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Analysis of Mexican organic tomato prices for export in the period 2001-2015

Análisis de precios del tomate orgánico mexicano para exportación en el período 2001-2015

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Technological innovation: Methodology for the analysis of the price of organic tomato to export.

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Resumen

Debido a que el precio es una variable determinante en el desempeño de las empresas exportadoras. En esta investigación se analiza el comportamiento de los precios de tomate orgánico de México, en los mercados de Estado Unidos. El objetivo del presente trabajo es describir el comportamiento de cuatro variedades representativas de tomate orgánico mexicano, para ofrecer una visión de la incursión de estos productos en los mercados estadounidenses. Los datos se obtuvieron del Departamento de Agricultura de los Estados Unidos del Servicio de Investigación Económica. El método se refiere al análisis de serie temporal de precios, mediante técnica espectral para detectar la tendencia de la serie y describir su comportamiento, utilizando el software Excel XLSTAT. Los resultados mostraron una diferencia tanto en el origen de los productos como en el estatus de orgánico, durante el período de evaluación 2001 a 2015. Este período de tiempo, permite justificar y soportar los resultados, lo que revela una clara tendencia de fluctuaciones en los precios mensuales y anuales de los productos, con valores atípicos al inicio del análisis de la serie, explicado por las condiciones del mercado externo. Su principal limitación consiste en que se debe tener una gran cantidad de observaciones, es un modelo ateórico y sólo puede ser aplicado a series estacionarias.

Palabras clave: exportaciones, tomate orgánico, análisis de precios.

Abstract

Due to price is a determining variable in the performance of exporting companies. This research analyzes the behavior of organic tomato prices from Mexico in the markets of the United States. The objective of this work is to describe the behavior of four representative varieties of Mexican organic tomato to offer a vision of the incursion of these products in the US markets. Data was obtained from the United States Department of Agriculture's Economic Research Service. The method refers to the analysis of the time series of prices, through a spectral technique to detect the trend of the series and describe its behavior using the Excel XLSTAT software. The results showed a difference, both in the origin of the products and in the status of organic, during the evaluation period 2001 to 2015. This period allows to justify and support the results, which reveals a clear trend of fluctuations in the monthly and annual prices of the products, with atypical values at the beginning of the analysis of the series, explained by external market conditions. Its main limitation is that it must have a large number of observations; it is a model without theory and can only be applied to stationary series.

Keywords: organic tomato, price analysis, time series.

Introduction

One of the main currents of sustainable agriculture is organic farming, which is based on the use of natural products, non-contaminants such as compost, the use of authorized products to control harmful organisms and the use of abundant labor working. Organic food is produced without using pesticides and conventional fertilizers and without adding synthetic ingredients. Food cannot be labeled as Organic if it is produced from genetically modified or irradiated organisms. Also, it should be able to identify and track an organic product from origin to the processing part. Therefore, the aim of this paper was to describe the behavior of prices of four varieties of organic Mexican tomato to export.

To achieve this objective, the work was divided into four sections, each one covering general aspects of the production of organic tomato in Mexico through the construction of the database, the analysis, and conclusions. The methodology consisted of an analysis of the time series of prices that took place through a spectral analysis to detect the trend of the series and describe their behavior, the complement spreadsheet on Excel XLSTAT was used for the analysis. The results of this study can be used in the strategic planning of the producer company of organic tomato export to make decisions about the purchase and sales by the government to encourage public policy through organic agricultural production.

Reference framework

According to (INEGI, 2015) vegetable exports have a higher annual average rate of 7%, and on this group of vegetables, tomato occupies a preferential place; its tendency to export not only has kept growing in the last decade, but it has distinguished from the rest of the vegetables. As you can see in Figure 1, tomato is one of the most important crops in Mexico; it is produced in the 32 states of the Republic being the state of Sinaloa the most representative one, which leads in production. At 2015 states like Baja California, Baja California Sur, Jalisco, Michoacán, San Luis Potosi, Sonora and Zacatecas are the closest competitors of Sinaloa, and even if the margin of advantage is so wide, the efforts of these

states to foray into the production highlight the importance of this crop in Mexico.

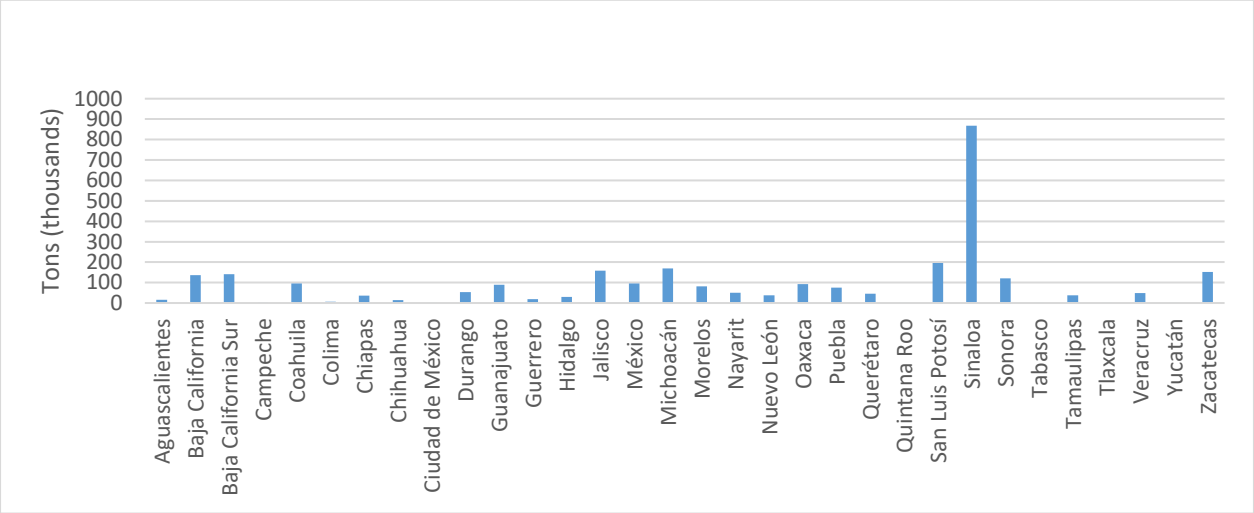


Figure 1. Production of tomato in Mexico 2014.
Source: Based on (SIAP, 2015).

Cano et al. (2004) describes that, one of the main paths in sustainable agriculture is Organic Agriculture, which is based on the use of natural products, non-contaminants such as compost, the use of authorized products for the control of harmful organisms and the great use of handwork, said agriculture represents a complete alimentary safety.

Fundamental aspects that interfere with the price of organics products

Organic Agriculture is a production system that seeks to use the land resources to the maximum, giving emphasis to soil fertility and the biological activity and at the same time, it tries to minimize the use of non-renewable resources, reducing or eliminating the use of fertilizers and synthetic pesticides to protect the environment and human health (SAGARPA, 2012).

Clayton et al. (2011) explains that, organic food is produced without using pesticides and conventional fertilizers and without adding synthetic ingredients. Food cannot be labeled as Organic if it is produced from genetically modified or irradiated organisms. In addition, it should be able to identify and track an organic product from origin to the processing part. The coexistence of organic and non-organic substances during processing, storage and transport is not allowed.

According to FAO (2003), with the increasing demand for food and organic products, the technological innovations, and economics of scale of the company or producer, should reduce costs of production, processing, distribution, and marketing of said products. Prices of organic foods include not only the cost of the production itself, but also other factors that are not contained in the prices of staple foods, such as: a) The promotion and protection of the environment (and avoid future expenses to mitigate pollution). For example, higher prices of commercial organic crops compensate the small gains or rotation periods necessary to enrich soil fertility.; b) increased animal welfare; c) elimination of risks to farmers by

improper handling of pesticides (and elimination of future medical expenses) and d) rural development through the creation of more agricultural jobs and ensure fair and adequate income to the producers.

The organic market is incentivized by several reasons; among them, we can mention the benefits to the health of consumers, the information at the fingertips of the consumer that allows them to learn about the situation environment damage caused by the production, and finally the flavor and freshness that characterize these products (Salgado 2019). However, the importance of each feature mentioned above varies according to the region and country, the awareness of the population and the state's role in promoting production and consumption.

International scenario

Developing countries have identified a major opportunity in the organic food production market, however, under the overall situation in which is immersed economic activity, producers, traders and other multinational players are in a position that allows them to access the international market more efficiently. The limited quantities of organic products and the quality standards imposed on the final market on these products as well as production and processing costs could represent a limiting factor for small producers when trying to satisfy this demand. The marketing of organic food may no longer be encouraged because of difficulties when it comes to international standards and the high cost of certification systems, especially when not established international equivalence. The access to inspection and certification, as well as the need to develop new ways to process organic food, are the challenges that big food companies, already established, and could face better. There are 170 countries worldwide with official data on organic farming activities. The leading countries in organic farming are Australia with 17.2 million hectares, Argentina with 3.2 and the United States with 2.2. (FAO, 2003).

By 2013, 2 million farmers specialized in organic products in this category. The leading countries are India with 650,000, Uganda with 189,610 and Mexico with 169,703. It is estimated that by 2013 the average per person consumption of organic food reached 10.30 US dollars being the countries with higher consumption by each person Switzerland with 210 euros, Denmark with 163 and Luxembourg 157 euros each (FiBL and IOFAM, 2015).

Description of the situation in Mexico

In Mexico, the leading producing states of organic foods are Chiapas, Oaxaca, Michoacán, Chihuahua, and Guerrero, which concentrate 82.8% of the total organic area. Chiapas and Oaxaca alone cover 70% of the total. Mexico grows more than 45 organic products, of which coffee is the most important one by cultivated surface, with 66% of the total (70,838 ha) and a production of 47,461 tons; blue and white corn come in second place, with 4.5% of the area (4,670 ha) and a production of 7,800 tons, in the third place there is sesame seed, with 4% of the area (4124 ha) and a production of 2,433 ton; these crops are followed in importance by vegetables with 3831 ha; agave, with 3047 ha; herbs, with 2510 ha; mango with 2075 ha; orange, with 1,849 ha; beans, with 1597 ha; apple, with 1444 ha; papaya, with 1171 ha, and avocado with 911 ha. Other products like soybeans, bananas, cocoa, vanilla, peanut, pineapple, jamaica, lemon, coconut, walnut, litchi, garbanzo, passion fruit and peach are produced in smaller amounts (SIAP, 2015).
Other types of products are also obtained with organic practice, such as: honey, milk,

cheese, bread, yogurt, sweets, and cosmetics. Mexico is one of the top 20 producers of organic food in the world with 520 thousand hectares of land dedicated to organic farming. It is the largest producer and exporter of organic coffee and the third largest producer of organic honey. In the last decade, the government and private sector have joined forces to promote organic production. As a result, they have opened some farmer's markets for organic products in different regions of the Mexican Republic (USDA-FAS, 2011).

Figure 2 shows the evolution of organic products in Mexico from 2004 to 2013, it's shown how in the period of 2008 to 2011 the area stayed at 332,485.1 ha. However, from this period is noticeable the growing behavior of the used area for these products until it reached 501,363.6 ha in 2013.

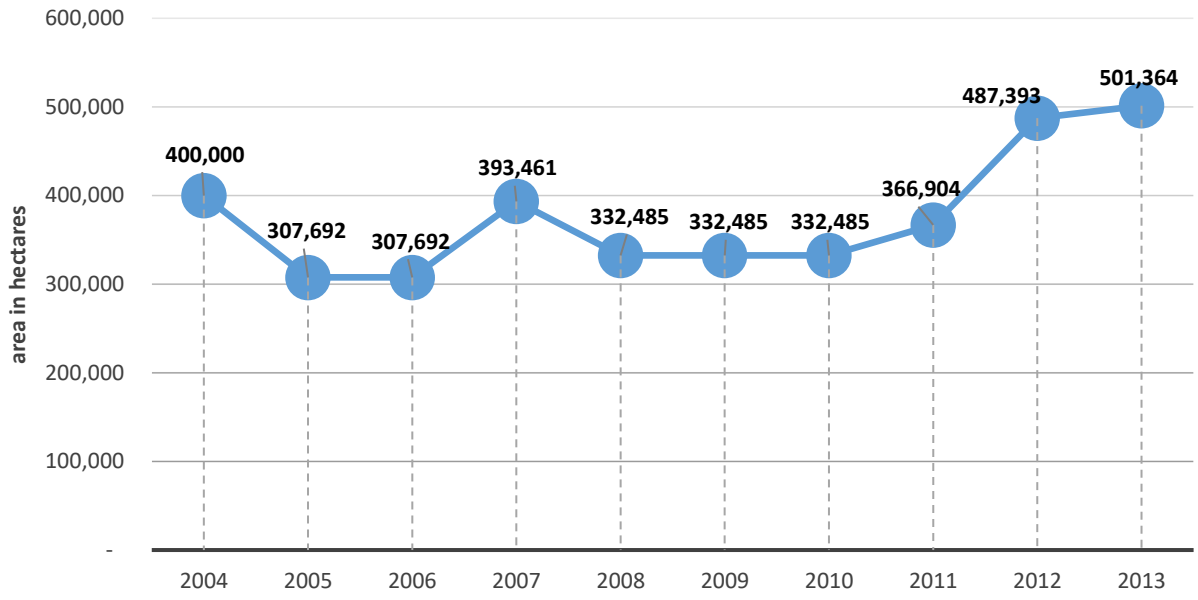


Figure 2. Mexico Planted surface of organic Products in Mexico 2004-2013.
Source: Based on (Organic world, 2015).

According to public politics, the Mexican Council of Organic Production coordinated by ASERCA[a] promoted the integration of Promotion Council "Organic Mexican Impulse A. C.". This Council implements the project "Development and Promotion of the Consumption of Certified Mexican Organic Products" under the following objectives: a) To know the level of consumer acceptance for such products; b) boost sales of organic products and c) promote organic in major markets both nationally and internationally. In each ordinary reunion, ASERCA reports the annual promotion strategy for organic products and the achieved progress. (CNPO, 2015).

Methodology

Description of the information data

The database was built from the prices of organic products in the main market of primary products in Mexico and the United States. This was obtained from the USDA[4].

[a] *Agency of Services for the merchandising and development or agricultural markets.*

[4] *United States Department of Agriculture (USDA).*

The database incorporates the monthly price from 2003 to 2015, considering the average prices or tomato market in its four organic varieties of exportation (Red tomato, Cherry, Grape and Plum).

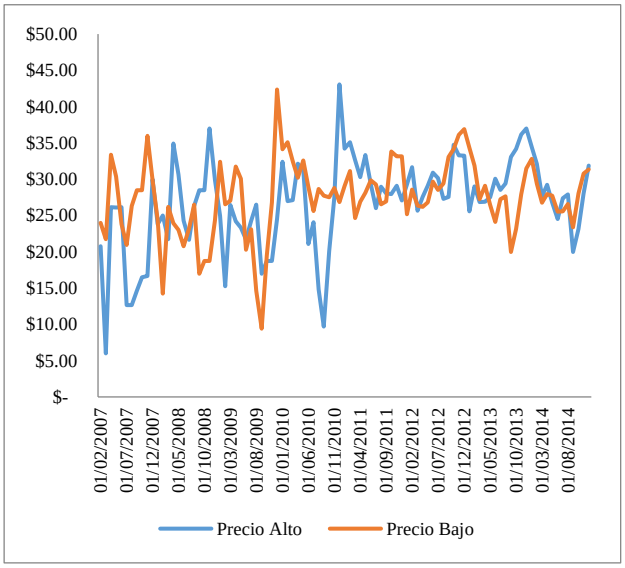
Justification for using a time series

For *time series* we refer to statistical data collected, observed, or register at regular time intervals (daily, weekly, semi-annual, annual, etc.). The term ´time series´ applies to data, for example; recorded on a regular basis. In the economic analysis the choice of series throughout the series is of a certain degree of difficulty. Too short series preclude detection cycles or seasonal patterns precisely not provide sufficient repetitions. Series too long risk treated as a single process to processes that occur over time and reveal markedly different structures. The main objective for a time series lies in the preparation of analyzes to carry out forecasts.

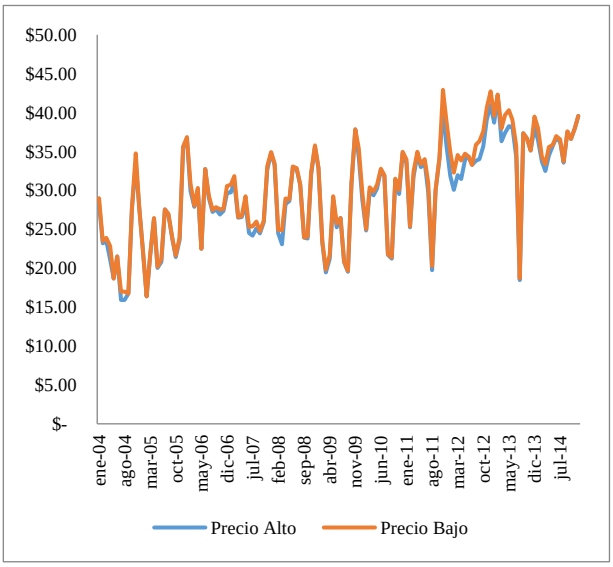
Description of the time series

In Figure 3 was showed the tendency of prices of exportation organic tomato had a presence in the American market since 2004, it is the case of cherry tomato. The other varieties' presence started in 2007 (red tomato and grape) and plump tomato in 2008, see figure 3.

A) Tomato



B) Cherry



C) Grape D) Plum

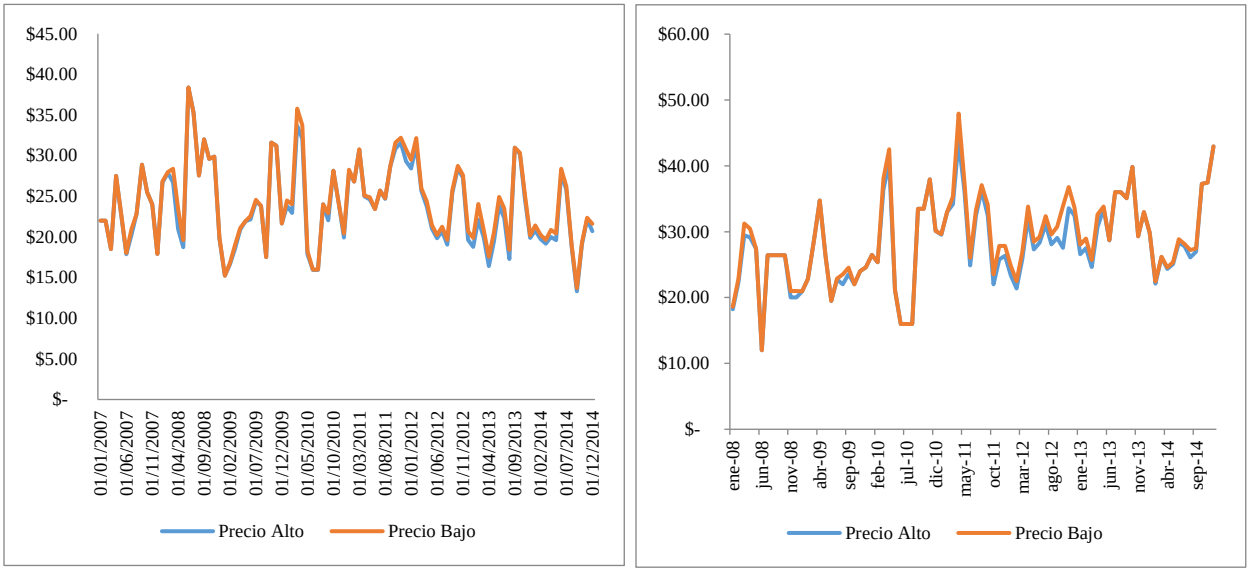


Figure 3. Description of the database of some varieties of organic tomato.
Source: Based on (USDA-FAS, 2011).

Spectral decomposition to corroborate the existence of cycles

Methodologically, all mathematical screening procedures involve cycle's stationary series as presented in Table 1. A series is weakly stationary if: a) The expected value of temporal observations is independent of time, b) The covariance between observations depends only on the temporal distance between them. When a series is not stationary in variance, a logarithmic transformation is required. However, logarithmic transformation is common even in series with relatively constant over time dispersion (Fuentes, 2012). Once the transformation unit root test of Phillips-Perron (Phillips & Perron, 1988) is applied to test the null hypothesis that the time series unit root against the alternative hypothesis of stationary.

Table 1. Average price of tomato.

Red Tomato			**Cherry Tomato**		
	High	Low		High	Low
Tau (Observed value)	-0.461	-0.529	Tau (Observed value)	-0.147	-0.187
Tau (Critical Value)	-1.944	-1.944	Tau (Critical Value)	-1.943	-1.943
value-p (unilateral)	0.513	0.485	value-p (unilateral)	0.631	0.617
Alpha	0.050	0.050	Alpha	0.050	0.050
Grape Tomato			**Plum Tomato**		
	High	Low		High	Low
Tau (Observed value)	-0.746	-0.711	Tau (Observed value)	-0.083	-0.127
Tau (Critical Value)	-1.944	-1.944	Tau (Critical Value)	-1.945	-1.945
valor-p (unilateral)	0.391	0.406	valor-p (unilateral)	0.652	0.637

Alpha	0.050	0.050	Alpha	0.050	0.050

Interpretation of the test: H0: There is a unitary square for the series. Ha: There is no unitary square for the series. The series is stationary.

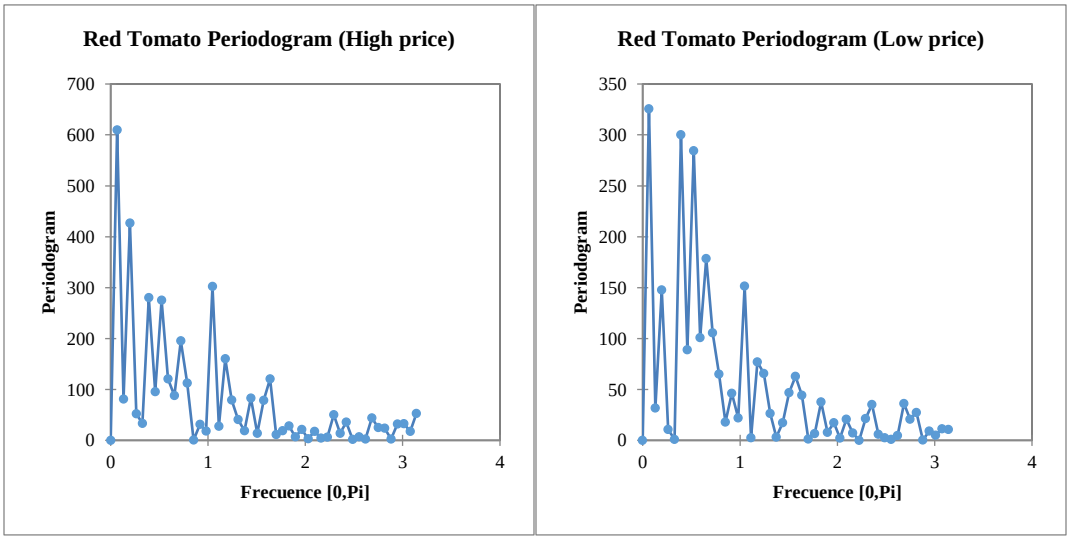
Source: Based on (USDA-FAS, 2011).

In the case of data analysis for the two types of price studied in each of the varieties of organic tomato export could test the null hypothesis of Phillis-Perron without intersection, since the p-value computed is less than the significance level alpha = 0.05, must reject the null hypothesis H0, the risk of accepting the null hypothesis when it is true is 48.52%.

Spectral analysis

Spectral analysis decomposes a data set in terms of their repetitive or cyclical components; originally, it was applied in spread option pricing, where Fourier transforms methods (Hurd and Zhou, 2010). This method has been accepted as base procedure; but now it used in the statistical analysis standards as well (Gonzalez, 2001). Spectral analysis isolates the contribution of seasonal factors and measured the spectrum intensity of each cycle for each given frequency. The output of the analysis is a graph called Periodogram, which assigns a value to each frequency in the analyzed range. A high value for a given frequency means that the data shows a cyclic behavior that often (Lazzati, 2004).

As the signal sent by the graphics shown (Figure 4) in the periodogram is very similar to the description of the data given in the previous section, that is the importance of starting export exceeds the rest of the period analyzed.



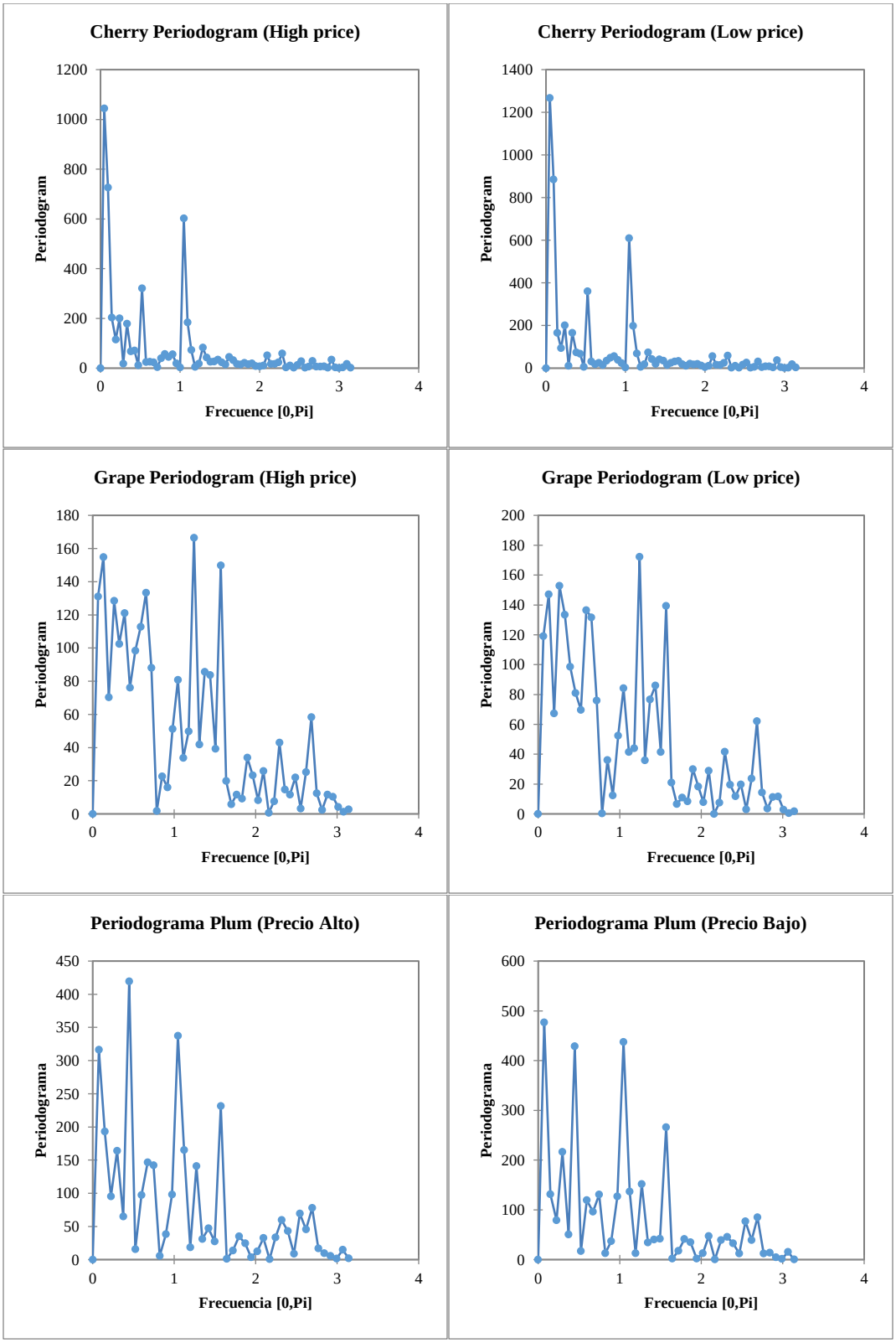


Figure 4. Periodogram of average tomato prices.
Source: Based on (USDA-FAS, 2011).

Decomposition of series

The classic model of time series analysis assumes that the series can be expressed as the sum or multiplication of three basic components: trend, seasonality, and the random error term. The types of generally accepted models are three: additive, multiplicative, and logarithmic. The additive model is used when independence can be assumed between components. As in economic series independence rarely occurs, the multiplicative model is used. The logarithmic model is an additive version of the multiplicative model (Fernandez, 2006).

Identification three key elements: trend, seasonality and error trend or tendency

Figure 5 and 6 showed the trend component is the one that captures the long-term movements in the values of the series, and changes in direction. The trend must be expressed through a continuous and differentiable function of time. Any trend can be represented with high precision by a polynomial. One of the procedures used to estimate the trend is moving averages; this is to estimate the trend component taking linear combinations of a set of data series (Lazzati, 2004).

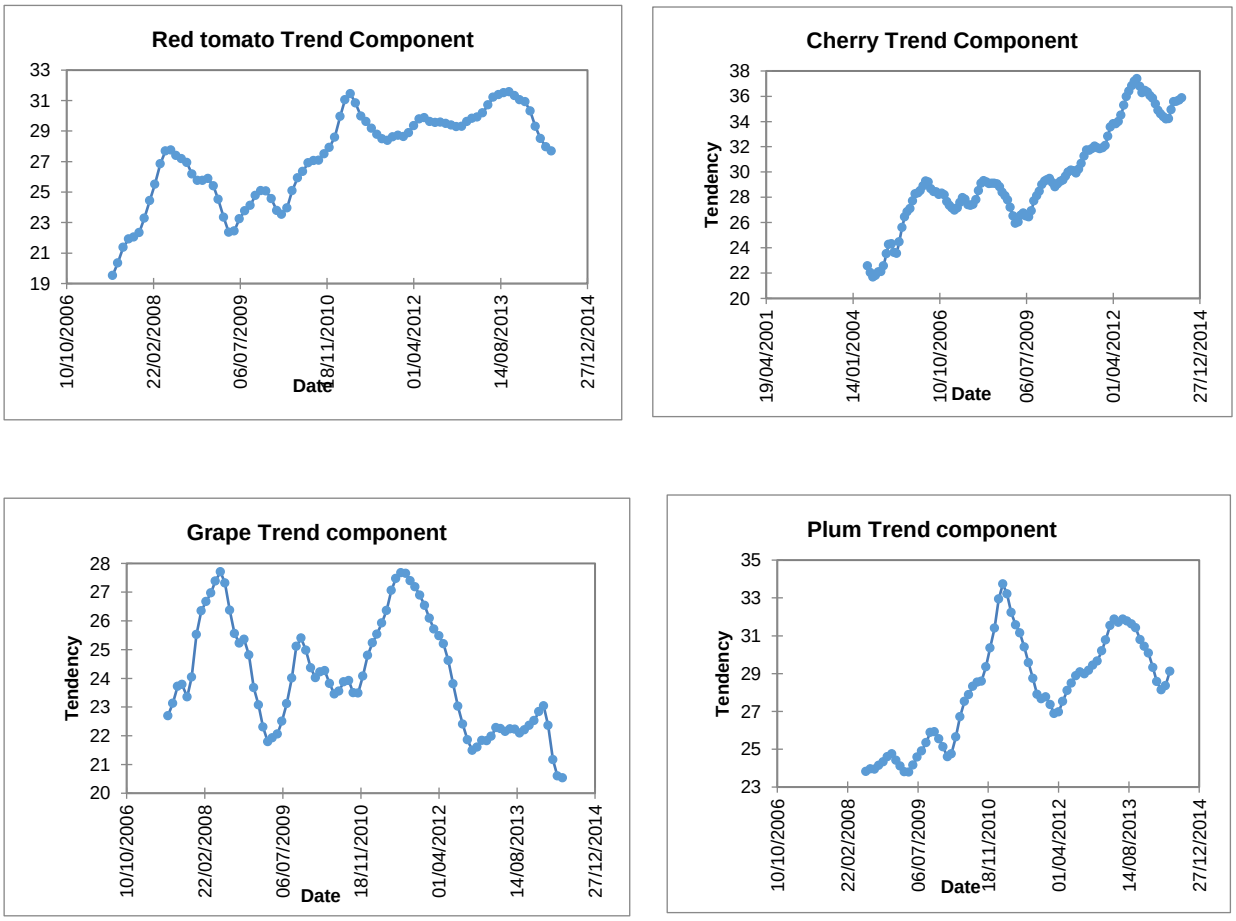


Figure 5. High price average Trend Component.
Source: Based on (USDA-FAS, 2011).

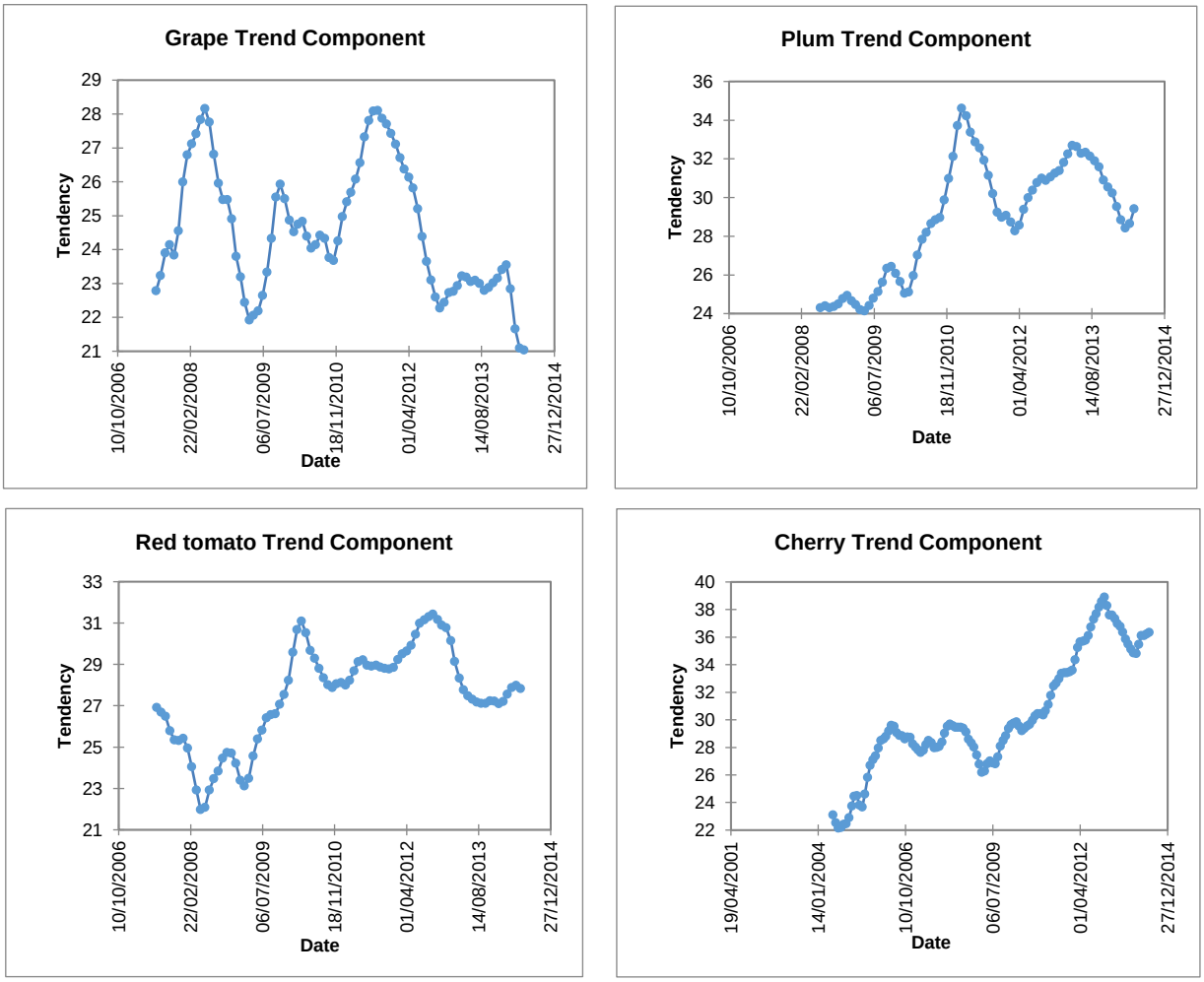


Figure 6. Average low-price, trend component.
Source: Based on (USDA-FAS, 2011).

If the analysis is done by tomato variety the trend component (in both price scenarios) is revealing, it is observed in the case of red tomato as the trend is at first irregular revealing disadvantages inserting the organic market, this sustained while for the lateness of this variety in entering the organic market as it was until the end of 2006 and regularly during 2007 onwards it is present. When advancing the time is noted as the stability of this variety of tomato dominates the rest of the period. Cherry tomato had a greater number of observations due to the presence in the market since 2004. This time had given stability in the markets, and then showing a behavior predictable in some months, even if its price falls seen in the trend graph. Grape variety showed similar tendency to the Red tomato when both had been on market at the same time. Finally, to the variety Plum scenario was as following. The trend component presents an atypical value, between October 2010 and the end of December 2011, in this period the value is not within the marked trend of the period. However, it is important to note that this variety enter the market only in 2008. The atypical period can be justified by the entry of a new product to the market.

Seasonality

The seasonal component observed in Figure 7 reflects oscillations between periods around the trend, repeated similarly. To rectify the additive (or logarithmic) model is first necessary to eliminate the trend component of the series (INEGI, 2004). The seasonal index is constructed by averaging the observations with no tendency for each month for each year observed (Islands, 2012).

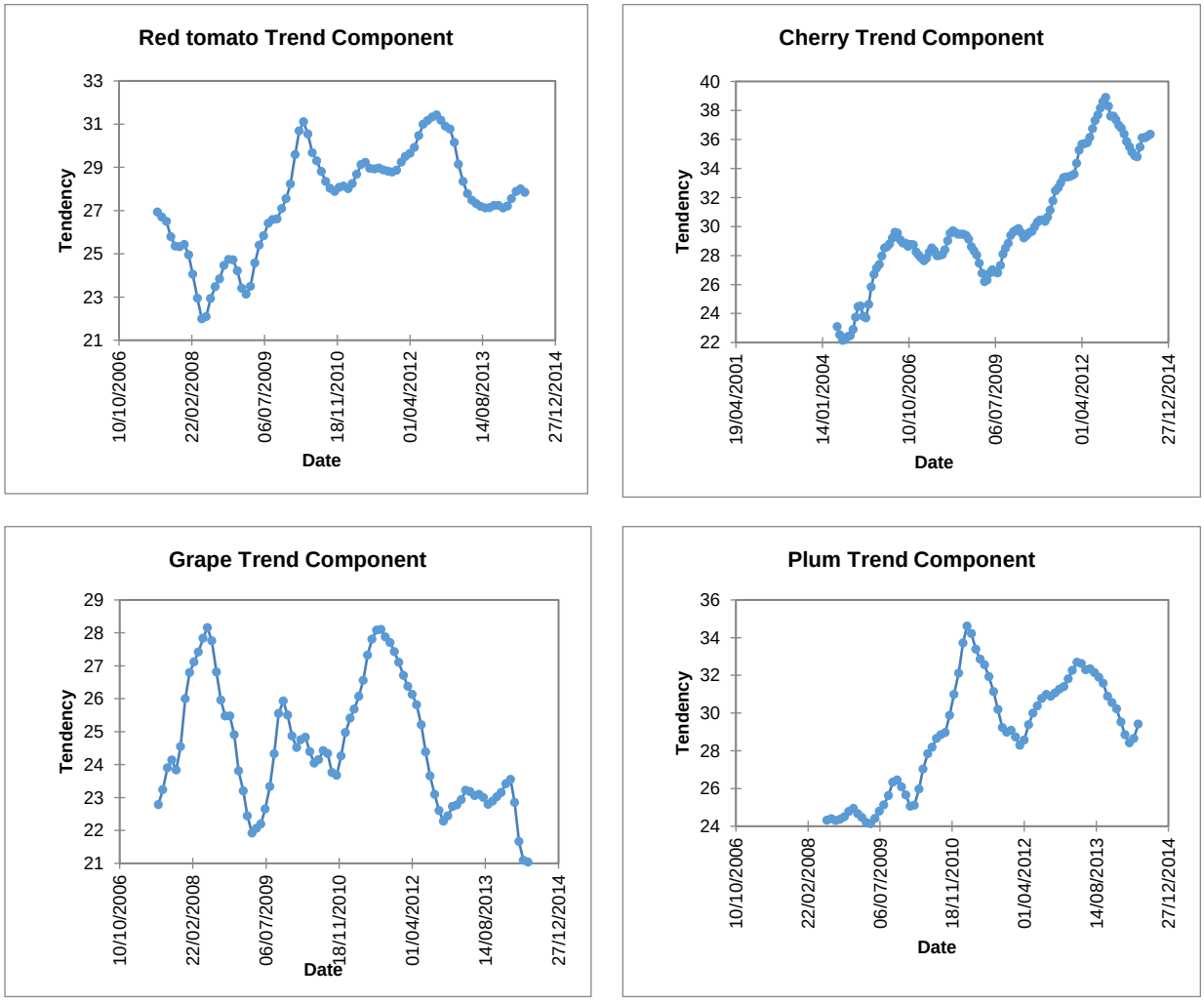


Figure 6. High price average trend Component.
Source: Based on (USDA-FAS, 2011).

In the four varieties is seen as the process managed to isolate the seasonal component leaving aside the trend, and corroborating information. We are talking about a stationary series, the construction of this series (described above) reflects price changes monthly and offers the possibility of building a future analysis regarding past behavior.

Waste

The waste (Figure 8) showed, the component was obtained by subtracting the original series components and seasonal trend.

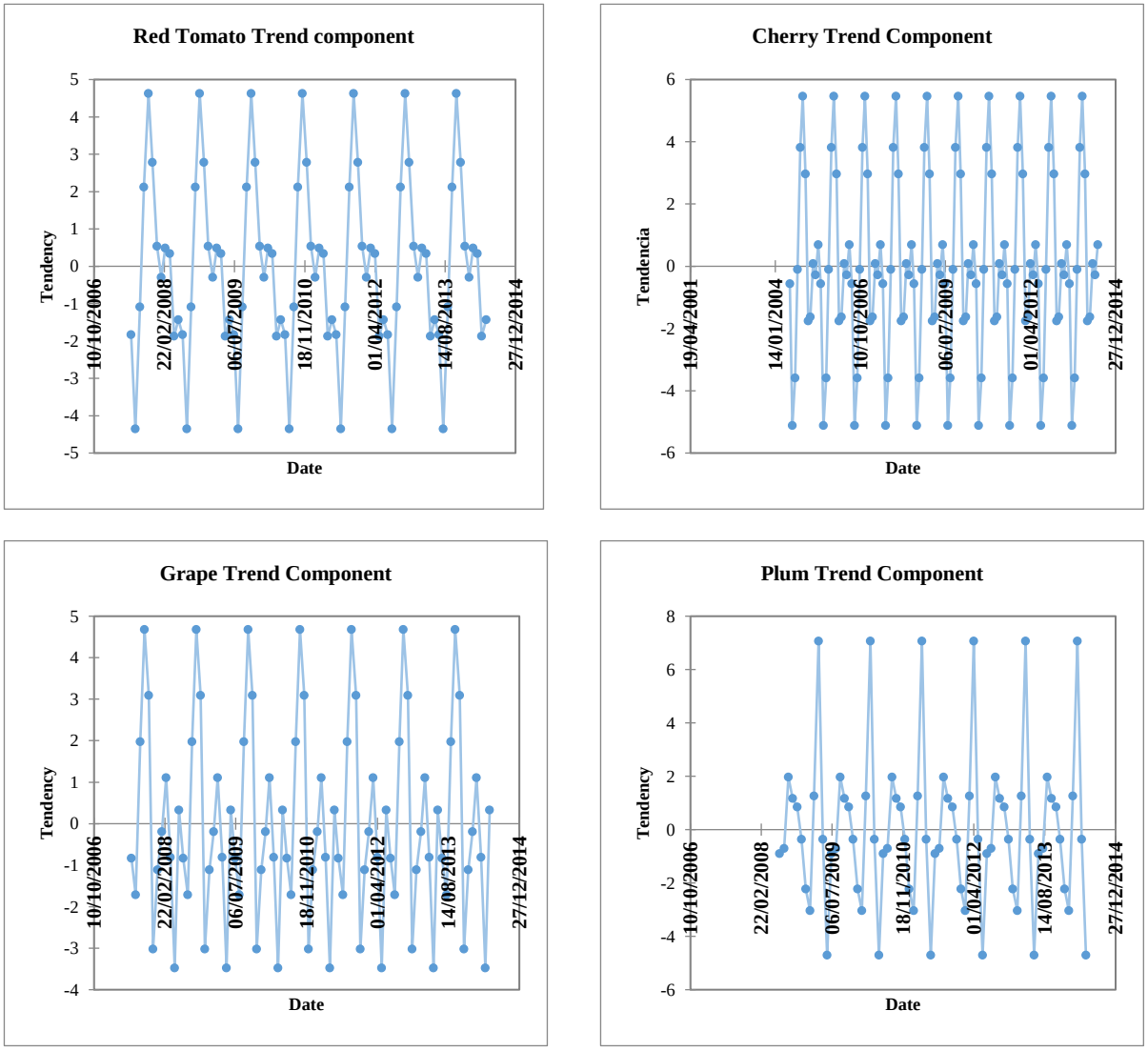


Figure 7. Low price average trend component.
Source: based on (USDA-FAS, 2011).

Conclusions and recommendations

The aim of this paper was understanding the organic vegetables market and price action of tomato export in Mexico during the period 2001-2015. The conclusions of Spectral Analysis in series and its main component showed: 1. The tendency price was repeated in the same manner for each month and each year analyzed, it was noteworthy that at the beginning of period atypical performance that can be explained by errors in learning the sales process were observed of these products, 2. The trend is widely noticeable in the plum and red varieties, for the grape variety the trend is less noticeable. 3. The change in trend may be due to climatic, political, and economic changes beyond the control of the company, 4. Monthly component values were fully consistent with the seasonal supply of this crop, and with economic fundamentals that explain its price in the market and, 5. A strong stability was

observed in the price of the four varieties of tomato scenarios studied in the high and low price during most of the period under study. The main limitation for this type of work is that it must have a large number of observations, in addition to being an empirical model, so that it can only be applied to a stationary series.

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