Lecture 5

Forecasting Crop Prices Using Fundamental Analysis: Ending Stock Models

by

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Required Reading:


Fundamental Analysis

- Definition: An assessment of _____ based on the underlying ______ and _______ factors and the changes in those relationships.

- Motivated by economic ______ of supply and demand.

- The task of the market is to establish a price that will ________________.

- Fundamental analysis can be thought of as the process of anticipating the market clearing price.

- Techniques: Subjective judgment to sophisticated statistical models.

- Goal: Estimate ______________________ and compare to ____________.
  - Bullish: Value > Price
  - Bearish: Value < Price
Ending Stocks and Price

- Ending stocks indicate the ______ between supply and demand

- Ending stocks _____, price _____

- Ending stocks _____, price _____

- Relationship between ending stocks and price is often used to forecast prices

Source: USDA
US Corn, Ending Stocks/Total Use, 1975/76-2011/12

Source: USDA
Building an Economic Model

- A model is an ________ from the real world
- Must be _____ yet capture _______ economic relationships
- A model of a market can be thought of as one or more _______ that describe the important ______________among the variables in the market

The Simplest Market Model

\[ QD_t = a - b \, P_t \]  \hspace{1cm} (Demand)

\[ QS_t = d + e \, P_t \]  \hspace{1cm} (Supply)

\[ QD_t = QS_t \]  \hspace{1cm} (Equilibrium)
Economic Model Underlying Balance Sheets before Planting

Price

Q₀

Demand

Supply

P₀

Quantity

ACE 427, University of Illinois
Adding Shifter Variables

- In the simple model, there is only one ________ because nothing ever_______!

- In reality, we know that:
  - Demand curves shift due to changes in the ________________, ________ and other variables
  - Supply curves shift due to changes in the ____________, __________ and other variables

- Key point: Changing equilibrium prices and quantities are driven by changes in the level of ________________
A More Realistic Market Model

\[ QD_t = a - b P_t + c I_t \]  (Demand)

\[ QS_t = d + e P_t \]  (Supply)

\[ QD_t = QS_t \]  (Equilibrium)
An Even More Realistic Market Model

\[ QD_t = a - b P_t + c I_t \quad \text{(Demand)} \]

\[ QS_t = d + e P_t - f F_t \quad \text{(Supply)} \]

\[ QD_t = QS_t \quad \text{(Equilibrium)} \]
A Complete Pricing Model in Linear Form

(1) \( S_t = a_1 + a_2 p_{t-1} - a_3 F_t \) Supply

(2) \( D_t = b_1 - b_2 p_{t-1} + b_3 I_t \) Domestic/Export Demand

(3) \( K_t = c_1 - c_2 p_t - c_3 i_t \) Stock Demand

(4) \( S_t = D_t + K_t \) Equilibrium Condition

Forecasting with Pricing Model

• In equilibrium, the relationship between prices and ending stocks can be found by _________ the stock demand function and fixing the value for the shifter variable in this equation (3):

\[
p_t = \left( \frac{c_1}{c_2} + \frac{c_3}{c_2} i_t \right) - \left( \frac{1}{c_2} \right) K_t
\]

• Basic pricing function used by many market analysts

• Essential to note that this assumes ___ shifter variables are held _________!
US Corn, Farm Price vs. Ending Stocks/Total Use, 1975/76-2011/12

Source: USDA

$y = -0.0269x + 3.236$

$R^2 = 0.1702$

Source: USDA
Logical Characteristics of Relationship between Price and Stocks

- As ending stocks approach ____, theoretically, there is no __________ for price

- As ending stocks get very large, price is unlikely to go below some minimum ______________ level

Theoretical Functional Form between Price and Ending Stocks
Transformations and Least Squares Regression

- All is not lost when the relationship between $x$ and $y$ is ________
- LS regression “works” for any non-linear transformation of the ________
- We can take logs, divide or multiply variables
- Valid as long as we do not transform ___________ (e.g. square, cube, etc.)

Regression Functional Forms between Price and Ending Stocks That Account for Non-Linearity

- Double-log functional form:

$$ln(y) = b_1 + b_2 \ln(x)$$

- Reciprocal functional form:

$$y = b_1 + b_2 \left( 1/x \right)$$
Properties of the Reciprocal Functional Form

\[ y = b_1 + b_2 \left( \frac{1}{x} \right) \]

- \( b_1 \) measures the ________ (or maximum) level of \( y \)

- \( b_2 \) does not measure change in \( y \) for a one-unit change in \( x \), but instead change for a one unit change in \( 1/x \)

- Hence, the slope (change in \( y \) for a one unit change in \( x \)) ______ for different ______ of \( x \)

\[ \Delta y/\Delta x = dy/dx = -b_2 \left( \frac{1}{x^2} \right) \]
Corn: Setting Up the Data for a Reciprocal Model in Excel

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Use</th>
<th>Ending Stocks</th>
<th>x = Stocks/Use (%)</th>
<th>1/x</th>
<th>y = Corn Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1975/76</td>
<td>5767</td>
<td>633</td>
<td>11.0</td>
<td>0.09</td>
</tr>
<tr>
<td>2</td>
<td>1976/77</td>
<td>5789</td>
<td>1136</td>
<td>19.6</td>
<td>0.05</td>
</tr>
<tr>
<td>3</td>
<td>1977/78</td>
<td>6207</td>
<td>1436</td>
<td>23.1</td>
<td>0.04</td>
</tr>
<tr>
<td>4</td>
<td>1978/79</td>
<td>6995</td>
<td>1710</td>
<td>24.4</td>
<td>0.04</td>
</tr>
<tr>
<td>5</td>
<td>1979/80</td>
<td>7604</td>
<td>2034</td>
<td>26.7</td>
<td>0.04</td>
</tr>
<tr>
<td>6</td>
<td>1980/81</td>
<td>7282</td>
<td>1392</td>
<td>19.1</td>
<td>0.05</td>
</tr>
<tr>
<td>7</td>
<td>1981/82</td>
<td>6975</td>
<td>2537</td>
<td>36.4</td>
<td>0.03</td>
</tr>
<tr>
<td>8</td>
<td>1982/83</td>
<td>7249</td>
<td>3523</td>
<td>48.6</td>
<td>0.02</td>
</tr>
<tr>
<td>9</td>
<td>1983/84</td>
<td>6693</td>
<td>1006</td>
<td>15.0</td>
<td>0.07</td>
</tr>
<tr>
<td>10</td>
<td>1984/85</td>
<td>7032</td>
<td>1648</td>
<td>23.4</td>
<td>0.04</td>
</tr>
</tbody>
</table>

US Corn, Farm Price vs. Ending Stocks/Total Use, 1975/76-2011/12

\[
y = 14.78(1/x) + 1.71 \\
R^2 = 0.31
\]

Source: USDA
Different Approaches to Account for Shifts in Relationship

- Include _____ variables directly in the pricing model and estimate ____ model for the entire sample period
  - Approach taken by Westcott and Hoffman
  - 3 additional independent variables for corn
  - 5 additional independent variables for wheat
- Estimate ______ pricing models for _____
  - Shifter variables have different levels across the sub-periods
  - The level of shifter variables is assumed to be relatively _________ within a sub-period
Slope changes with $x$

- Ending stocks/use = 5
  $$\Delta y/\Delta x = -8.34 \left(1/5^2\right) = -$0.33/bu.$$

- Ending stocks/use = 25
  $$\Delta y/\Delta x = -8.34 \left(1/25^2\right) = -$0.01/bu.$$
US Corn, Farm Price vs. Ending Stocks/Total Use, 1990/91-2011/12

\[ y = 8.34(1/x) + 1.64 \]

\[ R^2 = 0.78 \]

Source: USDA
What Changed During the 2006/07-2011/12 Marketing Years?

- All else equal, supply shifted to the ______
  - High input prices due to rising energy prices?
  - Weather?

- Or, demand shifted to the _____
  - Ethanol demand?
  - Export demand?
  - Feed demand?
  - Stock demand?

- Some _____________ of supply and demand shifts
Building a New Model

- Assume that 2006/07 is a transition year and remove it from the sample

- Add a dummy variable to the regression to allow the intercept for the model to increase during 2007/08-2011/12 (D is zero for 1990/01 to 2005/06 and one otherwise)

US Corn, Farm Price vs. Ending Stocks/Total Use, 1990/91-2011/12

Estimated model:
\[ y = 11.57\left(\frac{1}{x}\right) + 1.40 + 2.16D \]
\[ R^2 = 0.89 \]

2007/08-2010/11:
\[ y = 11.57\left(\frac{1}{x}\right) + 3.56 \]

1990/91-2005/06:
\[ y = 11.57\left(\frac{1}{x}\right) + 1.40 \]

Source: USDA
### First ACE 427 Corn Balance Sheet Estimates for 2013/14

<table>
<thead>
<tr>
<th>Item</th>
<th>USDA/WASDE 2011/12</th>
<th>USDA/WASDE 2012/13</th>
<th>ACE 427 2013/14</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planted Acreage (million acres)</td>
<td>91.9</td>
<td>97.2</td>
<td>98</td>
</tr>
<tr>
<td>Harvested Acreage (million acres)</td>
<td>84.0</td>
<td>87.4</td>
<td>91</td>
</tr>
<tr>
<td>Yield (Bushels/Acre)</td>
<td>147.2</td>
<td>123.4</td>
<td>160</td>
</tr>
<tr>
<td>Beginning Stocks (million bushels)</td>
<td>1,128</td>
<td>989</td>
<td>632</td>
</tr>
<tr>
<td>Total Production (million bushels)</td>
<td>12,360</td>
<td>10,780</td>
<td>14,528</td>
</tr>
<tr>
<td>Imports (million bushels)</td>
<td>28</td>
<td>200</td>
<td>5</td>
</tr>
<tr>
<td>Total Supply (million bushels)</td>
<td>13,516</td>
<td>11,969</td>
<td>15,165</td>
</tr>
<tr>
<td><strong>Consumption:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed and Residual (million bushels)</td>
<td>4,547</td>
<td>4,350</td>
<td>4,900</td>
</tr>
<tr>
<td>Food, Seed, and Industrial (million bushels)</td>
<td>6,437</td>
<td>5,887</td>
<td>6,150</td>
</tr>
<tr>
<td>Ethanol (million bushels)</td>
<td>5,021</td>
<td>5,000</td>
<td>4,700</td>
</tr>
<tr>
<td>Exports (million bushels)</td>
<td>1,543</td>
<td>900</td>
<td>1,450</td>
</tr>
<tr>
<td>Total Consumption (million bushels)</td>
<td>12,527</td>
<td>11,237</td>
<td>12,750</td>
</tr>
<tr>
<td>Ending Stocks (million bushels)</td>
<td>989</td>
<td>632</td>
<td>2,415</td>
</tr>
<tr>
<td>Ending Stocks/Total Consumption (%)</td>
<td>7.9%</td>
<td>5.6%</td>
<td>18.9%</td>
</tr>
<tr>
<td>Average Price ($/bu.)</td>
<td>6.22</td>
<td>7.20</td>
<td>???</td>
</tr>
</tbody>
</table>

Note: USDA WASDE estimates were released in February 2013
• Ending Stocks/Use Forecast:

\[(2,415/12,750) \times 100 = 18.9\%\]

• Forecast price:

\[y = 11.57 \left( \frac{1}{18.9} \right) + 3.56\]
\[y = 11.57 \left( 0.053 \right) + 3.56\]
\[y = $4.17/\text{bu.}\]
Final Thoughts

We must always keep in mind that price and ending stocks are determined ____________

The true __________ relationship is:

<table>
<thead>
<tr>
<th>Supply and Demand</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shifter</td>
<td>and</td>
</tr>
<tr>
<td>Variables</td>
<td>Ending Stocks</td>
</tr>
</tbody>
</table>

In other words:

- It is not logical to specify the level of _______ _______ without knowing _______

- It is not logical to specify ______ without knowing the level of __________

Therefore, price and ending stocks models are only a __________ or ______ to forecasting crop prices

Knowledge of underlying ______________________ relationships is required to make more accurate price forecasts
In addition, forecasts from price and ending stocks models for _____ or _____ stock levels may be quite sensitive to the assumed _______ form

- Reciprocal
- Double-log
- Log-linear

**Bottom line: price and ending stock models may be a good starting point, but they should be used with a great deal of caution**

For a more in-depth treatment of these issues, I highly recommend: