Effectiveness of United States Corn Futures Contracts as Hedging Instruments for Mexican Corn Producers

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Abstract

Mexico pledged 550 million pesos ($41 million USD) in 2012 to fund a price risk management program for agricultural producers (Stargardter, 2012). The program utilizes risk management tools based in the United States, primarily options on futures contracts. In some cases, the subsidy levels for option premiums were as high as 100%, but the program has scaled these back to an 85% subsidy or less. The purpose of this project is to determine the effectiveness of United States corn futures contracts as hedging instruments for Mexican corn producers.

Local cash prices for multiple locations across Mexico are reported by La Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación. These prices are available weekly from January 1998 to present. Futures prices for corn are from the CME Group. To determine the effectiveness of the CME Group corn futures contract as a price risk tool for Mexican corn producers linear regression models are estimated where the local cash price is the dependent variable and the futures price is the independent variable. The results of the model offer insight on the basis and optimal hedge ratio for Mexican producers, and we can comment that using futures contracts of yellow corn negotiated at the CME Group as a price risk management tool is effective if we consider white corn national data, since our regression model proves with a ninety five percent of confidence level that prices in Mexico are explain eighty three point five percent by prices at the CME group. However, basis given by the government appear to be insufficient according to our analysis.

Key words: Mexico, Corn, Subsidy, Producers, CME Group, Basis, Futures, Hedging.

Introduction/Background

Mexico is a country with a very important “Primary Sector” (crops, fruits, vegetables, livestock, fishing, hunting, recollection, catching, forestry activities, etc.) for economic growth and social welfare. This sector refers to Agriculture and Natural Resources (ANR), and has been analyzed by numerous economists.

During the first quarter of 2016, GDP of ANR grew at an annual rate of 3.1 percent, in relation to the same period of the year before and above the whole Mexican economy, which grew 2.6 percent year-over-year. By subsector, crops, fruits and vegetables activities increased 4 percent, the breeding and production of animals increased 2.1 percent and fishing, hunting and catching 9.8 percent. In contrast, forestry activities were reduced by 2.2 percent and services related with agricultural activities were reduced by 14.2 percent.

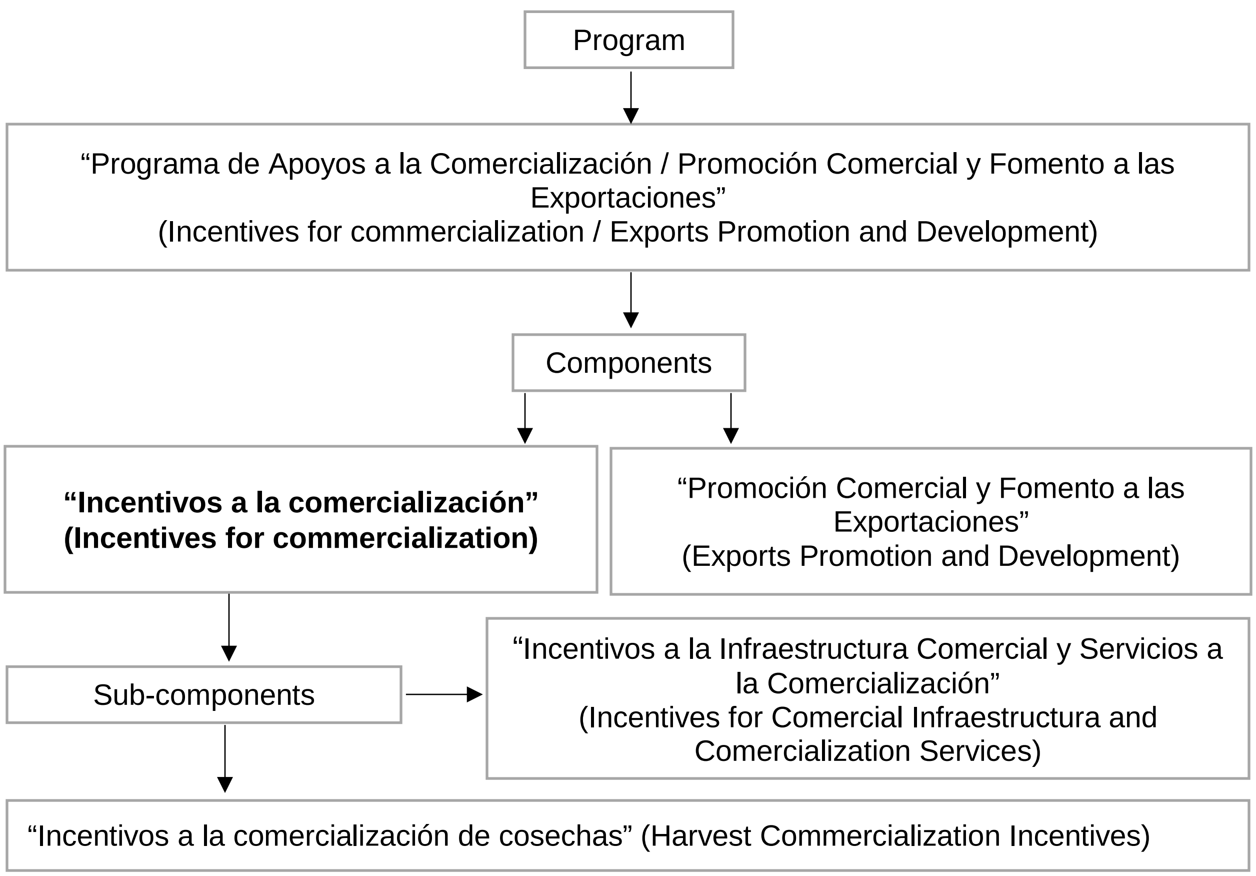
Nonetheless, the progress shown in ANR was a product of the increase in crops, fruits and vegetables production. This accounts for 62.9 percent of ANR GDP, breeding and production of animals for 31.8 percent, and the rest of activities for 5.3 percent (SAGARPA, 2016).

This provides the foundation of how important agriculture is to the Mexican Economy and why the government provides millions of dollars in subsides to agricultural activities through federal programs across the country. Also, there are several federal institutions, organizations and legal entities within the agricultural industry whose main objective is to build a stronger agricultural sector. These institutions include, but are not limited to, banks, financial institutions, agencies, and trusts.

Before the introduction of the North America Free Trade Agreement (NAFTA) went into effect in 1994, prices of main grains and other agricultural commodities in Mexico were regulated by the government through price support programs where the government purchased them at a minimum price (precio de garantía) (Guerrero, 2012). These programs where mainly managed by one of the most important Mexican institution at that time: CONASUPO. However in 1995, just one year after The NAFTA, CONASUPO was replace by “Agencia de Servicios a la Comercialización y Desarrollo de Mercados Agropecuarios” (ASERCA).

ASERCA has many different programs. However, most of them tend to change over time, not only by name, but also by content. This makes them difficult to track and analyze with accuracy. This is evidenced by Appendini (2014) who states: “…ASERCA observes no uniform standards for presenting data...and… The data are scattered across several ASERCA websites”.

Figure 1 depicts ASERCA’s component of interest *Incentives for Commercialization*. This, brought new strategies targeting commercialization for agro-producers across Mexico.



Source: https://www.gob.mx/aserca/acciones-y-programas/programa-de-apoyos-a-la-comercializacion (accessed November, 2017)

The second sub-component (Harvest Commercialization Incentives) focuses on Price Risk Management, Target Income and Commercialization Strategies.

For Price Risk Management, the sub-component *Harvest Commercialization Incentives* focuses mainly on the use of financial instruments, options on futures, negotiated at the CME Group; options function much like price insurance (ASERCA provides information by crop, type of option, price of coverage and so forth). The aim of this strategy is to "*protect the expected income for farmers, traders and consumers and to lower the risk of adverse international price fluctuations. Another goal is to familiarize agents of the Mexican countryside with the financial and stock market culture" (Appendini, 2014).*

Subsidies of the sub-component Harvest Commercialization Incentives are determined by product, agricultural cycle, federal entity or region, and are provided in Mexican Pesos according to producer's volume of operation measured by metric ton.

In 2005 ASERCA's subsidy for the sub-component "Incentivos a la Comercialización de Cosechas" (Harvest Commercialization Incentives), specifically Price Risk Management, was 497 million pesos (~45.68 million dollars at that time). This sub-component is the most important of its kind in Latin America, not only for the volume and number of contracts traded, but also for the subsidy granted to the premium option payment (Godínez, 2006). From this subsidy offered by ASERCA, corn producers received 46.6 percent, wheat producers received 21.1 percent, cotton producers received 8.4 percent and sorghum producers received 8.1 percent. Therefore, the corn industry is a major participant with respect to subsidies received since it is a very important part of Mexico's agriculture. Furthermore, 27 percent of agricultural land and 2.8 million farms were estimated to be engaged in maize production at the end of this millennium's first decade (INEGI, 2009). Also, in 2014 INEGI's National Agriculture Survey showed that Mexico planted 13,559,765.3 hectares (~ 33,506,910 acres) of annual and perennial crops from which corn represented 49.85 percentage of the total area planted and beans (the second highest) 12.23 percentage.

Therefore, based on the significant use of USA derivatives in Mexico, the purpose of this research is to determine the effectiveness of United States corn futures contracts as hedging instruments for Mexican corn producers. To do this we estimated regression models for Mexico and three of its regions using data from the [1] "Sistema Nacional de Información e Integración de Mercados (SNIIM)" and the CME Group.

Literature Review

The Mexican government supports a price risk management program for farmers administrated by a federal agency named ASERCA. However, according to Ortiz and Montiel (2016) *"...the market price of corn futures is not closely related to those recorded prices in some country states, so we can infer that the coverage by ASERCA program does not adequately serves the purpose of protecting domestic farmers growing white corn, although their use has increased*". This conclusion was made based on SNIIM data, from the first week of 2007 to the last week of 2012. This article stablish that not only *spot prices* for Mexico were obtained from the SNIIM, but also futures contract prices with an expiration date of March for yellow corn number two.

Ortiz and Montiel argued that they used futures contracts with an expiration date of March based on "Theoretical basis for corn" by MexDer, and through an analysis of multivariate stochastic volatility their conclusion arose.

Hedging is often presented within the framework of minimizing risk. Working (1953a) argued that hedgers are profit maximizers that seek to speculate on basis, just as a trader speculates on price. The outcome of risk reduction, according to Working (1953b), is merely an "incidental advantage gained". Following these, Johnson (1960) and Stein (1961) incorporated both the risk reduction aspects of hedging, which Working (1953b) remarked as incidental, and the speculative nature on basis risk via portfolio theory. This was further measured by Ederington (1979) who found that the optimal hedge ratio was the ratio of the covariance of the spot and futures price relative to the variance of futures price. Castelino (1992) showed that the hedge ratio is invariant over time. Collectively,

[1] SNIIM: Nacional System of Information and Market Integration

these results provide the foundation for determining the effectiveness of hedging whereby the coefficient resulting from regressing futures prices on cash prices is an indicator of the effectiveness of the futures market price when used as a hedging instrument in a specific cash market location.

The Mexican government supports price risk management for farmers. This is accomplished by way of option contracts that are traded on United States futures exchanges. An option contract is the right, but not the obligation, to obtain a futures contract with a set maturity date at a specific price (Purcell and Koontz, 1999). Options differ from using futures contracts directly since buyers are not obligated to exercise their option contract. As a result, the option contract is very similar to an insurance product whereby a premium is paid to the option seller and the option is used in the case of an adverse price event (the direction of the adverse price event will depend on the type of option purchased by the option buyer).

When an option is exercised, the option buyer opens a position in the futures market. Therefore, the relationship of the specific futures contract price and the local market price are inherently important. So long as this relationship is consistent, the price risk tool (in this specific case, an option contract, which, when exercised, becomes a futures market position) acts as a reliable price risk protocol.

Data

Local cash prices for multiple locations across Mexico are reported by La Secretaría de Economía (translated: Secretary of Economy) through the SNIIM. These prices are in Mexican pesos per kilogram for white corn commercialized in bulges of 50 kg. They are available weekly from January 1998 to the present and are classified by state of origin. Also, the data includes information such as product destination, minimum price paid, maximum price paid, mode price and some additional comments.

Prices from the second week of each month and from different locations across twenty nine Mexican States were selected in order to create a monthly time series of cash prices

(Raw Data). The second week is chosen since grain futures expire on the 15th business day of each contract month (or the closest business day preceding the 15th).

The Raw Data included six thousand seven hundred and thirty-three observations. From those, eight observations categorized as “Nacional” (National) were deleted to keep our geographic classification clear. Also, thirteen observations categorized as “Importación” (Imports) and two with the comment “EUA” were deleted as well, since the objective of this research was to study price relationships between Mexico cash prices and U.S. futures.

In addition, the Raw Data contained 120 comments across all observations. Since we deled two observations with the comment “EUA” the remaining one hundred and eighteen comments are mentioned below:

Table 1. Comments from SNIIM Price Data

Comment	**Number of observations with the comment:**
50 Kg. Bulge	46
Sales per Ton	40
Minimum Price is for Sales per Ton	12
Poultry	12
Shortage	2
Direct from producer	2
Change of Origin	2
8	1
9	1

Source: Own elaboration base on SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/

The observations with the comments above mentioned were kept since they do not have an impact on the purpose of this research according to our methodology.

Then, mode prices from different locations reported in each one of the twenty nine Mexican States during the second week of each month were averaged to condense multiple prices for individual locations into a single observation. This resulted in a new data series with 236 observations (Worked Data) of physical market prices across Mexico.

Futures Prices for corn compiled by the Livestock Marketing Information Center (LMIC), originated from the CME Group (formerly, the Chicago Board of Trade) were gathered. The futures data are condensed to the daily closing prices from each Wednesday of the second week of each month. The purpose of this was to match the cash price timeframe.

Since Futures Prices were display in dollars per bushels, prices from the SNIMM were converted to those units using an average of the daily exchange rate *Pesos per Dollar* provided by the Federal Reserve Bank of St. Louis.

Finally, in order to conduct regional analysis Mexican States were classified geographically into three different regions (North, Central and South). Then, mode prices from different locations reported in each one of the geographically classified state during the second week of each month were averaged to condense multiple prices for individual locations into a single observation for each region. This resulted in three new data series with 236 observations each one.

Data Summary Statistics

Visual data descriptions are provided in figures 1-16 and tables 4-8 using tools such as means, standard deviations, histograms, box plots, counts, percentages, graphs, correlations, minimums, maximums, variance, skewness and kurtosis.

Raw data:

Raw data classify geographically:

Origen	Count
Importación	13
Yucatán	116
Campeche	125
Tabasco	42
Chiapas	300
Veracruz	317
Oaxaca	71
Guerrero	1
Puebla	96
Morelos	3
Tlaxcala	36
Distrito Federal	189
Michoacán	221
México	432
Hidalgo	87
Querétaro	29
San Luis Potosí	2
Guanajuato	566
Jalisco	642
Nayarit	84
Aguascalientes	171
Zacatecas	189
Tamaulipas	438
Nuevo León	87
Coahuila	27
Durango	142
Sinaloa	1706
Chihuahua	358
Sonora	204
Baja California Sur	31
Nacional	8
Grand Total	6733

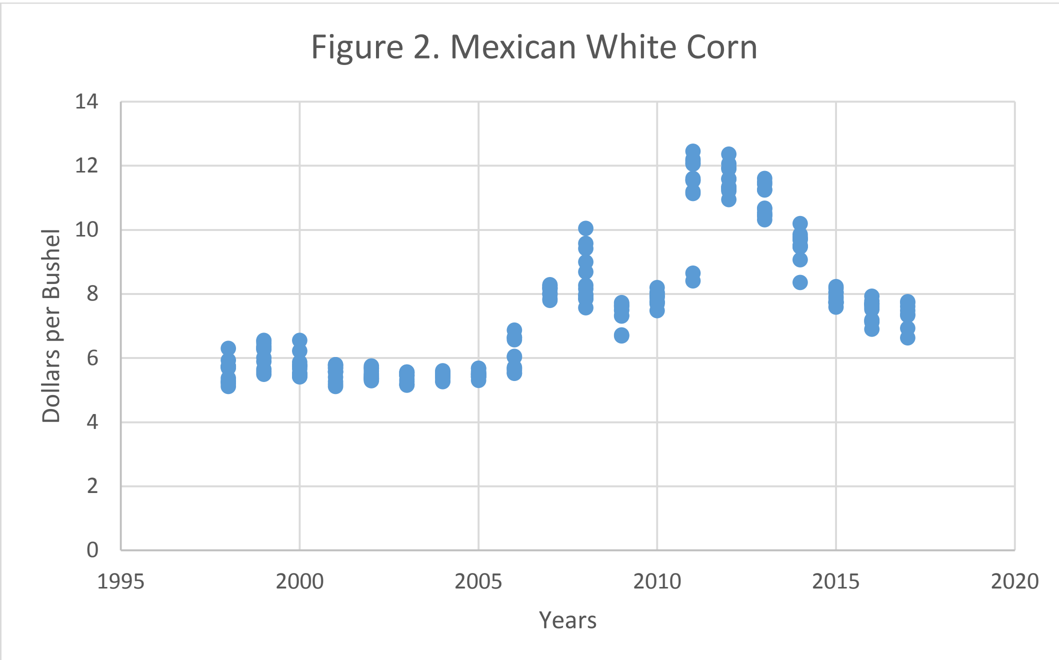
Raw data classify geographically/alphabetically:

Origen	Count	%Ocurrance
Aguascalientes	171	2.54%
Baja California Sur	31	0.46%
Campeche	125	1.86%
Chiapas	300	4.46%
Chihuahua	358	5.32%
Coahuila	27	0.40%
Distrito Federal	189	2.81%
Durango	142	2.11%
Guanajuato	566	8.41%
Guerrero	1	0.01%
Hidalgo	87	1.29%
Importación	13	0.19%
Jalisco	642	9.54%
México	432	6.42%
Michoacán	221	3.28%
Morelos	3	0.04%
Nacional	8	0.12%
Nayarit	84	1.25%
Nuevo León	87	1.29%
Oaxaca	71	1.05%
Puebla	96	1.43%
Querétaro	29	0.43%
San Luis Potosí	2	0.03%
Sinaloa	1706	25.34%
Sonora	204	3.03%
Tabasco	42	0.62%
Tamaulipas	438	6.51%
Tlaxcala	36	0.53%
Veracruz	317	4.71%
Yucatán	116	1.72%
Zacatecas	189	2.81%
Grand Total	6733	100.00%

Tables 2 and 3 source: Own elaboration base on SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/

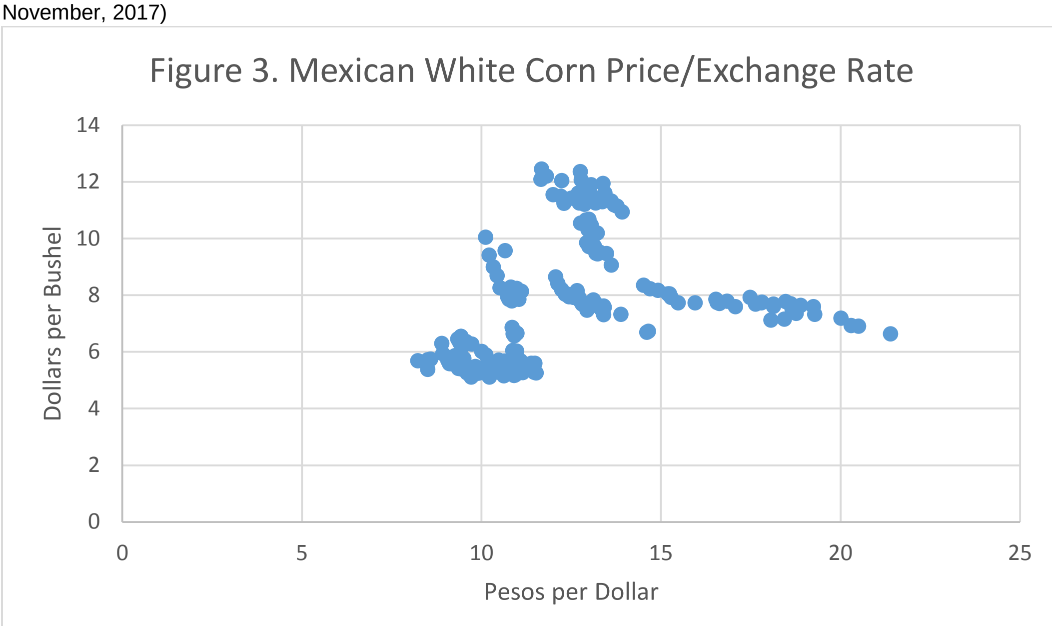
Observations from the Raw Data include 29 Mexican states out of the 31 there are. In which the following states are not included: Colima and Baja California 0 observations.

Variables interaction:



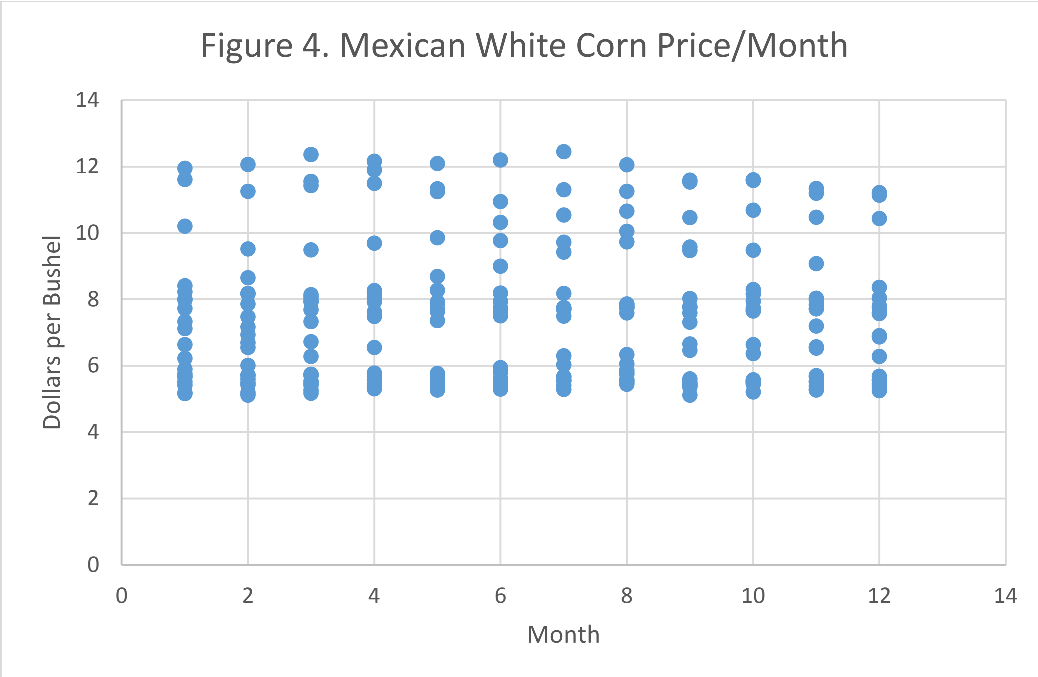
Correlation: 0.682598

Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/ and Exchange Rate ps://fred.stlouisfed.org (accessed November, 2017)



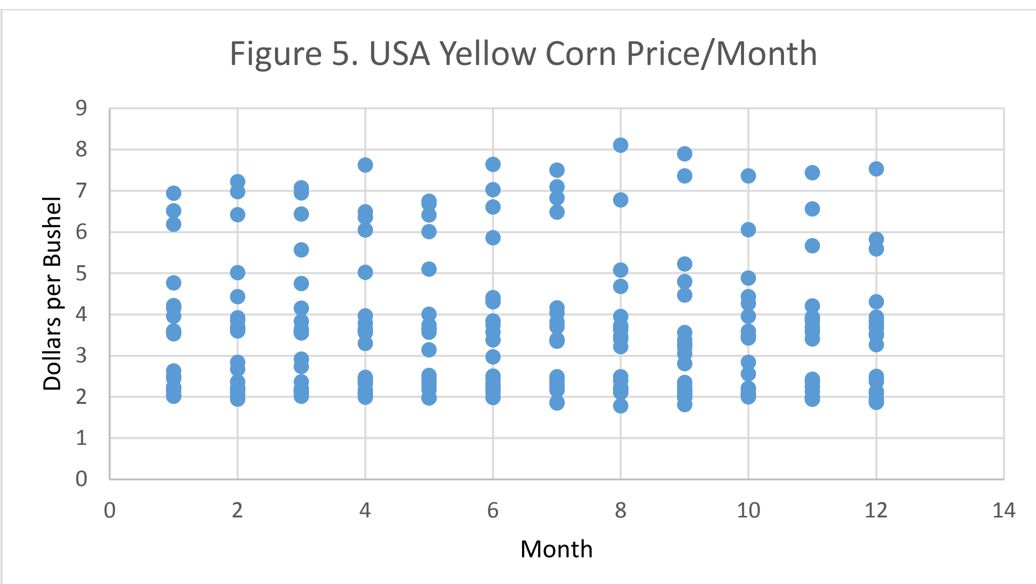
Correlation: 0.36514

Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/ and Exchange Rate ps://fred.stlouisfed.org (accessed November, 2017)



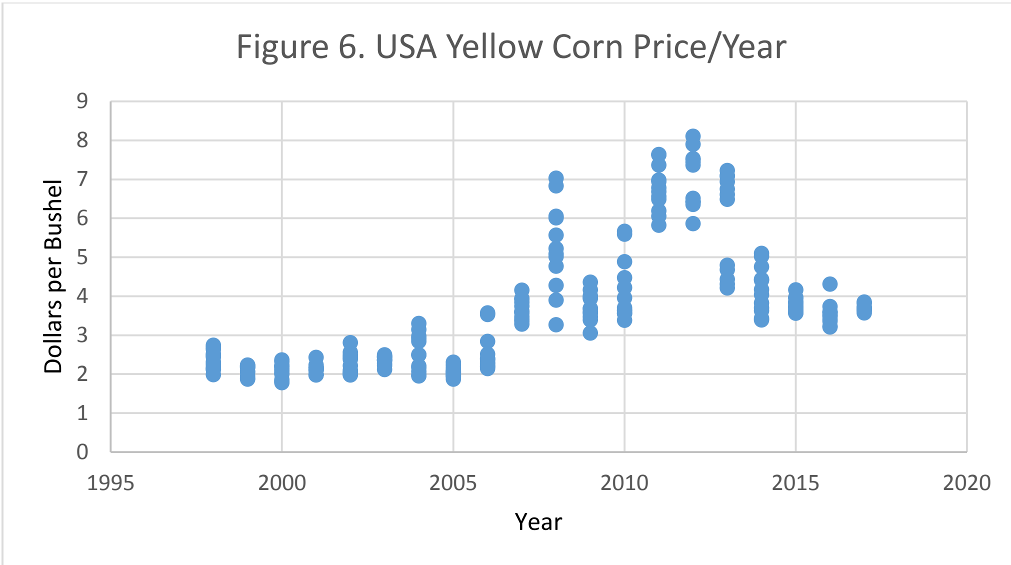
Correlation: 0.007617

Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/ and Exchange Rate ps://fred.stlouisfed.org (accessed November, 2017)



Correlation: -0.04916

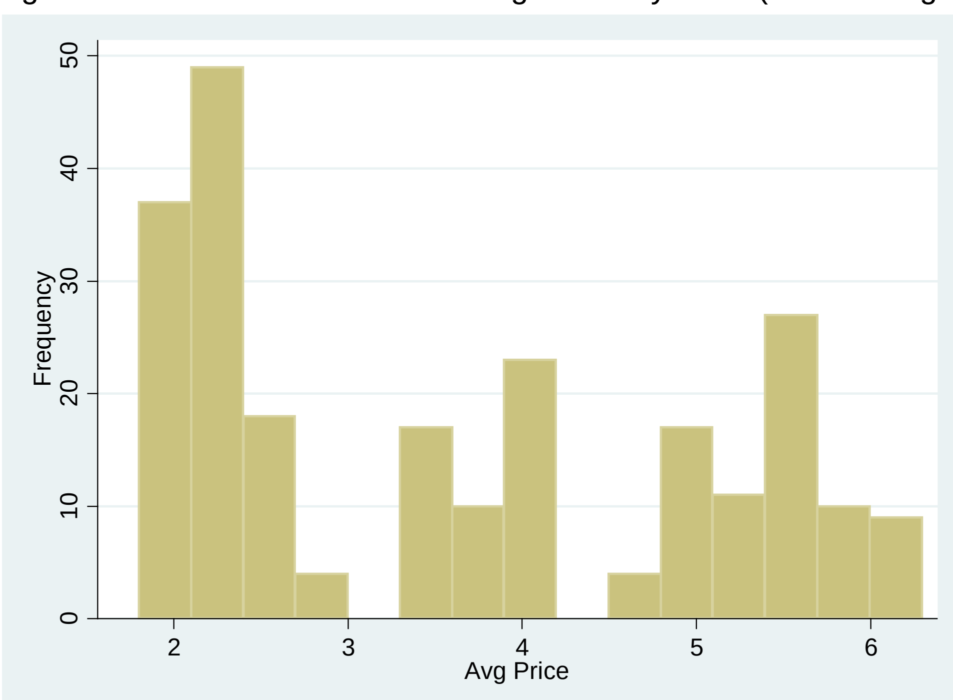
Source: LMIC prices for yellow corn http://www.lmic.info/spreadsheet/prices-and-production (accessed November, 2017)



Correlation: 0.63014

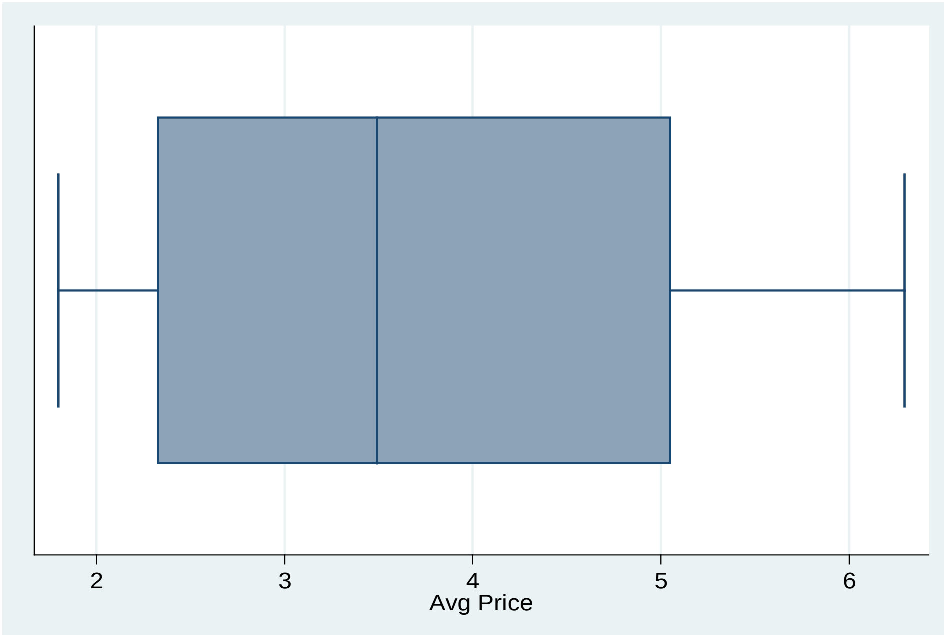
Source: SNIIM prices for yellow corn http://www.lmic.info/spreadsheet/prices-and-production (accessed November, 2017)

Figure 7. Mexican White Corn Average Monthly Price (Pesos/Kilogram)



Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/ (accessed November, 2017)

Figure 8. Box Plot Mexican White Corn Average Monthly Price (Pesos/Kilogram)



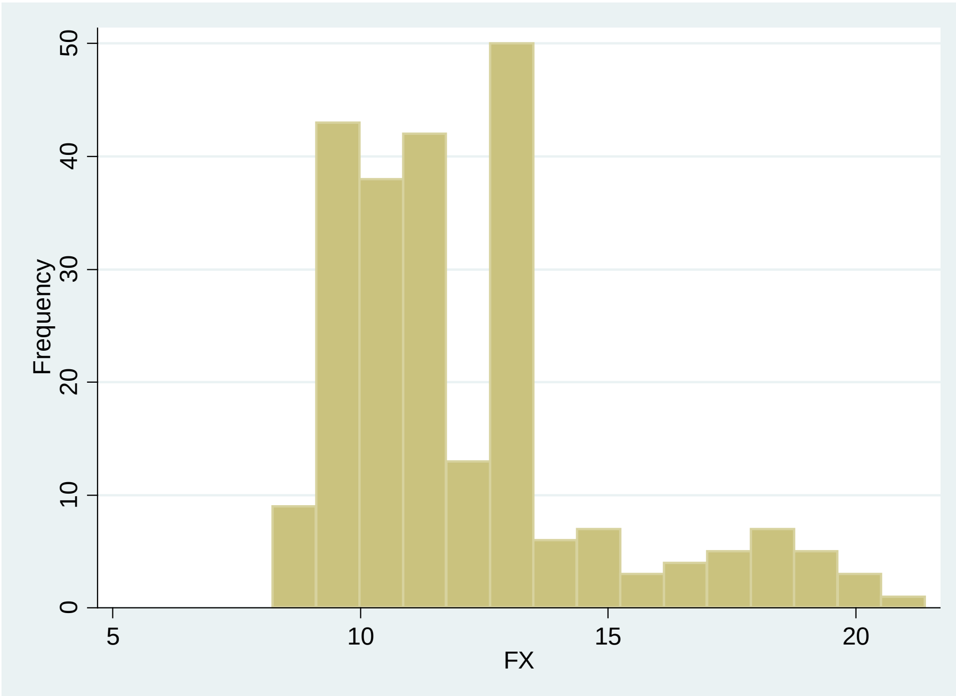
Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/ (accessed November, 2017)

Table 4. Descriptive Statistics of Mexican White Corn Price (Pesos/Kilogram)

White Corn				
	Percentiles	Smallest		
1%	1.915385	1.8		
5%	2.0125	1.84375		
10%	2.060417	1.915385	Obs	236
25%	2.326667	1.934615	Sum of Wgt.	236
50%	3.489643		Mean	3.626163
		Largest	Std. Dev.	1.433241
75%	5.049731	6.118064		
90%	5.658286	6.138064	Variance	2.054179
95%	5.89871	6.206	Skewness	0.3366639
99%	6.138064	6.293214	Kurtosis	1.560354

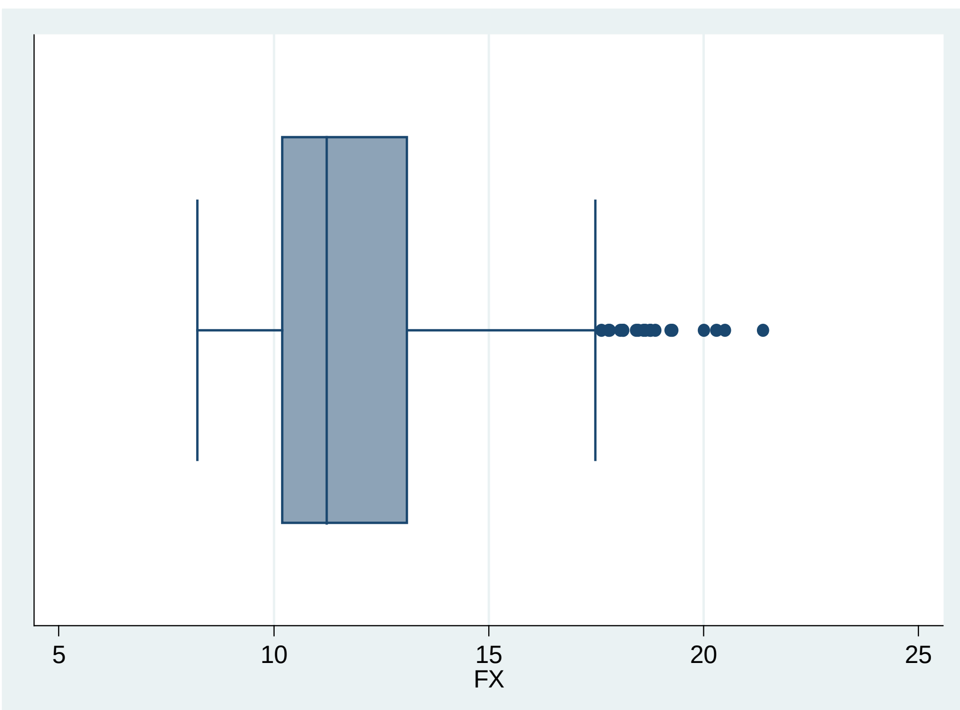
Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/ (accessed November, 2017)

Figure 9. Average Monthly Exchange Rate Pesos per Dollar



Source: https://fred.stlouisfed.org (accessed November, 2017)

Figure 10. Box Plot Average Monthly Exchange Rate Pesos per Dollar



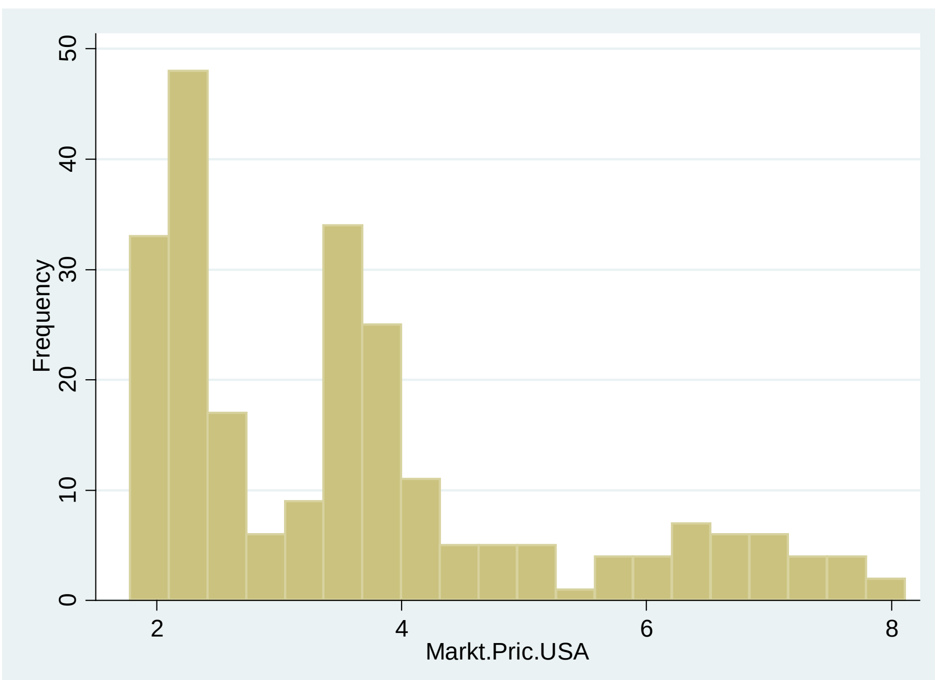
Source: https://fred.stlouisfed.org (accessed November, 2017)

Table 5. Descriptive Statistics of Average Monthly Exchange Rate Pesos per Dollar

FX				
	Percentiles	Smallest		
1%	8.5021	8.2272		
5%	9.1475	8.5017		
10%	9.3699	8.5021	Obs	236
25%	10.2023	8.5681	Sum of Wgt.	236
50%	11.22635		Mean	12.11013
		Largest	Std. Dev.	2.711286
75%	13.11505	20.0086		
90%	16.5697	20.3008	Variance	7.351073
95%	18.4742	20.4992	Skewness	1.267764
99%	20.3008	21.3911	Kurtosis	4.247172

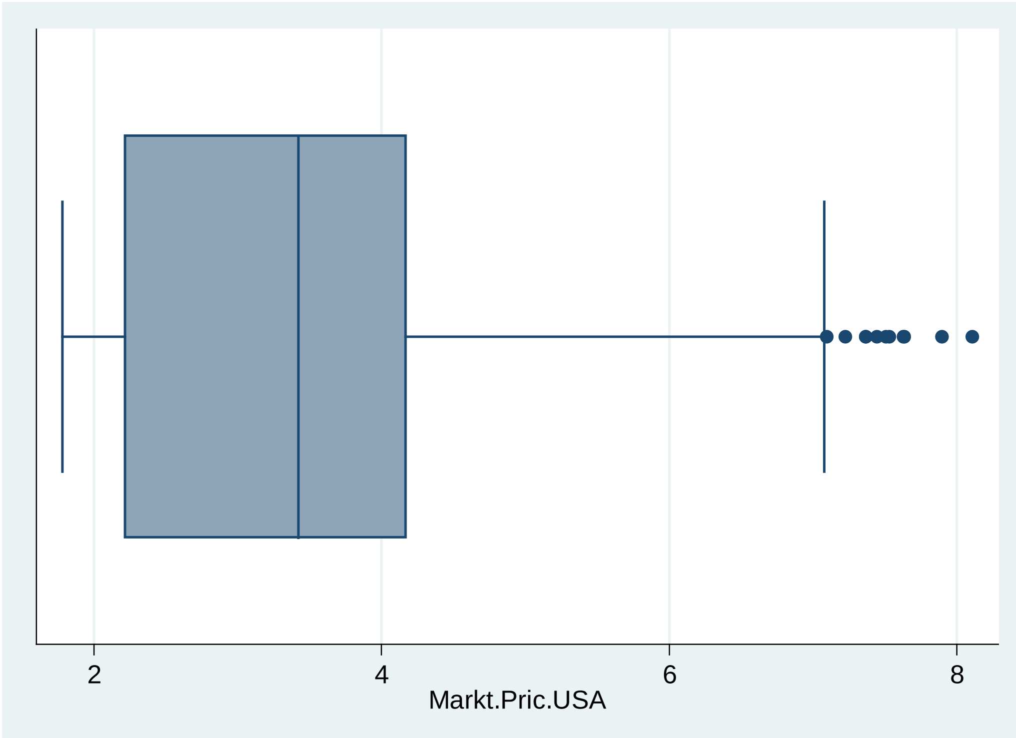
Source: https://fred.stlouisfed.org (accessed November, 2017)

Figure 11. Yellow Corn Average Monthly Price (Dollars/Bushel)



Source: http://www.lmic.info/spreadsheet/prices-and-production (accessed November, 2017)

Figure 12. Box Plot Yellow Corn Average Monthly Price (Dollars/Bushel)



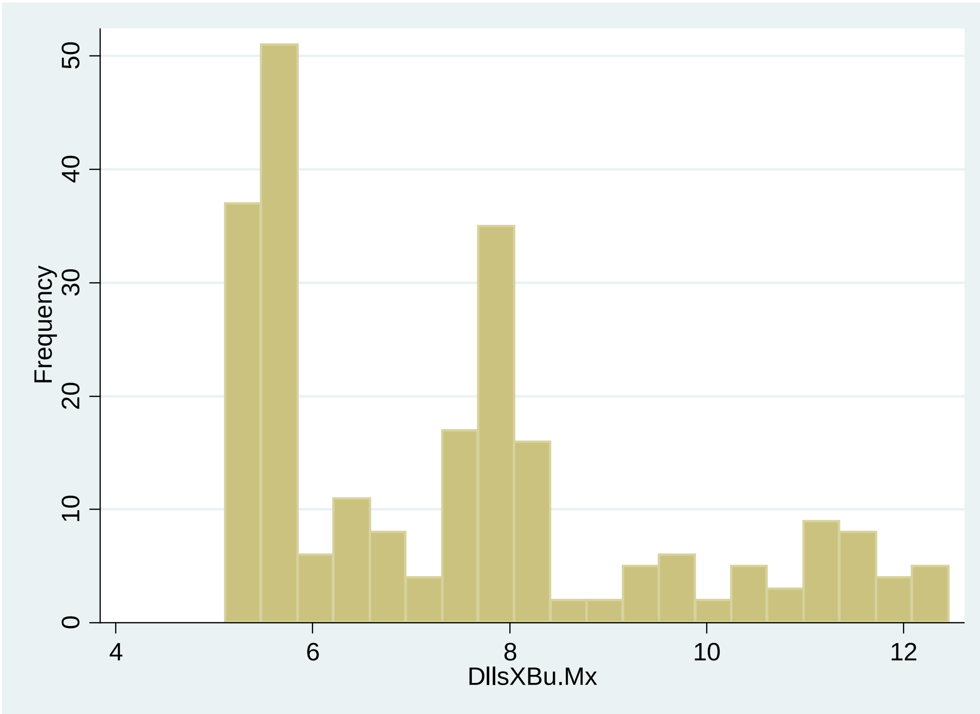
Source: http://www.lmic.info/spreadsheet/prices-and-production (accessed November, 2017)

Table 6. Descriptive Statistics of USA Yellow Corn Price (Dollars/Bushel)

Markt.Pric.USA			
Percentiles	Smallest		
1% 1.8525	1.7825		
5% 1.98	1.8175		
10% 2.0425	1.8525	Obs	236
25% 2.2175	1.87	Sum of Wgt.	236
50% 3.42125		Mean	3.605805
	Largest	Std. Dev.	1.622567
75% 4.1675	7.63		
90% 6.49	7.64	Variance	2.632725
95% 7.08	7.8975	Skewness	1.049353
99% 7.64	8.1075	Kurtosis	3.13145

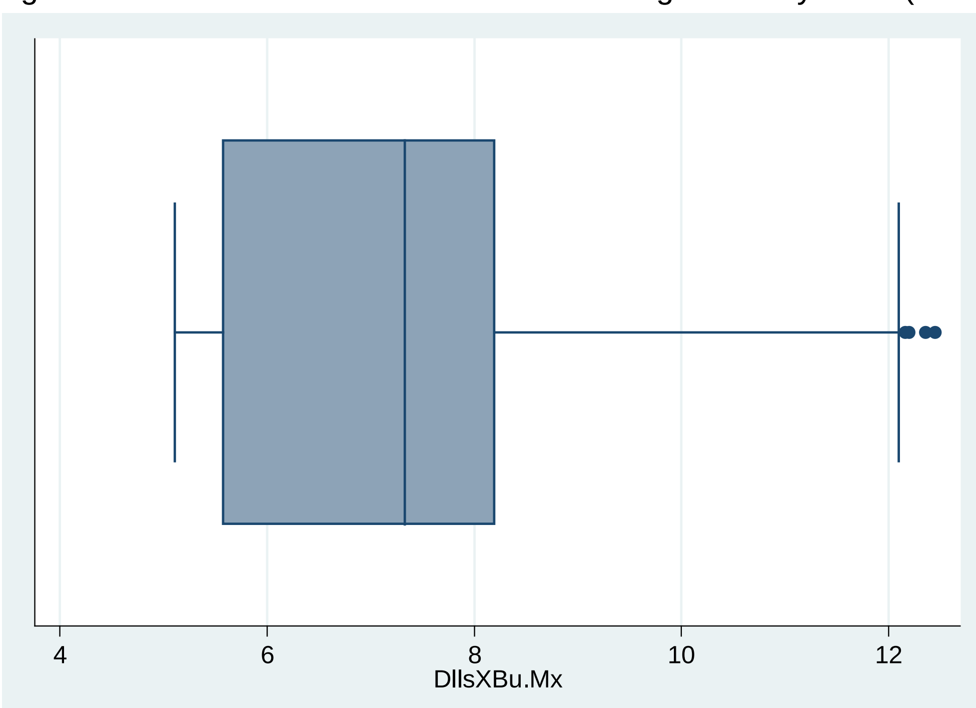
Source: http://www.lmic.info/spreadsheet/prices-and-production (accessed November, 2017)

Figure 13. Mexican White Corn Average Monthly Price (Dollars/Bushel)



Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/ and Exchange Rate ps://fred.stlouisfed.org (accessed November, 2017)

Figure 14. Box Plot Mexican White Corn Average Monthly Price (Dollars/Bushel)



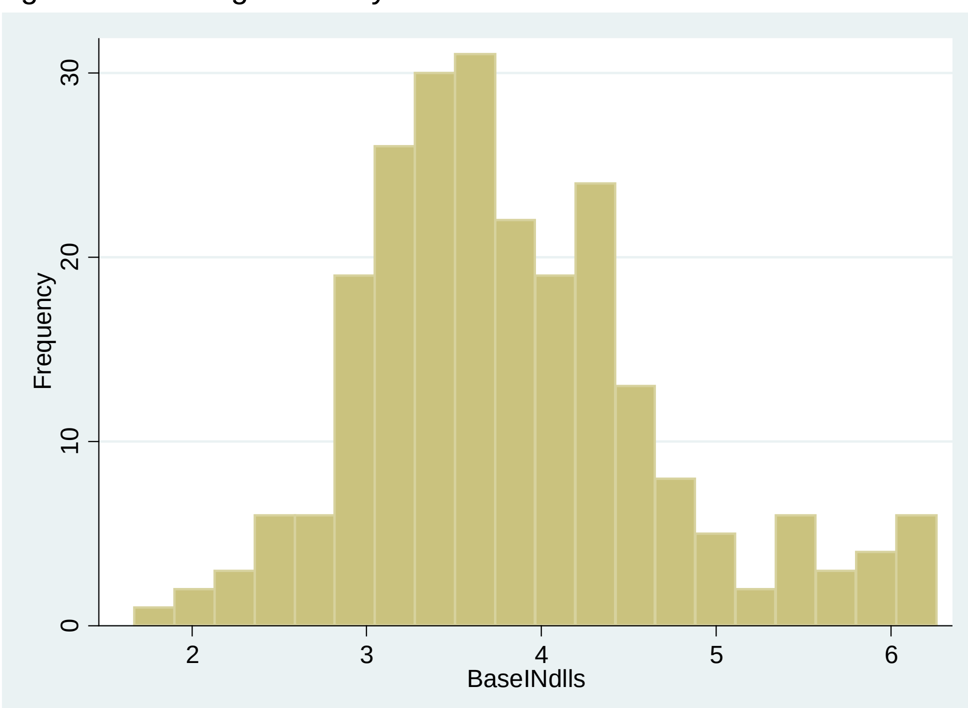
Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/ and Exchange Rate ps://fred.stlouisfed.org (accessed November, 2017)

Table 7. Descriptive Statistics of Mexican White Corn Price (Dollars/Bushel)

DllsXBu.Mx			
Percentiles	Smallest		
1% 5.16	5.11		
5% 5.28	5.12		
10% 5.41	5.16	Obs	236
25% 5.575	5.17	Sum of Wgt.	236
50% 7.33		Mean	7.438263
	Largest	Std. Dev.	2.058627
75% 8.195	12.16		
90% 11.21	12.2	Variance	4.237946
95% 11.59	12.36	Skewness	0.8421885
99% 12.2	12.45	Kurtosis	2.643654

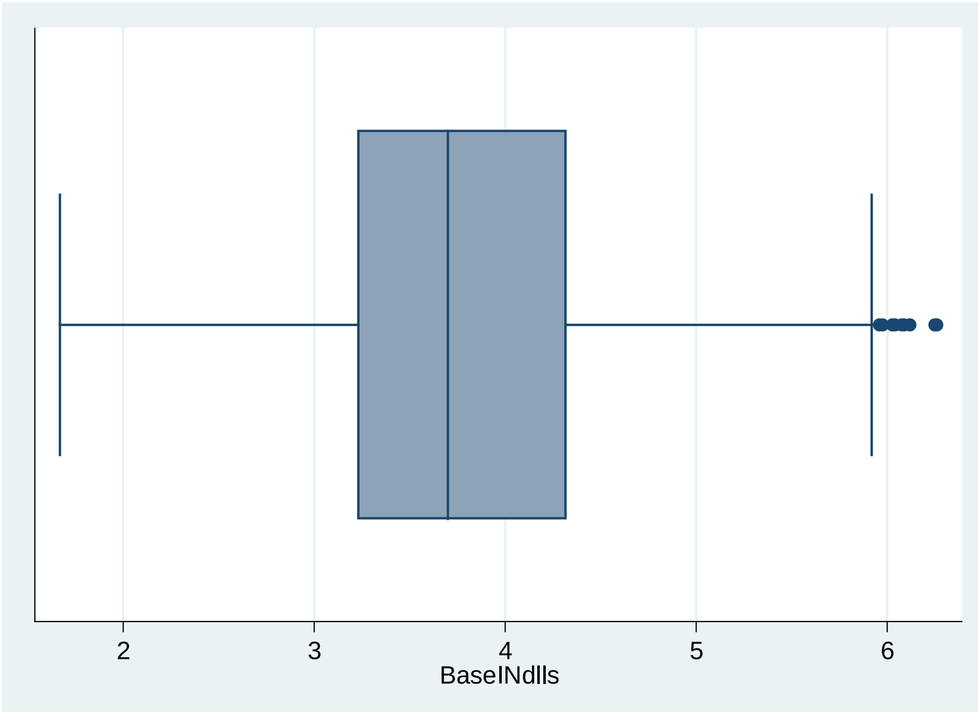
Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/ and Exchange Rate ps://fred.stlouisfed.org (accessed November, 2017)

Figure 15. Average Monthly Basis for White Corn in Mexico



Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/, http://www.lmic.info/spreadsheet/prices-and-production and Exchange Rate ps://fred.stlouisfed.org (accessed November, 2017)

Figure 16. Box Plot Average Monthly Basis for White Corn in Mexico



Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/, http://www.lmic.info/spreadsheet/prices-and-production and Exchange Rate ps://fred.stlouisfed.org (accessed November, 2017)

Table 8. Descriptive Statistics of Average Monthly Basis for White Corn in Mexico

BaseINdlls			
Percentiles	Smallest		
1% 2.12	1.67		
5% 2.54	1.96		
10% 2.91	2.12	Obs	236
25% 3.23	2.16	Sum of Wgt.	236
50% 3.7		Mean	3.832331
	Largest	Std. Dev.	0.8750641
75% 4.315	6.09		
90% 5	6.12	Variance	0.7657371
95% 5.67	6.25	Skewness	0.6445312
99% 6.12	6.26	Kurtosis	3.46467

Source: SNIIM prices for white corn http://www.economia-sniim.gob.mx/nuevo/, http://www.lmic.info/spreadsheet/prices-and-production and Exchange Rate ps://fred.stlouisfed.org (accessed November, 2017)

Methods

To determine the effectiveness of the CME Group corn futures contract as a price risk tool for Mexican corn producers, we used Mexican national data previously described and we classified it into three different regions to estimate the following linear regression model:

$$Cash\ Price_{i,t} = \beta_1 + \beta_2 Futures\ Price_t + \varepsilon_t \qquad [1]$$

where, Cash Price is the calculated cash corn price for region i at time period t, and Futures Price is the closing price for the corn futures contract price for the same time period t. From equation [1], the slope coefficient takes the following form:

$$\beta_2 = \frac{\sigma_{CP,FP}}{\sigma_{FP}^2} \qquad [2]$$

Where, the numerator is the covariance between the cash price (CP) and futures price (FP) and the denominator is the variance of futures price. This defines the relationship between cash and futures prices.

The ordinary least squares regression offers the opportunity to test the following hypothesis:

H0: $\beta_1 = 0$ Hypothesis A
HA: $\beta_1 \neq 0$

The intercept from equation [1] signifies the intercept. For this specific model, this is an indicator of the difference between the cash and futures price, which represents the basis.

H0: $\beta_2 = 1$ Hypothesis B
HA: $\beta_2 \neq 1$

If the futures market is an efficient hedging instrument for the local cash price, then the slope of equation [1] should be one and we would accept the null hypothesis.

Also, using the same rational from equation [1], a national regression model was estimated where, Cash Price is the calculated cash corn price at time period t, and Futures Price is the closing price for the corn futures contract price for the same time period t.

Results and Conclusions

As our methodology states four different simple regression models were developed using two hundred and thirty six observations in each one of them. These observations are different in each model as data was classified geographically and then observations were gathered. However, time frame stayed the same and the regression results are shown from tables 9-12.

Table 9. Regression Results of National Corn Price in Mexico

Variable	*Coefficients*	*t Stat*
Intercept	3.2578	24.4625***
US CMEG Corn Price	1.1594	34.4111***
Adjusted R Square	0.8343	

Table 10. Regression Results of North Region Corn Price in Mexico

Variable	Coefficients	t Stat
Intercept	3.2522	24.3753***
US CMEG Corn Price	1.1847	35.0964***
Adjusted R Square	0.8397	

Table 11. Regression Results of Central Region Corn Price in Mexico

Variable	Coefficients	t Stat
Intercept	3.1753	19.5821***
US CMEG Corn Price	1.1450	27.9096***
Adjusted R Square	0.7680	

Table 12. Regression Results of South Region Corn Price in Mexico

Variable	Coefficients	t Stat
Intercept	3.5437	24.2329***
US CMEG Corn Price	1.0967	29.6425***
Adjusted R Square	0.7888	

*Note: '***' indicates significance at 1% level for tables 9-12.*

As we can see our regression models show multiple correlation coefficients (Multiple R) of (National) 0.9138, (North) 0.9167, (Central) 0.8769 and (South) 0.8886. These numbers are also the correlation coefficient between our two data series (white corn prices/yellow corn prices) since we worked with a simple linear regression model. Also, we obtained R squares of (National) 0.8350, (North) 0.8403, (Central) 0.7690 and (South) 0.7897 which is the percentage of the variation in the dependent variable (white corn prices) that is explain by the variation of the independent variable (yellow corn prices). Therefore, we can conclude that using national data yellow corn prices at the CME Group explain 83.5 percent of the variation in white corn prices in Mexico, and using data from the north region this relationship is one percentage point stronger. However, we observed weaker relationships in the central and south regions which could be an important difference implementing the sub-component *Harvest Commercialization Incentives.*

Additionally, we can observe four different intercepts. The first one (National) is 3.2578, the second one (North) is 3.2522, the third one (Central) is 3.1752 and the fourth one (South) is 3.5437. These numbers give us the theoretical idea that if a bushel of yellow corn in the CME group were 0 dollars a bushel of white corn in the North region of Mexico would be 3. 2522 dollars, in the Central region 3.1752 and in the South region 3.5437.

Therefore, they also represent the basis in each region. All equation intercepts are significantly different from zero at the 1% level, therefore we reject the null hypothesis A.

This information is interesting since ASERCA publish basis values for almost each state in Mexico. For example, regarding the scheme Agriculture by contract for the 2017 Spring-Summer agricultural cycle ASERCA's given basis to producers are the following:

Average basis North region: 0.9427 dollars per bushel
Average basis Central region: 1.1837 dollars per bushel
Average basis South region: 0.9093 dollars per bushel

This indicates that ASERCA's basis are lower than our estimated basis from the regression results, and they are inconsistent with our calculated basis from table 8 and the associated figures 15-16. However, these lower basis are partially offset by the exchange rate, since they are set in American Dollars and a weaker Mexican Peso.

Finally, our yellow corn price coefficients are: National 1.1594, North 1.1847, Central 1.1450 and South 1.0967 which is interpreted as the hedge ratio in each region and nationally. More specifically, this indicates that for a Mexican white corn producer to protect the price of one bushel of white corn in the North region they should hedge 1.1847 bushels at the CME group. For the Central region this ratio is 1:1.1450, for the South region 1:1.0967, and for the National model it is 1:1.1594. Finally, we reject null hypothesis B, that the coefficients are equal to one, at the 1% significance level.

In conclusion, we can assume that using futures contract of yellow corn negotiated at the Chicago Mercantile Exchange as a price risk management tool is effective since prices represented by them have a high correlation with prices of white corn across Mexico, and our regression models proves with a ninety five percent of confidence level that prices in Mexico are explain eighty three point five percent by prices at the CME Group, and at least seventy nine percent regionally. However, basis given by the government appear to be insufficient according to our analysis.

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