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## Mean Reversion & Chronic Low Interest Rates

By Bob Crompton

Interest rates continue at levels lower than historical norms. In early July of 2016, shortly after Brexit, yields on 10-year Treasury bonds had dropped below 1.50 percent and yields on 20-year Treasury bonds had dropped below 2.00 percent. Although interest rates have since recovered to pre-Brexit levels and higher, they remain low compared to what many people think as normal. This has caused me to think again about interest rate mean reversion.

There are currently a number of factors operating to keep interest rates at historically low levels rather than moving back to what many of us think as the historical norms—the “old normal.” In this article I recapitulate interest rate mean reversion and why mean reversion doesn’t mean we should expect higher interest rates any time soon. I also discuss a few of the developments that have given us the “new normal,” chronic low interest rates. In addition, I discuss some changes that might lead back to the old normal.

### INTEREST RATE MEAN REVERSION

#### What Do We Mean By The Term “Mean Reversion?”

Mean reversion is usually taken to mean that market prices or interest rates will change in the opposite direction from a prior change, and that the current change may generate future changes until the price or interest rate reaches the mean of the generating function for the economic series under consideration.

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The length of time it takes for each move may vary from extremely short to extremely long.

### Does Mean Reversion Really Exist For Interest Rates?

Mean reversion has been established statistically for equity prices, but for interest rates, there is only limited statistical evidence of mean reversion.

However, many fixed income traders believe interest rate mean reversion exists. The late Fischer Black, one of the most astute observers of capital markets, made the following statement:

“I believe that there is normally a considerable amount of mean reversion in the market—but it’s hard to estimate how much.”

Although Black made the statement in the context of equity prices, it is clear that he believed that mean reversion existed for interest rates as well. One only has to take a quick look at the Black-Karasinski short interest rate model to see that.

In addition, the paper “Mean Reversion Models of Financial Markets”<sup>1</sup> makes the point that mean reversion can exist and yet leave very little statistical evidence.

Perhaps the correct answer to the question is, “To the best of our understanding, mean reversion exists for interest rates, but we have a limited understanding of the causes and mechanisms of such mean reversion.”

### What Causes Mean Reversion?

There is no strong theoretical underpinning to interest rate mean reversion. Mean reversion models have been developed to capture the historical data rather than to reflect critical aspects of financial and economic theories.

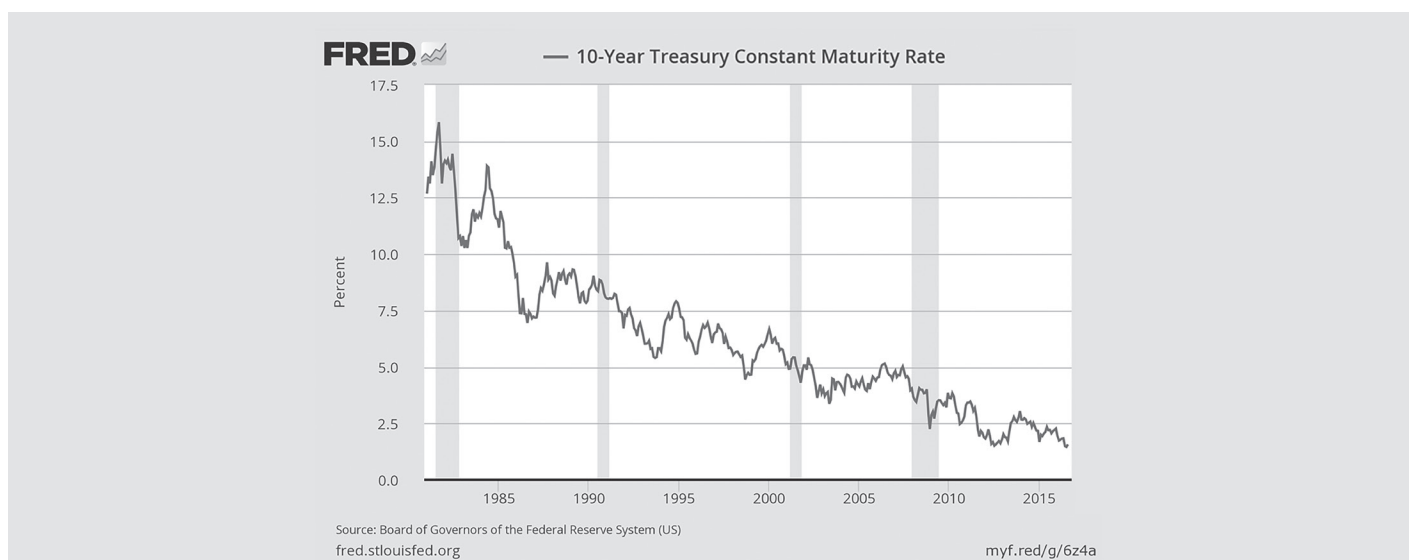
Some ideas that have been developed include:

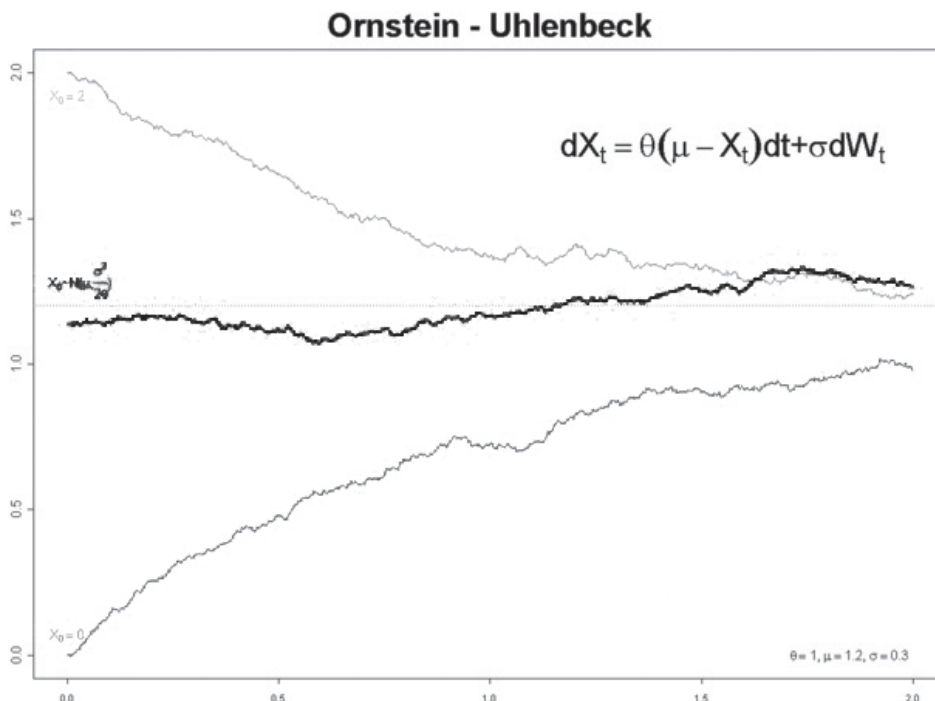
- Interest rates revert to a long-term equilibrium. This is interesting, but leaves too much to the imagination. What does the long-term equilibrium look like, and how does it differ from today’s economy? What sort of evolution should we expect to see from today’s world to the long-term equilibrium?
- Interest rates fluctuate due to psychological factors affecting market participants, causing them to over-react to emerging news. There is probably some truth to this, but by itself seems inadequate to explain long-term reversion.
- Because there is a natural range for prices or interest rates, they will move within the range and naturally tend toward the center of this range. This is the naïve view that ignores the generating function for rates.

### How Do I Determine What The Mean Reversion Point Is?

There is no good answer to this question. Since neither the mean reversion point nor the speed of reversion are observable, and since there is no solid theoretical framework from which to proceed, determination can only be indirect and approximate.

A typical approach used by actuaries is to take the mean of historical rates over some arbitrary time scale. This is clearly a methodology developed to be easily calculated and easily explained. To see why this approach is, in general, not the best way to estimate the reversion point, see the chart below. It shows 10-year Treasury yield rates from January 1981 through August 2016. It is certainly possible to calculate the mean of this historical series, just as it is possible to calculate the mean of any time-ordered data series. But it is difficult to understand why—when there is such a clear and persistent downward trend—anyone would use an average as representative of the mean reversion point.





Based merely on a quick scan of the chart on page 3, we could reasonably conclude that interest rates at August 2016 are the reversion point of the historical rates. This is a likelier result than any sort of average over a trending period.

In fact, the trajectory of rates in the chart on page 3 (FRED) is reminiscent of the upper path in the chart above<sup>2</sup> showing sample paths from an Ornstein-Uhlenbeck process. Recall that Vasicek’s model of interest rates was based on the Ornstein-Uhlenbeck process.

No one would claim that you determine the mean reversion point for this by averaging across historical path values. Yet this is what the typical “actuarial” approach does. The actuarial approach will give a reasonable result when applied to a period of stable interest rates, but in general it is not a good approach.

An approach that might work better is to start with the Federal Reserve’s targeted inflation rate, then add an appropriate spread to obtain the short reversion target. Completion of the rate curve depends on the view one has of the shape of the curve at the time reversion is reached. For instance, if mean reversion is associated with some form of long-term equilibrium, you probably want an upward-sloping yield curve with a standard short-long spread, but other views are also possible.

A third approach is to simply poll the experts—fixed income traders. Find out what sort of mean reversion they are using in their pricing formulas.

**DEVELOPMENTS FAVORING LOW INTEREST RATES**

I believe we are unlikely to see much interest rate movement due to mean reversion. There are a number of developments that indicate we are currently in a period of low interest rates.

**Supply Of Financial Capital**

Since interest rates represent the cost of borrowing, both the supply and demand for financial capital are determinants of interest rates.

The table below shows GDP, wealth and global capital for 2010, the most recent year for which I could find an amount for global capital.

\$ Trillions		
Global GDP	Global Wealth	Global Capital
\$65.6	\$216.3	\$600.0

For reference, global GDP in 2014 was \$77.8 trillion and global wealth was \$262.6 trillion.

There is no official tally of global financial capital, so where did I get these amounts? Global GDP is readily available.<sup>3</sup> Global wealth comes from the annual report put out by Credit Suisse.<sup>4</sup> This statistic is included as a reasonableness check for the global capital amount since this is so surprisingly large. The amount of global capital is from the publication, *A World Awash in Money*.<sup>5</sup> This was published by Bain & Company.

Clearly there is an abundance of capital in the world. There may be difficulties in deploying capital, but there is no shortage with global capital at nine times the total amount of goods and services produced in a year. How did this happen? The financial sector of the economy has been growing faster than the production and service sectors. Leveraging of financial assets currently generates a greater return than the use of non-financial assets.

The sheer amount of capital available means interest rates will likely not rise to historical norms for some time to come. The supply of capital is so great, and the search for return on capital so competitive, that economic activity will have to increase significantly before interest rates will rise due to capital.

For example, an entrepreneur who has developed a business to the point of needing capital, may find it much easier to sell an ownership interest to a hedge fund rather than leveraging the firm through borrowing. While this approach may forego future gains, this is offset by the insurance provided to the entrepreneur's wealth function through such a transaction.

And so it is throughout the economy. As capital seeks a return, it rushes in where debt capital used to tread—and sometimes in places where debt capital feared to tread. The relentless drive for capital to be productive means the crowding-out of debt capital and downward pressure on interest rates.

### Demand For Capital

Demand is the other side of the coin from Supply. If there is an abundance of capital, we could restate this by saying that there is a paucity of demand for capital. Although there are no available statistics on global demand for capital, a few qualitative observations are in order.

First, production of both goods and services has become notably more efficient over the last few decades. This increased efficiency is attributable to a number of factors, including:

- Improved supply chain management,
- Process improvement and
- Automation.

Increased efficiency affects interest rates by reducing the amount of new investment in production capacity compared to what would have been required even a decade ago.

Second, there is significant unused production capacity, particularly in China. Reliable statistics are difficult to come by, but this<sup>6</sup> reference gives some indication of the extent of the capacity glut. Such overcapacity limits new investments with a corresponding drag on interest rates.

Third, there seems to be a shift in new enterprises—at least for high-profile companies. These new companies often require

little or no capital investment. For example, in 2014 WhatsApp had a greater market value than Sony, but required next to nothing in terms of cost of entry.

If this is representative of new businesses, there is a significant drag on demand for investment capital.

### Secular Stagnation

Some economists have recently revived the idea that developed nations have entered the age of economic senescence. This idea was first publicized back in the 1930s, and it said that the Great Depression signaled that the economy had moved into a chronic period of slow growth or contraction. The current reincarnation of this idea posits that the growth of the economy from 1940 to today was largely due to a series of fortunate one-off events that include the following:

- The kick-start the economy received from WWII,
- The baby boom's reversal of demographic contraction,
- Expansion of post-secondary education through such measures as the GI Bill and
- The expansion of work force participation rates from the large scale entry of women into the work force.

Secular stagnation states that since these one-off events will not be repeated, we should expect the economy to return to the trajectory it was on at the end of the Great Depression. This means that the next generation will not be richer than our generation, and may be poorer because the developed economies have chronically slowed. More detailed information on secular stagnation can be found in the publication, *Secular Stagnation: Facts, Causes and Cures*.<sup>7</sup>

In a world where our economy has slowed due to old age, we should expect interest rates to be permanently lower than they were during the more vigorous economic days. In a permanently slowed economy, there will be less expansion, less new business and less demand for borrowing.

### Chronic War

Although there have been no major wars since 1945, there have been plenty of smaller conflicts since then. A Google search for “wars since 1945” yields a list far too long to include in this article.

War is tragic from many perspectives. From the perspective of this article, wars depress business activity in areas where fighting and destruction occur, and cause capital to seek safety. Both of these have the effect of lowering interest rates (certainly this is true in capital havens, and may also be true in the war zones as well).

In addition, these conflicts occur in developing nations, where capital typically has its greatest productivity, since these are nations that are farther from the economic equilibrium of more economically mature nations.

In the U.S., one of the reasons that Treasury yields are depressed is because of increased global demand for safe haven assets. The more unstable the world becomes, the more demand there is for capital havens.

As well, continued armed conflict has a depressing effect on business and a corresponding effect on demand for investment capital.

### Globalization And Anti-Globalization

Globalization—the free movement of goods, people and capital between nations—has many compelling reasons from the perspective of business and commerce. It might not be hyperbole to say that continued prosperity depends on increasing globalization.

Yet there are other views and perspectives on globalization than the perspective of business. Many people feel threatened by globalization. Globalization may mean alienation, loss of influence, impoverishment and loss of control of “our way of life.” Many of these fears come from a visceral level that is not amenable to reason. We know that the other is evil.

In this Manichean world, there is a tug-of-war between the forces for globalization and the forces opposed to globalization. Whenever the forces of anti-globalization win a battle against globalization, capital owners will seek protection of their capital.



The reaction to Brexit points this out. There was an immediate flight of capital to safety, resulting in a sharp drop in U.S. Treasury yields. This sharp drop has moderated since then, but the point is that anti-globalization tends to depress interest rates by causing a flight to safety and by keeping economic growth lower than its potential level.

### DEVELOPMENTS THAT WOULD FAVOR HIGHER INTEREST RATES

I do not believe that mean reversion will move interest rates very far from their current levels, but this does not mean that we are doomed to a world of low interest. There are other forces than mean reversion that change interest rates.

From a statistical view, the changes that we need are such that they will change the parameter vector of the interest rate generating function. From an economic view, these changes will disrupt the current equilibrium.

### Signs And Portents

What events and developments should we expect as harbingers of increasing interest rates? I propose two main signs of impending changes in the overall level of interest rates. The first is a significant improvement in global political stability and the second is a large-scale commercial breakthrough of some existing technology.

First, any developments that generate increased political stability point to increasing interest rates. Political stability will reduce the flight to safety effects that cause reductions in interest rates in capital havens.

In addition, because business loves predictability, an improvement in political stability will tend to increase business activity.

The other main harbinger of higher interest rates is commercialization of some critical technological improvement. There has historically been a gestation period between discovery and commercialization, so it is possible that some existing technology could soon affect the economy. A number of areas seem to have the potential to come to a boil in the foreseeable future. These include:

- Genetic engineering,
- Materials science,
- Nano-scale construction and assembly and
- Robotics.

Any of these areas has the potential to create large-scale industries that would affect both sides of the economic balance sheet—production as well as consumption. It is the production side of this picture which distinguishes these potential businesses

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from the high profile developments where there is very little effect on the production side of the economy.

Although any of these areas could commercially explode, we should keep in mind that every solution creates its own set of problems. Any of these developments may solve low interest rates, but like a bad science-fiction movie, create new issues that are just as problematic. Utopia remains just as far away as ever.

## CONCLUSION

Because low interest rates may still be with us for a long time, it is important to consider carefully how we project interest. We need interest rate generators that have the ability to generate scenarios that are reminiscent of today's interest rates.

We have to be careful not to use mean reversion as a magical incantation to set assumptions at inappropriately high levels. Since there is nothing that tells us that interest rates will return to the old normal, we need to use considerable caution in setting the mean reversion point.

Finally, actuaries may need to become conversant with economic forecasts and how economic developments are likely to influence interest rates. For most of us, interest rates are often considered as divorced from economic conditions. But it is the economic conditions which give rise to mean reversion and interest rate movements. ■



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## ENDNOTES

- 1 This can be accessed at [http://elib.suub.uni-bremen.de/diss/docs/E-Diss549\\_diss02.pdf](http://elib.suub.uni-bremen.de/diss/docs/E-Diss549_diss02.pdf)
- 2 By Thomas Steiner—File:OrnsteinUhlenbeck3.png, CC BY-SA 3.0, <https://en.wikipedia.org/w/index.php?curid=22786192>
- 3 Available without charge at <http://www.statista.com/statistics/268750/global-gross-domestic-product-gdp/>
- 4 This publication is available at <https://www.credit-suisse.com/ch/en/about-us/research/research-institute/publications.html>
- 5 This publication can be downloaded at <http://www.bain.com/publications/articles/a-world-awash-in-money.aspx>
- 6 <http://www.reuters.com/article/us-china-overcapacity-idUSKCN0W05R>
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