Commodity Market Forecasting

What know and what we don’t know about the future

Global Insights 40th Anniversary

22 October 2003
Contents

1) The Lessons of History
2) Commodity Markets Today
3) Key Issues for the Future
There are two incompatible approaches to commodity price forecasting.

**Fundamental**
- Demand is derived from economic activity
- Supply takes place in response to resource availability
- Imbalances are resolved by inventory changes which drive prices
- Used for both long-term and short-term forecasts

**Technical**
- All relevant market information is contained in the price
- Price trends are the key to price forecasting
- Prices forecast by purely statistical techniques and chart analysis
- Used mostly for very short-term forecasts
Commodity futures prices are no substitute for a decent forecast

- Example: average absolute error using LME 3 month aluminum price as a forecast is $100/t
  - this is 3-4 times the average absolute error of forecasts by Chase Econometrics/Resource Strategies/CRU

- “Future” price is actually today’s price for a physical delivery in the future

- This incorporates today’s market expectations
  - new information obviously affects expectations in the mean time; so outcomes are not as predicted

- But: futures prices happen to be a statistically unbiased predictor of actual prices
Three equally “unbiased” forecasts – but one is clearly better!

Price

Right direction 75% of the time

Forecast A  Forecast B  Forecast C  Actual
Statistical trend analysis and fundamental research yield similar results for copper.
The same is true for nickel.
But the aluminum trend is improbably low due to structural shift in power markets.

Real Aluminum Price

Jan-80 Jan-81 Jan-82 Jan-83 Jan-84 Jan-85 Jan-86 Jan-87 Jan-88 Jan-89 Jan-90 Jan-91 Jan-92 Jan-93 Jan-94 Jan-95 Jan-96 Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03

Median - LRMC

Statistical trend

SRMC
Similar result in zinc, probably due to Europe exit barriers & Chinese competition

Real Zinc Price

Statistical trend

Median - LRMC

SRMC
The really important decisions tend to require fundamental forecasts

- New project feasibility studies are not “bankable” without a fundamental forecast
- Long-term fundamental forecasts are required for asset valuations and for effective implementation of value based management
- Critical technical issues (definition of reserves, life of mine planning) require fundamental forecasts
- Industry stakeholders continue to make or buy fundamental forecasts despite their mediocre accuracy record
Forecasting methods have adapted to the market environment

<table>
<thead>
<tr>
<th>Period</th>
<th>Market Environment</th>
<th>Forecasting Trends</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960-1973</td>
<td>Strong demand growth, nationalization to secure economic rents, stable or rising prices</td>
<td>First formal econometric forecasting models; classic market clearing; aggregated data</td>
</tr>
<tr>
<td>1973-1982</td>
<td>Oil crisis, severe cycles in demand and price, threat of hyper-inflation</td>
<td>Highly disaggregated forecasting linked to detailed macroeconomic models</td>
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<tr>
<td>1982-1989</td>
<td>Reduced inflation, high interest rates, weak demand, sharp fall in prices, privatization begins</td>
<td>Focus on supply side forecasting and understanding production costs</td>
</tr>
<tr>
<td>1989-2001</td>
<td>Collapse of communism, sustained growth based on globalization and low inflation, prices still fall</td>
<td>Hybrid forecasting techniques geared to understanding structural issues</td>
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</tbody>
</table>
The market clearing model – a simplified version

World Economy

- Demand
- Supply
- Market Balance
- Inventories
- Prices
- Capacity
- Operating Rate

- Production Costs

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World Economy

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- Production Costs
The demand side lessons

- Far richer macro forecasts – but more detailed is not necessarily more accurate
- Minimal progress on understanding price elasticities
- Cost culture has weakened link between demand and investment
The supply side lessons

- Comprehensive mine by mine, plant by plant databases
- Sophisticated understanding of cost structures
- Investment dynamics have experienced structural change
Commodity markets have asymmetrical pricing dynamics

<table>
<thead>
<tr>
<th>Condition</th>
<th>Required Signals</th>
<th>Price Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surplus markets</td>
<td>Demand is fully satisfied and stocks are high and rising; market signals the need to cut production</td>
<td>Prices fall to the industry’s short-run marginal costs (SRMC)</td>
</tr>
<tr>
<td>Deficit markets</td>
<td>All available capacity is operating but stocks are low and falling; auction market until marginal consumer defers demand</td>
<td>Prices rise to large premium over costs of even the highest cost producer; reflect short-run opportunity cost of the marginal consumer</td>
</tr>
<tr>
<td>In between markets</td>
<td>Demand is satisfied and producers who wish to operate are doing so; inventories are reasonable and/or trends are unclear</td>
<td>Prices reflect SRMC plus a premium based on future expectations; in equilibrium this equals industry long-run marginal costs (LRMC)</td>
</tr>
</tbody>
</table>
Prices are more often predictably below trend than unpredictably above.

### Metal Price Deviations from Trend
January 1980 to July 2003

<table>
<thead>
<tr>
<th>Monthly Data</th>
<th>Al</th>
<th>Cu</th>
<th>Pb</th>
<th>Zn</th>
<th>Ni</th>
<th>Metals</th>
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</thead>
<tbody>
<tr>
<td>Below Average</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>#</td>
<td>142</td>
<td>193</td>
<td>191</td>
<td>147</td>
<td>140</td>
<td>163</td>
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<tr>
<td>Average Deviation</td>
<td>-12.2%</td>
<td>-19.9%</td>
<td>-19.4%</td>
<td>-11.8%</td>
<td>-18.5%</td>
<td>-16.4%</td>
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<tr>
<td>Max Deviation</td>
<td>-28.7%</td>
<td>-40.1%</td>
<td>-40.0%</td>
<td>-33.1%</td>
<td>-43.4%</td>
<td>-37.1%</td>
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<tr>
<td>Above Average</td>
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<tr>
<td>#</td>
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<td>90</td>
<td>92</td>
<td>136</td>
<td>143</td>
<td>120</td>
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<tr>
<td>Average Deviation</td>
<td>23.3%</td>
<td>16.6%</td>
<td>22.9%</td>
<td>22.1%</td>
<td>34.2%</td>
<td>23.8%</td>
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<tr>
<td>Max Deviation</td>
<td>106.7%</td>
<td>55.5%</td>
<td>122.8%</td>
<td>98.6%</td>
<td>191.7%</td>
<td>115.1%</td>
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<td>15</td>
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<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Average Deviation</td>
<td>-10.9%</td>
<td>-22.8%</td>
<td>-19.2%</td>
<td>-8.7%</td>
<td>-16.6%</td>
<td>-15.6%</td>
</tr>
<tr>
<td>Max Deviation</td>
<td>-21.9%</td>
<td>-35.5%</td>
<td>-35.2%</td>
<td>-29.8%</td>
<td>-32.8%</td>
<td>-31.0%</td>
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<tr>
<td>Above Average</td>
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<td>10</td>
<td>8</td>
<td>10</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Average Deviation</td>
<td>21.0%</td>
<td>10.9%</td>
<td>20.7%</td>
<td>23.5%</td>
<td>34.5%</td>
<td>22.1%</td>
</tr>
<tr>
<td>Max Deviation</td>
<td>70.4%</td>
<td>29.6%</td>
<td>76.2%</td>
<td>68.0%</td>
<td>104.3%</td>
<td>69.7%</td>
</tr>
</tbody>
</table>
“Fan Charts” illustrate the role of expectations in determining prices.

Structure of Forward Aluminum Prices Since 1989
Contents

1) The Lessons of History
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The big picture across commodity metals reflects the global economy

- Commodity metal prices peaked between Q3 2000 and Q1 2001
  - reflecting a global slowdown that predated 9/11
- The period of decline lasted 18-24 months
  - basically flat to recovering since mid 2002
- The recovery has been very uneven to date
  - well over 50% of volume growth in most metals is coming from China
  - most of the rest from other Asia and North America
  - CIS has turned round, but absolute volumes are low
Prices, however, are still well below pre-recession averages – except nickel

Average 3-month price: June 2003 vs 1993 - 2002

Special case reflecting the failure of new technology which deterred investment in late 1990s
Normal (inverse) relationships between inventories and prices except for nickel

LME stock and price changes, Dec ’02 – June ’03
The “heatchart” shows considerable divergence among metals.
We forecast that there will be relatively few changes in 2004.
Contents

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There are four major issues that we can now identify:

- The impact of China on demand and supply
- Globalization versus protectionism
- The ability to manage the cycle and deliver shareholder value
- The impact of new technologies
Chinese risk is now a critical factor in virtually every commodity market

- China accounts for 50%-70% of the annual growth in global demand (greater impact than Japan in the 1960s)
  - will coastal prosperity spread to interior China?
  - when will the growth rate mature?
- China is a major producer and exporter of key commodities
  - most ferroalloys, zinc, magnesium etc
  - unsustainable development of power-intensive sector
- Potential exists for unexpected and severe swings in net trade balances
The triumph of globalization over protectionism is not a done deal

- Steel sectors continue to be heavily protected
  - will be increasingly challenged by technology change in upstream iron and steel sectors
- Non-ferrous smelting and refining is being subsidized via tariffs on imports, especially in Asia
  - copying traditional Japanese practices which contribute to excess capacity bias
- Emerging problem of deindustrialization starting to affect highly efficient, competitive downstream sectors in North America
  - will be a problem in Europe in next 5-10 years
Good news and bad news on cyclical management potential

- Industry consolidation is producing stronger and more disciplined corporate entities
  - Alcoa, Alcan, Rusal etc in aluminum
  - Diversified companies like Rio Tinto, BHP-Billiton, Anglo American and Xstrata in other markets
  - Governments have basically exited these sectors

- Potential loss of North American swing capacity reduces overall industry supply flexibility
  - devastating experience of zinc (no US swing capacity) in the current cycle
  - virtually no progress in Europe towards flexible production concepts
New technologies potentially trigger structural shifts that disrupt markets

- Inert anode technology in aluminum
  - potential drop of 25% in real cost of producing aluminum
- Leaching of primary copper sulphide deposits
  - fundamental reduction in costs, scale and entry barriers
- Similar developments in other markets
  - Mt Isa’s zinc technology, APL in nickel etc
- New technologies for primary iron production
  - Rio’s Hismelt project and its rivals threaten integration of iron and steelmaking
The challenges have escalated at least as fast as the lessons have been learned!

- Global and national economic risk
- Political, social and environmental constraints
- Technology change
- Industry management issues and challenges

*The “Renaissance Man” challenge*