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OSFI's academic foray

A recent white paper reveals low standards

In March 2012, the Office of the Superintendent of Financial Institutions (OSFI) released a paper titled "Evidence for Mean Reversion in Equity Prices."

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The paper attempts to justify their decision not to allow segregated fund guarantee reserve and capital requirements for insurance companies to be based on equity return models using the assumption of mean reversion.

I have long advocated that OSFI release their internal research and analysis to the public. This paper only exacerbates my fears regarding OSFI's ability to execute its mandate to "monitor and evaluate system-wide or sector issues that may impact institutions negatively." Regrettably, I don't think the arguments made in the paper hold up to serious scrutiny.

Mean reversion in equity prices

Mean reversion is often confused with sampling error in what is referred to as the "regression fallacy" or "regression to the mean." For example, for coin tossing we can predict the long-term proportion of heads and tails is 50:50. If the first three tosses are all heads, the chances of a head on the fourth toss remains 50%. The expected average will be 50%, but only because the probability on every toss is 50%.

This can be contrasted with an experiment of drawing from a box that contains an equal number of red and white balls, without replacing the balls once drawn. Just as with coin tossing, the expected proportion for any sample is 50:50. But in this case, if the first three draws are all white, then the probability a red ball is drawn increases because the proportion of red balls in the box has increased.

This example of drawing balls from a box illustrates mean reversion: we must adjust future probabilities based on prior results. Anyone who believes the odds in a coin toss change because of the first three results has fallen victim to the regression fallacy.

Do equity prices exhibit long-term mean reversion? OSFI stated that the evidence was not strong enough to support "the large reduction in segregated fund guarantee reserve and capital requirements from assuming mean reversion in equity returns." While the conclusion may be correct, their supporting arguments show a faulty understanding of the issue.

The questionable nature of their decision is exemplified by the fact that they disregard the Canadian Institute of Actuaries (CIA) 2002 report that's heretofore served as the basis for segregated fund guarantee capital requirements in Canada.

This report specifically allows state-dependent models (a class that includes mean-reverting models) provided they are based on historical data and meet calibration criteria (i.e., a minimum probability of various levels of poor results over a variety of time frames).

PROBLEM #1: THE EFFICIENT MARKET HYPOTHESIS

OSFI claims mean reversion contradicts the efficient market hypothesis (EMH), stating "traders would be able to earn excess returns […] by buying stocks that have had lower-than-average returns in prior periods and short-selling stocks that have had higher-than-average returns."

This begs the question of whether mean reversion exists at the universe level. After a stock index has declined substantially, mean reversion implies that expected future returns for the index increase. This has no bearing on the relative returns of any two individual stocks; past winners and losers may be assumed to have precisely equal distributions of future returns.

In addition, as Burton Malkiel, one of the great defenders of the EMH, states in The Efficient-Market Hypothesis and the Financial Crisis: "It is highly unlikely that either real interest rates or required risk premiums are stable over time. Stock prices should adjust with changes in required rates of return, and such price volatility may be entirely consistent with EMH.

"Over short holding periods, there is some evidence of momentum in the stock market, while for longer holding periods, mean reversion appears to be present."

PROBLEM #2: MEAN REVERSION OF ECONOMIC INDICATORS

OSFI claims, "Long-run economic performance in real terms is generally a function of population and productivity growth, neither of which are inherently mean reverting. Since the performance of many asset classes has a tendency to be broadly linked to economic growth prospects, this casts doubt as to whether mean reversion in equity prices will always occur."

But as Siddhartha Chib and Michael Dueker note in a Federal Reserve Bank of St. Louis working paper, "Autoregressive models are popular in economics because many economic variables appear to respond more to their own past values than they do to a distributed lag of any other variable."

There are many government policies which seek to make population growth mean reverting: these include the Government of Canada's immigration policy, the province of Quebec's population policy and the Government of China's one-child policy.

If equity-return models are to be judged based on their ability to replicate the Great Depression and a world war, I suggest this requirement be publicized.

In addition, there is the simple unpleasant fact that too large a population will simply outstrip available resources. Conversely, an increase in the productivity of arable land will allow a higher population. This implies mean reversion of global population towards a figure dependent upon food production.

It is not obvious that investment portfolio equity returns are tightly linked to economic growth as defined by GDP. The innovators themselves will enjoy a considerable share of the fruits of productivity improvement. Jay Ritter of the University of Florida goes so far as to say that "economic growth does not benefit equity holders."

Christian-Marc Panneton, whose work is singled out for criticism in the second half of the OSFI paper, points out that actions taken by governments to stabilize the markets during the credit crunch are in and of themselves sufficient to show that there is some level of state-dependency in equity returns.

PROBLEM #3: OPTION PRICING

OSFI states, "If market participants truly believe that equity markets revert to the mean over the long run, then this should be observable in option prices, which reflect the market price of hedging long-dated equity guarantees.

In particular, the cost of purchasing put option protection against a long-run decline in equity markets should be minimal. However, the cost of purchasing such protection is in fact very expensive, if it is available at all, which suggests that the market does not believe in mean reversion."

This statement exhibits a misunderstanding of how long-dated options are priced in the marketplace. Panneton points out that long-term option costs and mean reversion are not directly related because the portfolio used to hedge the option must be rebalanced frequently.

So it is this constant need to rebalance that drives long-term option pricing, not the views of market participants regarding long-term price changes.

Emanuel Derman, Deniz Ergener and Iraj Kani argue in a 1994 Goldman Sachs white paper that "[f]irst, continuous weight adjustment is impossible, and so traders adjust at discrete intervals.

This causes small errors that compound over the life of the option, and result in replication whose accuracy increases with the frequency of hedging.

"Second, there are transaction costs associated with adjusting the portfolio weights which grow with the frequency of adjustment and can overwhelm the profit margin of the option. Traders have to compromise between the accuracy and cost."

When traders quote prices for long-term options, they don't underestimate the costs of the transaction.

David Bayliffe and Bill Pauling go so far as to claim that "market participants do not use a Black Scholes model to price these options. Models actually used are likely to reflect the non-normality of market returns, the high transactions costs of adjusting hedges over long time periods and a profit margin."

This is well known to OSFI, or at least to certain departments within OSFI. Their recently released paper, "Life Insurance Regulatory Framework," states that "[t]he current approach to determining liability and regulatory capital requirements for financial guarantees embedded in segregated fund products has the following drawback: It can produce values that are materially lower than the cost of hedging."

PROBLEM #4: DISPROOF BY COUNTER-EXAMPLE?

OSFI cites three instances of stock indices showing an extremely long — or not yet complete — recovery from their peaks and claims that this "calls into question whether this model accurately represents real-world equity returns."

These three instances are: the Dow Jones Industrial Average peaking in 1929 and not recovering until 1954; the NASDAQ Composite Index peaking in 2000 and not yet recovering; and the Nikkei 225 index peaking in 1989 and not yet recovering.

The CIA's Committee on Life Insurance Financial Reporting specifically chose to ignore the Great Depression in their 2012 report, stating that this tragedy was partly caused by inept monetary policy.

The drawdown model includes only positive adjustments to expected returns after a crash and does not include negative adjustments to expected returns after a bubble, though the OSFI condemnation of the model does not explore this line of criticism.

Nor do they provide any tests of the model's conclusions with respect to the capitalization of life insurance companies' segregated fund guarantees. Could such a company utilizing the drawdown model have been insufficiently capitalized under these conditions? OSFI does not consider this question.

It is also unclear whether these three examples of poor equity performance are present in any of OSFI's more formal stress-testing. The projection period for these tests was only five years at the time the model was proposed.

More recent guidelines do not specify duration, speaking only of "periods of severe and sustained downturns, including its ability to react over the time horizon appropriate for the business and risks being tested."

If equity-return models are to be judged based on their ability to replicate the Great Depression and a world war, I suggest this requirement be publicized.

PROBLEM #5: PRUDENCE OF REDUCTION IN CAPITAL RESERVES

OSFI states that "[g]iven the large reduction in segregated fund guarantee reserve and capital requirements that would result from assuming mean reversion in equity returns, it would not be prudent for OSFI to approve equity return models that are based on the assumption of mean reversion without strong evidence that

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mean reversion actually occurs in the market and is likely to continue in the future."

But there is another risk to be considered: we waste resources if we insist on unnecessary solvency capital.

It is the easiest thing in the world to insist that every risk be covered to the greatest feasible extent; it is much more difficult to make a judgment regarding the proper trade-off between risk and cost, and more difficult still to formulate a coherent argument defending that judgment.

OSFI and the Federal Ministry of Finance seem to pride themselves on the safety of the Canadian financial system while paying very little attention to the cost of these measures.

This has led the Canadian banking system to become a monolithic, bloated oligarchy, with bank assets equal to 199% of our GDP in 2010, versus 99% in the U.S.; and with financial equities comprising approximately 33.4% of the S&P/TSX 60 Index, compared to the U.S. figure of 14.4% of the S&P 500 Index.

PROBLEM #6: IGNORING CALIBRATION CRITERIA

As noted earlier, the 2002 report by the CIA included calibration criteria for equity return models. These standards were developed for periods of up to 10 years. For instance, models had to incorporate a probability of at least 2.5% that total return over a 10-year period would be -15% or worse.

This model was updated by OSFI in October 2010 to incorporate a longer period of data, but only the shortest-term standards (six months and one year) were affected; longer periods were left as is.

Finally, in February 2012, an actuarial research group provided a further update to these calibrations that explicitly excluded the assumption of mean reversion.

These revisions result in standards for modelling periods of one year that are considerably more favourable for insurance companies than the OSFI 2010 standards (and include a rather breathtaking 8% mean expected return for broadly based U.S. indices), but

these revised actuarial guidelines have not received any formal recognition by the regulator.

Regrettably, OSFI ignored this update in its mean reversion commentary, despite the fact that the 2002 CIA report explicitly permitted state-dependent models with such assumptions.

PROBLEM #7: OUTDATED REFERENCES

OSFI provides eight references in the paper, of which one is the 2002 paper in which the severely criticized drawdown model was developed. Of the other seven, the most recent is from 1993.

There has been a great deal of research on the matter in the past 19 years, which OSFI has chosen to ignore.

Conclusion

The OSFI paper held great promise to explain to the investing public why it made a particular decision — a practice that allows us to become more familiar with OSFI's priorities and the underlying philosophy that forms the framework for its decisions. This promise was not fulfilled.

If OSFI wishes to gain credibility as a knowledgeable and effective regulator of the Canadian financial system, it needs to produce analysis at a much higher standard. Both academia and the private sector offer considerable expertise on regulatory practice, and it should be harnessed.

OSFI may have made the correct decision when it prohibited models incorporating mean reversion — a decision that took into account not only the benefits of more strongly capitalized insurance companies, but also the cost to society of having all that capital tied up in one sector. But the OSFI paper is of little use to investors and consumers seeking to understand the question.

It has been fewer than 30 years since the last Canadian financial crisis in 1983-85, when fifteen members of the Canadian Deposit Insurance Corporation, including two banks, failed. Researchers at the Bank of Canada have identified many other instances of high stress levels in the Canadian banking system. Attempts by regulators and investors to mitigate the effect of the next crisis must be informed by far better research than OSFI's discussion of equity mean reversion. **AER**

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