Script to accompany BME Powerpoint presentation, 10th January 2010

BME aluminium market case study:

using mathematical models to sharpen thinking

and to de-personalise debate on metal prices

[Slide 1] Mathematical price modelling is a very useful tool, long-known within the industry, but one which got forgotten during the 1980s, when base metals prices were very low and very flat.

For those old enough to remember, there always used to be two strands to market analysis: (1) in depth knowledge of supply, demand and stocks and (2) mathematical modelling of prices (or of whole industries). There was often a degree or rivalry between the two branches.

During the 1980s, for many base metals, prices were moribund for a decade and very nearly all mathematical price modellers exited the sector – many moving to the foreign exchange markets. While metals prices 'flat-lined', there wasn't a lot to understand about them.

With price modellers almost all gone, there was a very general tendency for the supply – demand – stock experts to simplify price analysis to a reading on a single curve: that of prices versus stocks or prices versus stock to consumption ratios.

That was an over-simplification which made prices much harder to understand once they stopped just being a flat line.

[Slide 2] Let's start to explore what is wrong with relying just on the price to stock curve, before demonstrating how quite simple models make the process of understanding price vastly easier. Slide 2 sets out the LME cash price to LME stock relationship for aluminium over the period from 1990 to 2004. For aluminium (unlike copper) this was a very poor relationship that offered little real guidance on how to link specific prices to particular market conditions. For instance in that period, prices of US$1400 / tonne had coexisted with stock levels all the way from ~350 kt to ~2650 kt. Conversely, stocks of ~1650 kt had coexisted with prices from around $1100 to $2100, which was in those days almost the entire trading range of prices.

[Slide 3] This **s**hows how many non-price-modellers dealt with the poor fit. There was a widespread tendency for analysts to draw a trend line through the scatter and call that line the "fundamentally justified price". By implication, variations around the trend were assumed to be random or just speculatively driven. In fact, the variation around the trend was systematic and reflected two other fundamental drivers which were mostly neglected by analysts – in the absence of modellers.

[Slide 4] The next slide shows one of these other two fundamental forces: the rate of aluminium demand growth or the economic growth rate generally (we are using year-on-year growth in global industrial production – IP - here). At any given stock level, faster IP growth coexisted with higher prices. When LME stocks were below ~1450 kt, rapid IP growth tended to yield prices about $600 higher than the same stock level combined with very slow IP growth.

[Slide 5] The next slide shows the other fundamental force that was being neglected when people drew a trend line through the stock to price scatter diagram. This is the strength or weakness of the US dollar. With LME stocks of aluminium below around 1450 kt, a very strong dollar yielded prices perhaps $400 lower than would prevail at the same stock level but with a very weak US dollar.

[Slide 6] This slide brings together the degree of fit of prices against three fundamental drivers, then the three combined in simple models, for the period from 1990 through 2004. Note the huge differences between the main price relationships of copper and aluminium. Copper prices show two very strong links (inverse relationships to LME stocks and US$ strength with R squareds of 0.62 and 0.59, respectively), whilst aluminium has no single price relationship that would provide much guidance on price, taken in isolation. The degree of fit of aluminium price with IP growth had an R squared of just 0.14, LME stocks 0.13, and dollar strength a ludicrous 0.09. We say ludicrous because the aluminium market was behaving as if virtually the entire industry was within the US dollar zone, and it wasn't. Note that however weak they were in isolation, the three drivers in combination (in a simple three driver model) gave a more respectable R squared: 0.69. Earlier in our model development programme, we would have considered that to be a partial failure of modelling. Today however, we are more confident of our modelling experience, and would say that this indicates that aluminium was always a very inefficient market. It is only a slight exaggeration to say that in the era when physical market fundamentals were esteemed so highly, aluminium didn't have any. Make of that what you will.

[Slide 7] This slide describes the purposes and benefits of price models.

Constructing a mathematical model forces a modeller to think much more rigorously about mechanisms in the market. For instance, modelling establishes that demand affects price twice: once as a rate of growth, once as part of the supply – demand balance.

While a series of two dimensional charts is quite easy to look at, it is in fact much easier to use a model to assess the simultaneous impact of several forces. A model allows you more rigorously to quantify links between market circumstances and price.

A model facilitates rigorous scenario analysis.

A model also tells you quickly when price relationships have changed. Models can be at their most useful when they go wrong – especially if models of different markets all go wrong simultaneously. At the end of 2005, BME was the first company to publish the view that investment in futures by index funds had raised the price level that corresponded to any given stock level. That something had changed was clear from deviations between actual and modelled prices in a whole series of base metals.

[Slide 8] This slide describes the limitations and risks of fundamentals-based models.

Such models were only of use over the medium- and long-term periods when fundamentals drove prices. For the short term, it was always better to use BME technical analysis expert systems.

Fundamentals-based models do not inherently have a mechanism for anticipating wholly new forces that might affect prices. One needs to use a human brain too!

When quantitative relationships first change, a model user may be over-confident that it is a temporary deviation, and may trade the wrong way.

Over-emphasis on modelling can cause non-quantitative price drivers to be neglected.

[Slide 9] In constructing a price model, BME uses multivariate regression splines. Splines fit different slopes to different ranges and can incorporate pinch points, floors and ceilings to price.

[Slide 10] This shows a BME price model covering the period from 1997 to 2004. The software initially constructs a basis level, then adds increments in $ / tonne for IP growth, stock levels and dollar strength or weakness.

[Slide 11] The next slide shows how dramatically aluminium price to stock relationships changed after 2004.

[Slide 12] This shows BME's interpretation of the forces behind the shifts. Dollar weakness has raised the curve. However, BME's interpretation (a working hypothesis rather than something absolutely proven) is that net-long investments in aluminium futures has raised the curve far more and tilted it (increased its slope). Higher energy costs will have raised the whole curve too.

[Slide 13] The next slide shows very briefly what we believe to be the mechanism. This is something that we explored at great length in an article in Commodities Now's 2009 LME Week Supplement [a pdf of this is available on our website] so we will be brief here. Before 2005, producer and other hedge shorts exceeded consumer hedge longs and the balance of the futures market used to be provided by speculative longs. However, from 2005, the volume of producer hedge shorts dropped away sharply whilst the volume of investment longs increased (especially index fund longs). The balancing force in the market became speculative shorts whose behaviour is very different from speculative longs, especially at low stock levels. As investment longs increase, sufficient speculative shorts only emerge at higher and higher prices for any given stock level. When thinking about this, people's first interpretation is that this represents an artificial price rise. But one might alternatively think of it as a way of keeping stocks higher at prices which were needed in any case. There is an element of truth about both approaches.

[Slide 14] This slide shows actual prices versus those modelled using just the old physical market drivers. The scale of the deviation from early 2006 is spectacular.

[Slide 15] The next slide shows a split of what we consider to be the cause of the deviation into two components of a total investment-net long. This is a fairly smoothly growing positive only index fund component and a much more volatile alternately long / short component which we have labelled "hedge fund" but which will also be incorporating other speculators. From discussions with the trade, we believe that the maximum total hedge fund net shorts, post-Lehman, were broadly similar in scale to the maximum hedge fund net longs, in 2006 and early 2008. From that we have derived a split between the two forces which we reckon to be roughly right. It is the best that we think can be done given the difficulties in obtaining fully quantitative externally sourced data. What it does do is give one a reasonable basis for forecasting the extent to which hedge funds' anticipatory or trend-following behaviours might affect prices in future, one of the main elements of price risk.

[Slide 16] This shows recent output from the BME aluminium price model, which incorporates both the traditional fundamental drivers and what we consider to have been the two financial drivers (index funds and hedge funds). Note that we have adjusted the model's mathematically derived basis layer to give an approximate value to the effect of higher production costs from 2005.

[Slide 17] This splits out the modelled price drivers' various contributions. Note that responsiveness of aluminium prices to currency factors has increased in recent years, compared to the period through 2004. This increase in market efficiency we would be inclined to attribute to hedge funds' involvement.

[Slide 18] This shows recent forecast output from the BME aluminium price model. Note that the shift of prices sharply higher appears to be largely driven by recovering rates of IP growth, according to the model.

[Slide 19] The next slide moves on to how our customers use BME price models.

Many users begin by using the model to convince sceptics and conspiracy theorists that metal prices really are understandable to a reasonable extent, once the interaction of three price drivers is considered. That is even more important in aluminium and nickel, than it is in copper, because the historical dreadful fit between prices and stocks in aluminium and nickel caused some people to think of these simply as manipulated markets.

Licensees also use the models to de-personalise discussions on price, across one or more metals. Instead of wanting to say to their colleagues (or bosses) unhelpful things like "you are wrong" they can now be more constructive and say things like "the aluminium department's assumption on the impact of currency factors is at odds with the assumptions of the copper department: who does the CFO think is right?".

Licensees use it to explore a range of future scenarios quickly and easily.

Where hedging is undertaken (or being considered) they use it in discussion.

If they do feel obliged to forecast prices (which is a necessity if one is to value assets or rank projects), they can at least use models rigorously to make compatible forecasts across a range of metals. But models are not magic. Even using them, forecasting is a very difficult exercise.

[Slide 20] This slide moves on to contrast how modellers and non-modellers tend to view the long term price outlook for valuation purposes.

Many companies which need to work with long-term prices do not (yet) incorporate insights from price modelling. Many assume a simple, smooth reversion from today's very high investment / speculation boosted prices to much lower, production-cost related levels.

Companies taking in insights from mathematical modellers on the contrary would analyse the anticipated legacy of excess stocks and structural over-capacity that would result from any continuation of excess (i.e. investment / speculation driven) prices.

The latter companies would then try to assess when and for how long prices would be below assumed cost-related levels, whilst legacy excess stocks were worked off.

The two approaches would yield very different asset valuations. BME believes that the approach bringing in insights from modelling will yield better results.

[Slide 21] Shows graphically a typical long-term price scenario analysis that might be constructed by a non-modeller.

[Slide 22] Shows in contrast a possible view of modellers. They will probably have the same very long term view as non-modellers, but their short-term view is likely to be higher and their medium term view much lower. A company drawing insights from modelling might thus place higher relative valuations on producing assets than on new projects.

[Slide 23] This slide emphasises that understanding commodities prices is a moving target. It is also where we begin our sales pitch (not until slide 23!).

BME was the industry's 'thought leader' over 2002 to 2005, when we brought modelling back into the mainstream of base metals analysis. We broadened people's focus from stocks as the key indicator, to the combination of stocks, demand growth rates and currency factors. This was especially important in aluminium and nickel, where the link between prices and stocks was always poor.

From 2005 to 2009, we were the industry's 'thought leader' in analysing markets that had become hybrid: part industrial raw material market, part investment vehicle.

In 2010, we shall be moving further ahead, modelling the feedback loop from investment-influenced (i.e. excessive) prices to (upward) stock trend. This will be absolutely crucial in the aluminium market, where investment driven excess prices have already got LME stocks above 4.5 Mt and create the prospect in some forecasters' minds of a market surplus of 4 Mt in 2010. In an investment driven market, prices drive stock trend not vice versa. For aluminium, an investment driven market is proving dis-functional as a setter of prices for the industry itself, creating substantial over-capacity and over-production – or so BME fears.

In 2010 we shall also be drawing on BME Price Models' earlier work on equity investor sector rotation, to explore sector rotation between equities, bonds and commodities, and model likely future trends and cycles of investment flows into (and out of) commodities.

[Slide 24] In this slide, we contrast the old world of commodities market analysis, which was dominated by individual metal specialists, to a more complex world where no-one will be able to understand a single commodity market in isolation from broader financial influences. That slide encapsulates BME's philosophy.

[Slide 25] This explains how our customers can gain access either to standard or customised BME price models.

Our current models run with monthly data through 2012. They are updated and circulated to clients monthly.

The models are being extended to cover the long term to allow users to explore in full issues such as (i) future legacies of excess stock (ii) eventual disinvestment and (iii) short-, medium- and long-term price prospects.

There are five standard models: aluminium, copper, nickel, zinc and lead. Annual licences cost £10,000 for one metal, £16,000 for two metals, £20,000 for three metals, £23,000 for four, £25,000 for five.

BME would be happy to work with clients to customise these models or create new ones.

Peter Hollands, 10th January 2010

See also our website www.bloomsburyminerals.com on nickel and aluminium.