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THE PRICE ELASTICITY OF THE DEMAND AND REVENUE INCREASE FOR SOME FISHERY PRODUCTS

LA ELASTICIDAD PRECIO DE LA DEMANDA Y EL CAMBIO ANUAL EN EL INGRESO PARA ALGUNOS PRODUCTOS PESQUEROS

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ABSTRACT

The price elasticity of demand (PED) measures the variation of the quantity demanded due to a price variation. A concept closely related to PED is the Revenue Increase (RI) that measure weather the demand is elastic or inelastic. The main goal of this paper was to estimate PED and its impacts on the income and demand of six fishery products from Mexico, such as Salmon, Tuna, Sardine, Shrimp and Prawn, Trout and Tilapia. The data were obtained from the Foreign Agriculture Service of United States Department of Agriculture (1,998-2,018 Period) through the tables provided and published on the Internet (secondary data). In this paper, the arc method was applied to calculate both PED and RI of the selected fishery products. All of these products showed an elastic demand price in almost all years of the period under study; while the RI presented no defined trend. There was a significant positive correlation between export reference price of demand and income for Tuna and significant negative for Trout and Sardine. There was a significant negative correlation between exported volume and export reference price for Shrimp and Prawn, Trout and Sardine and significant positive for Tuna. For Salmon and Tilapia, the associations were not significant. It was observed no clear effects of the PED on income; aspect that violates the PED theory.

Key words: Economics; elasticity; price of demand; sea products; revenue increase

RESUMEN

La elasticidad precio de la demanda (PED en inglés) mide la variación de la cantidad demandada debido a la variación en el precio. Un concepto íntimamente relacionado al PED es el Aumento de los Ingresos (RI en inglés). El objetivo de este trabajo fue estimar la PED y su impacto en los ingresos y la demanda de seis productos pesqueros de México, como Salmón, Atún, Sardina, Camarones y Gambas, Trucha y, Tilapia. Los datos se obtuvieron del Servicio de Agricultura Exterior del Departamento de Agricultura de Estados Unidos (período 1.998-2.018) a través de las tablas proporcionadas y publicadas en Internet (datos secundarios). En este trabajo se aplicó el método de arco para calcular el PED y el RI de los productos seleccionados. Estos seis productos mostraron un precio de demanda relativamente elástico en la mayoría de los años, mientras que el RI mostró una tendencia no definida. Se encontró una correlación positivamente significativa entre el precio de referencia de exportación de la demanda y el ingreso para el Atún, y negativo significativo para la Trucha y la Sardina. Se determinó también una correlación negativamente significativa entre el volumen exportado y el precio de referencia de exportación para Camarones y Gambas, Truchas y Sardinas, y positivo significativo para Atún. Para Salmón y Tilapia, las asociaciones no fueron significativas. No se observaron efectos claros de la PED en los ingresos, aspecto que viola la teoría PED.

Palabras clave: Economía; elasticidad; precio de la demanda; productos del mar; incremento de ingresos

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INTRODUCTION

Mexico is currently the third largest merchandise trading partner of United States of America (USA) with $ 611.5 billions (b) in bidirectional trade in goods during 2,018. Exports of goods totaled $ 265.0 b; imports of goods amounted to $ 346.5 b. The USA trade deficit with Mexico was $ 81.5 b in 2,018. Trade in services with Mexico (exports and imports) amounted to an estimated $ 59.4 b in 2,018. Service exports were $ 34.1 b; imports of services were $ 25.3 b. The USA trade services surplus with Mexico was $ 8.8 b in 2,018. Mexico was the second largest supplier of imports of goods from the USA in 2,018.

The top import categories in 2,018 was found: vehicles ($ 93 b), electrical machinery ($ 64 b), machinery ($ 63 b), mineral fuels ($ 16 b), and optical and medical instruments ($ 15 b). Total USA imports of agricultural products from Mexico amounted to $ 26 b in 2,018, the largest supplier of agricultural imports of USA. Main categories include: fresh vegetables ($ 5.9 b), other fresh fruits ($ 5.8 b), wine and beer ($ 3.6 b), snack products ($ 2.2 b), and fruits and processed vegetables ($ 1.7 b). US imports of services from Mexico were an estimated $ 25.3 b in 2,018, 0.6% ($ 164 million (m)) less than 2,017, but 59.3% higher than the levels reported in 2,008.

The law of demand [8] establishes that the existing relationship for a good and the quantity demanded is inverse, so the demand curve is descending (or with a negative slope) and the variables that have the most influence on demand are: the price of the own good, personal income, prices of related goods (substitutes or complementary), tastes and preferences, season, among others. In this sense, the elasticity of a price is usually expressed as a negative number, which represents a positive percentage value. It is from here that elasticity can be understood or defined as the percentage variation of one variable x in relation to another variable y. If the percentage variation of the dependent variable y is greater than the independent variable x, the relationship is said to be elastic, since the dependent variable y varies in greater quantity than that of the variable x.

In contrast, if the percentage variation of the variable x is greater than that of y, the relationship is inelastic. The inelasticity or elasticity of one variable in relation to another reflects, that if it is inelastic, the change in percentage terms made by the independent variable on the dependent is small, however if it is elastic, the percentage variation of the independent variable on the dependent it is notorious. Mathematically, elasticity can be expressed as the proportional change from one variable to another variable. The concept of elasticity can be used as long as there is a cause and effect relationship. In this way, the elasticity of the demand price is the proportional variation of the quantity demanded before a proportional variation of the price [4].

Mexico is the 4th most important fishing Country in America and occupies the 17th place in world fisheries production. Thanks to Mexico having privileged climatic and territorial conditions, a wide variety of crustacean, mollusk and fish can be found. The most representative species for the amount of income they generate in Mexico are: Tuna (*Thunnus* spp.), Mojarra (*Mayaheros urophthalmus*) and Shrimp (*Farfantepenaeus* spp.). Tuna and Shrimp fishing occur in almost all States that have a sea coast. The Mojarra is fished in practically all the national territory because it can be grown in estuaries and in freshwater ponds. Other important fishery products are Sardine (*Sardinops* spp.), Octopus (*Octopus vulgaris*), Lobster (*Panulirus interruptus*), Yellowfin Tuna (*T. albacares*), Bass (*Morone* spp.), Red Snapper (*Lutjanus* spp,) and Oyster (*Crassostrea* spp.), in addition to forty other species with lower production. Fishing in rivers, lakes, lagoons, dams and estuaries is smaller but of great value to some regions of Mexico for their food and economic contribution. In these internal bodies of water, fish or other aquatic organisms such as Trout (*Oncorhynchus* spp.), Bass, Catfish (*Ariopsis* spp.), Shrimp and Prawns (*Litopenaeus* spp.) are usually planted, which are produced through aquaculture [6].

In relation to the aquaculture production in Mexico, it generated a total of 404 thousand Tons (T) of fish and shellfish grown in coastal marine areas, inland waters and ponds in the national territory during 2,017, with a value of 17,813 million of Mexican pesos (Mp), which allowed to reactivate and boost the economy in rural communities of the national territory. Due to its impact on marginalized areas and in many rural communities in Mexico, aquaculture has been a determining factor in overcoming poverty, which is demonstrable by the high impacts and achievements that have been obtained. In addition, it was noted that in 2,013, aquaculture production was 246 thousand T worth seven thousand 568 Mp; However, with the impulse of incentives for the development of this activity and the efforts of thousands of producers throughout the Country, production increased 158 thousand T. Currently, the main aquaculture species in Mexico are Shrimp (150 thousand 76 T); Tilapia Mojarra (149 thousand 54 T); Oyster (45 thousand 148 T), Carp (30 thousand 300 T) and Trout (seven thousand T) [2].

The prupose of this research was to estimate the price elasticity of the demand of fishery products, and to determine the impact on this increase in the income of several fishery goods from Mexico such as Salmon, Tuna, Sardine, shrimp, Prawn, Trout, and Tilapia.

MATERIALS AND METHODS

It was selected six of the major export issues in the fishery exportation industry between USA and Mexico: Salmon, Tuna, Sardine, shrimp, Prawn, Trout, and Tilapia. In order to characterize this market, it was proposed to calculate the price elasticity of the demand (PED) and revenue increase (RI) of Salmon, Tuna, Sardine, Shrimp and Prawn, Trout and Tilapia. For this, it was necessary to obtain the data of exports in dollars and volume in metric Tons (MT) of these six fishery products. These data were

gathered from Foreign Agriculture Service (FAS) data Tables for 1,998-2,018 period [3] published on Internet (scondary data). Using this information, the elasticity matrix was created, which is what will be applied in the study. This elasticity matrix is made based on the reference export price in dollars for each MT and the volume exported in MT.

It is indicated that exports expressed in m of dollars will be considered as the general average price by which these fishery products were attained (since the price at which the fishery goods of export are sold and achieved, it is used to analyse in quantitative terms how the market of a certain good adapts or adjusts to variations in the price of the same accounted for in m of dollars, besides that these prices vary according to a change in the real exchange rate) and the record of T of export will be equal to the average annual amount demanded of these fishery products. Based on this, the estimations were determined according to the formula of the price elasticity of the demand of a good. The price elasticity of demand can be estimated using the Arc Method as follows [1, 9]

$$E_d = \frac{\Delta\%Q}{\Delta\%P} \qquad (1)$$

$$??_{??} = \frac{\frac{\Delta Q}{??1}}{\frac{\Delta P}{??1}} = \frac{??1}{??1} \times \frac{\Delta Q}{\Delta P} = \frac{??1}{??1} \times \frac{??2 - ??1}{??2 - ??1} \qquad (2)$$

I

where: P_1 = Initial price, P_2 = Final price, Q_1= Initial quantity and Q_2 = Final quantity

It must be pointed out that for the use of these formulae it was needed to know the amounts demanded at different prices, with all the other factors at constant consumers [7]. Total income (TI) can be defined as the unit price multiplied by the amount demanded, since this is the amount of income received by any seller in a product, who charges a unit price equal to P, multiplied by the total of units sold, Q. (TI = *P* × *Q*). The revenue increase (RI) can be calculated in both initial and final state, utilizing the equation of the total income formula as follow [10]

$$RI = \frac{??2 \times Q2 ??100}{??1??Q1} - 100 \qquad (3)$$

where: P_2, P_1 Q_2 and Q_1 as above.

The data of exports and volume of the six fishery products were introduced in the Excel software for processing and analysing and to estimate the price elasticity of the demand and revenue increase. Pearson's correlation coefficients were calculated between export reference price and total income and exported volume utilizing years (yr) as the common variable. They were calculated for all six Mexican fishery products when demand was elastic and inelastic. The significance of Pearson´s correlation coefficients was determined at 0.01 or 0.05 level of probability using the Statistical Package for Social Science (SPSS) version 25.0 [5].

RESULTS AND DISCUSSION

In this Section it was showed the principal results, and presented the discussion in the frame of the arc method used to calculate the PED and RI values, for all six fishery products exported to USA from Mexico during the period from 1,998 to 2,018. To guide the discussion, the results were presented separately, as follows.

Salmon:

The price elasticity of demand of Salmon oscillated from 0.63 (yr 2,007) and 22.29 (yr 2,009), the demand shows almost an elastic behaviour in 13 yr (PED>1), with an inelastic behaviour only in 1 yr (PED < 1). Also, the PED=1 in 4 yr, as shown in

As can be seen from TABLE I, the value of the revenue increase was negative in 10 yr and positive in other 10 yr. The highest RI was observed in 2,008 (1,175.57%) with the lowest values in 2,011 and 2,014 (-100.00%). The highest exported quantity was reached in 1,999 (419.0 MT) and the lowest in quantity in 2,007 (0.8 MT). With respect to the export referential price, it can be said that reaches the highest value in the 2,018 (17,916.2 US dollar, US$/MT) and the lowest in 1,999 (2,545.1 US$/MT). The reference price showed no clear trend. It was also noted that there were no exportations in 2,011 and during the period from 2,014 to 2,016 but continued in 2,017 and 2,018. In 2,018, Salmon products showed an elastic demand of 1.22, with a variation of 1% with respect to the export reference price. This fact has affected the demand in Salmon volume in just 1.22%.

Shrimp and Prawn: The results for this item were shown in TABLE II. Shrimp and Prawn has presented a changing demand, since varied from 0.37 in 2,001 to 10.37 in 2,011. There were 14 elastic demands and six inelastic demands. This indicates that the PED was elastics. With respect to the revenue increase, it was negative in 9 yr and positive in 11 yr. The highest value of the RI was 27.81% in 2,011 and the lowest -31.47% in 2,010 (TABLE II).

As can be noted, the exported volume was highest in 2,009 with 41,121.8 MT (the other case when exported volume overcame 40,000 MT was in 2,007 with 40,559.2 MT), with the lowest value occurring in 2,013, with just 18,486.6 MT (the only case when the exported volume was lower than 20,000 MT). In the case of the export reference price, this was highest during 2,014, with 14,893.5 US$/MT, and lowest during 2,009, with 8,082.1 US$/MT. As in the case of Salmon, the export reference price showed no

TABLE I

PRICE ELASTICITY OF THE DEMAND, REVENUE INCREASE AND OTHER ECONOMIC VARIABLES OF SALMON

	Years 1999-2000									
Variable *	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
ERP(US$/MT)	2,545.1	2,639.6	4,059.0	8,292.2	6,241.2	6,703.5	7,781.2	5,730.0	9,568.4	3,139.6
EV (MT)	419.0	249.4	66.1	1.2	3.4	22.3	14.6	1.1	0.8	31.1
PED	3.50	13.92	2.74	2.81	3.39	20.59	2.80	5.66	0.63	1.88
RI (%)	187.87	-38.27	-59.24	-96.29	113.25	604.47	-24.00	-94.45	21.45	1,175.57
	Years 2009-2018									
Variable *	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
ERP(US$/MT)	3,011.7	11,017.2		5,067.6	3,036.6				7,934.2	17,916.2
EV (MT)	11.4	1.0		32.8	12.8				11.7	32.5
PED	22.29	1.47	1.00	1.00	1.75	1.00			1.00	1.22
RI (%)	-64.84	-67.91	-100.00		-76.62	-100.00				527.25

* ERP: Export reference price; EV: Exported volume; PED: Price elasticity of the demand and RI: Revenue increase. ERP and EV are from FAS [6].

TABLE II

PRICE ELASTICITY OF THE DEMAND, REVENUE INCREASE AND OTHER ECONOMIC VARIABLES OF SHRIMP AND PRAWN

	Years 1999-2000									
Variable *	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
ERP(US$/MT)	11,018.8	13,860.3	12,689.6	10,869.1	11,535.4	11,294.5	11,395.0	9,097.7	8,839.3	9,865.1
EV (MT)	35,056.9	29,063.3	30,022.5	24,295.4	25,494.9	29,001.6	28,080.4	35,377.9	40,559.2	34,494.5
PED	0.51	0.82	0.37	1.36	0.81	6.10	3.64	1.03	4.74	1.47
RI (%)	1.03	4.28	-5.42	-30.69	11.37	11.38	-2.31	0.59	11.39	-5.08
	Years 2009-2018									
Variable *	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
ERP(US$/MT)	8,082.1	9,676.7	9,428.3	9,742.5	14,279.1	14,893.5	11,444.1	11,640.8	11,813.1	11,357.3
EV (MT)	41,121.8	23,536.2	30,873.0	26,292.0	18,486.6	20,356.5	27,995.4	25,324.4	28,539.3	24,884.2
PED	0.88	3.03	10.37	4.89	0.92	2.29	1.21	5.88	8.12	3.48
RI (%)	-2.33	-31.47	27.81	-12.00	3.05	14.85	5.67	-7.99	14.36	-16.17

* ERP: Export reference price; EV: Exported volume; PED: Price elasticity of the demand and RI: Revenue increase. ERP and EV are from FAS [6].

clear trend through this yr. For Shrimp and Prawn, in 2,018, PED was elastic with a value of 3.48, this is, the variation of 1% in the export reference price, originate a variation of 3.48% in Shrimp and Prawn demanded volumes.

Tuna: These results were displayed in TABLE III. As can be seen, the PED for Tuna was inelastic during 7 yr and elastic in 13 yr. The highest PED was obtained in 2,012 with a value of 33.79, and a lowest value of 0.09, 2,018. In the case of the RI, this displays negative values in a 10 yr period, with a lowest of -58.27% in 2,018; and other 10 yr positive-values period, with maximum of 359.44% in 2,016. As can be noticed, the export reference price reached a highest value in 2,018 of about 6,076.5 US$/MT, and lowest in 1,999 with a value of about 2,125.0 US$/MT. Exported volume was highest in 2,017 (8,586.2 MT) and lowest in yr 2,001 (1,316.4 MT), with an exported volume lower than 2,000 MT in 2,000 (1,662.2 MT). It is also observed from TABLE III, that Tuna exports in 2,018 were characterized by an

TABLE III

PRICE ELASTICITY OF THE DEMAND, REVENUE INCREASE AND OTHER ECONOMIC VARIABLES OF TUNA

	Years 1999-2000								
Variable *	1999	2001	2002	2003	2004	2005	2006	2007	2008
ERP(US$/MT)	2,125.6	3,813.6	3,518.1	4,754.8	5,336.7	4,779.0	3,427.7	3,853.9	3,336.9
EV (MT)	4,430.2	1,316.4	2,950.4	3,296.4	3,968.7	5,241.7	4,574.4	4,624.9	4,185.3
PED	2.37	29.05	9.50	0.37	1.60	2.51	0.41	0.09	0.69
RI (%)	33.68	-21.43	106.76	51.00	35.13	18.27	-37.41	13.68	-21.64
	Years 2009-2018								
Variable *	2009	2011	2012	2013	2014	2015	2016	2017	2018
ERP(US$/MT)	2,916.4	3,939.2	3,899.8	5,371.5	5,041.6	4,818.2	5,008.2	5,057.6	6,076.5
EV (MT)	4,494.8	4,213.5	5,937.5	4,956.2	7,387.3	6,453.8	7,807.2	8,586.2	8,434.1
PED	0.53	3.61	33.79	0.57	6.22	2.98	4.91	9.68	0.10
RI (%)	-6.14	32.77	39.51	14.97	39.90	-16.51	25.74	11.06	18.02

* ERP: Export reference price; EV: Exported volume; PED: Price elasticity of the demand and RI: Revenue increase. ERP and EV are from [6].

TABLE IV

PRICE ELASTICITY OF THE DEMAND, REVENUE INCREASE AND OTHER ECONOMIC VARIABLES OF TROUT

	Years 1999-2000								
Variable *	1999	2001	2002	2003	2004	2005	2006	2007	2008
ERP(US$/MT)	3,687.6	3,944.7	3,559.8	3,142.6	2,762.5	3,089.0	3,145.4	3,368.7	3,514.2
EV (MT)	96.6	74.2	64.4	80.0	86.9	36.7	56.5	120.3	37.3
PED	1.65	27.47	1.38	1.74	0.64	7.28	23.48	10.53	24.91
RI (%)	12.05	-36.71	-21.68	9.66	-4.51	-52.78	56.76	128.04	-67.65
	Years 2009-2018								
Variable *	2009	2011	2012	2013	2014	2015	2016	2017	2018
ERP(US$/MT)	4,896.6	4,172.9	6,217.3	5,183.5	6,656.7	4,650.7	5,817.7	4,238.5	5,150.5
EV (MT)	51.0	36.5	46.9	5.9	15.5	36.6	26.4	30.4	15.9
PED	0.94	3.74	0.63	8.56	3.61	2.28	1.45	0.45	3.22
RI (%)	90.52	-21.00	91.44	-89.51	237.38	64.97	-9.77	-16.11	-36.44

* ERP: Export reference price; EV: Exported volume; PED: Price elasticity of the demand and RI: Revenue increase. ERP and EV are from FAS [6].

inelastic PED value of about 0.10.

This means that a variation of 1% in the reference price, can only affect the demanded volume by 0.10%.

Trout. The price elasticity of demand of Trout exports show variations in the range 0.06- 27.47, with a 5 yr inelastic period, and a 15 yr elastic period, as can be noted from TABLE IV. The RI values showed an increase from negative values in an 11 yr period (with lowest value of about -89.51% in 2,018), to positive values within a term of 9 yr (with a maximum of 237.38%), as can be seen in TABLE IV. The highest exported quantity of Trout was reached in 2,007, with an amount of the order of 120.3 MT, with a minimum in 2,018 of about 5.9 MT.

Regarding the export reference price, 2,014 appears to be a critical yr in which, reference prices were subjected to variations from a maximum of 6,656.7 US$/MT to a minimum of 2,762.5 US$/MT. It was observed that in 2,018, the Trout exports had a PED of 3.22%, this is, a variation of 1% in export reference prices of Trout exports during this yr, caused a variation of 3.22% in the amount of Trout demanded.

TABLE V

PRICE ELASTICITY OF THE DEMAND, REVENUE INCREASE AND OTHER ECONOMIC VARIABLES

	Years 1999-2000									
Variable *	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
ERP(US$/MT)	2,339.1						5,760.7	4,305.8	7,362.9	
EV (MT)	7.3						0.4	11.5	2.0	
PED	1.62	1.00					1.00	6.45	2.69	1.00
RI (%)	147.63	-100.00						2,048.90	-70.26	-100.00
	Years 2009-2018									
Variable *	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
ERP(US$/MT)			3,538.7	3,092.7	7,738.0	7,132.7	7,606.0	6,179.3	6,572.7	5,342.0
EV (MT)			118.0	5.7	1,610.6	4,057.3	4,241.3	3,308.7	2,952.9	2,903.9
PED			1.00	13.50	2.32	10.61	0.69	1.19	1.84	0.08
RI (%)				-95.78	70,597.33	132.21	11.47	-36.62	-5.07	-20.07

* ERP: Export reference price; EV: Exported volume; PED: Price elasticity of the demand and RI: Revenue increase. ERP and EV are from FAS [6].

TABLE VI

PRICE ELASTICITY OF THE DEMAND, REVENUE INCREASE AND OTHER ECONOMIC VARIABLES OF SARDINE

	Years 1999-2000								
Variable *	1999	2001	2002	2003	2004	2005	2006	2007	2008
ERP(US$/MT)	943.4	703.2	813.9	1,010.7	950.3	965.3	988.9	1,130.1	1,048.3
EV (MT)	3,960.5	5,105.6	4,113.9	3,901.2	3,760.0	2,727.1	3,987.2	3,015.7	3,518.1
PED	1.49	0.94	1.47	0.25	0.60	20.39	15.53	2.08	2.05
RI (%)	-3.04	3.23	-6.74	17.75	-9.37	-26.33	49.78	-13.57	8.22
	Years 2009-2018								
Variable *	2009	2011	2012	2013	2014	2015	2016	2017	2018
ERP(US$/MT)	790.1	671.2	915.9	1,054.7	1,073.6	1,413.1	733.3	679.6	519.5
EV (MT)	5,759.6	2,104.0	1,556.6	973.1	1,094.1	346.9	3,071.3	4,411.5	
PED	1.72	1.14	0.97	3.27	6.61	3.80	2.52	4.71	3.75
RI (%)	23.39	-27.75	0.95	-28.01	14.44	-58.27	359.44	33.12	129.83

* ERP: Export reference price; EV: Exported volume; PED: Price elasticity of the demand and RI: Revenue increase. ERP and EV are from FAS [6].

Tilapia: The results for Tilapia were shown in TABLE V. It was seen that the demand for this product displays an inelastic demand in the period 2,012-2,018, where the value of the PED decreases from 13.50 in 2,012 to 0.08 in 2,018. It was observed that four isolated yr PED=1, so the price elasticity showed no regular trend. It was noticed an important increase of the RI, from -100% up to 70,597.3% in the period from 2,000 to 2,008. The PED could be estimated within the periods 2,001-2,004, and 2,009-2,010 because there were no exportations of Tilapia during these periods. The same applies to the RI in the periods 2,001-2,005, and 2,009-2,011.

The relation exported volume increases from 0.4 MT in 2,006 up to 4,241.3 MT in 2,016. The export reference price also increases from 2,339.14 US$/MT in 2,000 up to 7,737.97 US$/MT. The variation of the amount of Tilapia demanded with respect to the PED was similar to that of Tuna.

Sardine: As it was seen from TABLE VI, the price elasticity of demand displays an elastic behavior during 15 yr and inelastic in 5 yr, with lowest value of o.25 in 2,003, and highest value of 70.41 in 2,010. On the other hand, the RI varies from negative to positive, with lowest value of -58.27% in 2,015, and 359.44% in 2,016.

TABLE VII
PEARSON´S CORRELATION COEFFICIENTS (P) BETWEEN EXPORT REFERENCE PRICE (ERP) WITH EXPORTED VOLUME (EV) AND INCOME (I)

	Salmon	Shrimp& Prawn	Tuna	Trout	Tilapia	Sardine
Salmon	-0.369 & -0.032*					
Shrimp& Prawn		-0.690††† & 0.030				
Tuna			0.538† & 0.745†††			
Trout				-0.607†† & -0.447†		
Tilapia					0.581 & 0.604	
Sardine						-0.655††† & -0.519††

††† Highly significant (P ≤ 0.01).
†† Significant (P ≤ 0.05).
† Significant (P ≤ 0.10).
r´s without †††, †† and † are not significant (P > 0.10).
* First r´s are between ERP and EV and second r´s are between ERP and income.
Number of observations were 13, 14, 13, 15, 8 and 15 for Salmon, Shrimp and Prawn, Tuna, Trout, Tilapia and Sardine, respectively).
Income was calculated as: I = ERP × EV

The export reference price of Sardine increased from 433.97 US$/MT in 2,001 up to 1,413.14 US$/MT, with exportation volumes varying from 346.97 MT to 13,263.0 MT.

A variation of 1% on the export reference price induces a variation of 3.75% on quantity demand.

Pearson´s correlation coefficients

The Pearson´s correlation coefficients of all six fishery products were shown in TABLE VII and VIII. In TABLE VII it was reported the results for yr in which the PED was elastic. There was no significant relationship (*P*>0.10) between the exported volume and reference price for Salmon and Tilapia, However, for Tuna this relationship was positively significant (*P*>0.10), with a directly proportional relation between the two parameters. On the other hand, for shrimp, Prawn, Trout, and Sardine, this relationship was negatively significant ($P \leq 0.01$, $P \leq 0.01$, $P \leq 0.05$, and $P \leq 0.01$, respectively). This means that exported volume and reference price were inversely proportional.

According to the law of demand of Microeconomics [7], if the goods price increase then the quantity exported decrease. In contrast, for Tuna and Tilapia, this law was not accomplished because the relation was directly proportional: as price of a good increase, the quantity demanded of the good also increases; and as the price of a good decrease, the quantity demanded decreases. In short, a higher price typically causes reduced consumption of the good in question, but it can affect the consumption of other goods as well.

shows the Pearson´s correlation coefficients between exported volume and export reference price, for yr in which the PED was inelastic.

It can be noted that the relationship was not significant ($P > 0.10$) between both the exported volume and reference price, for shrimp, Prawn, Trout, and Sardine. However, for Tuna this relationship was positively significant ($P \leq 0.10$). These indicate that, in the case of Tuna, exported volume and reference price were directly proportional, as in the case of an elastic PED. In shrimp, Prawn, Trout, and Sardine, the relation exported volume/ reference price has no defined trend. Due to the lack of data for Salmon and Tilapia, correlation coefficients could not be estimated. These results are indicative that when the PED is inelastic, the product departs from the demand law.

CONCLUSIONS

In this work it was presented a report on the state of the exports regarding fishery commerce between USA and Mexico in between the period 1,998-2,018. For this study it was selected six of the main fishery products: Salmon, Tuna, Trout, shrimp, Prawn, Tilapia, and Sardine. For this study it was employed the arc method to characterize both the price elasticity demand (PED), and the revenue income.

All selected products showed an elastic demand price in almost all yr in the period under study, with short periods of

TABLE VIII

PEARSON´S CORRELATION COEFFICIENTS (P) BETWEEN EXPORT REFERENCE PRICE (ERP) WITH EXPORTED VOLUME (EV) AND INCOME (I)

	Salmon	Shrimp& Prawn	Tuna	Trout	Tilapia	Sardine
Salmon	NE					
Shrimp& Prawn		-0.846† & -0.032 *				
Tuna			0.634 & 0.846†			
Trout				-0.589 & 0,446		
Tilapia					NE	
Sardine						-0.861† & -0.139

† Significant (P ≤ 0.10). r´s without † are not significant (P > 0.10).

* First r´s are between ERP and EV and second r´s are between ERP and income. NE: No estimated

Number of observations were 1, 6, 7, 5, 2 and 5 for Salmon, Shrimp and Prawn, Tuna, Trout, Tilapia and Sardine, respectively) when elasticity was inelastic. Income was calculated as: I = ERP × EV

inelastic demand. This was in contrast to the revenue increase, which behavior presented no define trend. In periods when the PED was elastic, the relation export volume/export reference price was inversely proportional for shrimp, Prawn, Trout, and Sardine, in agreement with the law of demand. In the case of Tuna and Tilapia, this relation was directly proportional. This may be an indicative of distortions in the market of these products in periods of elastic PED. For periods of inelastic PED, almost all markets depart from the law of demand, or there was no a defined relationship; aspect that violates the PED theory.

Since USA/Mexico is one of the most important commercial partnerships in North America, the results of this work appear to be a very useful tool to predict future trends in fishery exportations between these two Countries.

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BIBLIOGRAPHIC REFERENCES

[1] ALLEN, R. The Concept of Arc Elasticity of Demand. **Rev. Econom. Stud.** 1 (3): 226–229.1933.

[2] COMISIÓN NACIONAL DE ACUACULTURA Y PESCA (CONAPESCA). Produce acuacultura mexicana más de 400 mil toneladas de pescados y mariscos. Gobierno de México. 2018. En línea: https://www.gob.mx/conapesca/prensa/produce-acuacultura-mexicana-mas-de-400-mil-toneladas-de-pescados-y-mariscos-172,466. 10. 22. 2019.

[3] FOREIGN AGRICULTURAL SERVICE (FAS). Global agriculture trade system online. United States Department of Agriculture. 2019. En línea: https://apps.fas.usda.gov/gats/default.aspx. 09. 08. 2019.

[4] FLOREZ-BOLAÑOS, J. Estimación de las elasticidades de programas de pregrado. (Reporte No. 2). Oficina de Planeación y Desarrollo Institucional. Área de Modelación y Proyección, 8 pp. 2009.

[5] INTERNATIONAL BUSINESS MACHINE (IBM). SPSS Statistics 25.0 Package, 2019.

[6] MONTIEL, M. Importancia de la pesca mexicana y sus variedades. Gastrómadas MX. Revista Electrónica Digital Gastronómica de México. 2015. On line: https://gastronomadas.com.mx/?s=Importancia+de+la+pesca+mexicana+y+sus+-variedades. 10. 15. 2019.

[7] MILLER, R.; MEINERS, R. Investigación de los conceptos de elasticidad. **Microeconomía**. Ciudad de México, México, McGraw-Hill, 703pp. 1990.

[8] NICHOLSON, W.; SNYDER, C. Income and substitutions effects. **Microeconomic Theory: Basic Principles and Extensions.** 11th. Ed. Mason, OH: South-Western, 154 pp. 2012.

[9] PARKIN, M.; POWELL, M.; MATTHEWS, K. Elasticity. **Economics.** 9th European Ed. Harlow-Pearson, 82 pp. 2014.

[10] PAZ-SOLDÁN, M.; VILLARROEL, J. La elasticidad precio de la demanda para algunos productos de la economía boliviana. Publicación del Instituto de Estudios Avanzados en Desarrollo bajo el auspicio de la Embajada del Reino de los Países Bajos en Bolivia.17 pp. 2009.

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