MEMORANDUM

To: Ms. Nancy Morris
Secretary
Securities and Exchanges Commission
100 F. Street, N.E.
Washington, D.C. 20549-1090

From: John Parsons, Executive Director
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Date: February 16, 2008

Subject: **FILE NO. S7-29-07, COMMENTS REGARDING CONCEPT RELEASE 33-8870**

This submission responds to Question #10 in the Commission's Concept Release 33-8870:

> 10. Should we reconsider requiring companies to use a sale price in estimating reserves? If so, how should we establish the price framework? Should we require or allow companies to use an average price instead of a fixed price or a futures price instead of a spot price? Should we allow companies to determine the price framework? How would allowing companies to use different prices affect disclosure quality and consistency? Regardless of the pricing method that is used, should we allow or require companies to present a sensitivity analysis that would quantify the effect of price changes on the level of proved reserves?

The Problem

Complaints about the year-end pricing rule are generally rooted in the large short-term volatility exhibited by the oil price. The spot oil price occasionally exhibits large swings up or down which are then followed by reversals back towards some central tendency. The most dramatic example of such a swing is the sharp price spike occasioned by the first Gulf War in late 1990. Starting from a level below $18 per barrel in mid-July, the price peaked above $40 per barrel in October, then falling back below $18 per barrel by late-February 1991. A less dramatic example is the

drop in prices that occurred in 1993 when conflicts within OPEC resulted in a temporary glut of supplies and prices went from over $18 per barrel in August to below $14 per barrel in December, recovering back to over $18 per barrel again in June 1994. From December 1998 to November 2000 the price nearly tripled from $11 to $35 per barrel. But this dramatic increase was marked by several reversals down by $10 per barrel before the upward trend recovered. Then within the space of slightly more than a year, the price fell again down to $18 per barrel and recovered as quickly back above $30, continuing its rise marked by swings of as much as $10 per barrel. Even during the last three years as the price has run-up toward $100 per barrel, there have been wide swings around this trend.

If the year-end arrives during one of these sharp swings, then the price used to estimate reserves will not accurately reflect the true long-term economics. In February 2005, when Exxon Mobil announced its 2004 results using the end-of-year pricing method, it simultaneously issued a press release to advertise the arbitrary effect of short-term volatility. Exxon Mobil was forced to remove from its reserves approximately 500 million barrels in its Cold Lake field, a heavy oil-bitumen steam project in Canada. Although bitumen prices "were strong for most of 2004,…on the day of December 31, 2004, prices were unusually low due to seasonally depressed asphalt sales and industry upgrader problems in Western Canada. Prices quickly rebounded from December 31, and through January 2005, returned to levels that have restored the reserves to the proved category."[1] The end-of-year pricing method resulted in a reserve replacement ratio for Exxon of 83%: under Exxon's former methodology it would have been 112%.

The Two Kinds of Volatility

Unfortunately, discussions about the volatility of the oil price do not adequately distinguish between different types of volatility. The oil price is volatile, but not all of the volatility can be associated with fluctuations around a well known fundamental value. Some of the volatility is a reflection of changes in the fundamental value of oil at any given time. When the fundamental value is changing rapidly, as it appears it has been in the most recent number of years, it is important that this changing value be incorporated into management decisions, investor valuations and reserve declarations. The hard problem is how to distinguish between short-term, transient fluctuations in the price of oil and long-term, persistent movements.

Financial economists who study the movements of commodity spot and futures prices have developed models that are able to capture both the short-term, transient volatility in the oil price and the long-term, fundamental volatility. Gibson and Schwartz (1990) and Schwartz (1997)

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[1] Exxon Mobil press release, February 18, 2005, "Exxon Mobil Corporation Announced 2004 Reserves Replacement".

develop a two factor dynamic model of the term structure of oil futures prices which exploits this feature of futures prices. Baker, Mayfield and Parsons (1998) and Smith and Schwartz (2000) show that the two-factors can be represented as a short-term, transient component in the spot oil price and a long-term, lasting component. Each component is subject to shocks. Shocks to the short-term component do not have a lasting effect on the future price of oil. They dissipate gradually. In contrast, shocks to the long-term component are lasting and so cumulate. The observed volatility of the spot price is a function of the volatilities of both factors.

In a recent paper with my co-authors Miguel Herce and Robert Ready (2005), we estimated the total volatility of the oil price, and the share of that volatility that was due to the short-term and the long-term factors. The total volatility was approximately 37%. Approximately 22 percentage points of this volatility was due to short-term volatility—i.e., due to swings around the fundamental value. The remaining 14 percentage points of this volatility was due to long-term factors—i.e., represents the changing level of the fundamental value.

Changes in the fundamental value should be reflected in the price used in reserve calculations. That the fundamental value is volatile cannot be helped. It would be unwise to seek a pricing rule that failed to reflect this volatility. This fact is often overlooked by those who criticize the present system and complain about the volatility of the oil price. Much of the volatility is in the fundamentals. Management decisions need to be responsive to this volatility. Investor valuations will reflect this volatility. And reserve calculations should, too.

Unfortunately, using the year-end pricing rule causes the price used in reserve calculations to reflect as well the short-term, transient volatility that does not reflect the true long-term economics of the reserves. This is the source of the problem.

Solutions?

Is it possible to identify a pricing rule that successfully reflects the long-term volatility of the oil price, i.e., that reflects the true fundamentals as best we know them, and that successfully filters out the short-term volatility? There are 4 main alternatives to the year-end pricing rule:

- average historical price,
- futures price,
- company price.

I will address the first two alternatives and how they compare against the year-end spot price. I have not seen any thorough presentations about how the third alternative would be made workable.

Average historical price. This is a popular alternative. It provides an easy tool for eliminating the short-term transient volatilities. If the oil price were predominantly a mean-reverting process, without any significant long-term volatility, this would be better than using the spot price at year-end.

Unfortunately, the oil price does not appear to be exclusively mean-reverting. Many people believe that the price run-up of the last few years reflects a permanent change in fundamentals. Long-maturity futures prices certainly support this contention. An average historical price is a backward looking figure. Whenever the fundamental value changes rapidly over a period of time, this method will fail to fully reflect such a change. This method would have been slow to recognize the changes in fundamental value as they have occurred in the last few years.

Futures price. This is attractive on both theoretical and practical grounds. Long-maturity futures contracts successfully reflect changes to the fundamental value, and reflect less of the short-term, transient volatility that plagues the spot price. The longer the maturity of the contract, the less of this short-term volatility is reflected. In our paper, Herce, Parsons and Ready (2005) show that a 17-month futures price is immune to more than 90% of the short-term volatility while capturing all of the fundamental volatility.

The main disadvantage to using the futures price is the concern that the futures market may sometimes not be liquid enough so that the reported price is not a true market price. For many commodities this concern is reasonable, but the oil market is one of the deepest commodity markets in the world, and the futures market is, too. The concern is sometimes expressed that the market may be deep for the spot commodity, and for very short maturity contracts, but the market for longer maturity contracts is not deep. There are two points to be made here. First, futures contracts of any maturity are an improvement over the spot price. Assuming that there is market depth, then the improvement increases the longer the maturity of the contract. So the question becomes, what maturities have sufficient depth. This decision may need to be made by the regulator and revised over time. Second, there is good evidence that in recent years the oil futures market has become very deep at relatively long maturities. This evidence comes from a study by Haigh, Harris, Overdahl and Robe (2007).

Comparisons. At the MIT Energy and Environmental Policy Research Workshop in May 2007, I presented a comparison of these alternative prices for reserve valuation. Attached to this memo are a set of charts from that presentation showing the spot price of oil from 1990 through 2006, as well as an historical average price (a 1-year rolling average) and the 1-year future price contract. Also shown is a calculation of the underlying fundamental value through time—labeled the estimated long-term price. This fundamental value was calculated in my paper with Miguel Herce and Robert Ready (2005).

In this window of time there are 16 year ends. Using the estimated long-term price as the benchmark of performance, we find that the spot price deviated most from the benchmark, while the moving average and the futures price performed equally well.

This window of time may not have been representative, so I produced a simulation of possible future price paths with the same statistical properties as the historical path. I set the short- and long-term volatility parameters the same, but simulate many random shocks to the price path. I once again used the long-term price as the benchmark, and compared the year-end spot price to

it, the moving average and the futures price. In this case, the moving average performed as poorly as the year-end spot price, while the futures price clearly dominated.

Futures prices are clearly preferred wherever they are practical. Average historical prices produce stability at the cost of informativeness, so that it is hard to understand how their use would be a step forward. Any alternative is going to be subject to anecdotal criticism based on 20-20 hindsight.

References

Baker, Malcolm P., E. Scott Mayfield and John E. Parsons, 1998, Alternative models of uncertain commodity prices for use with modern asset pricing methods, Energy Journal 19, 115-148.

Gibson, Rajna and Eduardo S. Schwartz, 1990, Stochastic convenience yield and the pricing of oil contingent claims, Journal of Finance 45, 959–976.

Haigh, Michael S., Jeffrey H. Harris, James A. Overdahl, Michel A. Robe, 2007, Market Growth, Trader Participation and Derivative Pricing, Working Paper.

Herce, Miguel, John E. Parsons and Robert C. Ready, 2006, Using Futures Prices to Filter Short-term Volatility and Recover a Latent, Long-term Price Series for Oil, MIT-CEEPR Working Paper #06-005.

Schwartz, Eduardo S., 1997, The stochastic behavior of commodity prices: implications for valuation and hedging, Journal of Finance 52, 923-973.

Schwartz, Eduardo S. and James E. Smith, 2000, Short-term variations and long-term dynamics in commodity prices, Management Science 46, 893-911.

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CEEPR Workshop
Cambridge, MA
May 2007

What Price Should Be Used in Estimating Reserves?

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The Estimated Long-Term Series

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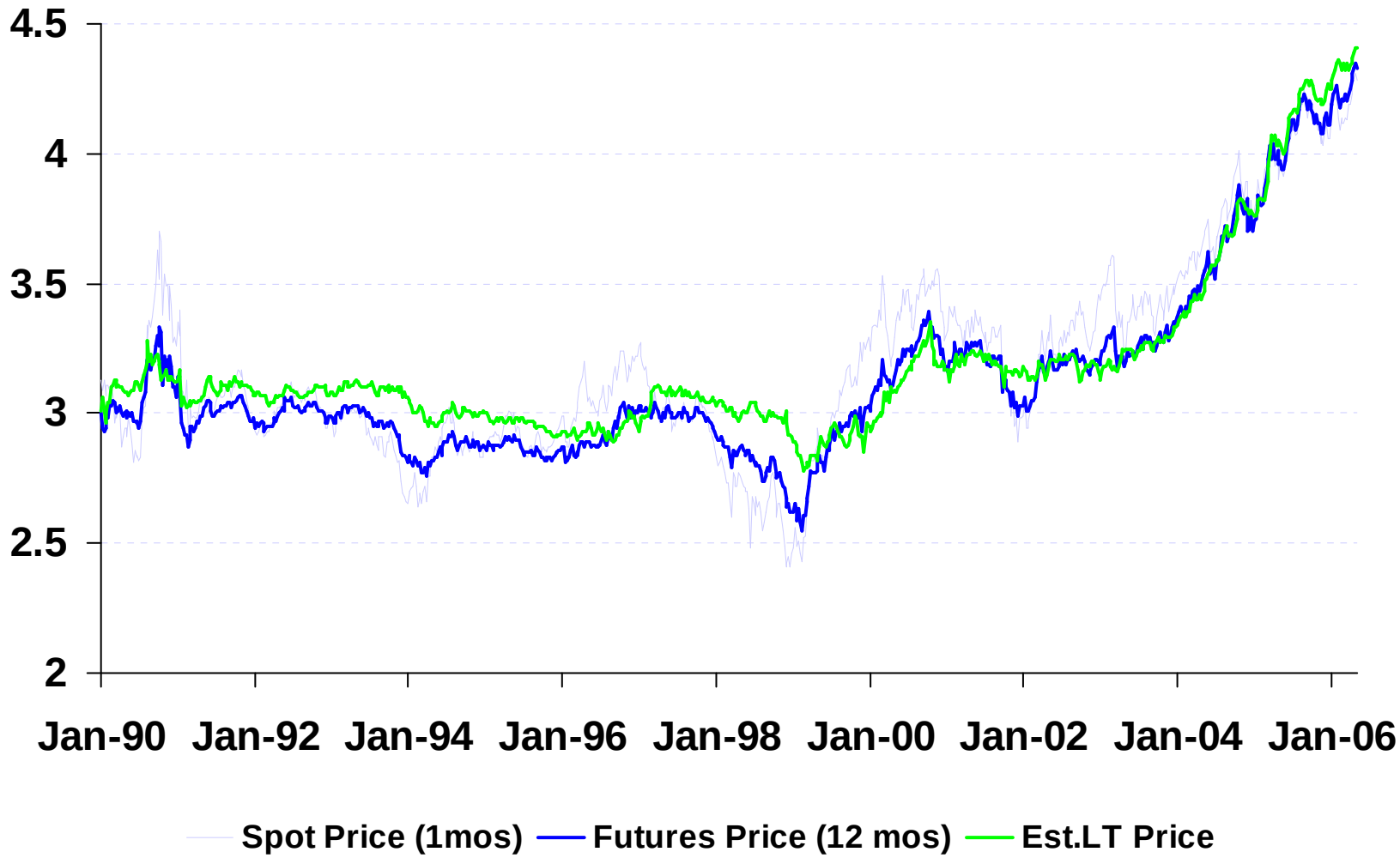
Versus the 1 year Futures Price



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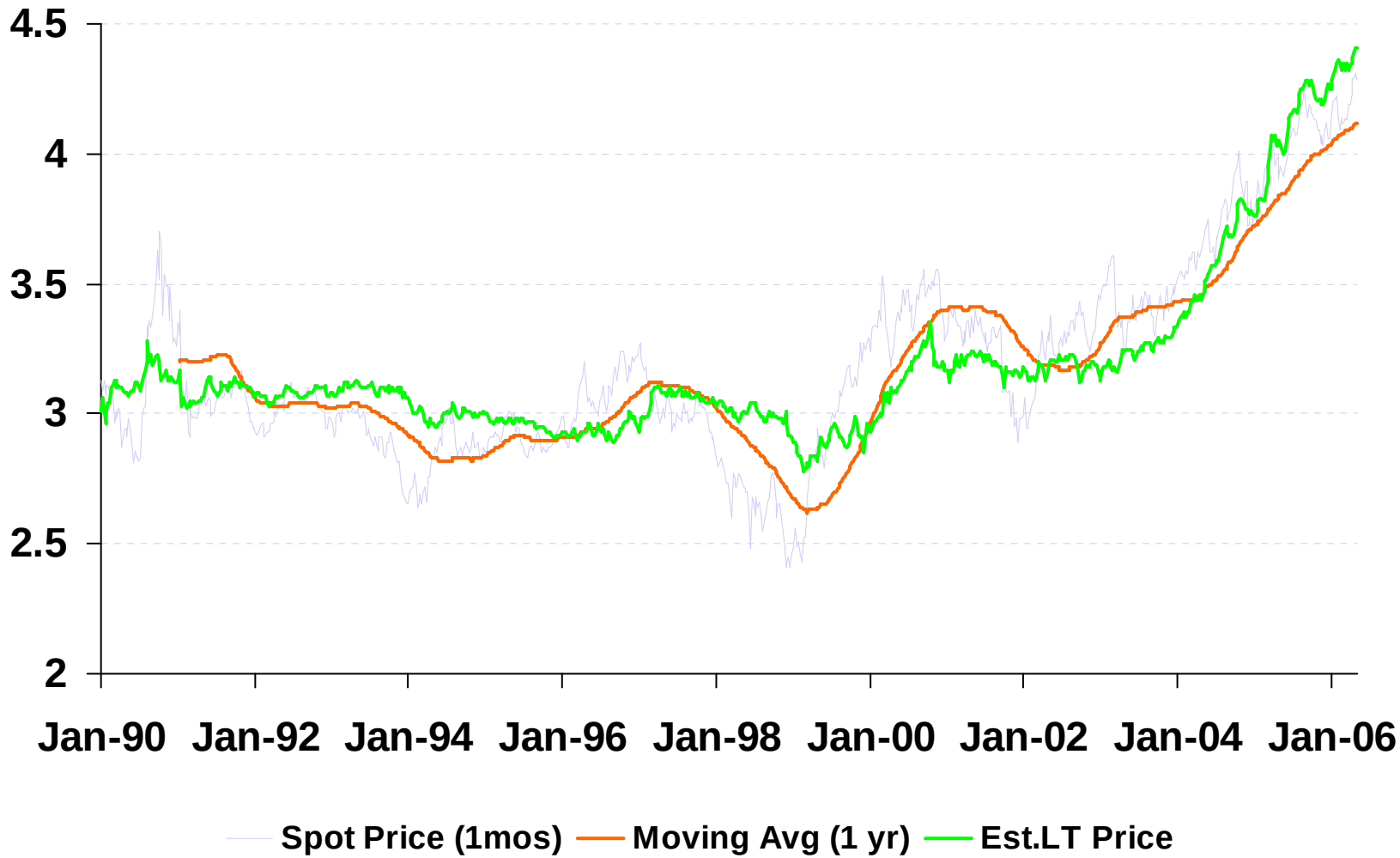
Versus the Moving Average



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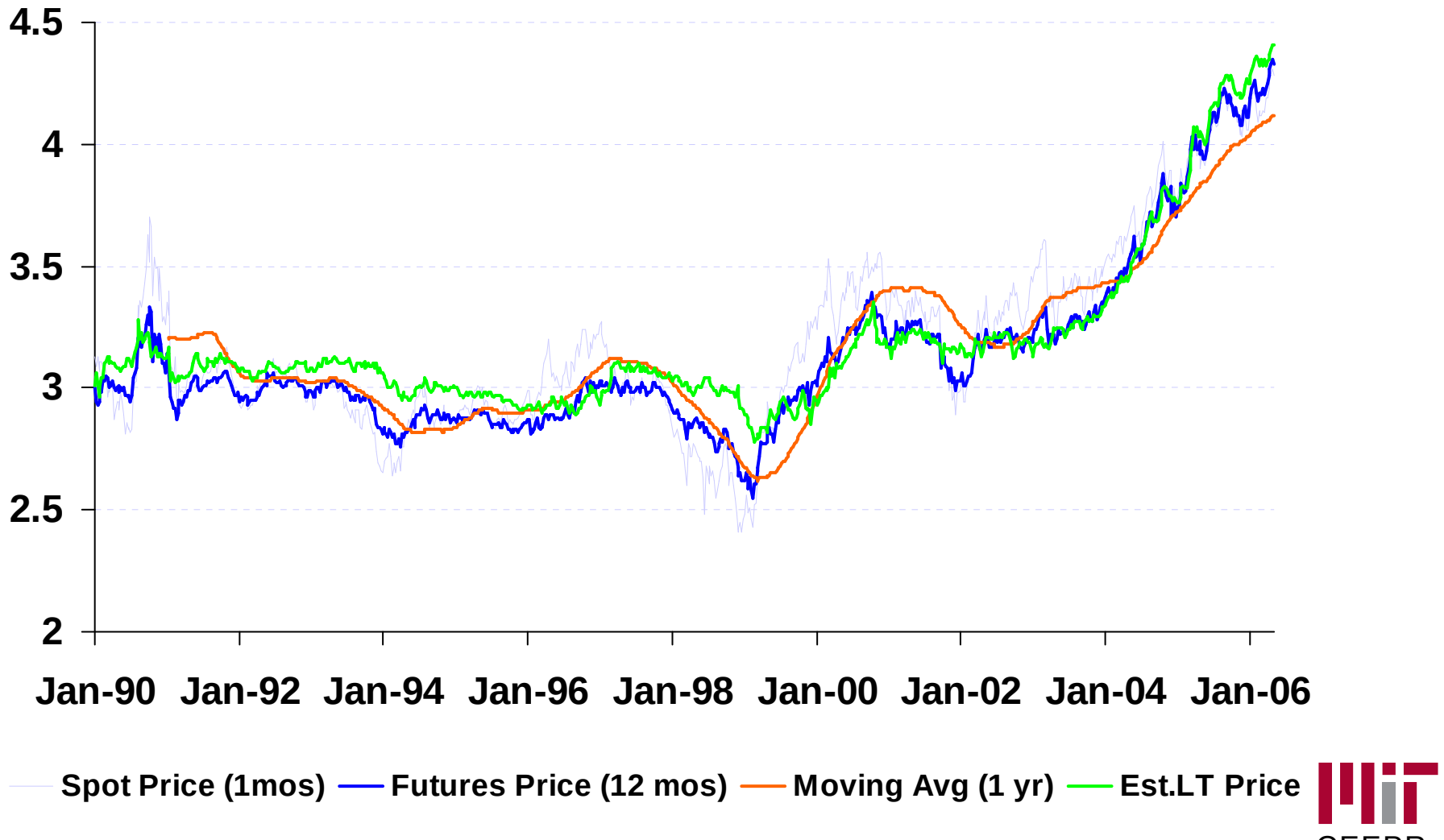
Futures Versus the Moving Average



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