from the municipality of Cuautepec de Hinojosa, Hidalgo, which states that:

6.8. Conclusions

The most important category of consumed pork meat is steak, which represents more than 27% of pork consumption; this is followed closely by rib and chop which represent 26.3%. The type of cut consumed on average varies depending on the state where the consumer lives and also the decile of income.

Butcher shops are the main point of sale for pork meat (where 55% of the total is sold). Markets are the second most important channel (with 21% of sales). Supermarkets only represent 11% of sales.

Consumption is highly concentrated in a few states. The states of Mexico, Veracruz, Jalisco, Puebla and Mexico City make up 51.3% of pork consumption in monetary terms. In per capita terms, there is great heterogeneity in consumption by state. Citizens of the south-eastern states of Mexico spend the most on pork, followed by the inhabitants of Colima, Tlaxcala and the state of Mexico. The states with the lowest consumption are in northern Mexico.

There is no evidence that the concentration in the distribution markets is significant (especially in the final marketing part) and there is no evidence of economies of scale or purchasing power of customers.

There is no information about the amount of investment necessary to establish a distribution centre, so there are no elements to conclude if there could be barriers to entry to that activity. What is known is that in some projects it is possible that the investments are significant, depending on the volume and if the establishment is a multi-product distributor. In the case of butchery-type retail establishments, the investment is low.

Given that, in addition to federal regulations, the opening of retail establishments requires authorisation from the local authorities, there may be requirements in addition to those at the federal level that could affect competition.

"In order to avoid that, with the opening of a new business, unfair competition, hoarding or violation of free competition, the socio-economic studies ordered by the Municipal Presidency will be carried out. The same procedure will apply to requests for change of address or already existing business address."

See www.ordenjuridico.gob.mx/Estatal/HIDALGO/Municipios/Cuautepec/Reg13.pdf

Chapter 7. Commercial practices

This chapter analyses vertical relationships in the pork value chain. In this chain there may be relationships between agents with unequal bargaining power. There is both a trend to vertical integration and various contractual forms that companies use and have similar effects to vertical integration.

7.1. Vertical relationships throughout the value chain

In the pork value chain, suppliers of inputs, especially of genetic materials, food and medicine, coexist with a sector of heterogeneous pig producers.

In the value chain, there are large vertically integrated producers from the production of feed to commercialisation. There are also less integrated producers, generally smaller, who raise pigs and sell them to processors and packers.

Although there is no evidence of livestock farming by contract in Mexico, some large producers have sharecropping contracts with smaller producers to whom they contract the fattening of these animals. These contracts present some advantages for the contracting parties and are being promoted by FIRA.

7.2. Relationship between input suppliers and primary producers

Genetics

Genetics is very important in the current production of pork. The trend towards technification of processing requires animals of homogeneous characteristics. Certain genetic branches have characteristics of parturition levels or quality of carcasses, which will have an impact on the productivity of the farms. Most swine genetic material is supplied by large genetics companies that are transnational and have patented genetic lines.[63] Large swine producers have breeding farms, usually in collaboration with genetics companies. However, small pig farmers buy doses of semen from genetics companies, distributors or producers through GTCs. Access to genetic material can be expensive for traditional producers.

The relationship between small pig farmers and genetics companies can be unequal, and can lead to high prices and less efficient use of genetic material. To counter such effects, the Mexican government is searching alternative sources of genetic material to that of the transnationals. In this sense, SAGARPA has supported the creation of GTCs.

GTCs have laboratories where genetic materials are processed to improve and identify pure breeds. These centres provide the support of a paternity line to pure breeds and those of high genetic value, so as to be able to follow their development and use. The objective of

[63] According to interviewees, “PIC”, “Topics”, “Hypor”, “Genesus” and “Danbred” are identified as recognised genetics brands.

the centres is to achieve standards of high productive value in the animals (measured in terms of productivity per female) and to be able to replicate them on the farms. In addition to improving the genetics of livestock consumed in Mexico, the objective is to commercialise the genetic material developed in the country.[64]

SAGARPA´s view is that, although currently around 99% of genetic material is imported, GTCs will be consolidated within two years.

Animal feed and medicine

The pig producing sector is heterogeneous and although there are large producers who produce their own feed and buy large amounts of corn, there are also many small producers who do not have the scale to do so. According to the interviewees, it is possible that the sector supplying balanced animal feed and medicines is more concentrated. For example, many pig producers have access to such inputs in retail establishments. These producers may be paying prices for their inputs that are higher than if they purchased them wholesale.

The grouping of small producers to purchase such inputs together can provide savings. The joint realisation of input purchases changes the price formation mechanism: instead of being price-acceptors buyers acquire the power to negotiate better conditions. For this reason, collaboration among primary producers could allow them to access the benefits of acquisition of inputs on a larger scale.

7.3. Vertical contracts between primary producers and processors

Strategic alliances for vertical integration

Smithfield is the most important pig processor in the world. In Mexico, it has two important alliances that allow it to achieve full vertical integration in this value chain: Carroll and Norson.

In 1999, the American company Smithfield acquired Carroll, which breeds, commercialises and processes pigs. This acquisition had an impact on Carroll Farms (which is now 50% owned by AMSA group and 50% owned by Smithfield), in Puebla and Veracruz. The acquisition of Carroll in the United States is part of a vertical integration strategy of Smithfield group. Through this acquisition, Smithfield became a leading company in the processing, packaging and marketing of pigs and a company leader in the breeding sector. The leading company in the world is thus vertically integrated.

In 1999, Agroindustrial del Noroeste formed a strategic alliance with Smithfield, with the resulting Norson. This alliance is part of Smithfield's vertical integration strategy that contributes processing-packaging technology and marketing strategy. Local producers are in charge of the entire process of raising the pigs.

Livestock by contract and sharecropping

In Mexico, livestock farming by contract is not common. The most widespread type of vertical contract in the livestock sector is sharecropping. Sharecropping is established in the Federal Civil Code and the Civil Code for the Federal District, in Chapter VII and

[64] According to representatives of SAGARPA, genetic material is acquired in transfer centres, where semen is obtained and selected and pigs are inseminated, thereby reducing costs. The contracts for the use of this genetic material are renewed every year, as stipulated in the contracts.

occurs in two forms: agricultural and livestock. Livestock sharecropping is defined in article 2752 of both regulations, which takes place when a person gives another a certain number of animals in order to care for and feed them, with the purpose of dividing the resulting production in the proportions agreed. The objective of sharecropping is livestock rearing and to obtain products, such as skins, mane, wool, milk, etc. The contractual conditions are established by the parties. In the absence of a contractual instrument, local custom is followed.

The contract states that there are two parties. The first is the owner of the animals; the second is the sharecropper, who agrees to take charge of livestock management. Article 2755 of both ordinances establishes that the sharecropper of livestock is obliged to use the same care in the treatment of the animals as they would ordinarily used in their own. Otherwise, they are responsible for any damages. On the other hand, the owner undertakes to guarantee the sharecropper the possession and use of the livestock and to substitute the lost animals for others, in case of eviction. Otherwise, the owner is liable for the damages and losses caused by the lack of compliance with the contract. The law prevents the sharecropper from having any head or offspring without the owner's consent. There may be different clauses in the contracts to reflect different elements. For example, an agreement of the owner to deliver the animals to be cared for by the sharecropper; a sharecropper's commitment to take care of, feed and handle the animals as if they were his own property; or the commitment to deliver a percentage of the profits to the sharecropper.

In a sharecropping contract, the company shares the risk with a direct operator, whose benefits depend directly on the profitability of the exploitation of the livestock. It also has the benefit of comparative advantage and better use of facilities and reduces capital and labour requirements; part of the investment and labour will be taken up by the sharecropper. There is also a reduction in the cost of sanitary control, since the sharecropper is responsible for ensuring that all his personnel comply with the sanitary guidelines requested by the company. There are also tax advantages. To make the payment to the sharecropper deductible, the company only requests an invoice for the amount resulting from multiplying the kilogrammes produced by the payment quota indicated by the sharecropping table according to the conversion obtained.

The way the process works is that the sharecropper receives the pigs (units and kilogrammes) and, from then on the process is carried out in co-ordination with the production department of the company, with detailed control of the delivery of animal feed, medication and vaccines. At the end of the fattening process, the sharecropper selects the pigs for sale and is responsible for shipping them, weighing and delivering them to the sales department of the company. The sharecropper is mainly interested in caring for the resources that are given to him; any care that results in greater productivity affects his results.

In sharecropping of pigs, the sharecropper contributes the farm, manpower, maintenance expenses, electric power, gas, and the company provides animal feed, genetic material, technical advice, vaccines and medicines. The sharecropper is paid based on the kilogrammes produced and a conversion scheme that encourages productivity in the process (for example, animal feed savings, management and other expenses). Payments are programmed in different ways, with a final settlement for the fattening of the pigs.

There are different types of sharecropping, with many exploitation variables in terms of the farm and the fattening site (Site 2, Site 3, or both) and where the sharecropping scheme must be suitable only based on what was paid, according to the modality to adjust the remuneration to the sharecropper. Within these various types, there are sharecroppers with

their own farms, sharecroppers with rented farms, sharecroppers with farms that belong to the company, sharecroppers with farms rented by the company and investor sharecroppers that build farms.

Although in other countries (for example, the United States or France) this type of contract was used in the past, sharecropping in Mexico goes back to 1984 when a partnership programme was created between Tyson de México and ten *ejidos* (common owners of land) of La Laguna for the production of chicken. Currently, it is used by companies such as Bachoco and Pilgrim´s and, in the particular case of pigs, Kekén is the most prominent case.

Kekén has a very successful business model for sharecropping. The Kekén model is based on three sites, of which the last one includes sharecropping. In this model, Kekén is responsible for the production of piglets up to 5 kg in maternity sites. After weaning, piglets are fattened up to 30 kg on different farms. In the final stage, pigs are fed by small and medium producers until they reach 110 kg and are delivered for sale. Kekén provides piglets, balanced feed, medicines and vaccines, technical assistance and marketing support.

FIRA has supported several of the projects of Kekén with sharecropping contracts signed between business and social sector producers. For a project to be completed with funds from FIRA, the institution requires that the company establish commitments of up to 10 years with the producers, which is the term required to amortise the farm. The credit is linked to the duration of the contract. In this way, the risk to the producer is reduced and the recovery of the credit portfolio is guaranteed.

7.4. Conclusions

This chapter analysed the vertical relationship between large input suppliers that interact with relatively small primary producers. SAGARPA has a very important role to play through genetic material transfer centres to provide quality swine genetic material to small farmers. The grouping of primary producers to make purchases can potentially reduce the costs of acquiring medicines and animal feed. For this it is necessary to harmonise the legal frameworks in fiscal and competition matters.

Although contract farming is not common in Mexico, some companies use sharecropping contracts primarily for the fattening stage of pigs. The sharecropping contracts provide the benefits of comparative advantage, reducing the capital and the cost of labour and sanitary control of pig producing companies. The more efficient the sharecroppers are, the greater their yield.

Chapter 8. Performance

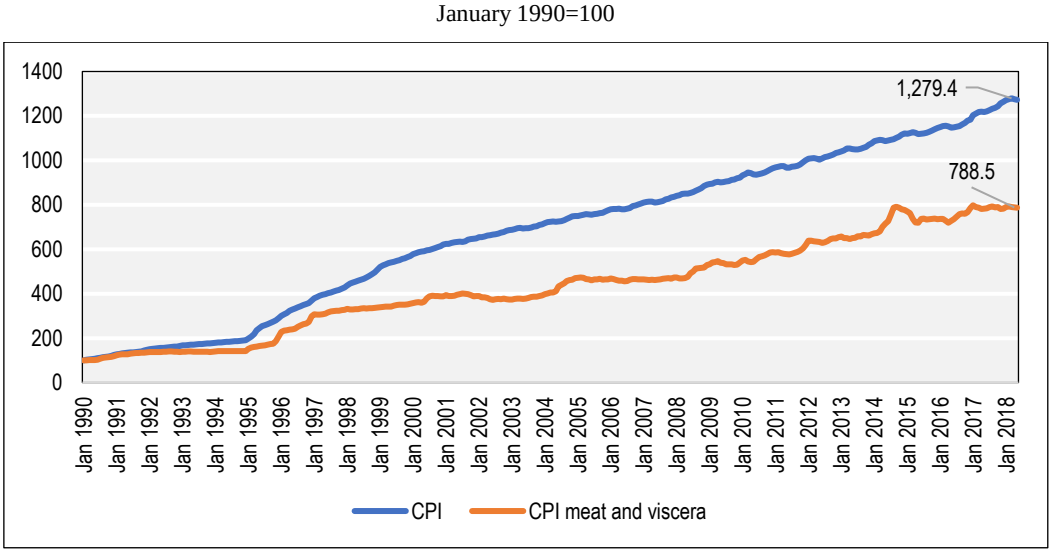
Several statistical tests on relative prices, margins and differences of means were performed to show certain elements to establish the interaction between the different links of the value chain, the link with the import products and the relationship between regions.

8.1. Prices

8.1.1. Evolution of consumer prices

Figure 8.1 shows the evolution of consumer prices in general and the price of pork meat and viscera, covering the period from January 1990 to May 2018. As can be seen, pork has significantly reduced in price, in real terms.

Figure 8.1. Evolution of CPI and pork meat and viscera price indexes, 1990-2018



Source: INEGI.

Figure 8.1 shows that, if January 1990 is taken as a basis, in general prices have increased 1 179%, while the price of pork has increased by 688%. This means that the price of pork has decreased, in real terms, by around 38%.

Based on this result, several statistical exercises were carried out to investigate in greater detail the operation of the chain. Relative prices were compared between links, for example, inputs for balanced feed, live animals, meat in carcass and cuts. A price comparison was also made between Mexican and imported products. Finally, the behaviour of prices by geographic zones was examined and compliance with the Law of One Price was verified,

taking as reference the price of pork chops. The exercises and their results are explained below.

8.1.2. Analysis of relative prices, between links in the chain

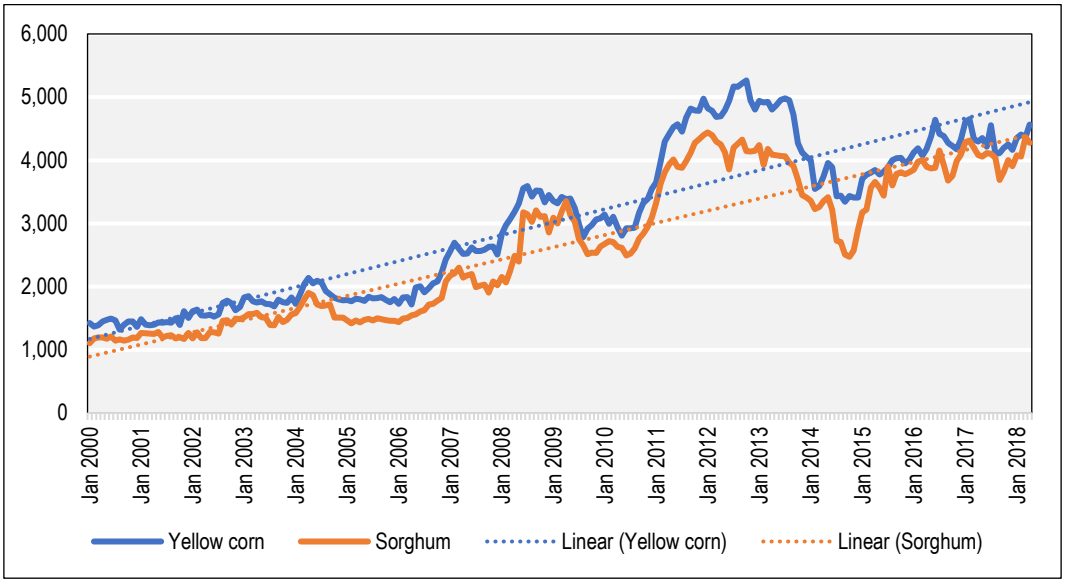
Prices of feed inputs

The main input to produce balanced animal feed is corn. Pig producer can use sorghum as an alternative to corn, depending on the prevailing price of grain in the market. In some regions, particularly in Sonora, it is also possible to use wheat.

The first exercise was to verify the price behaviour of yellow corn and sorghum. In general terms, the price of both cereals behaves in parallel, that is, the prices increase and decrease at the same time. However, corn tends to be more expensive – on average around 17% – although in recent years, the price gap has decreased. Despite the decreasing price difference, the interviewees pointed out that corn is preferred for its nutritional properties and its wide availability.[65] Figure 8.2 shows the evolution of both prices, between 2000 and the first quarter of 2008.

Figure 8.2. Evolution of corn and sorghum prices, 2000-2018

MXN/Tonne



Source: SNIIM.

65 The exercise consisted of a statistical test on the relative price stationary of both cereals. Therefore, data from the SNIIM were used. The price series used are a simple average of the monthly observations in different locations and cover the period from January 2000 to April 2018. The statistical tests of Dickey-Fuller Augmented and Phillips-Perron confirmed that the relative price is stationary, that is, there is no evidence of a difference in the behaviour of the prices of the products.

Supplies and balanced feed

The relative prices of corn and sorghum were also tested. These cereals serve as inputs to produce the balanced feed and affect its price. The objective was to verify if there has been any difference in the evolution of the prices of the inputs, with respect to the product obtained from them, that is, the animal feed. The results indicate that, in general, prices have had similar behaviour.[66]

Price comparison of live pigs

The SNIIM reports prices per kg of 2 varieties of live pig: creole and supreme. Figure 8.3 shows the behaviour of the relative price of both varieties. As shown, the creole pig has a price that is approximately 80% of the price of the supreme variety. The supreme variety refers to races obtained through genetic processes. The result indicates that for breeders, obtaining a supreme variety gives them a favourable price differential, in respect to those that breed creole varieties.[67]

[66] The information of balanced feed prices was obtained from the SNIIM. This system provides information on various categories of balanced feed: lactation, preinitiator, initiator, finisher, growth and development. Due to some irregular series, a simple average was constructed that adds all the products, with the exception of preinitiator, in the various reported locations.

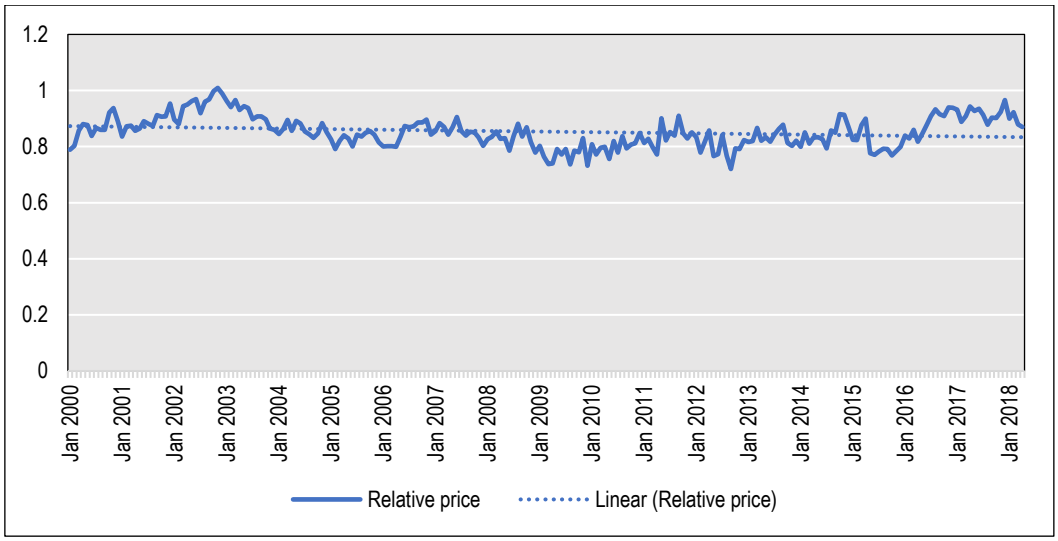
The statistical tests shows that the relative price of yellow corn/balanced feed is stationary in levels using the Phillips-Perron test. With the Dickey-Fuller Augmented test, it is possible that it is stationary if a model with a constant (C) is used, but not with both constant and trend (C and T).

Regarding the relative price of sorghum/balanced feed, similar results are obtained. It is stationary in levels using the Phillips-Perron test and the Dickey-Fuller Augmented test with constant (C). But it is not in a model with constant and trend (C and T).

[67] The series of prices used are the simple average prices for the set of localities for which the SNIIM reports information.

Figure 8.3. Relative price between creole and supreme pigs

January 2000 – April 2018

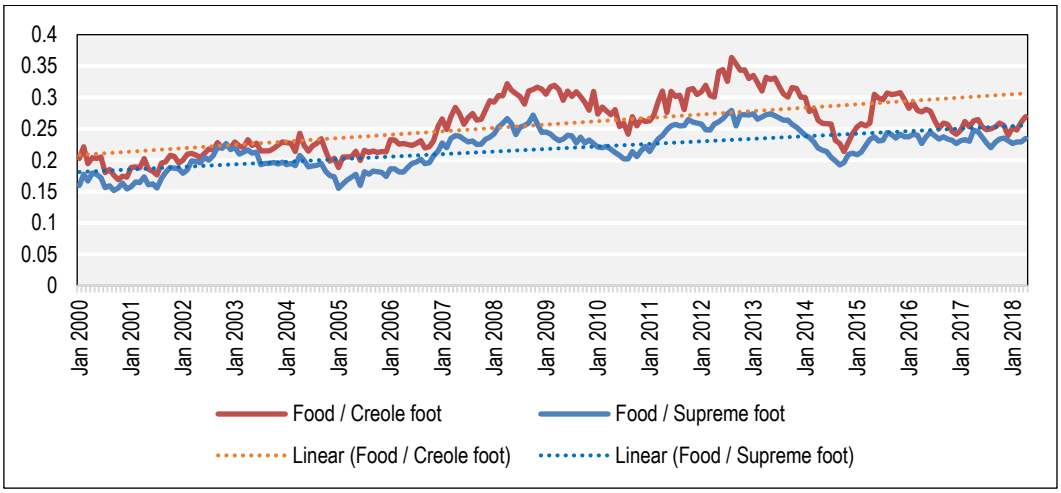


Source: SNIIM

With the data obtained, the evolution of the relative price of the balanced feed was analysed with respect to the price of the live pig for both varieties, per kg. Figure 8.4 shows the way in which relative prices evolved.

Figure 8.4. Relative price between balanced feed and live pig, creole and supreme

January 2000 – April 2018



Source: SNIIM.

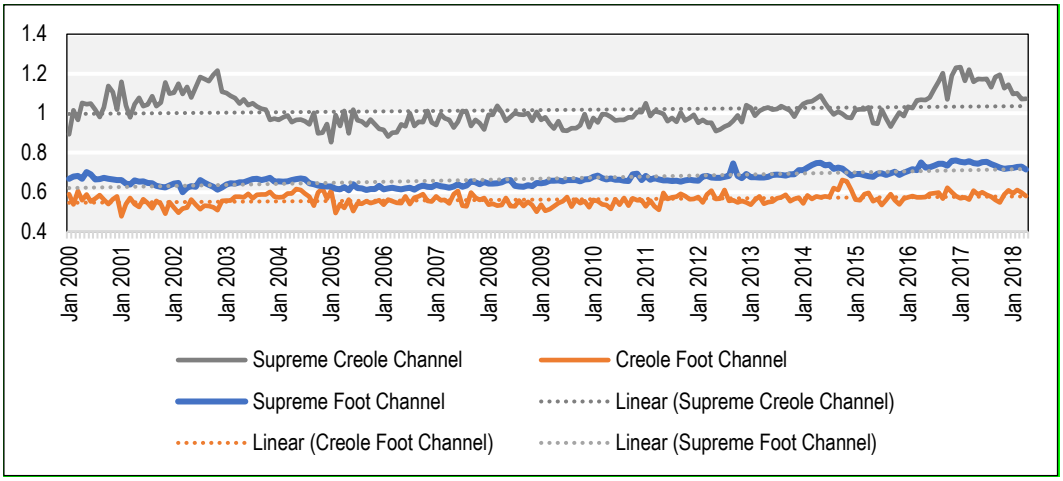
In both cases it can be verified that the price of the balanced feed increased above the prices of live pig varieties.[68] This relative increase in feed prices is a disadvantage for producers who are not vertically integrated with feed production.

Comparison of prices of live animals and meat in carcass

According to information from SNIIM, price series were constructed for carcass originating from creole and supreme pigs. From this and with information from the previous section, three comparative relative prices were obtained: i) prices of creole/supreme in carcass; ii) prices of supreme live pig/supreme pork in carcass, and iii) prices of creole live pig/creole in carcass.

Figure 8.5. Relative price of live pig and meat in carcass, by creole and supreme types

January 2000 – April 2018



Source: SNIIM

The most important result is that the price of meat in carcass, in the creole and supreme varieties, is practically the same, since the relative price is close to 1. We should remember that a price differential close to 17% was found in favour of live animals of the supreme variety with respect to the creole variety. This difference disappears when the comparison is made in carcass. What the results indicate, is that buyers of live animals can differentiate by animal variety. However, once slaughtering takes place, the market does not differentiate between carcasses of either variety, since meat is sold as an undifferentiated product.[69]

[68] The statistical analysis shows that the series are non-stationary and that the price per kg of the feed has increased more than the live pig.

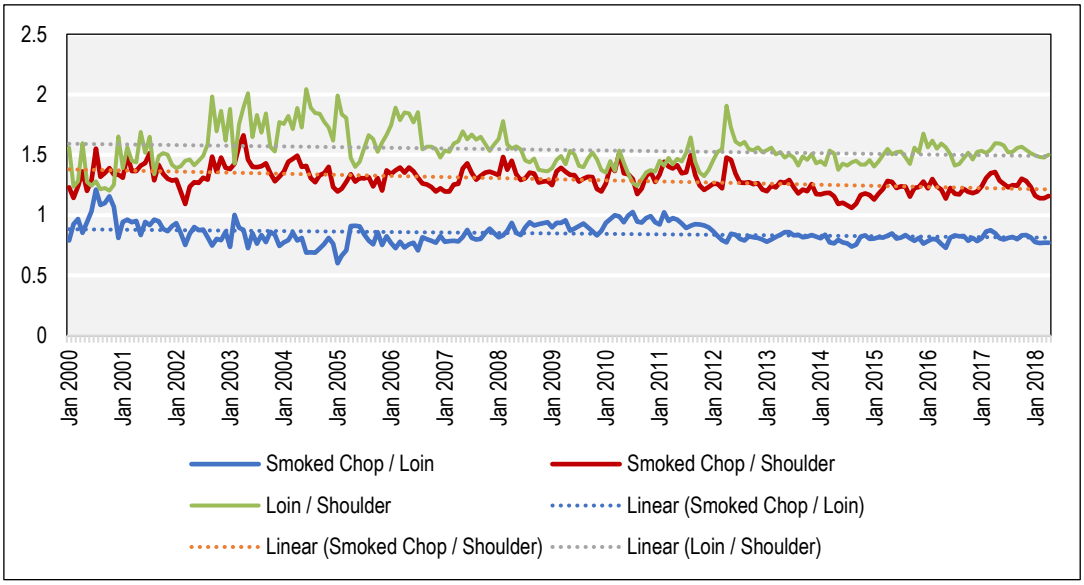
[69] The statistical tests indicate contradictory results, because the relative price of the live supreme pig, with respect to pork in carcass, is not stationary. The price of pork in carcass has decreased in relation to the live pig. As for the creole variety, the relative price of live pig with respect to the price of pork in carcass is stationary.

Comparison of cut prices

Prices of cuts were analysed at the meat preparation level. In particular, we obtained the average price series of smoked pork chop, loin and shoulder. Figure 8.6 shows that the relative prices of these cuts are more or less constant and there have been no differences in the behaviour of prices by type of cut.

Figure 8.6. Relative price between cuts and meat cutters

January 2000 – April 2018



Source: SNIIM

Stationary tests were carried out on the relative prices of each cut, with respect to the price of carcass meat, coming from creole or supreme animals. In all cases, the existence of stationarity was corroborated. That is, the prices of the cuts evolve along with the prices of meat in carcass, regardless of whether it comes from creole or supreme pig.

Comparison with import prices

An exercise was carried out to determine the relationship between the prices of meat to final consumers and the prices of the imported products.[70] For this, the following relative prices were obtained:

[70] For this exercise, series of prices for pork chop, steak and leg were obtained, based on filtering the average price information published by INEGI. For international prices, 2 indicators were obtained, based on information from the SIAVI. A sum of the total value of pork imports was made for the tariff codes considered in this survey and with them the implicit price in USD was obtained, which was then converted into MXN. The other indicator was a price index for pork imports, considering as weights the shares of the various tariff codes during 2014. It is worth mentioning that the series obtained by both methods had similar behaviours.

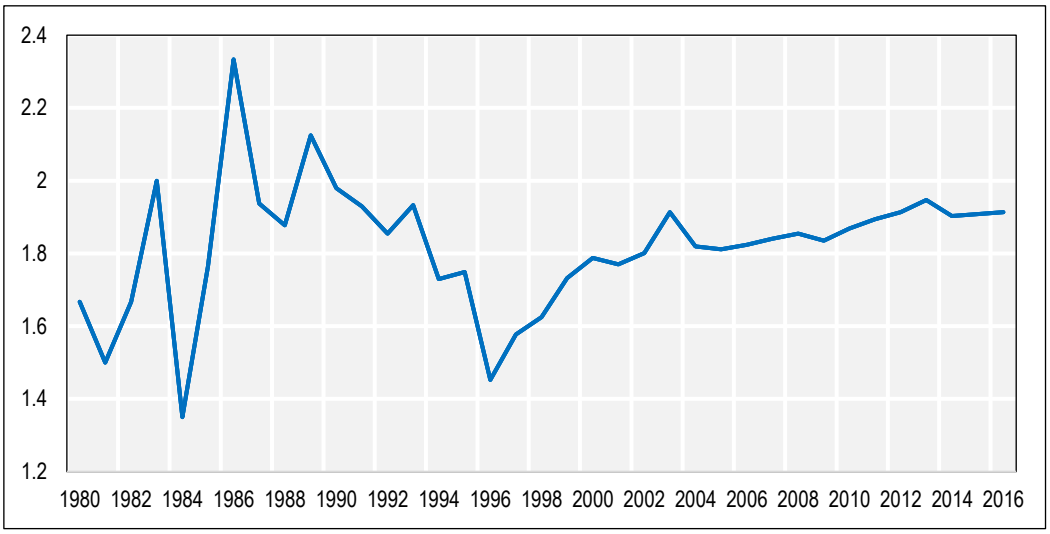
- chop/implicit price of imports
- leg/implicit price of imports
- steak/implicit price of imports
- chop/imports price index
- leg/imports price index
- steak/imports price index

No evidence was found that prices were not stationary. That is, there is a correlation between domestic prices and imported products. It is likely that imports have a significant influence on the formation of domestic prices, due to the high degree of consumption of imports.[71]

8.2. Structure of production and marketing costs

SIAP information provided the relative price of the live pig to meat in carcass, with annual data. This relationship is shown in the following Figure 8.7 below.

Figure 8.7. Relative price of live pork/meat in carcass, 1980-2016



Source: SIAP.

There is an unstable relationship between 1980 and 2000. Thereafter, the indicator stabilises.

Table 8.1 shows the margin of the producers of meat in carcass. The indicator was obtained as the gross profit with respect to the price of live pig. The data indicates that there has been an increase during recent years.

[71] However, the evidence is not sufficient to indicate that the imported products determine the domestic price.

Table 8.1. Gross margin, meat in carcass, various periods

Period	Gross margin
1980-1989	43.8%
1990-1999	42.5%
2000-2009	45.2%
2010-2016	47.5%
1980-2016	44.5%

Source: SIAP.

8.3. Analysis of difference of means of final prices of chop

INEGI provides information on average consumer prices, from January 2011 to April 2018, in 46 locations corresponding to the 32 states of the country. The information distinguishes 373 different presentations of meat cuts. The chop was selected to carry out a difference of means exercise. This product is the second most consumed and the series are quite regular.

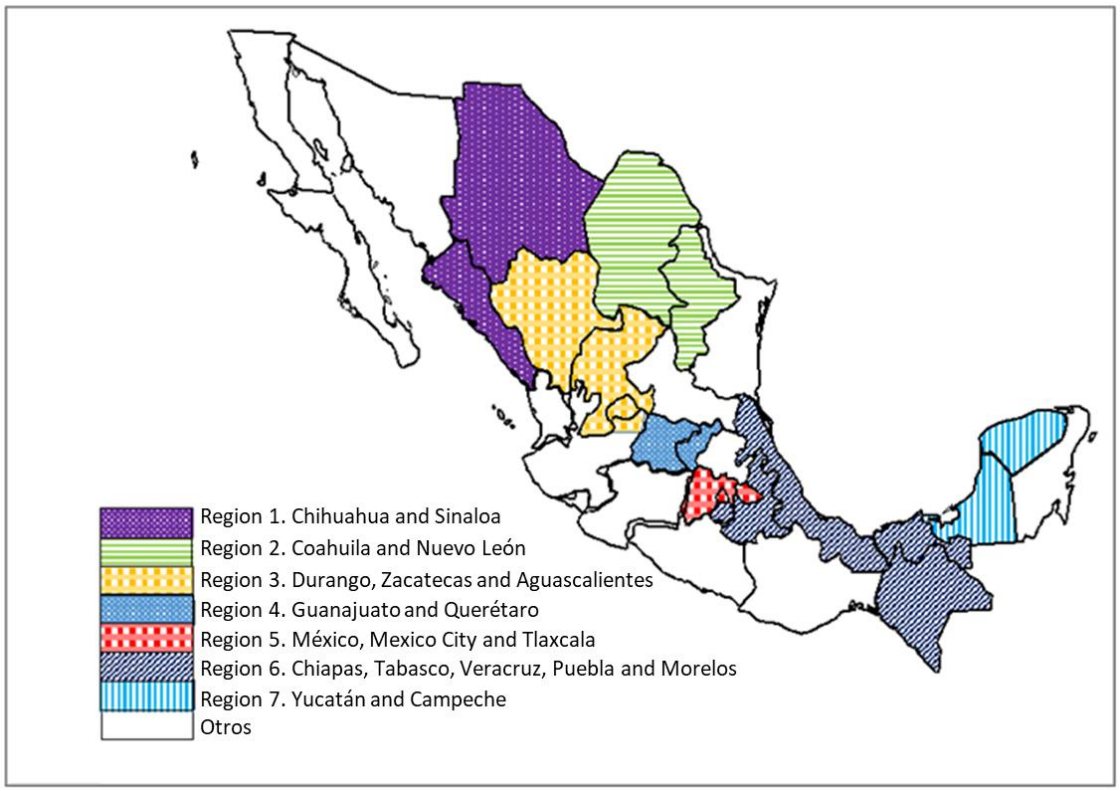
Based on real prices of chop, candidate regions which belong to the same region were grouped, based on similarity of price averages and contiguity. The average price of chop was obtained by filtering 38 presentations from January 2011 to April 2017.

By testing differences in means, states were grouped into seven regions:

- Region 1 - Chihuahua and Sinaloa
- Region 2 - Coahuila and Nuevo León
- Region 3 - Durango, Zacatecas and Aguascalientes
- Region 4 - Guanajuato and Querétaro
- Region 5 - México, Mexico City and Tlaxcala
- Region 6 - Chiapas, Tabasco, Veracruz, Puebla and Morelos
- Region 7 - Yucatán and Campeche

Graphically, the regions are represented as follows:

Figure 8.8. Regions of average real prices of chop in Mexico, 2011-2018



Source: INEGI.

8.4. One price test

The previous exercise was complemented with an exercise to determine if the Law of One Price is met. According to this Law, if the price of a product is not different in different geographical areas except for the transportation cost, then these areas could belong to the same market.[72]

[72] The exercise uses unit root and cointegration tests to determine if prices in different regions are subject to a common or long-term stochastic trend.

The time series must be of the same order of integration. If this occurs, it is feasible to specify Vector Autoregressive Models (VAR) together with stability tests (normality, autocorrelation and hereocedasticity), to see if the price series of each of the regions converge in the long term, meaning that they cointegrate.

If there is at least one cointegration vector, this can verify the LOP, through a block exogeneity test, which defines if a region has a behaviour that is independent of the rest (the variable is really exogenous) and if this has an influence on the other regions. If an independent region is identified, a Granger causality test can be performed in pairs to determine the relationship between the leading region and the other regions. See Jaunky, Vishal C. and Lundmark, Robert (2015), "Dynamics of Timber Market Integration in Sweden." Forests 6 (12), p. 4622 and Katrakilidis, C. (2008), "Testing for Market Integration and the Law of One Price: An Application to Selected European Milk Markets," International Journal of Economic Research, 5 (1), pp. 93-104.

Chop cut analysis

The chop is one of the cuts most widely consumed. By using statistical tests to determine if a region has a behaviour independent of the rest of the country and if this region has an influence on the other regions, an analysis has shown that there are 5 candidate regions that are exogenous or leaders (regions 1, 2, 4, 5 and 6). Table 8.2 summarises the results.

Table 8.2. Exogeneity block test results

Region	Regions that influence
Region 1 - Chihuahua and Sinaloa	2
Region 2 - Coahuila and Nuevo León	3
Region 4 - Guanajuato and Querétaro	2
Region 5 - México, Mexico City and Tlaxcala	3
Region 6 - Chiapas, Tabasco, Veracruz, Puebla and Morelos	4

Source: INEGI.

There is no clear result to show that any one region exerts a definitive influence on the rest of the market. The results obtained in the previous section indicate that it is possible to establish the existence of several regional markets but there is no one region that clearly stands out. The most relevant area is that represented by Region 6 which includes important producing states, such as Chiapas, Tabasco, Veracruz and Puebla, which represent 23.5% of production and mainly serve the national market.

8.5. Conclusions

An analysis of the stationarity of the different series of relative prices examined indicates that:

- In general terms there are no significant changes between the various links in the chain. The exception is the relative price between the balanced feed and live pork. There has been a relative increase in food prices, which creates a disadvantage for breeders that are not vertically integrated with food production.
- It is striking that there is a price difference between creole and supreme live pig, because the price of the supreme is 15% more expensive. However, this difference is not perceived when analysing the prices in carcass for the same type of animal. This could be attributed to the absence of mechanisms for differentiating meat. Once the animal is slaughtered, its meat is sold as a standardised product.
- Another important aspect is that the price of balanced feed has apparently increased more than the price of live pig, which could mean an advantage for vertically integrated producers. This emphasises the importance of eliminating legal mechanisms that inhibit collaboration among competitors, for the supply of inputs and participation in other links in the chain.
- There is also a parallel between the price of cuts sold to the final consumer and the price of imported products. Import prices and domestic prices are correlated. It is possible that this has to do with the high proportion of imports in apparent consumption.
- The analysis of gross margins, between sales in carcass with respect to the price of live pig, indicates volatility between 1980 and 2000. In recent years, there is an increase in margins between these links.
- The statistical tests have established seven price regions. They also identify five regions that could behave independently but the results do not identify a region that clearly exercises leadership over the others.

Chapter 9. Final conclusions

Overview of the industry

The consumption of meat has increased worldwide. Pork meat is the most popular in the international arena, although in Mexico it is the third most important meat consumed.

The pig faces cultural reluctance and sanitary prejudices. However, certain changes may allow the expansion of consumption. On the one hand, it has been shown that pork has favourable nutritional properties to the degree that it is considered to be white meat and is recommended for consumption by segments of the population with health conditions, for example, cardiac problems. On the other hand, its relative price with respect to chicken and beef has decreased, which gives the perception that it is a cheap product for consumers.

It is expected that in Mexico growth of the industry will continue, mainly through companies that process large volumes of pork. To achieve this, the industry works to encourage consumption in ways that are other than traditional. For example, pork marketing promotes its use as an alternative to beef or chicken in the preparation of stews.

As the industry consolidates and productive efficiency is improved, it will be possible to equate pork production with chicken production, in terms of use of resources. For example, improvements in the transformation of balanced feed into animal weight will make the production costs per kg of meat of both species similar. Pork, like other meats, has disadvantages that are difficult to solve in relation to the use of resources and inputs, such as water, land and food, as well as their possible effect on the environment.

The national cases reviewed show different market structures. For example, Germany, the main European producer, generally follows a vertically disintegrated model, in which collaboration between competitors at the level of pig producers is very important and strongly influences price formation. In Denmark there is vertical integration and primary producers control processing, as well as collaborating in the form of co-operatives. In the United States, a contractual relationship model has been developed, although not solely, between producers and processors. In the United States model processors may have bargaining power in relation to producers which may create a commitment problem, such as exists in the chicken market.

The cases analysed are identified as successful, because they have given rise to the development of genetic material, mechanisation and operational efficiency. However, in all cases there has been an increase in market concentration, particularly in processing activities.

It is difficult to compare Mexico with these countries. There is not enough information to fully understand the operation of the pork production chain. There are several producers who have been making significant investments, some through vertical integration and others through the establishment of contractual relationships. However, we do not know the market shares of the different links, the modalities of the relationships between links and the economic groups they belong to, among other elements.

International context

The international context is important because imports represent a significant proportion of pork consumption in Mexico. Production is concentrated in three places: China, the European Union and the United States.

The development of the industry depends on competitive access to food inputs, mainly corn. The yellow variety if this cereal comes mainly from the United States. If there is a continuation in the expansion of industries such as meat, other industrial uses and human consumption, the trade deficit in corn could increase.

General characteristics of the industry in Mexico

Pork meat represents approximately 20% of meat production. The industry has grown at a rate of 2.1% during recent years. Its per capita consumption has increased 50% since the 1990s. It is reasonable to anticipate that consumption will continue to increase. Production is highly concentrated in six states.

Imports have also increased due to the growth in national consumption and exports. Imports from countries with which there are no trade agreements are subject to tariffs ranging from 10% to 20%. There is no information to identify the groups involved in the importation of pork.[73] It is possible that there are groups that represent a considerable volume, which would allow them to act as a competitive force in the market.

The Mexican government has suspended the preferential tariff treatment for various pork products from the United States. To avoid price effects, the government established a quota to import without tariff. The information available indicates that there has been a low use of the quota, in fact only 1.5% of the volume granted.

Although detailed information is not available, it is possible that the degree of market concentration in production and processing links is lower than in other countries. If joint ventures by Smithfield are considered, it is possible that this company has a market share of approximately 15% of breeding sows in Mexico.

Swine industry

In Mexico, there are two systems for slaughtering pigs: the traditional system and the modern system. The modern system is highly specialised in the production stages, is highly mechanised, is vertically integrated and produces large volumes.

Production consists of several phases: pregnancy, weaning, pre-fattening and fattening. In the modern system the different stages are clearly differentiated; some farms separate the activities into three to ensure better efficiency and sanitary control.

Animal feed represents approximately 67% of the total production costs. Another important input is breeding sows.

Mexico has unfavourable productivity indicators in relation to other countries, although there have been improvements in recent years. Part of the industry has been provided with market incentives to move to self-regulation schemes that allow it to be competitive in the international context.

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[73] There is a list of beneficiaries of export quotas on the SNICE website. See www.snice.gob.mx/cs/avi/snice/medidas.cupos.html

Processing

Slaughtering occurs in different types of establishments. There are TIF and municipal slaughterhouses, as well as unidentified facilities. Although there is federal supervision of the establishments, some interviewees have indicated that the degree of supervision among TIF and municipal facilities differs.

The government has promoted slaughtering in TIF establishments. Slaughtering in this type of facility requires the application of good livestock practices. However, the use of municipal facilities and other unidentified facilities persists. According to interviewees, the sanitary status of this kind of establishment is uncertain.

Although there are no figures on the cost of entering the processing market, the interviewees stated that it is an activity that requires substantial investment and could face restrictions in the management of land use by municipal authorities.

Distribution and marketing

Steak is the most popular cut, followed by rib and chop. These cuts represent 53% of household spending on pork. The consumption of cuts varies by type and also according to income segment.

In commercialisation, traditional establishments such as butcher shops and public markets prevail, together accounting for 76% of sales. The modern channel, represented by supermarket stores, represents only 11% of sales.

Consumption is concentrated in a few states. The State of Mexico, Mexico City, Veracruz, Jalisco and Puebla represent 51.3% of consumption. Per capita consumption is differentiated by state. In the southeast and Colima, Tlaxcala and the State of Mexico, the expenditure on pork is higher. In the north there is less consumption, probably due to the greater propensity of the inhabitants of those states to consume beef.

There is insufficient information to measure the degree of concentration in the distribution markets, by link and channel. Although there is a large number of establishments, these cannot be grouped by economic group. Barriers to entry into these activities appear to be low, although there may be local restrictions established by municipal authorities. In the modern retail channel there are three main chains of supermarket stores.

Commercial practices

Large producers are often linked to the development of genetic material. SAGARPA has favoured the creation of genetic transfer centres, which provide a supply of good quality animals, as indicated by several interviewees.

The interviewees pointed out the existence of areas of opportunity in the organisation of primary producers to make purchases that could reduce the costs of acquiring inputs, such as medicines and animal feed.

Some producers have established contractual supplier relationships with processors, in the form of sharecropping. FIRA has stimulated the development of this type of relationship and has encouraged the operation of “Parafinancieras”, which are institutions to support producers who do not have access to traditional credit sources.

Performance

The statistical price analysis indicates that the gross margin of carcass sales with respect to live pig has increased. However, there is no evidence that this has had an impact on final prices.

The analysis also shows that the price of balanced feed has increased relative to the price of live animals, which means that producers that are not vertically integrated with food production are at a disadvantage.

There is price differentiation amongst regions. However, there is no indication that any of them exercise leadership over the others.

There is a relationship between import prices and domestic prices. This is reasonable due to the relevance of imports in the consumption of pork meat.

Chapter 10. Recommendations

This report proposes the following recommendations, which could improve the efficiency and operation of the pork production and its value chain. Most of the proposals are similar to those expressed in the study of the chicken market, also prepared by the OECD (2018), and of the beef market, prepared by El Colegio de México for the Secretary of the Economy of Mexico (2017). This is because the regulatory issues identified are common to all meat production industries.

Proposal 1.

Situation: Pig producing farms provide the necessary input for slaughtering and processing. There is a relationship between farmers and processors which contains various elements: vertical integration; cash market operations; hiring and, in particular, sharecropping. In Mexico, there is not enough information to permit such identification. It is important to collect such data, in order to design policies to avoid distortions in the relationship and encourage investment.

Recommendation: Design and implement a register of contracts between primary producers and processors, which keeps a record of remuneration; this would include the type of contractual relationship; hiring deadlines; exclusivity relationships; economic groups; and input supply terms, among others. This proposal was already made in the study on the chicken market (OECD, 2018). The information gathered should be made public, applying specific measures to avoid disclosure of confidential terms that may compromise the business plans of companies or that may lead to of monopolistic practices. The Livestock Registry can be used as a point of departure from which this information can be collected.

Proposal 2.

Situation: It is a fact that more than half of slaughtering is carried out in TIF establishments. This means that producer farms must comply with good livestock practices. The operation of these farms is kept under supervision, and the producers are certified voluntarily by SENASICA. The product destined for export comes from this production. However, it is possible that more than half of national production used to meet domestic demand is not subject to any type of voluntary certification. This raises health risks of various kinds, not only related to the quality of meat, but also to the management of waste, residue and resources such as water. The existence of this non-certified segment of the pork industry may put the country's sanitary status at risk and may hinder the expansion of Mexican companies into the international market.

Recommendation: Study in detail the way in which producers that are not certified in good livestock practices operate, in order to propose public policy measures. Information must be obtained to identify these producers, their location and type of operations, among other elements. This could be carried out through the Livestock Registry or agricultural censuses.

Proposal 3.

Situation: Certification of good livestock practices is not mandatory for farms. As noted, the production units are certified voluntarily, otherwise they do not have access to TIF slaughtering.

Recommendation: Once it is possible to integrate information as indicated by Proposals 1 and 2, a regulatory model can be implemented that makes the certification of good livestock practices mandatory.

Proposal 4.

Situation: There is a growing gap between demand and national supply of pork meat. Imports amount to approximately 46% of apparent consumption. However, certain elements of its structure are unknown, such as the identity of the groups that import. It is necessary to deepen this information to prevent the phenomenon of concentration in distribution.

Recommendation: Study in depth the structure of imports in order to identify the main economic groups that participate in this activity.

Proposal 5.

Situation: Derived from the suspension of the preferential tariff treatment that Mexico granted to various pork meat products from the United States, Mexico implemented a quota of up to 350 000 t to imports from other countries. Some of these imports were tariff-free products to reduce the possible effect of the suspension in prices; 89% of the quota was assigned, but the information available shows that only 1.5% of the quota was taken up. The reason for the low use of the quota is unknown.

Recommendation: Study the reasons why the quota has not been used, to determine if it is due to a lack of sources of supply in the international market; the design of the allocation mechanism; non-tariff restrictions on imports or other reasons.

Proposal 6.

Situation: The success of countries, such as the United States or Germany and Denmark in the European Union, is accompanied by regulatory mechanisms that enable collaboration between competitors, under exemptions to the application of antitrust laws for some purposes. In Mexico this does not happen. In addition, fiscal provisions inhibit the expansion of co-operatives of primary producers into downstream activities.

Recommendation: Discuss the adoption of measures favourable to collaboration between agricultural producers, in the areas of tax and antitrust laws, in order to allow economic agents to reach higher levels of production and facilitate their integration with other productive links. This is without prejudice to the application of antitrust laws.

Proposal 7.

Situation: Animal feed is the main cost of producing pork. Corn is the most important input to make animal feed. The expansion of various agro-industrial activities, the increase in human consumption of corn derivatives and the expansion of livestock production will increase the demand for this grain which will not be fulfilled by national production.

Recommendation: In a previous study prepared for the Secretary of the Economy (2016), several proposals were presented, which synthetically consist of: i) expanding productive capacity and productivity in the cultivation of corn; ii) improving productivity in areas close to the largest consumption centres; iii) disseminating the use of best agricultural practices; iv) encouraging the development of an improved seed market, in collaboration with non-governmental organisations such as the International Maize and Wheat Improvement Center (CIMMYT).

Proposal 8.

Situation: The conditions in which sharecropping contracts are established are important to guarantee the success of investment projects and ensure the recovery of credits. FIRA has experience and has had an impact on the definition of contractual terms related to the credits that financial institutions grant by creating trust funds. FIRA programmes are a way to stimulate investment and have minimised the risks of opportunistic behaviour by processing companies.

Recommendation: Deeper analysis should be undertaken of the successful experiences of productive collaboration, in order to identify the aspects that minimise the risks of uncertainty in demand of products. These conditions should also be applied in other productive support programmes.

Proposal 9.

Situation: The regulation of the industry, including its structural aspects, is carried out through administrative agreements, issued by the sectoral authority. Elements such as the location of the farms, are not included in formal regulations. Participants in the market have commented that the federal environmental authorities participate in such regulation, although they only apply environmental criteria. Several interviewees stated that collaboration with environmental authorities is very poor.

The agreements can be modified unilaterally. They are not subject to mechanisms of analysis and public consultation. There is also no guarantee that they will be subject to international best practices. They have led to the suppression of official standards because they have fewer legal possibilities of applying the law and sanctions.

As noted, there is no mandatory certification of good livestock practices.

There is a growing international demand for certified products. Mexico is facing an opportunity, because it is one of a few countries that are free of the main diseases that affect pigs. Several producers have reacted, voluntarily adopting various certifications that allow their products to be accepted in countries such as Japan and South Korea.

The country could take advantage of international requirements if compliance with certification was demanded or at least promoted by Mexican authorities. Some elements that may become important in the next few years are related to animal welfare, waste disposal and compliance with environmental regulations. If Mexico wants to take advantage of its health position, it should foresee that in the future certain markets may demand greater attention to certification.

Recommendation: The country must opt for the use of the Mexican Official Standards mechanism, to regulate pork production with the appropriate certification.

Proposal 10.

Situation: As indicated by several interviewees, there is a practice of injecting aqueous solution in some meats. In countries such as the United States, producers must inform consumers through labelling if the product has been "improved" by this procedure. In Mexico there are no regulations on the content of aqueous solution or any consumer information.

Recommendation: Analyse the extent of the practice of injection of aqueous solution into meat. This will determine whether there is a need to create an official standard on the use of solutions and how to inform consumers.

Proposal 11.

Situation: There are no official standards for the classification of carcass. Consumers cannot distinguish between the different characteristics and qualities of the product. One of the statistical results shown in Section 8 is that the relative price of the supreme live pig with respect to carcass meat of the same type is higher than that of the creole live pig. But the prices of creole and supreme type carcasses are practically the same. This means that from the production of carcass, the difference in quality is not reflected in the price. This shows that there are opportunities for product differentiation that can create incentives to investment.

The interviewees pointed out that the United States and Canada are working to obtain a standard on the colour and texture of carcass.

Recommendation: Issue an official standard of pork classification in carcass.

Proposal 12.

Situation: There is a high geographical concentration of pork production in 6 states: Jalisco, Sonora, Puebla, Yucatan, Veracruz and Guanajuato, which represent about 76% of total production. In addition, in some cases, pork production is contiguous with the production of other products, such as chicken or eggs. This represents health risks and pollution. Several interviewees pointed out that although there are some provisions regarding water recycling, there is not enough clarity or the rules to avoid contamination of natural areas and the water table, due to the improper handling of waste. In addition, there is a risk that competitiveness and acceptance of the product in international markets will be limited in the future.

Recommendation: It is necessary to review best international practices, to define the rules applicable to the installation of farms and production density, as well as for the improper handling of waste.

Proposal 13.

Situation: Regarding foreign trade, several interviewees pointed out that there is no clarity on the application of import review and certification mechanisms and that there is a disparity in the treatment of exports.

Recommendation: Review the operation of the import review and certification mechanisms, in order to standardise their content and application with respect to Mexico's main trading partners.

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Annex A. Statistical annex

This section presents the results of the econometric exercises carried out to determine the existence of relative price stationarity between the series of prices of feed inputs for pork (corn and sorghum), the prices of the balanced feed, the prices of live animals and pig in carcass, the prices of some cuts and the implicit import prices.

1. Relative price of inputs

A stationarity analysis was carried out between links in the value chain, in order to verify whether there are constant price relationships, which would be indicative of changes in costs that translate into proportional changes in prices downstream.

The first analysis was between the prices of the main inputs for the production of balanced feed, corn and sorghum. The results are shown in Table A.1 below.

Table A.1. Relative price test, corn/sorghum

January 2000 – April 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-4.0949	-2.8747	0.0012
C and T	-4.7395	-3.4307	0.0008
Model (difference)	t-Statistic	1%	Prob
Constante	-22.4715	-3.4605	0.0000
C and T	-22.4223	-4.0009	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-6.7054	-2.8746	0
C and T	-7.5354	-3.4306	0
Model (difference)	t-Statistic	1%	Prob
Constant	-38.8400	-3.4618	0.0001
C and T	-38.8495	-4.0028	0.0001

2. Relative prices of balanced feed/supplies

The stationarity of relative prices between balanced feed and corn and sorghum, which are inputs for the first, was analysed.

Table A.2. Relative price test, balance feed/corn

January 2000-April 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-2.8679	-2.8747	0.0508
C and T	-2.8659	-3.4307	0.1758
Model (difference)	t-Statistic	1%	Prob
Constant	-20.7389	-3.4605	0.0000
C and T	-20.7010	-4.0009	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.5761	-2.8746	0.007
C and T	-3.5652	-3.4306	0.0352
Model (difference)	t-Statistic	1%	Prob
Constant	-23.6940	-3.4605	0.0000
C and T	-23.8398	-4.0009	0.0000

Table A.3. Relative price test, balance feed/sorghum

January 2000 – April 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-2.9723	-2.8747	0.0392
C and T	-3.0484	-3.430669	0.1217
Model (difference)	t-Statistic	1%	Prob
Constant	-18.5654	-3.4605	0.0000
C and T	-18.5226	-4.0009	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.5670	-2.8746	0.0072
C and T	-3.7369	-3.4306	0.0219
Model (difference)	t-Statistic	1%	Prob
Constant	-18.4520	-3.4605	0.0000
C and T	-18.4106	-4.0009	0.0000

3. Relative price of live pork, creole/supreme varieties.

Price series of live pigs were obtained from the SNIIM of the SE, for creole and supreme varieties. The series refer to simple averages for the set of observations available in each month. The same procedure was used to obtain the information with which the subsequent exercises were carried out. The results of the statistical exercises are in Table A.4 below.

Table A.4. Relative price test, live pork, creole/supreme varieties

January 2000 – April 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-2.9075	-2.8747	0.0461
C and T	-2.9736	-3.430766	0.1421
Model (difference)	t-Statistic	1%	Prob
Constant	-12.6683	-3.4607	0.0000
C and T	-12.6461	-4.0013	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-4.8357	-2.8746	0.0001
C and T	-5.1834	-3.4306	0.0001
Model (difference)	t-Statistic	1%	Prob
Constant	-25.3187	-3.4605	0.0000
C and T	-25.2100	-4.0009	0.0000

4. Relative prices of balanced food/live pig, creole and supreme varieties

Tests were carried out to verify the relative price stationarity between balanced feed, and the creole and supreme varieties of live pig. The results are reported in Table A.5 below.

Table A.5. Relative price test, balance feed/creole live pork

January 2000 – April 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-1.7146	-2.874679	0.4225
C and T	-1.8335	-3.430669	0.6851
Model (difference)	t-Statistic	1%	Prob
Constant	-19.9380	-3.4605	0.0000
C and T	-19.9072	-4.0009	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-2.0523	-2.874617	0.2645
C and T	-2.4353	-3.430572	0.3603
Model (difference)	t-Statistic	1%	Prob
Constant	-19.8278	-3.4605	0.0000
C and T	-19.8878	-4.0009	0.0000

Table A.6. Relative price test, balance feed/supreme live pork

January 2000 – April 2018

Prueba Dickey-Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-2.2707	-2.874617	0.1825
C and T	-2.4250	-3.430572	0.3656
Model (difference)	t-Statistic	1%	Prob
Constant	-16.4998	-3.4605	0.0000
C and T	-16.4795	-4.0009	0.0000
Prueba Phillips-Perron			
Model (level)	t-Statistic	5%	Prob
Constant	-2.2145	-2.874617	0.2018
C and T	-2.3317	-3.430572	0.4146
Model (difference)	t-Statistic	1%	Prob
Constant	-16.4856	-3.4605	0.0000
C and T	-16.4655	-4.0009	0.0000

5. Relative prices of live pig/pig in carcass

The relative price stability of live pig was verified in relation to pig in carcass, for creole and supreme varieties. The following tables show the results.

Table A.7. Relative price test, creole live pig/pig in carcass

January 2000 – April 2018

Dickey–Fuller Augmented test			
Model (level)	t-Statistic	5%	Prob
Constant	-4.2099	-2.8747	0.0008
C and T	-6.1146	-3.4307	0.0000
Model (difference)	t-Statistic	1%	Prob
Constant	-13.3956	-3.4607	0.0000
C and T	-13.3828	-4.0013	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-10.0706	-2.8746	0.0000
C and T	-10.5307	-3.4306	0.0000
Model (difference)	t-Statistic	1%	Prob
Constant	-39.8636	-3.4605	0.0001
C and T	-41.1392	-4.0009	0.0001

Table A.8. Relative price test, supreme live pig/pig in carcass

January 2000 – April 2018

Dickey–Fuller Augmented test			
Model (level)	t-Statistic	5%	Prob
Constant	-1.1959	-2.874741	0.6765
C and T	-3.4002	-3.430669	0.054
Model (difference)	t-Statistic	1%	Prob
Constant	-14.3517	-3.4606	0.0000
C and T	-14.3919	-4.0011	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-1.7118	-2.874617	0.4239
C and T	-3.7267	-3.4306	0.0226
Model (difference)	t-Statistic	1%	Prob
Constant	-20.6991	-3.4605	0.00000
C and T	-20.9511	-4.0009	0.00000

6. Relative prices of pork in carcass, creole and supreme varieties, and cuts

Relative prices between pork in carcass, its creole and supreme varieties, and various cuts were analysed. The cuts were selected (chop, loin and shoulder) considering the availability of information and its relevance in consumption. The results are the following:

Table A.9. Relative price test, pig in carcass, creole/chop varieties

January 2000 – April 2018

Dickey–Fuller Augmented test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.4376	-2.8747	0.0107
C and T	-4.2972	-3.4307	0.0038
Model (difference)	t-Statistic	1%	Prob
Constant	-12.0524	-3.4607	0.0000
C and T	-12.0303	-4.0013	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-4.2262	-2.8746	0.0008
C and T	-5.8088	-3.4306	0.0000
Model (difference)	t-Statistic	1%	Prob
Constant	-31.4354	-3.4605	0.0000
C and T	-32.0283	-4.0009	0.0000

Table A.10. Relative price test, pig in carcass, creole/loin

January 2000 – April 2018

Dickey–Fuller Augmented test			
Model (level)	t-Statistic	5%	Prob
Constant	-4.0827	-2.8747	0.0013
C and T	-4.1966	-3.4307	0.0053
Model (difference)	t-Statistic	1%	Prob
Constant	-20.3382	-3.4605	0.0000
C and T	-20.2906	-4.0009	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-5.5643	-2.8746	0.0000
C and T	-5.7256	-3.4306	0.0000
Model (difference)	t-Statistic	1%	Prob
Constant	-25.2396	-3.4605	0.0000
C and T	-25.1464	-4.0009	0.0000

Table A.11. Relative price test, pig in carcass, creole/shoulder

January 2000 – April 2018

Dickey–Fuller Augmented test			
Model (level)	t-Statistic	5%	Prob
Constant	-5.0842	-2.8747	0.0000
C and T	-5.0475	-3.4307	0.0002
Model (difference)	t-Statistic	1%	Prob
Constant	-20.3677	-3.4605	0.0000
C and T	-20.3351	-4.0009	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-6.0990	-2.8746	0.0000
C and T	-6.1097	-3.4306	0.0000
Model (difference)	t-Statistic	1%	Prob
Constant	-25.9606	-3.4605	0.0000
C and T	-25.8486	-4.0009	0.0000

Table A.12. Relative price test, pig in carcass, supreme/chop

January 2000 – April 2018

Dickey–Fuller Augmented test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.7879	-2.8747	0.0035
C and T	-6.0937	-3.4306	0.0000
Model (difference)	t-Statistic	1%	Prob
Constant	-20.4954	-3.4605	0.0000
C and T	-20.4422	-4.0009	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-4.5785	-2.8746	0.0002
C and T	-6.0459	-3.4306	0.0000
Model (difference)	t-Statistic	1%	Prob
Constant	-31.9556	-3.4605	0.0001
C and T	-31.8940	-4.0009	0.0000

Table A.13. Relative price test, pig in carcass, supreme/loin

January 2000 – April 2018

Dickey–Fuller Augmented test			
Model (level)	t-Statistic	5%	Prob
Constant	-5.4066	-2.8746	0.0000
C and T	-5.4591	-3.4306	0.0000
Model (difference)	t-Statistic	1%	Prob
Constant	-17.8501	-3.4605	0.0000
C and T	-17.8098	-4.0009	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-5.2448	-2.8746	0.0000
C and T	-5.3061	-3.4306	0.0001
Model (difference)	t-Statistic	1%	Prob
Constant	-30.3001	-3.4605	0.0000
C and T	-30.2586	-4.0009	0.0000

Table A.14. Relative price test, pig in carcass, supreme/shoulder

January 2000 – April 2018

Dickey–Fuller Augmented test			
Model (level)	t-Statistic	5%	Prob
Constant	-6.1163	-2.8746	0.0000
C and T	-6.1081	-3.4306	0.0000
Model (difference)	t-Statistic	1%	Prob
Constant	-19.9362	-3.4605	0.0000
C and T	-19.9123	-4.0009	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-6.1605	-2.8746	0.0000
C and T	-6.1442	-3.4306	0.0000
Model (difference)	t-Statistic	1%	Prob
Constant	-25.7224	-3.4605	0.0000
C and T	-26.0486	-4.0009	0.0000

7. Relative prices of cuts and import prices

The relative price stationarity between cuts and two import price indicators was verified. On the one hand, an implicit price of imports was obtained. Moreover, a price index was constructed, that is, the evolution of a specific basket of products was considered.

Table A.15. Relative price test, chop/implicit price of imports

January 2003 – March 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.637	-2.8955	0.0069
C and T	-3.6291	-3.4629	0.0331
Model (difference)	t-Statistic	1%	Prob
Constant	-10.8725	-3.5093	0.0001
C and T	-10.818	-4.0696	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.7719	-2.8955	0.0046
C and T	-3.7612	-3.4629	0.0235
Model (difference)	t-Statistic	1%	Prob
Constant	-10.8725	-3.5093	0.0001
C and T	-10.818	-4.0696	0.0000

Table A.16. Relative price test, chop/import price index

January 2003 – March 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.6093	-2.8955	0.0075
C and T	-3.5946	-3.4629	0.0361
Model (difference)	t-Statistic	1%	Prob
Constant	-10.0895	-3.5093	0.0000
C and T	-10.0337	-4.0696	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.7254	-2.8955	0.0053
C and T	-3.7098	-3.4629	0.0269
Model (difference)	t-Statistic	1%	Prob
Constant	-10.1021	-3.5093	0.0000
C and T	-10.0454	-4.0696	0.0000

Table A.17. Relative price test, steak/implicit price of imports

January 2003 – March 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.6166	-2.8955	0.0073
C and T	-3.7115	-3.4629	0.0268
Model (difference)	t-Statistic	1%	Prob
Constant	-11.1422	-3.5093	0.0001
C and T	-11.0908	-4.0696	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.7407	-2.8955	0.0050
C and T	-3.8362	-3.4629	0.0192
Model (difference)	t-Statistic	1%	Prob
Constant	-11.1614	-3.5093	0.0001
C and T	-11.1087	-4.0696	0.0000

Table A.18. Relative price test, steak/import price index

January 2003 – March 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.5993	-2.8955	0.0077
C and T	-3.6741	-3.4629	0.0295
Model (difference)	t-Statistic	1%	Prob
Constant	-10.3579	-3.5093	0.0000
C and T	-10.3037	-4.0696	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.7362	-2.8955	0.0051
C and T	-3.8127	-3.4629	0.0205
Model (difference)	t-Statistic	1%	Prob
Constant	-10.3678	-3.5093	0.0000
C and T	-10.3128	-4.0696	0.0000

Table A.19. Relative price test, leg/implicit price of imports

January 2003 – March 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.8298	-2.8955	0.0038
C and T	-3.912	-3.4629	0.0156
Model (difference)	t-Statistic	1%	Prob
Constant	-11.1879	-3.5093	0.0001
C and T	-11.1307	-4.0696	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.9288	-2.8955	0.0028
C and T	-4.0134	-3.4629	0.0117
Model (difference)	t-Statistic	1%	Prob
Constant	-11.2277	-3.5093	0.0001
C and T	-11.1693	-4.0696	0.0000

Table A.20. Relative price test, leg/import price index

January 2003 – March 2018

Dickey–Fuller Augmented Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.7805	-2.8955	0.0045
C and T	-3.8409	-3.4629	0.019
Model (difference)	t-Statistic	1%	Prob
Constant	-10.3293	-3.5093	0.0000
C and T	-10.2716	-4.0696	0.0000
Phillips-Perron Test			
Model (level)	t-Statistic	5%	Prob
Constant	-3.873	-2.8955	0.0033
C and T	-3.9362	-3.4629	0.0146
Model (difference)	t-Statistic	1%	Prob
Constant	-10.5261	-3.5093	0.0000
C and T	-10.4612	-4.0696	0.0000

8. Difference of means test

Table A.21 shows the descriptive statistics by region and the results of the statistical test. The exercise was carried out considering prices of chop cut, from January 2011 to April 2018, obtained from INEGI.

Table A.21. Results of differences of means test

Region 1	Variable	Data	Media	Std. Dev.	Std. Dev. Error
	CHIH_	88	60.30318	3.083696	0.328723
	SIN_	88	61.43443	4.563004	0.486418
	All	176	60.86881	3.924309	0.295806
	Method		**df**	**Value**	**Probability**
	Welch F-test*		152.753	3.712998	0.0558

Region 2	Variable	Data	Media	Std. Dev.	Std. Dev. Error
	COAH_	88	61.62534	3.360275	0.358207
	N_L_	88	62.38443	3.395178	0.361927
	All	176	62.00489	3.389546	0.255497
	Method		**df**	**Value**	**Probability**
	Welch F-test*		173.981	2.222182	0.1379

Region 3	Variable	Data	Media	Std. Dev.	Std. Dev. Error
	DGO_	88	64.88693	3.032995	0.323318
	ZAC_	88	64.1525	5.586014	0.595471
	AGS_	88	64.65148	3.629658	0.386923
	All	264	64.56364	4.221056	0.259788
	Method		**df**	**Value**	**Probability**
	Welch F-test*		166.146	0.595131	0.5527

Region 4	Variable	Data	Media	Std. Dev.	Std. Dev. Error
	GTO_	88	71.1592	5.042019	0.537481
	QRO_	88	72.475	4.353486	0.464083
	All	176	71.8171	4.742986	0.357516
	Method		**df**	**Value**	**Probability**
	Welch F-test*		170.379	3.433389	0.0656

Region 5	Variable	Data	Media	Std. Dev.	Std. Dev. Error
	EDO_MEX	88	67.86852	3.549322	0.378359
	CD_MX	88	68.41727	3.625038	0.38643
	TLAX_	88	69.18852	5.984457	0.637945
	All	264	68.49144	4.544851	0.279716
	Method		**df**	**Value**	**Probability**
	Welch F-test*		167.79	1.659567	0.1933

Region 6	Variable	Data	Media	Std. Dev.	Std. Dev. Error
	CHIS_	88	65.2333	3.12522	0.33315
	TAB_	88	65.64295	4.042863	0.430971
	VER_	88	65.79818	3.938915	0.41989
	PUE_	88	66.34091	3.502404	0.373358
	MOR_	88	65.79966	6.073297	0.647416
	All	440	65.763	4.256393	0.202916
	Method		**Df**	**Value**	**Probability**
	Welch F-test*		215.66	1.233303	0.2977

Region 7	Variable	Data	Media	Std. Dev.	Std. Dev. Error
	YUC_	88	63.34409	3.794255	0.404469
	CAMP_	88	63.28966	3.709258	0.395408
	All	176	63.31688	3.741361	0.282016
	Method		**df**	**Value**	**Probability**
	Welch F-test*		173.911	0.00926	0.9234

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