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

US Corn, Farm Price and Ending Stocks, 1975/76-2009/10*

![Graph showing US Corn, Farm Price and Ending Stocks, 1975/76-2009/10.](source: USDA)

*2009/10 Projected
US Corn, Ending Stocks, 1975/76-2009/10*

Source: USDA
*2009/10 Projected

US Corn, Total Use, 1975/76-2009/10*

Source: USDA
*2009/10 Projected
US Corn, Ending Stocks/Total Use, 1975/76-2009/10*

Source: USDA

*2009/10 Projected
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

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

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

\[ QD_t = QS_t \] (Equilibrium)
Economic Model Underlying Balance Sheets before Planting

\[ \text{Price} \]

\[ \text{Supply} \]

\[ \text{Demand} \]

\[ Q_0 \]

\[ P_0 \]

\[ \text{Quantity} \]
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

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

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

\[ QD_t = QS_t \]  \hspace{1cm} (Equilibrium)

\[\begin{array}{|c|c|}
\hline
\text{Q1}_t & \text{P1}_t \\
\hline
\text{Q2}_t & \text{P2}_t \\
\hline
\end{array}\]
An Even More Realistic Market Model

\[ Q_{Dt} = a - b \, P_t + c \, I_t \]  (Demand)

\[ Q_{St} = d + e \, P_t - f \, F_t \]  (Supply)

\[ Q_{Dt} = Q_{St} \]  (Equilibrium)
A Complete Pricing Model in Implicit Form

(1) \( S_t = f(p_{t-1}, z_t) \) \hspace{1cm} \text{Supply}

(2) \( D_t = g(p_b, p_{t-1}, z_t) \) \hspace{1cm} \text{Domestic/Export Demand}

(3) \( K_t = h(p_b, z_t) \) \hspace{1cm} \text{Stock Demand}

(4) \( S_t = D_t + K_t \) \hspace{1cm} \text{Equilibrium Condition}

Forecasting with Pricing Model

- In equilibrium, the relationship between prices and ending stocks can be found by substituting (1), (2), and (4) into (3) and ________ the stock demand function (3):

\[ p_t = h^{-1}(K_t, p_{t-1}, z_t) \]

- 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, 1975/76-2009/10*

$y = -0.0168x + 2.8633$
$R^2 = 0.1615$

Source: USDA

*2009/10 Projected
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:
  
  $$y = b_1 + b_2 \ (1/x)$$
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 \( x \)

\[
\frac{\Delta y}{\Delta x} = \frac{dy}{dx} = -b_2 \left( \frac{1}{x^2} \right)
\]
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>1975/76</td>
<td>5767</td>
<td>633</td>
<td>11.0</td>
<td>0.09</td>
<td>2.54</td>
</tr>
<tr>
<td>1976/77</td>
<td>5789</td>
<td>1136</td>
<td>19.6</td>
<td>0.05</td>
<td>2.15</td>
</tr>
<tr>
<td>1977/78</td>
<td>6207</td>
<td>1436</td>
<td>23.1</td>
<td>0.04</td>
<td>2.02</td>
</tr>
<tr>
<td>1978/79</td>
<td>6995</td>
<td>1710</td>
<td>24.4</td>
<td>0.04</td>
<td>2.25</td>
</tr>
<tr>
<td>1979/80</td>
<td>7604</td>
<td>2034</td>
<td>26.7</td>
<td>0.04</td>
<td>2.48</td>
</tr>
<tr>
<td>1980/81</td>
<td>7282</td>
<td>1392</td>
<td>19.1</td>
<td>0.05</td>
<td>3.12</td>
</tr>
<tr>
<td>1981/82</td>
<td>6975</td>
<td>2537</td>
<td>36.4</td>
<td>0.03</td>
<td>2.47</td>
</tr>
<tr>
<td>1982/83</td>
<td>7249</td>
<td>3523</td>
<td>48.6</td>
<td>0.02</td>
<td>2.55</td>
</tr>
<tr>
<td>1983/84</td>
<td>6693</td>
<td>1006</td>
<td>15.0</td>
<td>0.07</td>
<td>3.21</td>
</tr>
<tr>
<td>1984/85</td>
<td>7032</td>
<td>1648</td>
<td>23.4</td>
<td>0.04</td>
<td>2.63</td>
</tr>
</tbody>
</table>

US Corn, Farm Price vs. Ending Stocks/Total Use, 1975/76-2008/09

y=7.24(1/x) + 2.01  
R2=0.19

Source: USDA  
*2009/10 Projected
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
US Corn, Farm Price vs. Ending Stocks/Total Use, 1975/76-2009/10*


Source: USDA

*2009/10 Projected


$y=6.89(1/x) + 1.90$

$R^2=0.96$

Source: USDA

\[ y = 6.89 \left( \frac{1}{x} \right) + 1.90 \]

\( R^2 = 0.96 \)

Source: USDA

- Slope changes with \( x \)
  - Ending stocks/use = 5
    \[ \Delta y / \Delta x = -6.89 \left( \frac{1}{5^2} \right) = -0.28 \text{ $/bu.} \]
  - Ending stocks/use = 25
    \[ \Delta y / \Delta x = -6.89 \left( \frac{1}{25^2} \right) = -0.01 \text{ $/bu.} \]
US Corn, Farm Price vs. Ending Stocks/Total Use, 1989/90-2001/02

Source: USDA

y = 6.89(1/x) + 1.90
R² = 0.96

Source: USDA
What Changed During the 1998/99-2001/02 Marketing Years?

- All else equal, supply shifted to the ______
  - US commodity programs changed in 1996 with passage of the “Freedom to Farm” Act
  - New legislation ________ acreage set-asides, and effectively, the non-recourse loan program

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

- Some _____________ of supply and demand shifts
US Corn, Farm Price vs. Ending Stocks/Total Use, 1989/90-2003/04

\[ y = 6.89 \left( \frac{1}{x} \right) + 1.90 \]
\[ R^2 = 0.96 \]

Source: USDA

US Corn, Farm Price vs. Ending Stocks/Total Use, 1989/90-2005/06

\[ y = 6.89 \left( \frac{1}{x} \right) + 1.50 \]

Source: USDA
US Corn, Farm Price vs. Ending Stocks/Total Use, 1989/90-2005/06

y = 6.89(1/x) + 1.90
R^2 = 0.96
(89/90-97/98 regression)

US Corn, Farm Price vs. Ending Stocks/Total Use, 1989/90-2006/07

y = 6.89(1/x) + 1.90
R^2 = 0.96
(89/90-97/98 regression)

Source: USDA
US Corn, Farm Price vs. Ending Stocks/Total Use, 1989/90-2008/09

Source: USDA

\[ y = 6.89(1/x) + 1.90 \]

\[ y = 6.89(1/x) + 3.60 \]
US Corn, Farm Price vs. Ending Stocks/Total Use, 1989/90-2009/10

Source: USDA

*2009/10 Projected
First ACE 427 Corn Balance Sheet Estimates for 2010/11

<table>
<thead>
<tr>
<th>Item</th>
<th>USDA/WASDE 2008/09</th>
<th>USDA/WASDE 2009/10</th>
<th>ACE 427 2010/11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planted Acreage (million acres)</td>
<td>86.0</td>
<td>86.5</td>
<td>89.5</td>
</tr>
<tr>
<td>Harvested Acreage (million acres)</td>
<td>78.6</td>
<td>79.6</td>
<td>82.3</td>
</tr>
<tr>
<td>Yield (Bushels / Acre)</td>
<td>153.9</td>
<td>165.2</td>
<td>158.0</td>
</tr>
<tr>
<td>Beginning Stocks (million bushels)</td>
<td>1,624</td>
<td>1,673</td>
<td>1,719</td>
</tr>
<tr>
<td>Total Production (million bushels)</td>
<td>12,092</td>
<td>13,151</td>
<td>13,003</td>
</tr>
<tr>
<td>Imports (million bushels)</td>
<td>13</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Total Supply (million bushels)</td>
<td>13,729</td>
<td>14,834</td>
<td>14,732</td>
</tr>
<tr>
<td>Feed and Residual (million bushels)</td>
<td>5,246</td>
<td>5,550</td>
<td>5,400</td>
</tr>
<tr>
<td>Food, Seed, and Industrial (million bushels)</td>
<td>4,653</td>
<td>5,565</td>
<td>5,770</td>
</tr>
<tr>
<td>Ethanol (million bushels)</td>
<td>3,677</td>
<td>4,300</td>
<td>4,500</td>
</tr>
<tr>
<td>Exports (million bushels)</td>
<td>1,858</td>
<td>2,000</td>
<td>2,100</td>
</tr>
<tr>
<td>Total Consumption (million bushels)</td>
<td>12,056</td>
<td>13,115</td>
<td>13,270</td>
</tr>
<tr>
<td>Ending Stocks (million bushels)</td>
<td>1,673</td>
<td>1,719</td>
<td>1,462</td>
</tr>
<tr>
<td>Ending Stocks/Total Consumption (%)</td>
<td>13.9</td>
<td>13.1</td>
<td>11.0</td>
</tr>
<tr>
<td>Average Price ($/bu.)</td>
<td>4.06</td>
<td>3.70</td>
<td>??</td>
</tr>
</tbody>
</table>

Note: USDA WASDE estimates were released in February 2010
• Ending Stocks/Use Forecast:

\[(1,462/13,270) \times 100 = 11.0\%\]

• Forecast price:

\[y = 6.89 \frac{1}{11.0} + 3.35\]
\[y = 6.89 \times 0.091 + 3.35\]
\[y = $3.98/\text{bu.}\]
Final Thoughts

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

The true _________ relationship is:

Supply and Demand                  Price
    Shifter                          and
    Variables                       Ending Stocks

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

- Reciproal
- 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: