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Factors explaining price decrease of chicken meat in Mexico

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ABSTRACT

Objective: to determine the main factors that explain the decrease in the real price of chicken meat for the producers in Mexico during the period 1994-2021.

Design/ Methodology/Approach: an inverse supply function was used to determine the percentage change in the price of chicken meat when the factors that determine this variable vary.

Results: it was proved that technological change was the main variable explaining the decrease in the price of this white meat. Other factors, such as decrease in the price of competitive products and the inputs used as feed for broilers, also favored price drop.

Study limitations/ Implications: a limitation of the study is that only Mexico's domestic data were used.

Findings/Conclusions: a drop in the price of chicken meat to the producer in Mexico is explained by the behavior of the factors that determine chicken meat supply in the period analyzed. Such factors were technological development, as well as the decrease in the prices of the inputs used in production, and other competitive goods, which explain price drop to the producer.

Keywords: chicken meat, price to the producer, technological change, inverse supply function, flexibility.

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INTRODUCTION

The decrease in the price of chicken meat in Mexico in recent decades has contributed to one of the main objectives of domestic economy policy, this is to keep the inflation rate in single digits. According to Mexico's Agrifood and Fisheries Information Service (SIAP, 2022), chicken, beef, pork and eggs had a 5% share in the National Consumer Price Index in November 2022; which allow us to assume that the 26.3% decrease in the real price to the producer of chicken meat that was experienced from 1994 to 2021 has caused also a decrease in the real price of this meat to the consumer, thus reducing inflationary pressure on the Mexican economy and increasing the overall purchasing power of Mexicans.

The decrease in the price of chicken meat brought benefits for consumers of this meat, the first of which was a consumption increase. The Organization for Economic Cooperation and Development (OCDE, 2018) states that in the last 40 years there has

been an increase in the production and consumption of several types of meat, chicken meat industry has been the most successful in this expansion. This agency adds that the price of this meat is lower than that of other types of meat, so the evolution of the price of chicken meat has been lower than the evolution experienced in the National Consumer Price Index. If the prices of January 1990 are taken as reference, overall prices increased 1083% up to January 2016; whereas chicken unit price increased by 662%.

Due to the decrease in price, the amount of chicken meat consumed in Mexico experienced growth in the same period, from 1.25 million tons (Megagrams, Mg) in 1994 to 4.48 million Mg in 2021; this means a growth of 258.5% in the period of analysis, with a 4.8% average annual growth. The consumption of chicken meat was supplied with national production and imports. From 1994 to 2021, the amount of chicken meat produced in Mexico increased 2.54 million Mg, from 1.1 to 3.7 million Mg produced in the cited period (SIAP, 2024), this means a 225.8% growth rate and a 4.31% average annual growth.

The growth of chicken meat in recent years seems to indicate that the decrease in the price of chicken meat is due to a growth in the supply of this industry, which would mean a shift of the supply curve to the right, according to economic theory. Tomek & Kaiser (2014) indicated that the supply of a good is a function of the price of the good, the price of goods that compete for resources (competitive goods), the price of goods related to the product under analysis, and technological development, among others. Therefore, in the period 1994-2021 there are factors that increased the supply of chicken meat and explain price drop of this meat.

To address the high consumption of chicken meat in Mexico, the objective of this research was to determine the factors that explain the decrease in the real price of this meat to the producer. In particular, considering the quantity of chicken meat produced, the real price of balanced feed for broilers, the real price of pork meat to the producer, and technological development. The main hypothesis considers that the real price of chicken meat to the producer will be determined mainly, by technological development and by the real price of the balanced feed used for chicken meat production.

MATERIALS AND METHODS

If we observe that consumption has increased, then demand is excluded as a factor explaining price drop of chicken meat. Therefore, the decrease is due to the shift in the supply curve, caused by the behavior of factors that affect supply, such as technological change and the price of inputs used in feeding chicken. The model to determine those factors that explain price drop in chicken meat is an inverse supply function that allows determining the percentage of change in the price of chicken meat when the factors that determine this variable vary.

To obtain the model, the following supply function is used:

$$QPCP_t = f\left(PPCP_t, PPCC_t, PRAB_{t-1}, CA_t\right) \quad (1)$$

where $QPCP_t$ is the quantity of carcass chicken produced in a year t in Mg; $PPCP_t$ is the real producer price of carcass chicken in year t in Mexican pesos (MXN $) per Mg; *PPCCt*

is the real price to the producer of carcass pork in year t in MXN \$ Mg^{-1}; $PRAB_{t-1}$ is the real price of broilers feed in year $t-1$, in MXN \$ Mg^{-1}; and CA_t is the feed conversion in year t, in g of carcass chicken per kg of balanced feed.

The model was formulated based on microeconomic theory, which stipulates that changes in the quantity supplied of a product will be determined by A) observed changes in its price; B) price of inputs; C) price of goods that compete with the targeted factors of production; and D) technological development, which determines the efficiency of production, therefore, its production costs (Tomek & Kaiser, 2014).

Then you get the *QPCP* differential:

$$dQPCP = \frac{\partial QPCP}{\partial PPCP} dPPCP + \frac{\partial QPCP}{\partial PPCC} dPPCC + \frac{\partial QPCP}{\partial PRAB} dPRAB + \frac{\partial QPCP}{\partial CA} dCA \quad (2)$$

and divide both members of the supply function by *QPCP* and multiply the four independent variables of this function by *PPCP*/*PPCP*, *PPCC*/*PPCC*, *PRAB*/PRAB and *CA*/*CA*. So, the resulting equation,

$$\frac{dQPCP}{QPCP} = \frac{\partial QPCP}{\partial PPCP}\frac{PPCP}{QPCP}\frac{dPPCP}{PPCP} + \frac{\partial QPCP}{\partial PPCC}\frac{PPCC}{QPCP}\frac{dPPCC}{PPCC} + \frac{\partial QPCP}{\partial PRAB}\frac{PRAB}{QPCP}\frac{dPRAB}{PRAB} + \frac{\partial QPCP}{\partial CA}\frac{CA}{QPCP}\frac{dCA}{CA} \quad (3)$$

can be expressed in percentage terms (—) as follows:

$$\overline{QPCP} = \varepsilon_1 \overline{PPCP} + \varepsilon_2 \overline{PPCC} + \varepsilon_3 \overline{PRAB} + \varepsilon_4 \overline{CA} \quad (4)$$

where (—) indicates percentage change of the variables of the model; ε_1 is the proper price elasticity of supply; ε_2 is the cross-price elasticity of supply; ε_3 is the elasticity that relates the quantity of chicken meat produced to the price of the balanced feed; and ε_4 is the elasticity that relates the supply of chicken meat and feed conversion and where $\varepsilon_1, \varepsilon_4 > 0$; y ε_2 y $\varepsilon_3 < 0$.

The inverse supply function can be obtained by expressing the price as a function of the quantity supplied; this is:

$$\overline{PPCP} = +\frac{1}{\varepsilon_1}\overline{QPCP} - \frac{\varepsilon_2}{\varepsilon_1}\overline{PPCC} - \frac{\varepsilon_3}{\varepsilon_1}\overline{PRAB} - \frac{\varepsilon_4}{\varepsilon_1}\overline{CA} \quad (5)$$

Since,

$$\frac{\varepsilon_2}{\varepsilon_1} = \frac{\dfrac{\partial QPCP}{\partial PPCC}\dfrac{PPCC}{QPCP}}{\dfrac{\partial QPCP}{\partial PPCP}\dfrac{PPCP}{QPCP}} = \frac{\partial PPCP}{\partial PPCC}\frac{PPCC}{PPCP} = \gamma_2 \quad (6)$$

and it is considered for the other independent variables that relations similar to the one expressed by equation 6 can be obtained; Then, equation 5 can be expressed as follows:

$$\overline{PPCP} = +\gamma_1 \overline{QPCP} + \gamma_2 \overline{PPCC} + \gamma_3 \overline{PRAB} - \gamma_4 \overline{CA} \quad (7)$$

where $\gamma_1, \gamma_2, \gamma_3$ and γ_4 measure the percentage change in *PPCP* when it varies by 1% *QPCP*, *PPCC*, *PRAB* and *CA*, respectively; and with the consideration of the sign of the elasticities, then γ_1 and $\gamma_4 > 0$ and γ_2 and $\gamma_3 < 0$.

Therefore, PPCP is expected to react directly to changes in PPCC, PRAB and QPCP; and conversely with CA. This indicates that a decrease in QPCP, PPCC and PRAB would drive the same effect as a shift of the supply curve to the right causing a decrease in the price, and an increase in CA would have the same effect.

The information used in the model was obtained from the sources mentioned below. Supply-related elasticities of chicken meat came from Nochebuena-Molina *et al.* (2023). The growth rates shown in the model equation 7 were calculated using information in the periods 1994-1996 and 2019-2021. From SIAP (2024) the quantity of carcass chicken produced; the producer price of a Mg of chicken meat; the producer price of one Mg of pork; and the producer prices of corn and soybeans were obtained. The values in real terms were obtained by dividing the independent variable by the 2018 value of the National Consumer Price Index, as it was reported by INEGI (2024).

The actual price of broiler feed (PRAB) was obtained as follows: A) the amount of corn and soybeans used in the production of feed constitutes 92.4% of a Mg of balanced feed; B) if the share of both inputs is established as 100%, it is obtained that corn constitutes 50.8% of the balanced feed and soybeans have a participation of 49.2%; C) a weighted average of the real producer prices of corn (PM_t) and soybeans (PS_t) was calculated to obtain the price of the balanced feed, that is,

$$PRAB = \left(PM_t * 0.508\right) + \left(PS_t * 0.492\right)$$

The time series referring to feed conversion (CA), the variable used here to represent technological development, was calculated as follows. A) The initial value for 1985 reported by Rigolin (2014) was used, this is 2.5 kg of balanced feed were necessary to obtain one kg of chicken meat in carcass; B) the final value reported by the National Union of Poultry Farmers (UNA, 2022) for 2021 was taken, where 1.75 kg of balanced feed were necessary to obtain one kg of chicken meat in carcass; C) the decision to use the indicator reported by the UNA (2022) as the final value was done because the

indicator reported previously by Rigolin (2014) is updated every 10 years. D) for the years between 1994 and 2021, the amount of balanced feed needed to obtain one kg of chicken meat was estimated with the equation 8; E) if this rate is applied to the value reported for 1985, the estimated value for 1986 is obtained, repeating the process until the value reported by the UNA in 2022 is obtained; and finally F) in order to observe whether technological development in the chicken meat industry has contributed to obtain more meat from one kg of balanced feed, the inverse of what was previously obtained was calculated, thus finding the amount of chicken meat in kg that is obtained from one kg of balanced feed.

The formula to obtain the growth rates of the independent variables in the model was as follows:

$$r = \left(\left(\frac{VF}{VI} \right)^{1/(n-1)} - 1 \right) * 100 \quad (8)$$

where r is the growth rate, VF is the final value, VI is the initial value, and n is the number of years in the time series.

RESULTS AND DISCUSSION

Table 1 presents the results of the model. Supply price flexibility measures the percentage change in the price to the producer when a 1% change occurs in the quantity supplied, *ceteris paribus*. This interpretation is similar for each independent variable used in the model. The estimated flexibilities are also shown in Table 1. It can be observed that the flexibility relating the price and supply of chicken meat was 5.26; this indicates that in the event of a 1% increase in the quantity offered, the price of chicken meat will increase by 5.26%; a response more than proportional to the unit increase in the quantity offered. In the period under analysis, chicken meat supply experienced a growth of 107.9%, which explains the partial growth of the price by 568.1%.

Table 1. Factors that explain the change in the price of chicken meat in Mexico.

Variable	Supply function QPCP=f(PPCP)			Inverse supply function PPCP=f(QPCP)		
	Elasticity	Change in independient variable	Partial change in QPCP	Flexibility	Change in independient variable	Partial change in PPCP
PPCP	0.19	−13.1	−2.5	-	-	-
PPCC	−0.48	−8.0	3.8	2.53	−8.0	−20.2
PRAB	−0.21	−8.3	1.7	1.11	−8.3	−9.1
CA	3.79	27.7	104.9	−19.95	27.7	−551.9
QPCP	-	-	-	5.26	107.9	568.1
Total change in PPCP	-	-	-	-	-	−13.1
Total change in QPCP	-	-	107.9	-	-	-

As a competitive product, the flexibility that relates the producer price of chicken meat with the producer price of pork was 2.53; This means a 1% increase in the real price to the producer of pork will cause an increase of 2.53% in the real price of chicken meat to the producer. Regarding the price of goods that compete for the use of resources and according to information from SIAP (2024) and INEGI (2024), the real producer price of pork in Mexico decreased by MXN $5359.25 Mg^{-1} between 1994 and 2021, with a growth rate of -11.85% and an average annual decrease of -0.47%. This would imply, according to economic theory, that at similar conditions of both supply and demand, chicken meat production is more competitive than that of pork meat, since the decrease experienced in the chicken meat industry was greater than that experienced in the pork industry.

The flexibility corresponding to the real price of balanced feed was 1.11, which caused a positive response in the price of chicken meat. This is, facing a 1% increase in the price of balanced broilers feed, the price of chicken meat will increase by 1.11%; That is a more than proportional response to the increase in the price of balanced feed. In relation to the price of feeds used for livestock feed such as corn and soybeans, the Organization for Economic Cooperation and Development-OECD (OCDE, 2018) stated that balanced feed for broilers is a mixture of corn (which provides energy), soybeans (which provides protein), oils, fats, supplements and vitamins. Nochebuena-Molina *et al.* (2023) indicated that one Megagram of balanced feed for broilers contains 469 kg of corn and 459.91 kg of soybeans (jointly supplying 92.4% of total inputs).

As a technological variable, feed conversion presented a flexibility of −19.95, which means that, in the event of a 1% increase in this indicator, the price of chicken meat will decrease by 19.95%. This inverse effect of the technological variable (feed conversion) on the price of chicken meat is the most determining to the price of chicken meat in Mexico. Innovation by market participants can provide a number of desirable outcomes, such as increased production efficiency that can lead to decreased costs, improvements in product quality, a greater variety of products, and improvements in product safety (OECD, 2016).

In regard to technological change, Barbut (2015) stated that the decrease in chicken meat prices has its origin in improvements on genetics, health, breeding and processing. The selection of more efficient breeds in terms of meat production has resulted in better feed efficiency (*i.e.* the amount of balanced feed needed to obtain one kg of meat). In 1925 this index was 4.7, whereas in 2010 it was 1.92; which means that using balance feed promoted a more efficient use of resources, decreasing production costs in the chicken meat industry, so making it more competitive.

The value of the flexibilities and the growth rate of the independent variables allow us to analyze what has been the factor that explains the decrease observed in the price, which during the period of analysis was −13.1%. The independent variables QPCP, PPCC, PRAB and CA showed a growth of 107.9, −8.0, −8.27 and 27.7% in the period 1994/96-2019/21. The decrease in the producer price of pork made the production of this meat less profitable and the resources were then channeled to chicken meat. In such a way that the fall in PPCC caused a 3.8% growth in chicken meat production, causing

a price drop of −20.2% in the price of chicken meat to the producer, that made it more competitive.

The decrease in the PRAB caused the production costs of chicken meat to decrease, which stimulated its production by 1.7% and a −9.1% drop in the price of chicken meat. Finally, the increase in CA caused a better use of balanced feed, thus reducing production costs in the chicken meat industry, which stimulated its production by 104.9%. Such an increase in supply caused a −551.9% decrease in the price of chicken meat. These data indicate that the behavior of the variables PPCC, PRAB and CA determined price drop of chicken meat, and that the most determining variable in the behavior of this price was feed conversion. To what was mentioned above, Barbut (2015) added that those improvements in breeding and processing, in combination with innovation in the primary processing sector of chicken industry, and in the agricultural sector have led to an overall decrease in the price consumers pay for a unit of chicken meat.

In the absence of studies that analyze the effect of technological development on the prices of agricultural products and, especially, on the chicken meat market, the results are compared with what is stipulated by economic theory. As Tomek and Kaiser (2014) stated, in a given market, constant technological development causes the supply function to shift to the right, and if the supply of the analyzed good increases faster than demand, then the price of the product will decrease. If this occurs over time, the trend in the prices of a given product will be downward. Salvatore (2009) established that, if a production process presents a technological improvement that reduces production costs, the supply curve will shift downwards; this is, towards an increase in supply and a decrease in the price of the product.

In 2022, the OECD joined with the Food and Agriculture Organization of the United Nations (FAO), indicated that it is expected an increase between 12 and 13% in chicken meat production in Mexico from 2022 to 2031. This increment would be promoted by a rising demand and a favorable meat-forage price ratio compared to other meats, in response to technological development in animal health, feeding practices and genetics. Regarding the consumption of this type of meat in the country, OECD-FAO expect the above mentioned increase, due to the tendency to consume more white meat because of ease in preparation and a perception of being a better food option. In turn, these perceptions are coupled with the fact that the prices of chicken meat are lower than those of other types of meat. Regarding prices, OECD-FAO stated that the world reference price of chicken meat, after experiencing an increase in 2021, shall resume a downward trend, and it will continue so in real terms until 2031.

Regarding technological change, OECD-FAO (OCDE-FAO, 2022) projected an improvement in the forage to meat conversion rate in those countries that have this rate set at 1.75 (similar to that of Mexico), where this rate is expected to decrease by 0.05% per year until 2031. The United States Department of Agriculture (USDA, 2022) projected that global chicken meat consumption will increase by 16.7% from 2023 to 2031, driven by an increase in the population of developing countries and an increase in population income. This Agency expects Mexico's poultry production to grow during the 2023-2031

period at a slower rate than consumption, which would cause an increase in chicken meat imports in order to meet demand. As for prices, the Agency established that the nominal prices of chicken meat products will show an upward trend until 2031; but, it will depend on inflation if real prices increase or decrease.

Derived from the above, it is proposed that those Mexican policies that stimulate the development and acquisition of chicken breeds with a higher feed conversion rate would be the best instruments to face the challenge of the constant increase in demand for chicken meat.

CONCLUSIONS

The increase in the supply of chicken meat was greater than the increase in demand during the period 1994 to 2021 because of technological development. The inverse effect of the technological variable caused the decrease in the price of chicken meat to the producer. Due to this decrease in the real price of chicken meat to the producer, the activity remained profitable, because of the observed decrease in the total cost of production. The behavior of the factors that explain the supply of chicken meat in the period analyzed were determinants to price drop.

The decrease in the prices of the competitive good evaluated and the inputs used as feed for broilers, as well as the technological change (an improved feed conversion rate) explained the drop in the price of chicken meat to the producer. Those positive effects of free trade could be nullified in the near future if global economics would determine an increase in the price of inputs used for feeding broilers, or a change in the price of goods that compete with the chicken industry. If that were the case, the price of chicken meat would eventually be increased.

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