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# Elasticity of Demand for Avocado to the European Market and the United States, Years 2010 – 2020

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**Abstract**

*The analysis was carried out for the period from 2010 to 2020, where the production and export volumes of avocado to European and North American countries are shown. The objective of this study is to determine the elasticity of demand for avocado in these countries. "Since Alfred Marshall included it in his work Principles of Economics.*

*An analysis is made of the statistical series of each variable, its historical evolution, as well as its individual trends.*

*Based on the following econometric model:*

$$Qd(t) = \beta o + \beta 1(P)t + \beta 2(Yp)t + \beta 3(TC)t + \beta 4(N) + u$$

*Eviews 9.0 software was used, applying a log-log econometric model where the data series are given in years.*

*To measure the elasticity of demand for avocado, the indicators used were consumption, population, per capita income in dollars, and the international price of avocado in dollars.*

*In the Netherlands, the demand for Peruvian avocado shows the following behavior:*

*a. A 1% increase in price causes a reduction in demand of 0.16 %.*

*b. An increase in per capita income of 1% causes the demand for avocado to increase by 2.7%.*

*c. A 1% increase in population causes the demand of avocado to increase by 8.23 %.*

*In Spain, the demand for Peruvian avocados shows the following behavior:*

*a. A 1% increase in price generates a reduction in demand of 0.09 %.*

*b. If per capita income increases by 1%, the demand for avocado increases by 0.13 %.*

*c. A 1% increase in population generates that the demand for avocado increases by 3.49%.*

*In the U.S., demand for Peruvian avocados shows the following behavior:*

*a. A 1% increase in price generates a reduction in demand of 1.25%.*

*b. If per capita income increases by 1%, the demand for avocado increases by 16.99%.*

*c. A 1% increase in population causes the demand for avocado to decrease by 1.38%.*

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*In ENGLAND, the demand for Peruvian avocado shows the following behavior:*
*d. A 1% increase in price generates a reduction in demand of 0.03 %.*
*e. If per capita income increases by 1%, the demand for avocado decreases by 0.47%.*
*f. A 1% increase in population generates that the demand for avocado increases by 3.62%.*

## INTRODUCTION

In the last decade, Peru has seen an increase in avocado production, which has led to a surplus of avocado production being exported to European and North American markets, which has been reflected in the behavior of the increase in demand. Thus, for Baroke and Hancock, countries such as "Peru, Mexico, Chile, Dominican Republic, are exporting avocado to the United States, Holland, Spain, England, and China, as a result of this offer, countries are expanding their cultivated areas" (2016, p. 3.). We should also highlight "that the production of Peruvian avocado has grown at an average annual rate of 10.5% in the period 2001-2018, being the region of La Libertad with a growth of 41% of the total produced the one that leads this growth". (ADEX, 2019, p. 09).

The analysis carried out dates from 2010 to 2020, where the production and export volumes of avocados to European and North American countries are exposed. The objective of this study is to determine the elasticity of demand for avocados in these countries.

## THEORETICAL FRAMEWORK

The Demand

The demand for a "good is a function of the price of the item, the buyer's income, the prices of substitute and complementary goods, and his tastes" (Salvatore, 1977, p.09). It is then detailed in the following equation, according to Salvatore:

Qdx=f(Px,I,Pob,G,Ps,Pc)

Qdx = Quantity demand of good x

Px = Price of good x

I = Monetary income

P = Population

G = Taste

Ps = Price of substitute products

Pc = Price of complementary products" (1977, p. 09).

According to this demand function, only the relationship of the demand with these factors is shown, now it is necessary to see its variations with the changes of the factors, for this, the elasticity coefficient is used.

ELASTICITY

Alfred Marshall defined elasticity, it is true that before Marshall "the idea of elasticity already existed in its purest meaning, as the proportional change of a variable concerning the change of another related variable" (Miguel Cervantes Jiménez and Abraham Aparicio Cabrera 1993, p. 10). Elasticity is currently used as an instrument of analysis in economics. "Since Alfred Marshall included it in his work Principles of Economics (1890), and since that time it has been used as a means of quantifying the variations experienced by one variable in the face of changes in another" (Veres Ferrer and José M. Pavía 2012, p.02). The measurement of foreign trade elasticities was promoted by the International Monetary Fund "through the Staff Papers, as expressed by Blejer, Khan and Masson (1995). This generated a wide literature on elasticity, expressed in equations, as well as excerpts of the contributions expressed in compilations" (Maximiliano Albornoz, 2018, p.02).

In the academic literature, there is work on "trade elasticity, framed in developed economies, on foreign trade elasticity (Fullerton, Sawyer, Sprinkle 1999). There is research on elasticity for some countries in the region, but there are no studies that include a larger number of countries" (Fullerton, Sawyer, Sprinkle 1999) (Maximiliano Albornoz, 2018, p. 3).

The coefficient of price elasticity of demand, as indicated by Salvatore, is detailed below:

Price elasticity of demand "is that which calculates the percentage change in the quantity demanded of an item per unit of time, in the face of a percentage change in the price of the same item" (1977, p. 36).

$e=(\Delta Q/Q)/(\Delta P/P)=(\Delta Q)/(\Delta P)*P/Q$

$e$ = Price elasticity of demand

$\Delta Q$ = Increase in the quantity demanded

$\Delta P$ = Increase in the price of the good

$Q$ = Quantity demanded

$P$ = Price of the asset.

The price elasticity of demand according to Salvatore is: "a) Unitary, i.e. it is equal to 1, b) Inelastic, its value is less than 1, the quantities demanded react little to changes in the prices of the merchandise, c) Elastic, it is greater than 1" (1977, p. 36).

## MATERIALS AND METHODS

The research used data published by the Central Reserve Bank of Peru on its website. These data are expressed in millions of U.S. dollars (US $), also with data collected from the Ministry of Agriculture and Irrigation, Sierra y selva exportadora, and ADEX, among others.

Exports (X) were disaggregated for the following countries. England, Holland, Spain, and the United States.

The statistical series for each variable are analyzed along; with their historical evolution, as well as their trends.

Based on the following econometric model:

$Qd(t) = \beta o + \beta 1(P)t + \beta 2(Yp)t + \beta 3(TC)t + \beta 4(N) + u$

Eviews 9.0 software was used, applying a log-log econometric model where the data series are given in years.

To measure the elasticity of demand for avocados, the indicators used were consumption, population, the exchange rate in soles/dollars, per capita income in dollars, the international price of avocados in dollars, and the international price of avocados in dollars.

Following the proposed objective, we first described the evolution of each of the indicators proposed for each of the variables and then proceeded to develop the proposed econometric model.

## RESULTS

WORLD AVOCADO PRODUCTION

Total production, tons (ton), and total planted area, hectares (ha.) are the indicators to be reviewed, taking into consideration the number of producing countries, as well as their degree of importance in world avocado production.

From 2010 to 2022, 17 countries were incorporated into avocado planting and production, which started in 1961 with 48 and by the end of 2019 had reached 65, an increase of 35% (see Table 1).

The demand for a good is a function of the price of the item, the buyer's income, the prices of substitute and complementary goods, and the buyer's tastes (Salvatore, 1977).

To carry out the research, actual data published by the Ministry of Agriculture and Irrigation on its web page was collected on the research variables, considering the period 2010 - 2021.

Total production, tons (ton.), and total planted area, hectares (ha.) are the indicators to be reviewed, taking into consideration the number of producing countries, as well as their degree of importance in world avocado production.

Table 1: Main avocado-producing countries, by Volume, in thousands of MT.

| Year | 2015 | 2016 | 2017 | 2018 | 2019 | 2015 - 2019 |
|---|---|---|---|---|---|---|
| Total Productior | 5,402 | 5,799 | 6,131 | 6,536 | 6,984 | 30,852 |
| Mexico | 1,644 | 1,889 | 2,030 | 2,185 | 2,379 | 10,127 |
| Dominican Rep. | 526 | 601 | 638 | 644 | 727 | 3,136 |
| Peru | 367 | 455 | 467 | 505 | 536 | 2,330 |
| Indonesia | 383 | 343 | 363 | 410 | 437 | 1,936 |
| Colombia | 310 | 294 | 308 | 327 | 352 | 1,591 |
| Brazil | 181 | 197 | 213 | 236 | 261 | 1,088 |
| Kenia | 136 | 176 | 218 | 234 | 231 | 995 |
| United States | 208 | 125 | 170 | 169 | 153 | 825 |
| Venezuela | 129 | 130 | 133 | 140 | 144 | 676 |
| Israel | 93 | 102 | 110 | 132 | 137 | 574 |
| Guatemala | 115 | 122 | 127 | 125 | 134 | 623 |
| China | 118 | 125 | 126 | 129 | 133 | 631 |
| South Africa | 86 | 90 | 63 | 128 | 130 | 497 |
| Chile | 147 | 139 | 132 | 125 | 123 | 666 |
| Spain | 87 | 92 | 93 | 90 | 97 | 459 |
| Malawi | 95 | 87 | 97 | 92 | 93 | 464 |
| Haiti | 89 | 91 | 92 | 91 | 89 | 452 |
| Cameron | 72 | 73 | 74/ | 75 | 75 | 369 |
| Australia | 49 | 68 | 57 | 63 | 72 | 309 |
| Rep. del Congo | 66 | 66 | 66 | 66 | 66 | 330 |
| Other countries | 502 | 234 | 554 | 573 | 617 | 2,480 |

Source: FAOSTAT - Elaboration: UIC-SSE

The production volume of avocado and/or avocado in thousands of MT in the period (2015-2019) of the main countries of the world amounted to 30,852 MT, being the top 3 countries in production, Mexico with 10,127 MT representing 32.82% of total production, Dominican Republic with 3,136 MT, representing 10.16% of total production, Peru with 2,330 MT, representing 7.55 % of total production.

Table 2: Evolution of World Avocado Production (thousands of tons)

| Years | Production |
|---|---|
| 2010 | 3,974 |
| 2011 | 4,266 |
| 2012 | 4,514 |
| 2013 | 4,745 |
| 2014 | 5,160 |
| 2015 | 5,402 |
| 2016 | 5,799 |
| 2017 | 6,131 |
| 2018 | 6,536 |
| 2019 | 6,984 |
| 2020 | 8,059 |
| 2021 | 8,100 |

Source: FAOSTAT

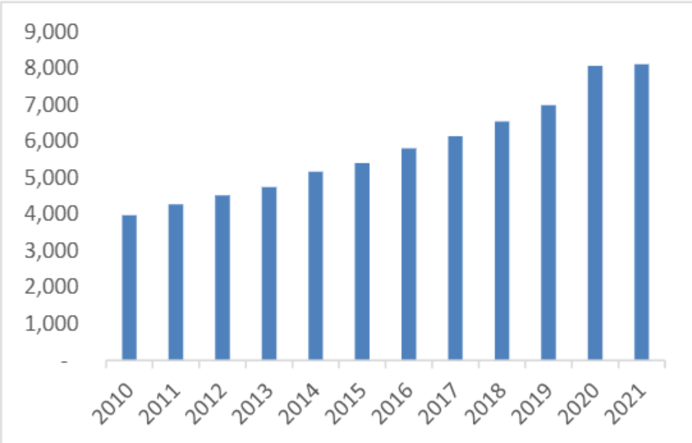



Figure 1. World Avocado Production (thousands of tons)

World avocado production in the period (2010-2021) increased on average between 1.05 and 1.07 % annually, except for the years 2019 and 2020, which amounted to 1.15%, demonstrating that avocado consumption worldwide is favorable for the producing countries in the sense that it generates profits and improves employment in the producing countries.

WORLD AVOCADO EXPORTS

Table 3: Evolution of world avocado exports by country (value in thousands of US$)

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2015 –19 |
|---|---|---|---|---|---|---|
| Total Export | 3330 | 4377 | 5826 | 5842 | 6499 | 25874 |
| Mexico | 1662 | 2051 | 2828 | 2562 | 2790 | 11893 |
| Netherlands | 426 | 645 | 797 | 888 | 1033 | 3789 |
| Peru | 304 | 397 | 581 | 722 | 751 | 2755 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Spain | 223 | 275 | 350 | 354 | 392 | 1594 |
| Chile | 162 | 297 | 391 | 274 | 301 | 1425 |
| Colombia | 10 | 35 | 53 | 63 | 175 | 336 |
| EE.UU. | 99 | 129 | 152 | 180 | 154 | 714 |
| Kenia | 53 | 53 | 64 | 78 | 118 | 366 |
| France | 47 | 58 | 71 | 62 | 92 | 330 |
| Dominican Rep. | 17 | 33 | 49 | 51 | 87 | 237 |
| Israel | 53 | 42 | 45 | 48 | 70 | 258 |
| South Africa | 71 | 72 | 64 | 116 | 71 | 394 |
| Belgium | 29 | 42 | 45 | 48 | 70 | 234 |
| New Zealand | 63 | 88 | 87 | 71 | 70 | 379 |
| Morocco | 17 | 17 | 46 | 56 | 51 | 187 |
| Other countries | 94 | 132 | 170 | 214 | 251 | 861 |

The volume of avocado and/or avocado exports in thousands of T.M in the period (2015-2019) from the main countries of the world amounted to 25,874 T.M, flourishing the top 3 countries in exports, Mexico with 11, 893 T.M representing 10.78 % of total exports, the Netherlands with 3,789 T.M, representing 3.99 % of total exports, Peru with 2,755 T.M, representing 2.90 % of total exports.

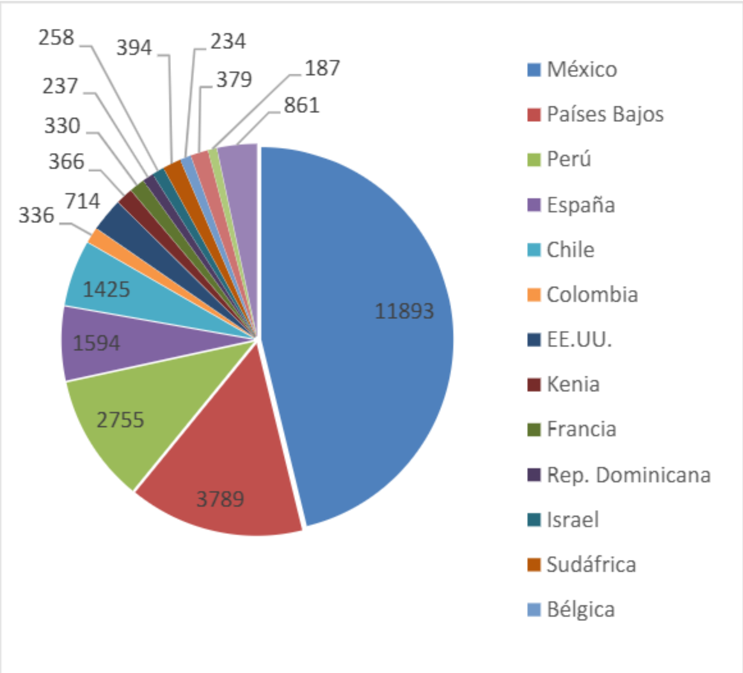



Figure 2. World avocado exports by country, in billions of US$ (total years 2015 to 2019)

AVOCADO PRODUCTION IN PERU

Table 4: Peruvian avocado production by department, 2011-2021 (in TM)

| Department | 2,011 | 2,013 | 2,014 | 2,015 | 2,016 | 2,017 | 2,018 | 2,019 | 2,020 | 2,021 | 2011-2021 | T.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 212,830 | 288,387 | 335,511 | 376,602 | 455,394 | 466,817 | 486,954 | 571,992 | 672,232 | 778,791 | 4,645,510 | |
| Amazon | 1,250 | 1,163 | 1,319 | 926 | 1,051 | 1,155 | 1,160 | 1,400 | 1,172 | 1,076 | 11,672 | 0.25 |
| Ancash | 6,813 | 26,218 | 27,927 | 26,116 | 20,456 | 11,473 | 17,547 | 20,180 | 33,363 | 37,129 | 227,222 | 4.89 |
| Apurímac | 1,847 | 2,445 | 3,072 | 3,727 | 3,795 | 3,945 | 4,403 | 4,416 | 4,957 | 10,160 | 42,767 | 0.92 |
| Arequipa | 7,920 | 9,943 | 13,585 | 12,067 | 12,579 | 15,862 | 20,085 | 22,731 | 27,528 | 24,397 | 166,697 | 3.59 |
| Ayacucho | 4,638 | 5,291 | 5,247 | 5,311 | 5,219 | 7,772 | 6,615 | 16,640 | 29,498 | 30,771 | 117,002 | 2.52 |
| Cajamarca | 4,769 | 4,462 | 5,219 | 4,745 | 4,510 | 5,699 | 5,003 | 3,676 | 4,981 | 4,921 | 47,985 | 1.03 |
| Cusco | 4,703 | 5,694 | 5,541 | 6,170 | 7,861 | 4,868 | 4,868 | 6,475 | 7,537 | 8,504 | 62,221 | 1.34 |
| Huancavelica | 765 | 671 | 661 | 642 | 729 | 811 | 811 | 2,425 | 11,883 | 15,566 | 34,964 | 0.75 |
| Huánuco | 2,470 | 2,446 | 2,454 | 2,741 | 2,833 | 3,297 | 3,297 | 3,547 | 3,698 | 3,983 | 30,766 | 0.66 |
| Ica | 30,829 | 39,439 | 45,047 | 56,638 | 57,049 | 53,924 | 53,924 | 71,591 | 80,560 | 81,700 | 570,701 | 12.29 |
| Junín | 30,540 | 34,505 | 32,977 | 31,917 | 34,128 | 36,607 | 36,607 | 44,808 | 45,122 | 52,100 | 379,311 | 8.17 |
| La Libertad | 52,409 | 74,698 | 97,470 | 112,775 | 178,272 | 197,271 | 204,526 | 202,727 | 215,319 | 226,700 | 1,562,167 | 33.63 |
| Lambayeque | 916 | 1,830 | 5,392 | 7,679 | 8,279 | 9,924 | 15,559 | 62,174 | 86,008 | 124,429 | 322,190 | 6.94 |
| Lima | 46,942 | 61,249 | 67,714 | 81,310 | 92,070 | 86,304 | 83,607 | 80,192 | 90,254 | 124,189 | 813,831 | 17.52 |
| Lima Metropolitana | | | | 1,634 | 1,820 | 1,739 | 1,504 | 1,499 | 1,297 | 1,394 | 10,887 | 0.23 |
| Loreto | 2,025 | 3,330 | 3,211 | 3,289 | 3,453 | 3,513 | 3,530 | 3,555 | 3,565 | 3,581 | 33,052 | 0.71 |
| Madre de Dios | 325 | 447 | 473 | 424 | 491 | 423 | 508 | 608 | 611 | 634 | 4,944 | 0.11 |
| Moquegua | 2,769 | 5,551 | 6,058 | 6,393 | 6,156 | 5,061 | 6,778 | 7,556 | 7,748 | 8,315 | 62,385 | 1.34 |
| Pasco | 2,582 | 1,841 | 1,977 | 2,212 | 2,384 | 3,066 | 2,601 | 2,942 | 4,493 | 6,187 | 30,285 | 0.65 |
| Piura | 3,264 | 1,700 | 4,370 | 4,267 | 7,025 | 8,364 | 7,930 | 7,679 | 6,204 | 5,973 | 56,776 | 1.22 |
| Puno | 1,915 | 2,279 | 2,393 | 2,430 | 2,469 | 2,463 | 2,460 | 2,485 | 2,516 | 2,499 | 23,909 | 0.51 |
| San Martín | 996 | 699 | 801 | 723 | 301 | 313 | 356 | 416 | 496 | 597 | 5,698 | 0.12 |
| Tacna | 185 | 202 | 225 | 378 | 377 | 410 | 280 | 212 | 287 | 421 | 2,977 | 0.06 |
| Tumbes | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| Ucayali | 1,956 | 2,283 | 2,378 | 2,088 | 2,087 | 2,553 | 2,995 | 2,056 | 3,136 | 3,566 | 25,098 | 0.54 |

Source: https://siea.midagri.gob.pe/portal/publicacion/boletines-anuales/4-agricola

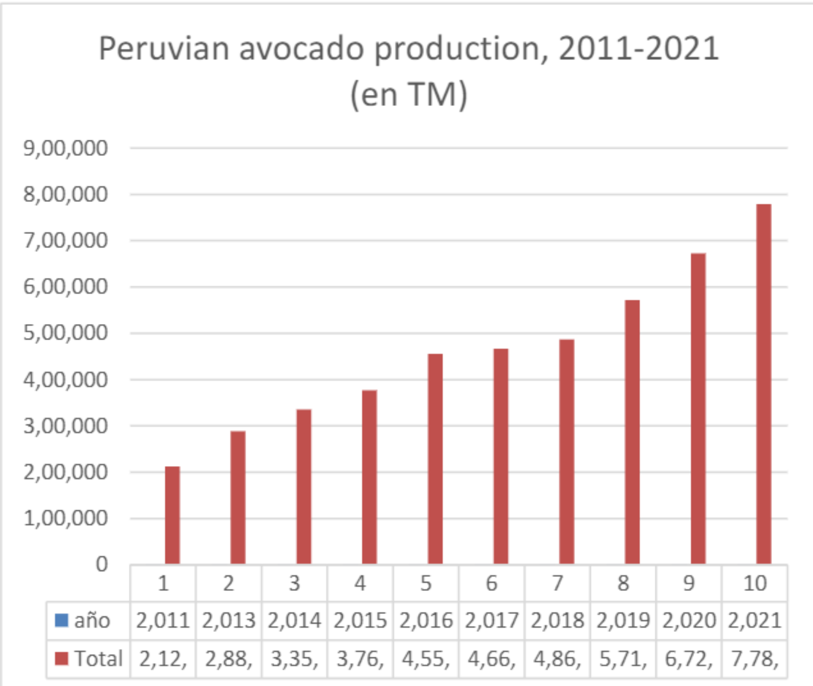



Figure 3. Peruvian avocado production (tons)

Table 5: Avocado HARVESTED AREA in Peru, 2008-2021 (hectares)

| Year | Has Harvested | Growth rate |
|---|---|---|
| 2007 | 13,522 | |
| 2008 | 14,370 | 6.3% |
| 2009 | 16,292 | 13.4% |
| 2010 | 17,748 | 8.9% |
| 2011 | 19,300 | 8.7% |
| 2012 | 21,615 | 12.0% |
| 2013 | 27,438 | 26.9% |
| 2014 | 30,320 | 10.5% |
| 2015 | 33,989 | 12.1% |
| 2016 P/ | 37,871 | 11.4% |
| 2017 P/ | 39,629 | 4.6% |
| 2018 P/ | 40,134 | 1.3% |
| 2019 P/ | 46,794 | 16.6% |
| 2020 P/ | 51,241 | 9.5% |
| 2021 P/ | 55,056 | 7.4% |

The production of avocado and/or avocado in thousands of T.M in the period (2011-2021) of the main departments of Peru amounted to 4'663,072 T.M, highlighting in first place the department of La Libertad with a production of 1'562,167 T.M., which represents 33.63% of the country's total production, followed by Lima provinces with a production of 813,831 MT, representing 17.52% of the total production, Junín with a production of 379,311 MT, representing 8.17% of the total production, Lambayeque with a production of 322,190 MT, representing 6.94% of the total production and Lambayeque with a production of 322,190 MT, representing 6.94% of the total production.

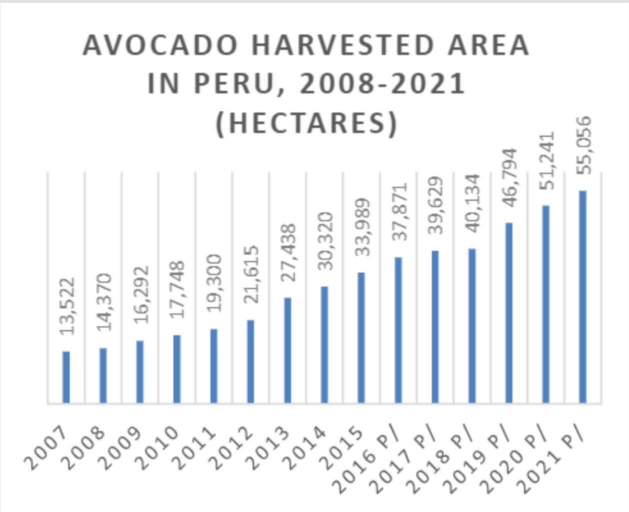



Figure 4: avocado HARVESTED AREA in Peru, 2008-2021 (hectares/year)

According to data from the Ministry of Agriculture and Irrigation, between 2007 and 2021, Peru experienced an average annual harvest of 31,021 hectares of avocado, increasing from 13,522 hectares in 2007 to 55,056 hectares in 2021. The growth of harvested area of avocado in Peru has had a steady growth during the fifteen years shown in Table 5, with 2013 being the year of highest percentage increase (27%); between the years 2011 and 2017 the period of greatest dynamism in the harvested area is observed, a period in which it went from 19,300 to about 40,000 hectares.

Although in the years after 2018, the dynamism of the increase in harvested hectares has slowed down, it can be seen that there is still an increase that has allowed it to reach over 55 thousand hectares harvested in 2021.

Table 6: PERU: avocado exports, main countries of destination between 2010 and 2021 (in US$)

| Country | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2011-21 | T.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NETHERLANDS | 38,897 | 74,381 | 57,849 | 84,513 | 96,581 | 117,599 | 163,331 | 206,002 | 267,613 | 249,540 | 254,458 | 346,810 | 1,957,574 | 35.8 |
| U.S.A. | 784 | 23,484 | 25,880 | 39,272 | 120,965 | 83,134 | 74,427 | 175,117 | 175,641 | 231,875 | 157,937 | 200,007 | 1,308,523 | 23.93 |
| SPAIN | 27,808 | 37,828 | 33,439 | 38,374 | 47,689 | 50,471 | 78,077 | 88,964 | 110,229 | 114,845 | 131,351 | 173,249 | 932,324 | 17.05 |
| CHILE | 112 | 1,439 | 945 | 481 | 3,325 | 13,380 | 12,480 | 10,028 | 35,287 | 26,944 | 44,484 | 121,234 | 270,139 | 4.94 |
| UNITED KINGDOM | 6,175 | 10,715 | 9,165 | 10,502 | 18,685 | 31,914 | 44,384 | 58,050 | 65,421 | 58,775 | 63,604 | 76,137 | 453,527 | 8.29 |
| CHINA | | | 40 | 37 | | 104 | 4,580 | 13,442 | 30,111 | 25,703 | 26,237 | 29,208 | 129,462 | 2.37 |
| OTHERS | 11,259 | 13,372 | 8,202 | 10,855 | 12,866 | 9,667 | 19,304 | 28,796 | 39,808 | 44,773 | 81,055 | 136,618 | 416,575 | 7.62 |
| **TOTAL** | 85,035 | 161,219 | 135,520 | 184,034 | 300,111 | 306,269 | 396,583 | 580,399 | 724,110 | 752,455 | 759,126 | 1,083,263 | 5,468,124 | |

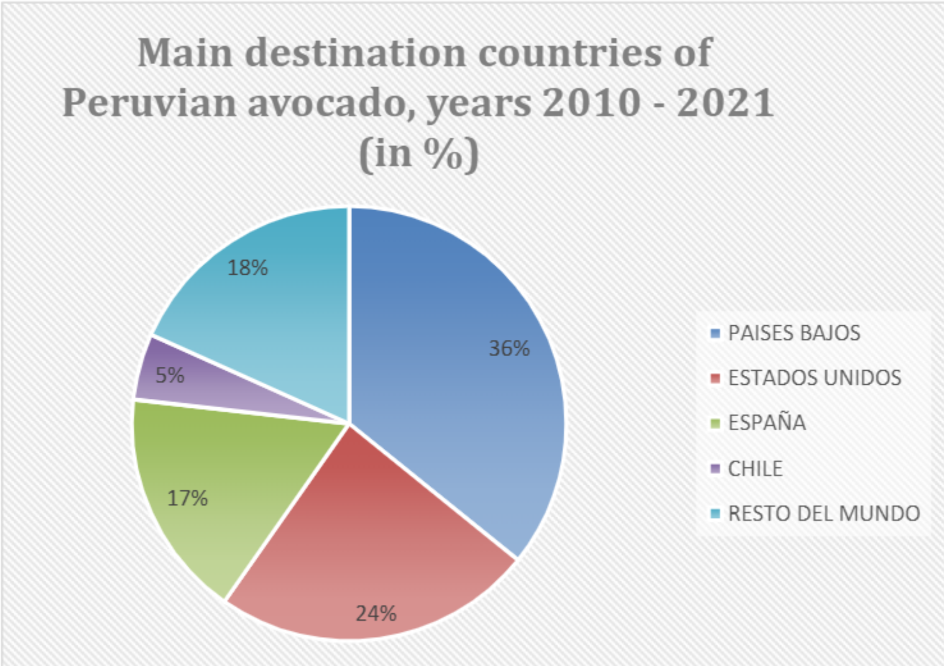



Figure 5. destination of peruvian avocado, years 2010 - 2021

The export of avocado and/or avocado during the period from 2010 to 2021 shows that the countries that have been destinations of our avocado, show the following detail: Netherlands consumes 1,957,574 T.M. which represents 35.50 % of all Avocado sales abroad; USA, is the second of the biggest avocado consumers, with 1,305,523 T.M, which represents 23.93 % of the global consumption of exports, Spain, consumes 932,324 T.M, which represents 17.05 % of the global consumption of exports, United Kingdom consumes 453,527 T.M, which represents 8.29 % of the global consumption of exports.

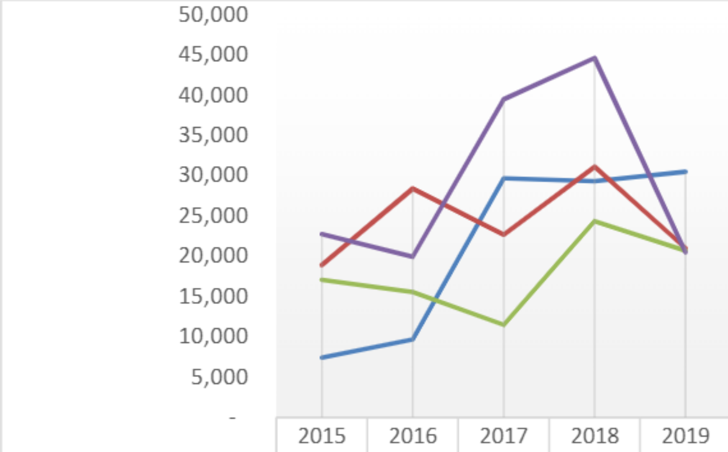
Table 7: PERUVIAN AVOCADO EXPORTING COMPANIES, IN THE YEARS 2015 TO 2019

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2015-19 | T.C |
|---|---|---|---|---|---|---|---|
| AVOCADO PACKING COMPANY S.A.C. | 7,412 | 9,656 | 29,656 | 29,326 | 30,487 | 106,537 | 8.25 |
| SOCIEDAD AGRICOLA DROKASA S.A. | 18,896 | 28,393 | 22,691 | 31,116 | 21,003 | 122,099 | 9.46 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AGRICOLA CERRO PRIETO S.A.C. | 17,070 | 15,552 | 11,483 | 24,363 | 20,670 | 89,138 | 6.91 |
| OL S.A. | 22,770 | 19,940 | 39,479 | 44,614 | 20,486 | 147,289 | 11.41 |
| CAMET TRADING S.A.C. | - | 11,627 | 11,819 | 16,874 | 16,907 | 57,227 | 4.43 |
| CONSORCIO DE PRODUCTORES DE FRUTA S.A. | 10,358 | 9,614 | 11,131 | 13,596 | 15,556 | 60,255 | 4.67 |
| VIRU S.A. | 3,229 | 4,379 | 10,421 | 15,641 | 11,103 | 44,773 | 3.47 |
| CORPORACION FRUTICOLA DE CHINCHA S.A.C. | 7,774 | 7,061 | 6,734 | 9,395 | 10,800 | 41,764 | 3.24 |
| ASR TRADING SOCIEDAD ANONIMA CERRADA | - | 827 | 5,906 | 10,124 | 9,159 | 26,016 | 2.02 |
| PLANTACIONES DEL SOL S.A.C | - | 174 | 3,212 | 7,179 | 8,229 | 18,794 | 1.46 |
| INCAVO S.A.C. | 2,233 | 3,337 | 4,326 | 7,919 | 7,511 | 25,326 | 1.96 |
| AGRICOLA HOJA REDONDA S.A. | 1,934 | 2,048 | 1,786 | 6,154 | 6,578 | 18,500 | 1.43 |
| AGRICOLA LAS MARIAS S.A.C. | 3,170 | 1,722 | 2,969 | 6,071 | 4,614 | 18,546 | 1.44 |
| AGRICOLA PAMPA BAJA S.A.C. | 749 | 2,815 | 1,743 | 5,394 | 4,590 | 15,291 | 1.18 |
| HASS PERU S.A. | 1,874 | 971 | 2,888 | 6,433 | 4,398 | 16,564 | 1.28 |
| AGRICOLA CHAPI S.A. | 3,037 | 2,804 | 2,829 | 3,194 | 4,261 | 16,125 | 1.25 |
| PROCESADORA LARAN SAC | 3,346 | 2,925 | 2,410 | 3,840 | 4,057 | 16,578 | 1.28 |
| ASICA FARMS S.A.C. | - | 1,464 | 3,788 | 2,520 | 3,698 | 11,470 | 0.89 |
| AGRICOLA ALPAMAYO S.A. 2, | 2,592 | 48 | - | 3,074 | 3,453 | 9,167 | 0.71 |
| COMPLEJO AGROINDUSTRIAL BETA S.A. | 1,184 | 1,443 | 1,457 | 1,937 | 3,395 | 9,416 | 0.73 |
| OTRAS EMPRESAS | 68,054 | 67,283 | 70,807 | 112,600 | 101,288 | 420,032 | 32.54 |
| Total exportado | 175,682 | 194,083 | 247,535 | 361,364 | 312,243 | 1,290,907 | |

Source: Veritrade. Elaboration: UIC- SSE

In Peru, an important number of avocado exporting companies exist, of which, as of 2019 20 companies exceeded 3,300 tons of annual exports; in 2015 the total volume of avocado exported by Peruvian companies was 68 thousand tons and in 2018 it reached a total volume of 112 thousand tons, an amount slightly higher (by 10%) than the volume that was reached in 2019.




| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| AVOCADO PACKING COMPANY S.A.C. | 7,412 | 9,656 | 29,656 | 29,326 | 30,487 |
| SOCIEDAD AGRICOLA DROKASA S.A. | 18,896 | 28,393 | 22,691 | 31,116 | 21,003 |
| AGRICOLA CERRO PRIETO S.A.C. | 17,070 | 15,552 | 11,483 | 24,363 | 20,670 |
| CAMPOSOL S.A. | 22,770 | 19,940 | 39,479 | 44,614 | 20,486 |

Figure 6: Main Peruvian avocado exporters, years 2015 to 2019

Among the main exporting Companies of avocado and/or avocado from Peru in the period (2015-2029) highlights the company CAMPOSO S.A with an export production of 147,289 T.M which represents 11.41 % of total exports, the company SOCIEDAD AGRICOLA DROKASA S.A with an export production of 122,099 T.M which represents 9.46 % of total exports, AVOCADO PACKING COMPANY S.A.C., with an export production of 106,537 metric tons, representing 8.25% of the total exports, AGRICOLA CERRO PRIETO S.A.C. with an export production of 89,138 metric tons, representing 6.91% of the total exports, and AGRICOLA CERRO PRIETO S.A.C. with an export production of 89,138 metric tons, representing 6.91% of the total exports.

INTERNATIONAL PRICE OF AVOCADO

Table 8: international price of avocado (US$ FOB/Kg)

| Month | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|
| January | 2.08 | 1.94 | 2.3 | 2.48 |
| February | 2.39 | 1.995 | 2.36 | 2.54 |
| March | 2.53 | 2.24 | 2.26 | 2.48 |
| April | 2.38 | 2.06 | 2 | 2.21 |
| May | 1.98 | 2.19 | 1.72 | 1.95 |
| June | 1.81 | 2.58 | 1.68 | 1.82 |
| July | 1.95 | 2.68 | 1.75 | 1.69 |
| August | 1.99 | 2.73 | 1.92 | 1.81 |
| September | 1.89 | 2.79 | 2.3 | 2.07 |
| October | 1.5 | 2.11 | 1.73 | 1.76 |
| November | 2.01 | 2.32 | 2.06 | 1.87 |
| December | 1.96 | 2.3 | 2.38 | 1.99 |
| prom. Annual | 2.0392 | 2.3280 | 2.0383 | 2.0560 |

Source: trademark

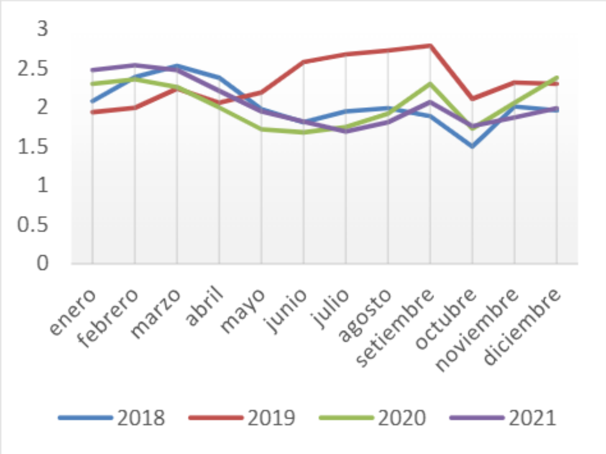



Figure 7: Monthly avocado prices in the international market, years 2018 to 2021.

According to Trademark data, in the last 4 years the average international price of avocado has slightly exceeded US$2, with its best performance between June and September 2019, when the price of avocado moved from US$2.68 to US$2.79; after this boom in the international price, a significant decrease in its international price has been observed, which has led to prices of this fruit reaching prices similar to those of 2018 in 2021, with a tendency to continue decreasing very slowly.

Regarding the seasonality of prices for the four years with data available, it can be observed that, in general, monthly prices, during the year, show a behavior of higher prices at the beginning of the year and then decrease significantly until the middle and third quarter of the year, to recover from the month of September onwards. The above behavior was counter-seasonal in 2019, due to lower world production levels due to climatic factors and a quite dynamic increase in the consumption of this product in developed countries, mainly. The lower production was also influenced by the high level of increase in fertilizer and energy prices, which had a direct impact on producers' costs.

Estimation with econometric model:

The statistical series for each variable are analyzed; their historical evolution, as well as their trends.

Based on the following econometric model:

$$Qd(t) = \beta o + \beta 1(P)t + \beta 2(Yp)t + \beta 3(TC)t + \beta 4(N) + u$$

Eviews 9.0 software was used, applying a log-log econometric model where the data series are given in years.

NETHERLANDS

Dependent Variable: TN_HOL

Method: Least Squares

Date: 06/24/23 Time: 22:18

Sample: 2010 2021

Included observations: 12

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| YP_HOL | 2.706632 | 1.209067 | 2.238613 | 0.0555 |
| PRECIO | -0.165403 | 0.175261 | -0.943753 | 0.3729 |
| P_HOL | 8.23E-05 | 9.28E-06 | 8.860452 | 0.0000 |
| C | -1287.691 | 122.0794 | -10.54797 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.945858 | Mean dependent var | 84.36800 |
| Adjusted R-squared | 0.925555 | S.D. dependent var | 48.71191 |
| S.E. of regression | 13.29089 | Akaike info criterion | 8.273237 |
| Sum squared resid | 1413.182 | Schwarz criterion | 8.434872 |
| Log-likelihood | -45.63942 | Hannan-Quinn criter. | 8.213393 |
| F-statistic | 46.58642 | Durbin-Watson stat | 1.870689 |
| Prob(F-statistic) | 0.000021 | | |

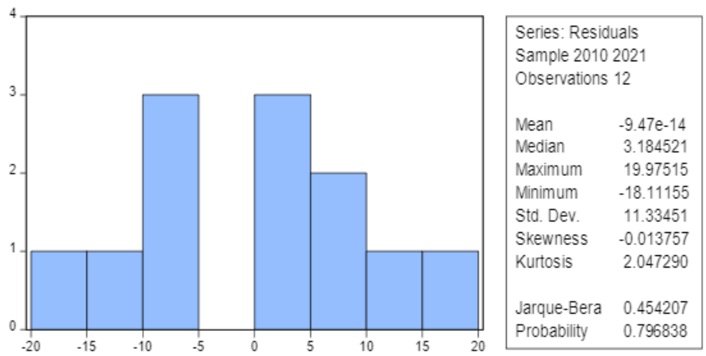
As shown in the table above, it can be stated that the total demand for avocado in the Netherlands is explained by the price of avocado in the country, as well as by the per capita income and population, and this relationship is supported by the following results:

- When the price of avocado increases by 1, on average the demand in the Netherlands decreases by -0.16 percentage points.

- When the per capita income in the Netherlands increases by 1, on average its demand for avocado increases by 2.7 percentage points.

- When the population in the Netherlands increases by 1, on average their demand for avocado increases by 8.23 percentage points.

NORMALITY TEST




The Jarque Bera test is used to test the normality of the model, where with a result of 0.45 and a probability greater than 0.05 (0.79) it is considered that the errors are normally distributed.

AUTOCORRELATION TEST

| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|---|---|
| | | 1 | 0.229 | 0.229 | 0.8002 | 0.371 |
| | | 2 | -0.269 | -0.339 | 2.0134 | 0.365 |
| | | 3 | -0.289 | -0.154 | 3.5778 | 0.311 |
| | | 4 | 0.100 | 0.160 | 3.7886 | 0.435 |
| | | 5 | 0.176 | -0.015 | 4.5320 | 0.476 |
| | | 6 | -0.084 | -0.149 | 4.7284 | 0.579 |
| | | 7 | -0.216 | -0.067 | 6.2907 | 0.506 |
| | | 8 | -0.150 | -0.128 | 7.2365 | 0.511 |
| | | 9 | -0.015 | -0.120 | 7.2494 | 0.611 |
| | | 10 | 0.015 | -0.074 | 7.2682 | 0.700 |
| | | 11 | 0.003 | -0.029 | 7.2696 | 0.777 |

The autocorrelation test determined by the Durbin Watson statistic, which for the model the result is 1.8706, in that sense, at a significance level of 95% we have that dL and dU is equivalent to 0.658 and 1.864 respectively; from these values, it is determined that the autocorrelation falls in the non-autocorrelation zone.

## HETEROSCEDASTICITY TEST

Heteroskedasticity Test: White

| | | | |
|---|---|---|---|
| F-statistic | 6.402772 | Prob. F (9,2) | 0.1423 |
| Obs*R-squared | 11.59748 | Prob. Chi-Square (9) | 0.2370 |
| Scaled explained SS | 2.699094 | Prob. Chi-Square (9) | 0.9750 |

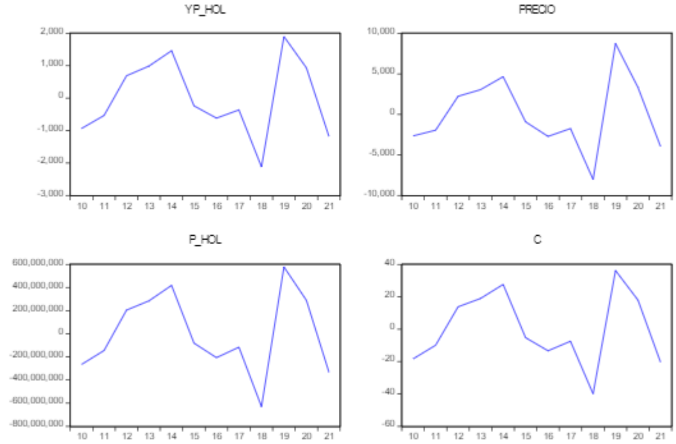
Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/24/23 Time: 23:27
Sample: 2010 2021
Included observations: 12

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -68917.15 | 26454.59 | -2.605111 | 0.1211 |
| YP_HOL^2 | -0.410349 | 2.789249 | -0.147118 | 0.8965 |
| YP_HOL*PRECIO | 0.493520 | 0.320547 | 1.539620 | 0.2635 |
| YP_HOL*P_HOL | -5.16E-05 | 3.51E-05 | -1.470486 | 0.2792 |
| YP_HOL | 768.9419 | 336.4673 | 2.285339 | 0.1496 |
| PRECIO^2 | -0.240866 | 0.066970 | -3.596622 | 0.0694 |
| PRECIO*P_HOL | 2.12E-05 | 4.89E-06 | 4.340922 | 0.0492 |
| PRECIO | -258.2314 | 53.45386 | -4.830920 | 0.0403 |
| P_HOL^2 | -3.43E-10 | 9.30E-11 | -3.686310 | 0.0663 |
| P_HOL | 0.009329 | 0.003166 | 2.946219 | 0.0985 |

| | | | |
|---|---|---|---|
| R-squared | 0.966457 | Mean dependent var | 117.7652 |
| Adjusted R-squared | 0.815513 | S.D. dependent var | 125.8765 |
| S.E. of regression | 54.06634 | Akaike info criterion | 10.69321 |
| Sum squared resid | 5846.338 | Schwarz criterion | 11.09730 |
| Log-likelihood | -54.15925 | Hannan-Quinn criter. | 10.54360 |
| F-statistic | 6.402772 | Durbin-Watson stat | 2.157797 |
| Prob(F-statistic) | 0.142328 | | |

| **Positive Autocorrelation** | **Zone of Indecision** | **No Autocorrelation** | | **Zone of Indecision** | **Negative Autocorrelation** |
|---|---|---|---|---|---|
| Reject Ho | | Accept Ho | | Reject Ho | |
| 0 | dl | du 2 | 4-du | 4-dl | 4 |
| | 0.658 | 1.864 | 2.136 | 3.342 | |
| | | **1.8706** | | | |

Results greater than 0.05 show that the homoscedasticity assumption is met, with no heteroscedasticity problem of any order in the model.




SPAIN

Dependent Variable: TN_ESP
Method: Least Squares
Date: 06/24/23 Time: 23:35
Sample: 2010 2021
Included observations: 12

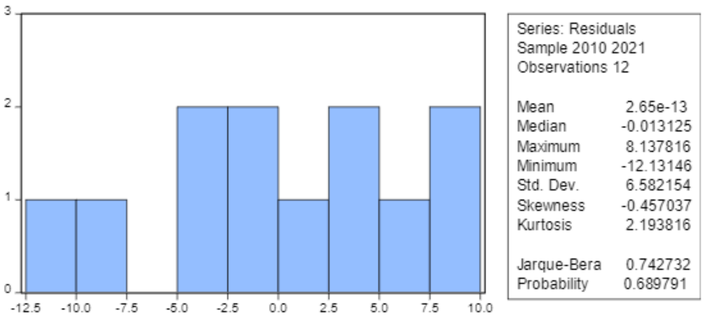
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| YP_ESP | 0.130640 | 1.310296 | 0.099702 | 0.9230 |
| P_ESP | 3.49E-05 | 4.36E-06 | 8.003867 | 0.0000 |
| PRECIO | -0.098734 | 0.092574 | -1.066538 | 0.3173 |
| C | -1245.560 | 162.4059 | -7.669428 | 0.0001 |

| | | | |
|---|---|---|---|
| R-squared | 0.905836 | Mean dependent var | 42.47350 |
| Adjusted R-squared | 0.870525 | S.D. dependent var | 21.44995 |
| S.E. of regression | 7.718260 | Akaike info criterion | 7.186256 |
| Sum squared resid | 476.5723 | Schwarz criterion | 7.347892 |
| Log-likelihood | -39.11754 | Hannan-Quinn criter. | 7.126413 |
| F-statistic | 25.65282 | Durbin-Watson stat | 1.826712 |
| Prob(F-statistic) | 0.000186 | | |

As shown in Table *, it could be stated that the total demand for avocados in Spain is explained by the price of avocado in the country, as well as by the per capita income and its population, such relationship is subject to the following results:

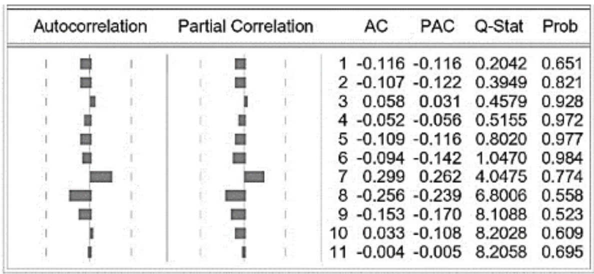
- When the price of avocado increases by 1, on average the demand in Spain decreases by -0.09 percentage points.
- When the per capita income in Spain increases by 1, on average its demand for avocado increases by 0.13 percentage points.
- When the population in Spain increases by 1, on average its demand for avocado increases by 3.49 percentage points.

NORMALITY TEST




The Jarque Bera test is used to test the normality of the model, where with a result of 0.74 and a probability greater than 0.05 (0.68) it is considered that the errors are normally distributed.

AUTOCORRELATION TEST



| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|---|---|
| | | 1 | -0.116 | -0.116 | 0.2042 | 0.651 |
| | | 2 | -0.107 | -0.122 | 0.3949 | 0.821 |
| | | 3 | 0.058 | 0.031 | 0.4579 | 0.928 |
| | | 4 | -0.052 | -0.056 | 0.5155 | 0.972 |
| | | 5 | -0.109 | -0.116 | 0.8020 | 0.977 |
| | | 6 | -0.094 | -0.142 | 1.0470 | 0.984 |
| | | 7 | 0.299 | 0.262 | 4.0475 | 0.774 |
| | | 8 | -0.256 | -0.239 | 6.8006 | 0.558 |
| | | 9 | -0.153 | -0.170 | 8.1088 | 0.523 |
| | | 10 | 0.033 | -0.108 | 8.2028 | 0.609 |
| | | 11 | -0.004 | -0.005 | 8.2058 | 0.695 |

| **Positive Autocorrelation** | **Zone of Indecision** | **No Autocorrelation** | | | **Zone of Indecision** | **Negative Autocorrelation** |
|---|---|---|---|---|---|---|
| Reject Ho | | Accept Ho | | | Reject Ho | |
| 0 | dl | Du | 2 | 4-du | 4-dl | 4 |
| | 0.658 | 1.864 | | 2.136 | 3.342 | |
| | | | **1.826712** | | | |

The autocorrelation test determined by the Durbin Watson statistic, which for the model the result is 1.8267, in that sense, at a significance level of 95% we have that dL and dU are equivalent to 0.658 and 1.864 respectively; from these values, it is determined that the autocorrelation falls in the autocorrelation zone.

HETEROSCEDASTICITY TEST

Heteroskedasticity Test: White

| | | | |
|---|---|---|---|
| F-statistic | 0.894206 | Prob. F(9,2) | 0.6317 |
| Obs*R-squared | 9.611430 | Prob. Chi-Square(9) | 0.3828 |
| Scaled explained SS | 2.549840 | Prob. Chi-Square(9) | 0.9795 |

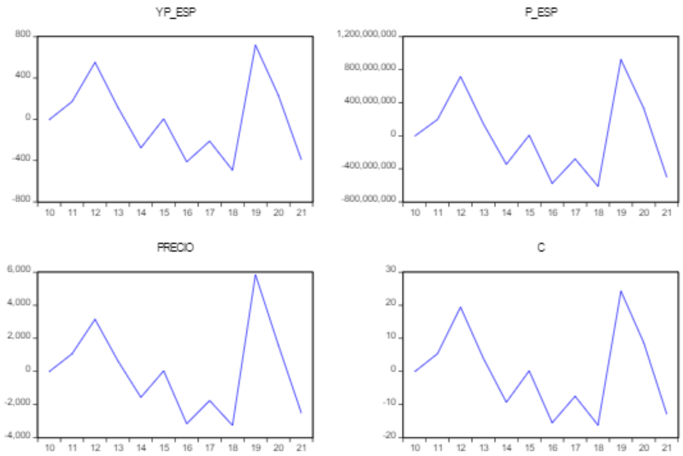
Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/25/23 Time: 00:04
Sample: 2010 2021
Included observations: 12

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| C | 70384.49 | 174092.6 | 0.404293 | 0.7251 |
| YP_ESP^2 | -11.87994 | 10.14458 | -1.171063 | 0.3622 |
| YP_ESP*P_ESP | -1.00E-05 | 1.96E-05 | -0.511059 | 0.6601 |
| YP_ESP*PRECIO | 0.369081 | 0.619038 | 0.596218 | 0.6115 |
| YP_ESP | 975.9213 | 1056.429 | 0.923793 | 0.4531 |
| P_ESP^2 | 3.55E-11 | 1.22E-10 | 0.290494 | 0.7988 |
| P_ESP*PRECIO | 5.69E-06 | 3.48E-06 | 1.637921 | 0.2431 |
| P_ESP | -0.003504 | 0.009367 | -0.374127 | 0.7443 |
| PRECIO^2 | -0.084662 | 0.065684 | -1.288926 | 0.3264 |
| PRECIO | -188.3885 | 105.4244 | -1.786953 | 0.2159 |

| | | | |
|---|---|---|---|
| R-squared | 0.800952 | Mean dependent var | 39.71436 |
| Adjusted R-squared | -0.094761 | S.D. dependent var | 45.32215 |
| S.E. of regression | 47.42095 | Akaike info criterion | 10.43091 |
| Sum squared resid | 4497.492 | Schwarz criterion | 10.83500 |
| Log likelihood | -52.58547 | Hannan-Quinn criter. | 10.28130 |
| F-statistic | 0.894206 | Durbin-Watson stat | 2.064093 |
| Prob(F-statistic) | 0.631676 | | |

Results greater than 0.05 show that the homoscedasticity assumption is met, with no heteroscedasticity problem of any order in the model.




EE.UU.

Dependent Variable: TN_EU
Method: Least Squares
Date: 06/25/23 Time: 00:17
Sample: 2010 2021
Included observations: 12

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| YP_EU | 16.99038 | 25.40450 | 0.668794 | 0.5225 |
| PRECIO | -1.253821 | 1.565937 | -0.800684 | 0.4464 |
| P_EU | -1.38E-05 | 2.00E-05 | -0.689655 | 0.5099 |
| C | 2960.848 | 3810.136 | 0.777098 | 0.4595 |

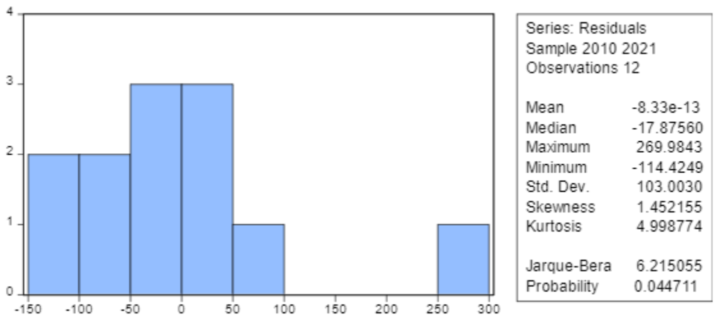
| | | | |
|---|---|---|---|
| R-squared | 0.175385 | Mean dependent var | 86.60792 |
| Adjusted R- | -0.133846 | S.D. dependent var | 113.4291 |

| | | | |
|---|---|---|---|
| squared | | | |
| S.E. of regression | 120.7818 | Akaike info criterion | 12.68705 |
| Sum squared resid | 116705.9 | Schwarz criterion | 12.84868 |
| Log likelihood | -72.12230 | Hannan-Quinn criter. | 12.62721 |
| F-statistic | 0.567165 | Durbin-Watson stat | 1.215891 |
| Prob(F-statistic) | 0.651960 | | |

As shown in Table *, it could be stated that the total demand for avocado in the U.S. is explained by the price of avocado in the country, as well as by the per capita income and its population, this relationship is subject to the following results:

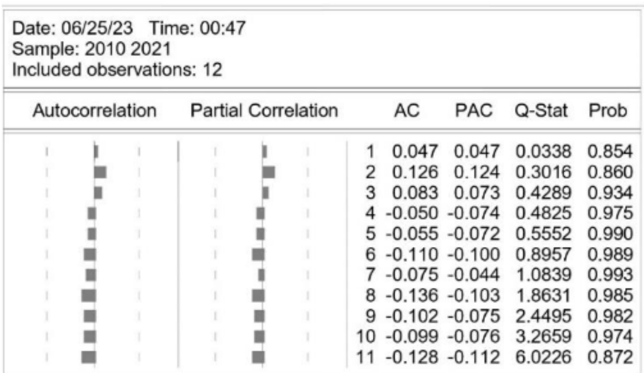
- When the price of avocado increases by 1, on average U.S. demand for avocado decreases by -1.25 percentage points.
- When U.S. per capita income increases by 1, on average their demand for avocado increases by 16.99 percentage points.
- When the U.S. population increases by 1, on average your demand for avocado increases by -1.38 percentage points.

NORMALITY TEST




The Jarque Bera test is used to test the normality of the model, where with a result of 6.21 and a probability of less than 0.05 (0.044) it is considered that the errors are abnormally distributed.

AUTOCORRELATION TEST



Date: 06/25/23 Time: 00:47
Sample: 2010 2021
Included observations: 12

| | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|
| 1 | 0.047 | 0.047 | 0.0338 | 0.854 |
| 2 | 0.126 | 0.124 | 0.3016 | 0.860 |
| 3 | 0.083 | 0.073 | 0.4289 | 0.934 |
| 4 | -0.050 | -0.074 | 0.4825 | 0.975 |
| 5 | -0.055 | -0.072 | 0.5552 | 0.990 |
| 6 | -0.110 | -0.100 | 0.8957 | 0.989 |
| 7 | -0.075 | -0.044 | 1.0839 | 0.993 |
| 8 | -0.136 | -0.103 | 1.8631 | 0.985 |
| 9 | -0.102 | -0.075 | 2.4495 | 0.982 |
| 10 | -0.099 | -0.076 | 3.2659 | 0.974 |
| 11 | -0.128 | -0.112 | 6.0226 | 0.872 |

| **Positive Autocorrelation** | **Zone of Indecision** | **No Autocorrelation** | | | **Zone of Indecision** | **Negative Autocorrelation** |
|---|---|---|---|---|---|---|
| Reject Ho | | Accept Ho | | | Reject Ho | |
| 0 | dl | du | 2 | 4-du | 4-dl | 4 |
| | 0.658 | 1.864 | | 2.136 | 3.342 | |
| | | | **1.2158** | | | |

The autocorrelation test determined by the Durbin Watson statistic, which for the model the result is 1.2158, in that sense, at a significance level of 95% we have that dL and dU is equivalent to 0.658 and 1.864 respectively; from these values, it is determined that the autocorrelation falls in the positive autocorrelation zone.

HETEROSCEDASTICITY TEST

Heteroskedasticity Test: White

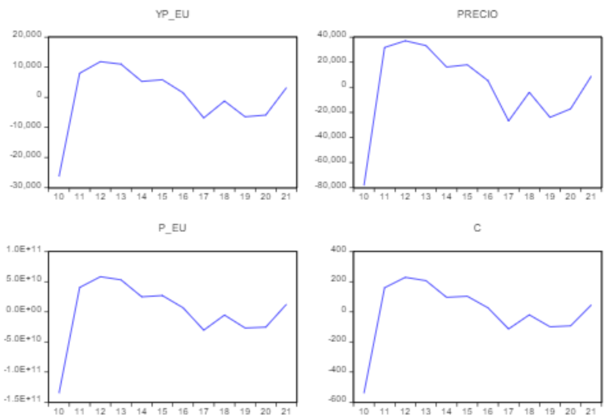
| | | | |
|---|---|---|---|
| F-statistic | 7.491860 | Prob. F(8,3) | 0.0626 |
| Obs*R-squared | 11.42798 | Prob. Chi-Square(8) | 0.1786 |
| Scaled explained SS | 10.15509 | Prob. Chi-Square(8) | 0.2543 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/25/23 Time: 00:57
Sample: 2010 2021
Included observations: 12
Collinear test regressors dropped from specification

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 8544113. | 4218119. | 2.025574 | 0.1359 |
| YP_EU^2 | -771.6358 | 1006.256 | -0.766838 | 0.4990 |
| YP_EU*PRECIO | -187.9659 | 131.2020 | -1.432645 | 0.2474 |
| YP_EU*P_EU | 0.001026 | 0.000921 | 1.114653 | 0.3463 |
| YP_EU | -145110.9 | 106044.4 | -1.368397 | 0.2647 |
| PRECIO^2 | -4.884706 | 11.27915 | -0.433074 | 0.6942 |
| PRECIO*P_EU | 0.000222 | 9.79E-05 | 2.267356 | 0.1082 |
| PRECIO | -45706.42 | 18113.84 | -2.523287 | 0.0859 |
| P_EU^2 | -1.93E-10 | 1.27E-10 | -1.515091 | 0.2270 |

| | | | |
|---|---|---|---|
| R-squared | 0.952332 | Mean dependent var | 9725.490 |
| Adjusted R-squared | 0.825216 | S.D. dependent var | 20312.77 |
| S.E. of regression | 8492.193 | Akaike info criterion | 21.04539 |
| Sum squared resid | 2.16E+08 | Schwarz criterion | 21.40907 |
| Log likelihood | -117.2723 | Hannan-Quinn criter. | 20.91074 |
| F-statistic | 7.491860 | Durbin-Watson stat | 1.626522 |
| Prob(F-statistic) | 0.062636 | | |

Results greater than 0.05 show that the homoscedasticity assumption is met, with no heteroscedasticity problem of any order in the model.



ENGLAND

Dependent Variable: TN_ING
Method: Least Squares
Date: 06/25/23 Time: 01:07
Sample: 2010 2021
Included observations: 12

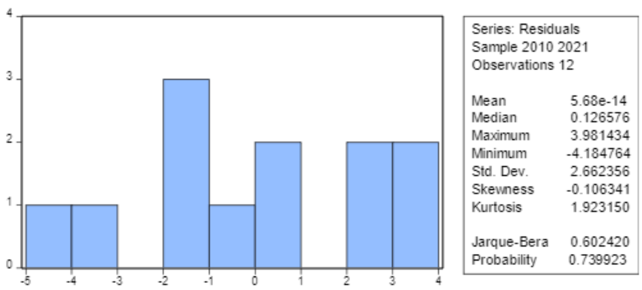
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| YP_ING | -0.476120 | 0.414108 | -1.149748 | 0.2835 |
| PRECIO | -0.035452 | 0.043692 | -0.811409 | 0.4406 |
| P_ING | 6.62E-06 | 6.79E-07 | 9.756830 | 0.0000 |
| C | -311.7954 | 31.40058 | -9.929608 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.951215 | Mean dependent var | 18.62392 |
| Adjusted R-squared | 0.932921 | S.D. dependent var | 12.05383 |
| S.E. of regression | 3.121889 | Akaike info criterion | 5.375955 |
| Sum squared resid | 77.96951 | Schwarz criterion | 5.537590 |
| Log likelihood | -28.25573 | Hannan-Quinn criter. | 5.316112 |
| F-statistic | 51.99545 | Durbin-Watson stat | 1.526176 |
| Prob(F-statistic) | 0.000014 | | |

As shown in table *, it could be stated that the total demand for avocado in England is explained by the price of avocado in the country, as well as by the per capita income and its population, this relationship is subject to the following results:

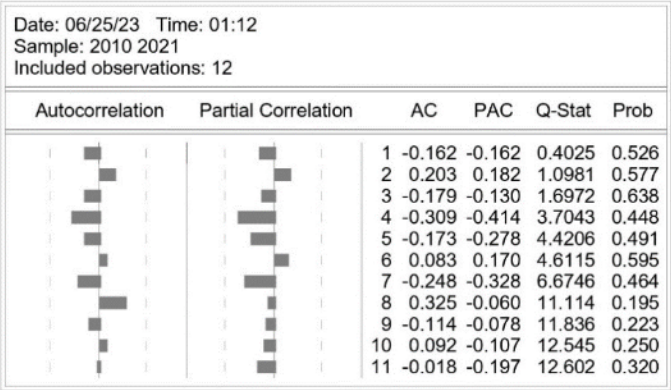
- When the price of avocado increases by 1, on average demand in England decreases by -0.03 percentage points.
- When England's per capita income increases by 1, on average its demand for avocado increases by -0.47 percentage points.
- When the population in England increases by 1, on average its demand for avocado increases by 6.62 percentage points.

NORMALITY TEST




The Jarque Bera test is used to test the normality of the model, where with a result of 0.60 and a probability of less than 0.05 (0.73) it is considered that the errors are normally distributed.

AUTOCORRELATION TEST



Date: 06/25/23 Time: 01:12
Sample: 2010 2021
Included observations: 12

| | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|
| 1 | -0.162 | -0.162 | 0.4025 | 0.526 |
| 2 | 0.203 | 0.182 | 1.0981 | 0.577 |
| 3 | -0.179 | -0.130 | 1.6972 | 0.638 |
| 4 | -0.309 | -0.414 | 3.7043 | 0.448 |
| 5 | -0.173 | -0.278 | 4.4206 | 0.491 |
| 6 | 0.083 | 0.170 | 4.6115 | 0.595 |
| 7 | -0.248 | -0.328 | 6.6746 | 0.464 |
| 8 | 0.325 | -0.060 | 11.114 | 0.195 |
| 9 | -0.114 | -0.078 | 11.836 | 0.223 |
| 10 | 0.092 | -0.107 | 12.545 | 0.250 |
| 11 | -0.018 | -0.197 | 12.602 | 0.320 |

| Positive Autocorrelation | Zone of Indecision | No Autocorrelation | | | Zone of Indecision | Negative Autocorrelation |
|---|---|---|---|---|---|---|
| Rechazo Ho | | Acepto Ho | | | Rechazo Ho | |
| 0 | dl | du | 2 | 4-du | 4-dl | 4 |
| | 0.658 | 1.864 | | 2.136 | 3.342 | |
| | | | **1.5261** | | | |

The autocorrelation test determined by the Durbin Watson statistic, which for the model the result is 1.5261, in that sense, at a significance level of 95% we have that dL and dU is equivalent to 0.658 and 1.864 respectively; from these values, it is determined that the autocorrelation falls in the positive autocorrelation zone.

HETEROSCEDASTICITY TEST

Heteroskedasticity Test: White

| | | | |
|---|---|---|---|
| F-statistic | 0.526283 | Prob. F(9,2) | 0.7951 |
| Obs*R-squared | 8.437343 | Prob. Chi-Square(9) | 0.4907 |
| Scaled explained SS | 1.730874 | Prob. Chi-Square(9) | 0.9950 |

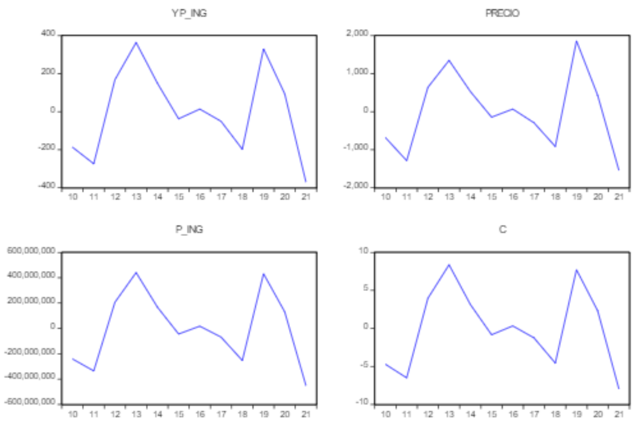
Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/25/23 Time: 01:22
Sample: 2010 2021
Included observations: 12

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4524.400 | 6977.843 | 0.648395 | 0.5832 |
| YP_ING^2 | -0.785751 | 0.640092 | -1.227560 | 0.3445 |
| YP_ING*PRECIO | -0.046409 | 0.201876 | -0.229890 | 0.8395 |
| YP_ING*P_ING | 1.43E-07 | 1.09E-06 | 0.131305 | 0.9076 |
| YP_ING | 70.56853 | 89.85638 | 0.785348 | 0.5145 |
| PRECIO^2 | 0.002812 | 0.017683 | 0.159039 | 0.8882 |
| PRECIO*P_ING | -2.17E-09 | 3.87E-07 | -0.005622 | 0.9960 |
| PRECIO | 0.983610 | 9.369468 | 0.104980 | 0.9260 |
| P_ING^2 | 2.07E-12 | 2.32E-12 | 0.892062 | 0.4665 |
| P_ING | -0.000229 | 0.000296 | -0.773487 | 0.5201 |

| | | | |
|---|---|---|---|
| R-squared | 0.703112 | Mean dependent var | 6.497459 |

| | | | |
|---|---|---|---|
| Adjusted R-squared | -0.632884 | S.D. dependent var | 6.520397 |
| S.E. of regression | 8.332048 | Akaike info criterion | 6.953003 |
| Sum squared resid | 138.8460 | Schwarz criterion | 7.357092 |
| Log likelihood | -31.71802 | Hannan-Quinn criter. | 6.803395 |
| F-statistic | 0.526283 | Durbin-Watson stat | 2.994094 |
| Prob(F-statistic) | 0.795068 | | |

Results greater than 0.05 show that the homoscedasticity assumption is met, with no heteroscedasticity problem of any order in the model.




## CONCLUSIONS

1. In the years for which data are available, in general, monthly prices show behavior of higher prices at the beginning of the year and then decrease significantly until the middle and third quarter of the year, to recover from September onwards.

2. As of 2019, 20 companies in Peru exceeded 3300 tons of annual exports.

3. Between 2010 and 2021, the Netherlands represented 35.50 % of all our avocado sales abroad; the USA, 23.93 %, Spain 17.05 % of the global consumption of our exports, while the United Kingdom, with a consumption of 453,527 MT, represents 8.29 % of our exports.

4. Between 2007 and 2021, Peru has had an average annual avocado harvest of 31,021 hectares.

5. The demand for Peruvian avocados in the Netherlands has the following behavior:

a. A 1% increase in price generates a reduction in demand of 0.16 %.

b. If per capita income increases by 1%, the demand for avocados increases by 2.7%.

c. A 1% increase in population generates that the demand for avocado increases by 8.23 %.

6. In Spain, the demand for Peruvian avocados shows the following behavior:

a. A 1% increase in price generates a reduction in demand of 0.09 %.

b. If per capita income increases by 1%, the demand for avocado increases by 0.13 %.

c. A 1% increase in population generates that the demand for avocado increases by 3.49%.

7. In the U.S., the demand for Peruvian avocados shows the following behavior:

a. A 1% price increase generates a reduction in demand of 1.25%

b. If per capita income increases by 1%, the demand for avocado increases by 16.99%.

c. A 1% increase in the population generates that the demand for avocado decreases by 1.38%.

8. In ENGLAND, the demand for Peruvian avocados has the following behavior:

a. A 1% increase in price generates a 0.03% reduction in demand%

b. If per capita income increases by 1%, avocado demand decreases by 0.47%.

c. Un aumento de 1% en la población genera que la demanda de palta se incrementa en 3.62%.

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