The Trends of Coffee Futures

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Executive Summary

In analyzing coffee futures, we have decided to focus on its history, the basics of coffee futures trading, past trends, and the factors that affect the prices of coffee futures. History has provided a basic understanding as to how coffee and coffee trade has affected the economies of different countries worldwide. In order to perform our analysis, we needed a general understanding of how coffee futures are traded and which factors had the largest effect on coffee prices. The purpose of our analysis was to determine if there was a way to use these factors to predict the price of coffee futures going forward.

Along with the analysis, we also explored how coffee futures prices have behaved in the recent past, and whether we can explain the movements in prices. Analysis of the variables that theoretically affect coffee futures prices should provide us with an explanation.

Due to the fact that coffee is one of the most widely traded commodities, there are factors and influences from each corner of the map that may sway or influence the prices of coffee futures. In our paper we plan to see which of these complex global factors have the largest effect on fluctuation of coffee prices. Our hypothesis is that general economic indexes, prices of other soft commodities, and the GDP of top producing nations could all be used as indicators in predicting the price of coffee futures.
Background of Coffee

Brief History of Coffee Trading

The Arabians were the first, not only to cultivate coffee, but also to begin coffee trading. It became popular due to its energizing properties and because it was found to be an acceptable substitute for other forbidden consumable goods. Furthermore, the popularity of coffee was spurred on by coffee houses, as they were a hotspot for social activity and a center for the exchange of information. With thousands of pilgrims from all over the world visiting the holy city of Mecca, the news of coffee quickly spread beyond Arabia. As demand for coffee began to spread internationally, there was tense competition for coffee production outside of Arabia. Although the Arabians closely guarded their coffee producing formula, the Dutch finally succeeded in obtaining some coffee seedlings and began a productive and thriving coffee trade of their own. Through many missionaries, travelers, traders and colonists, coffee seeds continued to spread worldwide and by the end of the 18th century, coffee had become a commodity and one of the world’s most profitable export crops. Today, it is possible to find good coffee in every major city on the planet and with over 600 billion cups consumed each year it has become a staple in the lives of many people.¹

Coffee Trading Overview

Coffee trading is of extreme importance to the world economy, as it is one of the most valuable primary products in world trade. It is rivaled only by oil as a source of foreign exchange to producing countries. Coffee trade is especially crucial to lesser developed countries, as in some cases, exports of

coffee accounts for more than 50 percent of their foreign exchange earnings. In addition, the process of making and trading coffee provides employment for millions of people worldwide.  

Coffee trees grow primarily in subtropical climates and thrive in temperatures averaging 70 degrees Fahrenheit. As a result, it is no surprise that South and Central America are the largest growers of coffee in world commerce. The top producers of coffee in 2010-2011 have been Brazil (with approx. 39% of the world total), Vietnam (with approx. 13% of the world total), followed by Columbia and then Indonesia. While there are several different species of coffee beans, two main species are cultivated today. Arabica coffee accounts for 75-80% of the world’s production, while Robusta coffee accounts for the 20% of the world’s production. Because Arabica coffee accounts for the majority of the world coffee production, this report will focus on the prices of the Arabica coffee bean species.

The Coffee, Sugar and Cocoa Exchange (CSCE) has been the premier world market for trading futures and options for soft commodities such as for sugar, cocoa, and coffee since 1993. It had been located in the World Trade Center before it was destroyed in the September 11th attacks of terror. Ever since then, the CSCE has merged with the New York Board of Trade, and then merged again with the Intercontinental Exchange (ICE).

The demand for coffee is primarily determined by its price point, but is also affected by the availability of substitute beverages and ever changing consumer tastes. Normally, the demand for coffee has proven to be price inelastic, in that when the prices of coffee futures change, there will only be a

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5 Forex Futures Options, “Coffee Futures and Options Education”, http://www.forex-futures-options.com/coffee_futures_options.htm
minimal change in the consumption of coffee. Over the last 30 years, per capita coffee consumption in the US has declined, which has largely been attributed to changing tastes such as enabling soft drinks to compete with coffee as a social drink.

**Dynamics of the Coffee Market**

Although the ICE is the world’s premier world market for coffee futures and options trading, they do not engage in determining the price for these contracts. It simply provides a free market setting where traders can conduct coffee futures and options trading subject to specified rules and regulations. This exchange market allows prices to reach their natural levels.

Soft commodities are known to be extremely volatile in regards to pricing, and are known for their large daily price movements. Because of this, they present extremely lucrative opportunities for traders despite their high risks. Coffee’s appeal as an investment stems from its wide use throughout the globe.

Historically, from 1972 until 2012, Coffee averaged 123.1 Cents/lb reaching an all-time high of 339.9 Cents/lb in April of 1977 and a record low of 42.5 Cents/lb in October of 2001.

The United States is the world’s largest importer of coffee. Kraft, Nestle , Procter & Gamble and Sara Lee are the major roaster companies and account for purchases of about 50%

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of all the annual production of coffee. Seasonally, U.S. coffee consumption tends to rise in the winter, which may lend support to coffee futures prices.\(^9\)

**The Basics of Coffee Futures**

Futures play a critical role in the way commodities are traded in today’s global marketplaces. A futures contract is a standardized, exchange version of a forward contract to buy or sell an asset in the future. The terms of this deal are negotiated at the time the contract is created.\(^{10}\) In the case of coffee, futures contracts would provide growers in high production areas such as Brazil, India, and Ethiopia\(^{11}\) a guarantee upon planting their crops early in the season that their harvest will be sold for a set price. Similarly it would allow coffee suppliers to buy a set amount beans to roast, grind, and sell for a negotiated price at the start of a growing season without the uncertainty of having to wait until harvest time to see whether demand drives the price up or down.\(^{12}\)

While futures and forward contracts are very similar they differ due to the fact that futures contracts are marketable and don’t carry a default risk. Futures, unlike forward contracts, also contain margin requirements and daily marking to market.\(^{13}\) Futures margin rates are set by the futures exchanges where these transactions take place. Some commodities brokerages will even add an extra premium on to this rate in order to reduce their risk exposure. Since margins are set on risk, the riskier or more volatile a commodity is, the higher its margin rate will be. Initial margins for futures contracts often


\(^{10}\) Michael Goldstein, “Chapter Ten: Derivatives Securities Markets”, [http://faculty.babson.edu/goldstein/Teaching/FIN3560Fall2012/Teaching_Materials/powerpoints/Chap010.ppt](http://faculty.babson.edu/goldstein/Teaching/FIN3560Fall2012/Teaching_Materials/powerpoints/Chap010.ppt)

\(^{11}\) Intercontinental Exchange, “Coffee Futures”, [https://www.theice.com/productguide/ProductSpec.shtml?sessionId=2026F6CED2A7C5C994B605BC7D16FBB&specId=15](https://www.theice.com/productguide/ProductSpec.shtml?sessionId=2026F6CED2A7C5C994B605BC7D16FBB&specId=15)

\(^{12}\) Johanna Lee, *The Pit*, 2009

\(^{13}\) Michael Goldstein, “Chapter Ten: Derivatives Securities Markets”, [http://faculty.babson.edu/goldstein/Teaching/FIN3560Fall2012/Teaching_Materials/powerpoints/Chap010.ppt](http://faculty.babson.edu/goldstein/Teaching/FIN3560Fall2012/Teaching_Materials/powerpoints/Chap010.ppt)
require traders to put up 5% to 15% of the contract’s total value when the purchase of the futures contract is made.

Using the International Coffee Organization (ICO)’s composite price for October 2012 (147.12 cents/lb) and Intercontinental Exchange (ICE)’s initial margin for the same time period ($4,455), it can be estimated that the initial margin rate for coffee was approximately 8.075%. The initial margin allows a trader to open a buy or sell position for a specific futures contract. The margin maintenance level is the specific point at which a loss on a futures position requires a trader to invest more money to bring the margin back to its initial margin level. For example, if you have bought a coffee futures contract with an initial margin of $2500 and the margin maintenance level is $2000, if the price of coffee drops 25% or $625, you will need to invest $625 in order to bring the margin back to its original level. Whenever a futures contract falls below its maintenance level a margin call is triggered. A margin call leaves a trader with two options, to either invest the amount required to bring their futures contracts back to their initial margin or to close their positions, therefore effectively liquidating the contracts in question. Futures contracts are based on the difference between today’s prices and the closest deliver month. The deliver months for coffee are March, May, July, and September.

Coffee traded in the US is split into five classes based on the quality of the product. Class 1 or Specialty Coffee is permitted to have up to five full defects per every 300 grams screened. Class 2 or Premium Coffee is allowed to have up to eight defects. Class 3 or Exchange Coffee, the standard for coffee traded on US markets, can have up to 23 defects. Class 4 Coffee is considered below standard and is permitted to have up to 86 defects. Anything worse than 86 defects is referred to as Class 5 or Off

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16 Chuck Kowalski, “All About Futures Margin”, [http://commodities.about.com/od/understandingthebasics/a/futures_margin.htm](http://commodities.about.com/od/understandingthebasics/a/futures_margin.htm)
Grade coffee. Because the grade of coffee determines the premium or discount paid on the contract, both coffee in Classes 1 and 2 would require premiums, while coffee in Classes 4 and 5 would be given discounts. The most active markets for trading coffee futures are New York Stock Exchange Euronext (NYSE), New York Mercantile Exchange (NYMEX), Tokyo Grain Exchange (TGE), and the Intercontinental Exchange (ICE). The current contract symbol for coffee futures is KC, and these futures have a standard contract unit size of 37,500 lbs. The minimum price movement for coffee futures trading is $.0005/lb which equates to $18.75 per contract. Trading hours for US Markets take place between 7:30-11:30am EST with Electronic Trading restricted to 3:30am-2:00pm EST.

Trends

Over the past decade the global demand for coffee has risen sharply, averaging a growth of 2.5% per year. This is due to the increase in the amount of coffee drinkers around the world, primarily in countries with emerging economies such as Brazil. Another major trend is the growing consumption in China and India, areas traditionally considered to be tea drinking nations. Booming economies, a growing middle class, and the rapid adoption of Western ideals in these densely populated regions has played a large role in why coffee consumption has expanded to these countries.

Logically, the higher worldwide demand in coffee over the past decade has been accompanied with similar increases in price. From October of 2001 until October of 2012, the price of coffee for the

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18 Coffee Research Institute, SCAA Coffee Beans Classification, [http://www.coffeeresearch.org/coffee/scaaclass.htm](http://www.coffeeresearch.org/coffee/scaaclass.htm)
Arabica variety has experienced a growth of 56.53 to 172.37 US cents/pound.\textsuperscript{23} The supply of coffee is growing at a substantially slower rate than demand over the past decade; 1.5% per year compared to 2.5% demand growth.\textsuperscript{24} Just last year in 2011, coffee demand was 138 million bags while production was only 132.7 million bags, resulting in a shortage of coffee causing prices to peak at 302.71 cents/pound for Arabica.\textsuperscript{25}

Coffee trade has historically been very volatile, because its prices are heavily affected by climates in producing nations, financial speculation and seasonality. Regarding the influence of climates in producing nations on the price of coffee and its futures contracts, it is important to consider that the majority of coffee production takes place in Vietnam, Columbia, and Brazil. That means the weather and climates in these countries have an enormous impact on the price of coffee.

Naturally, weather conditions can either be favorable or unfavorable with regards to the growing of coffee crops. Typically, rising prices are attributable to inclement weather which commonly comes in the form of freezes, hurricanes, droughts, disease, and heavy rain, all of which reduce supply. For instance, during 2011 Columbia’s coffee crop was reduced significantly due to heavy rainfall which disrupted the flowering process; this directly resulted in Columbia’s September production being reduced by 13%, causing coffee futures for December delivery of 2011 to rise 2.4%.\textsuperscript{26} However, ideal climate conditions and favorable weather patterns have the ability to stabilize or reduce coffee prices. Evidence of this can be seen in Brazil’s coffee crop that was harvested June 2012, for which favorable weather conditions contributed to a robust harvest; causing prices to drop to 169.79 US cents/pound for Arabica coffee, the lowest since May 2010. The recent unpredictable nature of weather and climates changes in coffee

\textsuperscript{23} IndexMundi, “Coffee Futures”, http://www.indexmundi.com/commodities/?commodity=other-mild-arabicas-coffee&months=180

\textsuperscript{24} Kevin Hall, McClatchy, “Got 10 bucks for a cup of joe? Speculators bid up coffee prices”, http://www.mcclatchydc.com/2011/08/25/121973/got-10-bucks-for-a-cup-of-joe.html#ixzz1Wji4mVnO


producing regions also plays a key role in the fluctuations of the price of coffee and its futures contracts by increasing volatility. An example of this is exhibited by the recent stream of bad weather over the past few years, coming in the form of heavy rainfall, has resulted in Columbia’s lowest coffee yield in over three decades, a mere 7.8 million bags in 2011.\textsuperscript{27}

The factor that is predominantly responsible for the volatility and obscuration of the market, aside from fundamental supply and demand effects, is financial speculation which comprises about 25\% of commodity price movements.\textsuperscript{28} Speculative trading by investors influences the price of these futures contracts through their use of information not purely related to fundamental supply/demand conditions in the market. Instead, these investors generate their decisions based on current market noise and their forecasts of forecasts of other participants in the market.\textsuperscript{29} An important distinction to make, regarding speculators, is that their purpose for trading these coffee futures are motivated solely by profits and that they have no intent of purchasing the actual cash commodity, which has the ability to potentially destabilize the market.\textsuperscript{30} These destabilizing effects give rise to short term pricing bubbles, and amplify pricing trends, both of which have negative effects on the market.\textsuperscript{31} However, speculation in some instances has positive effects on the market by aiding in price discovery, facilitating risk transfer, increasing liquidity, and smoothing out pricing anomalies in correlated markets.\textsuperscript{32} Though speculation can have both positive and negative effects on the market, both types increase the overall volatility of the coffee futures market.

\textsuperscript{27} Wynne McAuley, Sustainable Harvest, “Climate Change in Latin America” http://blog.sustainableharvest.com/?p=763
\textsuperscript{31} Ibid.
\textsuperscript{32} Ibid.
According to speculators, current trends suggest that prices for soft commodities, specifically coffee, are expected to increase in 2013 primarily due to increasing global demand.\textsuperscript{33} Suspicion that Arabica coffee is undervalued is also a driving force in the overall increase of coffee price which are expected to range between 170-185 US cents/pound for this variety in October of 2013.\textsuperscript{34} Record coffee crops in 2011/2012 also suggest that the supply for 2013 won’t be as abundant as it was during these years; which suggest a shortage for 2013 and tightening of stock levels, which effectively translates to an increase in price.\textsuperscript{35}

Aside from factors that cause variation in the price of futures contracts; there are some elements that provide certain predictability to the pricing of these contracts. Perhaps the most relevant factor that fit this description is the seasonality associated with the harvesting cycle of agricultural commodities.\textsuperscript{36} Brazil and Vietnam, being the two largest producing nations in the world, account for the seasonal patterns regarding their harvesting periods. Typically, in June, prices have a tendency to decline significantly in response to the Brazilian harvest; while prices in the winter months are usually lower in response to Vietnamese production.\textsuperscript{37}

\textsuperscript{34} Agrimoney, “Arabica coffee ‘most undervalued’ soft commodity”, \url{http://www.agrimoney.com/news/arabica-coffee-most-undervalued-soft-commodity--4547.html}
\textsuperscript{36} Thomas Fazio, “Commodities Seasonality And What It Says About Coffee Futures This Spring”, \url{http://article-niche.com/launch/Commodity-Seasonality-And-What-It-Says-About-Coffe.htm}
\textsuperscript{37} Ibid.
**Analysis Variables**

**Milk**

While a traditional black brew of coffee is still popular in some coffee-drinking cultures, the blend of milk and coffee has been increasingly prevalent for a large part of the last century. As a result, a change in the price of milk will move the price of coffee in the same direction, as they are complementary goods.

**Sugar**

Sugar is a key ingredient that will have an effect on the prices of coffee. Changes in the prices of sugar affect the prices of coffee because they are complementary goods. This means that these goods are usually purchased alongside one another.

**Wheat and Cocoa**

Wheat and Cocoa are used as an ingredient in coffee substitutes such as grain coffee and cocoa beverages. This means that they are a substitute good for coffee beans, and will have an inverse relationship with the price of coffee.

**S&P 500**

We wanted to see if the prices of coffee would follow general economic movements and we believe the S&P 500 was the best index to use as a variable for this theory.

**Tea and Orange Juice**

Tea and Orange Juice are both substitute goods for coffee, meaning that if the prices of these goods increase over time, it is more likely that more coffee will be purchased and consumed.
**US Unemployment Rate**

We wanted to see how the US unemployment rate affected the prices of coffee. When there is a larger workforce, there is more disposable income throughout the economy and we wanted to see if that translated to a higher demand, resulting in a higher price.

**Oil**

Oil is used in the transportation of the coffee beans, so we wanted to see how the changing prices in one of the major costs in the supply chain of coffee affected overall coffee prices.

**Corn**

Corn syrup is commonly used as a sweetener in many beverages, some of which are coffee related. As a result, we wanted to see how changes in the price of corn affected the demand for coffee.

**Sao Paulo Temperature**

Temperature is extremely important for coffee production, as coffee beans thrive in temperatures averaging 70 degrees Fahrenheit. Because it is such a large determinant in the production of coffee, we wanted to see how influential temperature is on coffee prices.

**Brazil and Vietnam GDP**

Brazil is the top producer of coffee with 39% of the world total while Vietnam is the second largest producer of coffee with 13% of the world total. Because GDP is one way to measure a country’s economic wellbeing, the better off a country is doing should mean a higher standard of living and wages in that country, which should be a factor in how expensive the production of coffee.
Analysis of the Changes in Coffee Prices

Creating the Ideal Model

To create our regression model to predict coffee prices, we collected annual averages for 10 years for the following variables: Milk, Sugar, Wheat, S&P500, Tea, Cocoa, Oranges, 10yr Treasury rate, Unemployment in the US, Oil, Corn, Sao Paulo climate, Brazil GDP and Vietnam GDP. (Exhibit 7)

After performing individual regression output for each of the variables (Exhibit 2) we concluded that Milk, Sugar, Tea, Corn, Brazil GDP and Vietnam GDP are significant factors that affect the price of Arabic coffee as a commodity. Each of these variables had a P-value lower than 0.05, had a relatively low S-value (standard Error) and a high R-Sq value (the proportion of variability in a data set that is accounted for by the statistical model). The statistical tests prove that these variables are significant candidates to analyze coffee prices.

These are the variables that have an effect on the prices of Coffee: (Exhibit 2)

**Milk:** For every cent increase in the price per pound of milk drives up the price of coffee by 15.8 cents per pound assuming other things remaining constant.

**Sugar:** For every cent increase in the price pound of sugar drives up the price of coffee by 8.4 cents per pound assuming other things remaining constant.

**Tea:** For every dollar increase in the price per kilogram of tea drives up the price of coffee by 0.935 cents per pound assuming other things remaining constant.

**Corn:** For every dollar increase in the price per metric of corn drives up the price of coffee by 0.779 cents per pound assuming other things remaining constant.

**Brazil GDP:** For every dollar increase in the GDP of Brazil drives up the price of coffee by 0.0820 cents per pound assuming other things remaining constant.
**Vietnam GDP:** For every dollar increase in the GDP of Vietnam drives up the price of coffee by 1.78 cents per pound assuming other things remaining constant.

Additionally we also attempted to use the S&P 500 10 year data to see if economic trends have a correlation to coffee prices, however, the statistical tests failed us. The p-value was significantly higher than 0.05, the S-value was much higher than 10% of the mean and the R-sq adjusted was as low as 5%. We introduced transformative variables such as: S&P 500 squared and S&P 500 square-rooted. Yet, the results we obtained were not good indicators to predict coffee prices.

**Choosing the Highly Correlated Variables**

The next step was to choose the best variables and analyze their co-relation. Using the “Step-wise” function on Minitab, we obtained various results. (Exhibit 3) Upon selecting all the variables, Brazil GDP, Sugar and Milk seemed to be the most effective in our final model on the basis that they were highly correlated to coffee prices. This makes sense as Milk and Sugar are complementary products hence are highly correlated to coffee. Also a large percentage of Brazil GDP results from Coffee production; hence this variable is highly correlated with that of coffee prices.

**Variables with the Lowest Standard Error**

One key factor yet to analyze was the standard error section of our model. This was the next & most crucial step to get to our final model. We utilized the “Best Subsets” function on Minitab. We ran this function using coffee prices as a predictor with variables such as: Milk, Sugar, S&P 500, Tea, Cocoa, Oil, Corn, Brazil GDP and Vietnam GDP.

Our results indicate that if we use the 3-variable (Milk, Sugar and Corn) model to predict the price of the coffee, our R-sq adjusted has a value of 96.6% with a low standard error of only 11.822 (less than the 10% of the mean {12.99}). This model seems effective with only 3 significant variables yielding a lower standard error.
Measuring the Accuracy of the Final Model

We tested the accuracy of our final model (Exhibit 5) using the observations we had in our data and comparing it to its actuals. For example, we tried to predict the price of Coffee in 2009, using the prices of Milk, Sugar and Corn in 2009. (Exhibit 6) In 2009 these were the following prices of Milk (cents/pounds), Sugar (cents/ pounds) and Corn ($/metric ton) 12.8 cents, 22.1 cents and $166 respectively. Using these inputs into our model, our resulting output was the predicted price of Coffee to be $146.36 per pound. If we compare that number the actual price of Coffee in 2009 is $141.60. The standard error of our prediction is a mere $6.93. Furthermore, we are 95% confident that the price of coffee is between $130.38 and $162.34 and we can predict to 95% that the price is between $114.76 and $177.96.

Conclusion

To conclude, we created a regression to predict the trend as well price for Coffee per pound using the prices of Milk per pound, Sugar per pound and Corn per metric ton. Analysts could use this model to predict commodity price of Coffee in the coming years to take positions on Coffee futures. Because of the high volatility in the commodity prices there is large speculation in this market and a large potential to make some capital gains.
**References**

*Text References*


The Pit. Dir. Johanna LEE. N.d.


Regression Data References


Exhibits

Exhibit 1

Descriptive Statistics: Coffee (cents/pound)

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>N*</th>
<th>Mean</th>
<th>SE</th>
<th>StDev</th>
<th>Minimum</th>
<th>Q1</th>
<th>Median</th>
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<tbody>
<tr>
<td>Coffee (cents/pound)</td>
<td>12</td>
<td>0</td>
<td>129.9</td>
<td>18.6</td>
<td>64.5</td>
<td>60.4</td>
<td>68.1</td>
<td>118.8</td>
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<table>
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<tr>
<th>Variable</th>
<th>Q3</th>
<th>Maximum</th>
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<tr>
<td>Coffee (cents/pound)</td>
<td>180.6</td>
<td>273.2</td>
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</table>

S value < 10% of mean =12.99

Exhibit 2 (Significant Variables)

Regression Analysis: Coffee (cents/pound) versus Milk (cents/ pounds)

The regression equation is
Coffee (cents/pound) = - 118 + 15.8 Milk (cents/ pounds)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coef</th>
<th>SE Coef</th>
<th>T</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-118.24</td>
<td>86.74</td>
<td>-1.36</td>
<td>0.203</td>
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<tr>
<td>Milk (cents/ pounds)</td>
<td>15.82</td>
<td>5.454</td>
<td>2.90</td>
<td>0.016</td>
</tr>
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</table>

S = 49.8578  R-Sq = 45.7%  R-Sq(adj) = 40.3%

Regression Analysis: Coffee (cents/pound) versus Sugar (cents/Pound)

The regression equation is
Coffee (cents/pound) = - 15.2 + 8.41 Sugar (cents/Pound)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coef</th>
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<tr>
<td>Constant</td>
<td>-15.18</td>
<td>18.32</td>
<td>-0.83</td>
<td>0.427</td>
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<tr>
<td>Sugar (cents/Pound)</td>
<td>8.4120</td>
<td>0.9863</td>
<td>8.53</td>
<td>0.000</td>
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</tbody>
</table>

S = 23.5208  R-Sq = 87.9%  R-Sq(adj) = 86.7%
Regression Analysis: Coffee (cents/pound) versus Tea ($/kg)

The regression equation is
Coffee (cents/pound) = 107 + 0.935 Tea ($/kg)

<table>
<thead>
<tr>
<th>Predictor</th>
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<tr>
<td>Constant</td>
<td>-106.5</td>
<td>34.41</td>
<td>-3.10</td>
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<tr>
<td>Tea ($/kg)</td>
<td>0.9354</td>
<td>0.1324</td>
<td>7.06</td>
<td>0.000</td>
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</table>

S = 27.6485   R-Sq = 83.3%   R-Sq(adj) = 81.6%

Regression Analysis: Coffee (cents/pound) versus Corn ($/Metric ton)

The regression equation is
Coffee (cents/pound) = 3.3 + 0.779 Corn ($/Metric ton)

<table>
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<th>Predictor</th>
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<tr>
<td>Constant</td>
<td>3.31</td>
<td>22.63</td>
<td>0.15</td>
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<tr>
<td>Corn ($/Metric ton)</td>
<td>0.7787</td>
<td>0.1277</td>
<td>6.10</td>
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</tbody>
</table>

S = 31.1527   R-Sq = 78.8%   R-Sq(adj) = 76.7%

Regression Analysis: Coffee (cents/pound) versus Brazil GDP ($)

The regression equation is
Coffee (cents/pound) = 20.5 + 0.0820 Brazil GDP ($)

<table>
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<tr>
<td>Constant</td>
<td>20.51</td>
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<td>Brazil GDP ($)</td>
<td>0.082023</td>
<td>0.008622</td>
<td>9.51</td>
<td>0.000</td>
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</table>

S = 21.3425   R-Sq = 90.0%   R-Sq(adj) = 89.1%

Regression Analysis: Coffee (cents/pound) versus Vietnam GDP ($)

The regression equation is
Coffee (cents/pound) = - 0.5 + 1.78 Vietnam GDP ($)

<table>
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<th>SE Coef</th>
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<th>P</th>
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<td>16.81</td>
<td>-0.03</td>
<td>0.977</td>
</tr>
<tr>
<td>Vietnam GDP ($)</td>
<td>1.7778</td>
<td>0.2094</td>
<td>8.49</td>
<td>0.000</td>
</tr>
</tbody>
</table>

S = 23.6186   R-Sq = 87.8%   R-Sq(adj) = 86.6%
Exhibit 3 (Step-wise using Significant Variables)

**Stepwise Regression: Coffee (cent versus Milk (cents, Sugar (cents, ...)**

Alpha-to-Enter: 0.15  Alpha-to-Remove: 0.15

Response is Coffee (cents/pound) on 10 predictors, with N = 12

<table>
<thead>
<tr>
<th>Step</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>20.506</td>
<td>-3.403</td>
<td>-77.736</td>
</tr>
<tr>
<td>Brazil GDP ($)</td>
<td>0.0820</td>
<td>0.0475</td>
<td>0.0236</td>
</tr>
<tr>
<td>T-Value</td>
<td>9.51</td>
<td>3.30</td>
<td>1.64</td>
</tr>
<tr>
<td>P-Value</td>
<td>0.000</td>
<td>0.009</td>
<td>0.140</td>
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<tr>
<td>Sugar (cents/Pound)</td>
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</tr>
<tr>
<td>T-Value</td>
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<td>4.24</td>
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<tr>
<td>P-Value</td>
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<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Milk (cents/ pounds)</td>
<td>5.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-Value</td>
<td>2.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P-Value</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>21.3</td>
<td>16.7</td>
<td>12.9</td>
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<tr>
<td>R-Sq</td>
<td>90.05</td>
<td>94.53</td>
<td>97.07</td>
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<tr>
<td>R-Sq(adj)</td>
<td>89.05</td>
<td>93.32</td>
<td>95.97</td>
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<tr>
<td>Mallows Cp</td>
<td>3.1</td>
<td>0.1</td>
<td>-0.7</td>
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</table>

**Stepwise Regression: Coffee (cent versus Sugar (cents, Tea ($/kg), ...)**

Alpha-to-Enter: 0.15  Alpha-to-Remove: 0.15

Response is Coffee (cents/pound) on 5 predictors, with N = 12

<table>
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</thead>
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<tr>
<td>Constant</td>
<td>20.506</td>
<td>-3.403</td>
</tr>
<tr>
<td>Brazil GDP ($)</td>
<td>0.0820</td>
<td>0.0475</td>
</tr>
<tr>
<td>T-Value</td>
<td>9.51</td>
<td>3.30</td>
</tr>
<tr>
<td>P-Value</td>
<td>0.000</td>
<td>0.009</td>
</tr>
</tbody>
</table>
Exhibit 4 (Best Sub-sets)

Best Subsets Regression: Coffee (cent versus Milk (cents, Sugar (cents, ...

Response is Coffee (cents/pound)

<table>
<thead>
<tr>
<th>Vars</th>
<th>R-Sq</th>
<th>R-Sq(adj)</th>
<th>Cp</th>
<th>Mallows</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>90.0</td>
<td>89.1</td>
<td>3.1</td>
<td>21.343</td>
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<tr>
<td>1</td>
<td>87.9</td>
<td>86.7</td>
<td>5.5</td>
<td>23.521</td>
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<td>95.2</td>
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<tr>
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<td>94.8</td>
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<td>14.651</td>
</tr>
<tr>
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<td>96.6</td>
<td>-1.3</td>
<td>11.822</td>
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<tr>
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<td>96.0</td>
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<td>0.5</td>
<td>12.056</td>
</tr>
<tr>
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<td>97.6</td>
<td>96.2</td>
<td>0.7</td>
<td>12.504</td>
</tr>
<tr>
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<td>96.5</td>
<td>2.2</td>
<td>12.115</td>
</tr>
<tr>
<td>5</td>
<td>97.8</td>
<td>96.0</td>
<td>2.5</td>
<td>12.941</td>
</tr>
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<td>96.1</td>
<td>4.0</td>
<td>12.730</td>
</tr>
<tr>
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<td>96.0</td>
<td>4.1</td>
<td>12.979</td>
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<td>95.6</td>
<td>5.8</td>
<td>13.477</td>
</tr>
<tr>
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<td>98.4</td>
<td>95.6</td>
<td>5.8</td>
<td>13.511</td>
</tr>
<tr>
<td>8</td>
<td>98.9</td>
<td>96.0</td>
<td>7.2</td>
<td>12.849</td>
</tr>
<tr>
<td>8</td>
<td>98.5</td>
<td>94.6</td>
<td>7.6</td>
<td>14.974</td>
</tr>
<tr>
<td>9</td>
<td>98.9</td>
<td>94.2</td>
<td>9.2</td>
<td>15.534</td>
</tr>
<tr>
<td>9</td>
<td>98.9</td>
<td>94.1</td>
<td>9.2</td>
<td>15.715</td>
</tr>
<tr>
<td>10</td>
<td>99.1</td>
<td>90.2</td>
<td>11.0</td>
<td>20.230</td>
</tr>
</tbody>
</table>
Best Subsets Regression: Coffee (cent versus Sugar (cents, Tea ($/kg), ...

Response is Coffee (cents/pound)

S  C
u  o
g  r
a  n
r  V
(Bi
(  $re
c  /at
e  TMzn
neeia
tatlm
sr
/  iG
P  (cDD
do$/PP
u/t
nko{

Mallows
dgn$

Vars  R-Sq  R-Sq(adj)  Cp  S  )  )  )
1  90.0  89.1  10.6  21.343  X
1  87.9  86.7  14.5  23.521  X
2  95.8  94.8  1.9  14.651  X  X
2  94.5  93.3  4.2  16.673  X  X
3  96.5  95.1  2.6  14.209  X  X  X
3  95.8  94.3  3.8  15.439  X  X
4  96.8  94.9  4.0  14.526  X  X  X  X
4  96.7  94.8  4.1  14.642  X  X  X
5  96.8  94.1  6.0  15.665  X  X  X  X

Exhibit 5 (Final Model)

Regression Analysis: Coffee (cent versus Milk (cents, Sugar (cents, ...

The regression equation is
Coffee (cents/pound) = - 81.1 + 4.67 Milk (cents/ pounds)
+ 5.97 Sugar (cents/Pound) + 0.214 Corn ($/Metric ton)

Predictor          Coef  SE Coef      T      P
Constant         -81.13  24.54  -3.31  0.011
Milk (cents/ pounds)  4.670  1.935   2.41  0.042
Sugar (cents/Pound)  5.9700  0.7652  7.80  0.000
Corn ($/Metric ton) 0.21420  0.09776  2.19  0.060

S = 11.8222  R-Sq = 97.6%  R-Sq(adj) = 96.6%
Exhibit 6 (Checking Accuracy for 2009)

Predicted Values for New Observations

<table>
<thead>
<tr>
<th>New Obs</th>
<th>Fit</th>
<th>SE Fit</th>
<th>95% CI</th>
<th>95% PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>146.36</td>
<td>6.93</td>
<td>(130.38, 162.34)</td>
<td>(114.76, 177.96)</td>
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</tbody>
</table>

Values of Predictors for New Observations

<table>
<thead>
<tr>
<th>New Obs</th>
<th>Milk (cents/pounds)</th>
<th>Sugar (cents/Pound)</th>
<th>Corn ($/Metric ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12.8</td>
<td>22.1</td>
<td>166</td>
</tr>
</tbody>
</table>

Exhibit 7 (Average Annual Variable Data)

<table>
<thead>
<tr>
<th>Year</th>
<th>10 yr treasury rate (%)</th>
<th>Unemployment US (%)</th>
<th>Oil ($/bbl)</th>
<th>Corn ($/Metric ton)</th>
<th>Sao Paulo (temp C)</th>
<th>Brazil GDP ($)</th>
<th>Vietnam GDP ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>5.04</td>
<td>4.74</td>
<td>29.86</td>
<td>89.61</td>
<td>21.20</td>
<td>553.58</td>
<td>32.69</td>
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<tr>
<td>2002</td>
<td>4.05</td>
<td>5.78</td>
<td>29.12</td>
<td>99.33</td>
<td>-</td>
<td>504.22</td>
<td>35.06</td>
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<td>4.15</td>
<td>5.99</td>
<td>34.60</td>
<td>105.19</td>
<td>20.60</td>
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<td>39.55</td>
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<td>4.22</td>
<td>5.54</td>
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<td>-</td>
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<td>4.76</td>
<td>4.61</td>
<td>66.45</td>
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<td>20.00</td>
<td>1088.90</td>
<td>60.91</td>
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<tr>
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<td>3.74</td>
<td>4.62</td>
<td>71.03</td>
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<td>20.40</td>
<td>1366.00</td>
<td>71.02</td>
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<td>5.80</td>
<td>97.33</td>
<td>223.25</td>
<td>19.60</td>
<td>1652.80</td>
<td>91.09</td>
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<td>9.28</td>
<td>57.18</td>
<td>165.54</td>
<td>20.00</td>
<td>1621.70</td>
<td>97.18</td>
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<tr>
<td>2010</td>
<td>3.39</td>
<td>9.63</td>
<td>75.05</td>
<td>186.01</td>
<td>20.10</td>
<td>2143.00</td>
<td>106.43</td>
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<tr>
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<td>1.97</td>
<td>8.95</td>
<td>88.93</td>
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<td>2476.70</td>
<td>123.96</td>
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<tr>
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<td>1.62</td>
<td>8.14</td>
<td>93.47</td>
<td>295.07</td>
<td>-</td>
<td>2500.00</td>
<td>123.96</td>
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</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Coffee (cents/pound)</th>
<th>Milk (cents/pounds)</th>
<th>Sugar (cents/Pound)</th>
<th>Wheat ($/metric ton)</th>
<th>S&amp;P 500</th>
<th>Tea ($/kg)</th>
<th>Cocoa ($/metric ton)</th>
<th>Oranges ($/metric ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>61.91</td>
<td>14.97</td>
<td>11.29</td>
<td>126.80</td>
<td>1150.00</td>
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<td>595.50</td>
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<td>179.19</td>
<td>1779.04</td>
<td>564.53</td>
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<td>9.74</td>
<td>146.14</td>
<td>1112.00</td>
<td>194.33</td>
<td>1753.07</td>
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<td>829.19</td>
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<td>123.25</td>
<td>19.13</td>
<td>14.00</td>
<td>255.21</td>
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<td>1350.00</td>
<td>346.74</td>
<td>2361.49</td>
<td>880.26</td>
</tr>
</tbody>
</table>
Exhibit 8 (World Coffee Production 2007-2010)

World production
Crop years commencing 2007 to 2010

![Bar chart showing world coffee production from 2007/08 to 2010/11.
- 2007/08: 116.7 million bags
- 2008/09: 128.3 million bags
- 2009/10: 122.9 million bags
- 2010/11: 134.2 million bags]