NIGMA CAPITAL & FINANCE, LLC

26843 Tanic Dr. Suite 102
Wesley Chapel, FL 33543
(813) 333-1243 TPA
(407) 355-0801 Orl
ccrespo@nigma.com
www.nigma.com

"Who knows what evil lurks in the heart of men?
The Shadow Knows!"

BRIEFING

About the Author

Carlos F. Crespo, M.Sc.
Founder & CEO

Mr. Crespo has over thirty years of experience developing real estate, structuring innovative funding strategies and building complex infrastructure, commercial, industrial, and institutional projects. He is a Florida State Certified General Contractor and has developed over 18 million square feet of commercial and industrial facilities in 17 countries. He developed the financial model for the first airport privatization project in the world based on the concept of build, operate, and transfer.

Mr. Crespo holds a Bachelors of Science Degree and a Masters of Science Degree in System Development and Integration from Indiana University at Bloomington, and a Masters of Science Degree in Financial Management from the University of London. He is an active member of the Charter Financial Analysts Institute, the Associated General Contractors of America, and the Construction Management Association of America.

Reminiscent of Orson Wells' iconic narration of The Shadow radio show in the late 1930s, where the Shadow could control the mind of men so they could not see him; economic forecasts today have been clouded by the Fed's unconventional monetary policy as historical patterns and correlations used in previous models have been rendered useless. A new quantitative model, pending publication, may illuminate a solution.

The problem

In response to the financial crisis, Ben Bernanke, the former Chairman of the Federal Reserve, proceeded to stimulate the economy through monetary policy. The idea was that changing the Fed Funds policy would lead to changes in economic decisions by businesses and households, impacting how much they spend, produce or invest.

In December of 2008, the Fed's primary monetary policy tool, short term interest rates, had already dropped to a range of 0 to 0.25% as targeted by the Federal Open Market Committee. In response to this limitation, Chairman Bernanke implemented a series of unconventional approaches (meaning experimental measures that have never been tried before) to increase economic stimulus beyond the limitation of the "Zero Lower Bound" (ZLB) of the short term interest rates. The new approach was aimed at influencing long term interest rates, which had not dropped to the ZLB yet, through a policy of forward guidance and large scale asset purchases.

The long term approach pursued by Bernanke was not just an innovative, daring approach to the problem of the ZLB condition, but it was also consistent with accepted financial economic theory. Milton Friedman's Permanent Income Hypothesis postulates that the reason why incomes are more volatile than consumption, and the long term marginal propensity to consume out of income is higher than the short run consumption function, is because individuals prefer to smooth their

Briefing: The Shadow Knows the Fed Fund Rate

consumption over the long term and not allow it to fluctuate with short term variations in factors such as income, interests rates, and uncertainty.

The Impact for Economic Forecasters

Prior to the introduction of unconventional monetary policies in 2008, the Federal Funds Rate was the proxy used for monetary policy. Models developed to define the effectiveness of monetary policy and to predict future economic outcomes were advanced from correlations in dynamic regression with other macroeconomic variables. With the Fed Funds rate at the ZLB since 2008, forecasters face a need to update their historical regressions in a way that is consistent with the new monetary policy approach.

The classic quantitative finance model used to explain the dynamics of interest rates in the ZLB was originally proposed by Fisher Black in 1995. This seminal paper, referred to as the "Death Bed Paper," was written by Black while experiencing the final stages of cancer. It posits an interpretation of a nominal short term interest rate as a call option on the "equilibrium" or "Shadow" interest rate, where the option is struck at zero percent. Black noted that when the short rates are close to such a "strike rate" the usual term-structure relationship can be affected by the value of the options embedded in current and expected short term rates. Accordingly, when nominal interest rates are at ZLB they exhibit an option like feature defined as:

The Fed's lowering of the shadow rate since 2009 can be credited with lowering unemployment by 0.13% relative to expectations absent unconventional measures.

$$r(t) = \max[0,p(t)] = p(t) + \max[0,-p(t)]$$

Where:

r(t)= the observed nominal short –term interest rate

p(t)= the equilibrium value of the short –term interest rate, defined as the value where the market for loanable funds clears. In Keynesian economics this is the value of the short rate that corresponds to the point of intersection between the IS and the LM curves.

This equality states that the observed short rate is a call option on p(t), struck at zero percent.

Black suggested that the shadow interest rate is linear in Gaussian factors with the actual short-term interest rate being the maximum of the shadow rate and zero. More succinctly, if the shadow rate is greater than the lower bound then the shadow rate is the short rate. In such case, the shadow rate contains more information about the current state of the economy than the short rate $r(t)$.

Black's model can be helpful in measuring the effects of policies as well as describing the relationship between different yields in the shadow rate term structure model (SRTSM). The problem with this model is that it is limited to a single factor model because, as a closed form pricing formula, its expansion introduces non-linearity into an otherwise linear system.

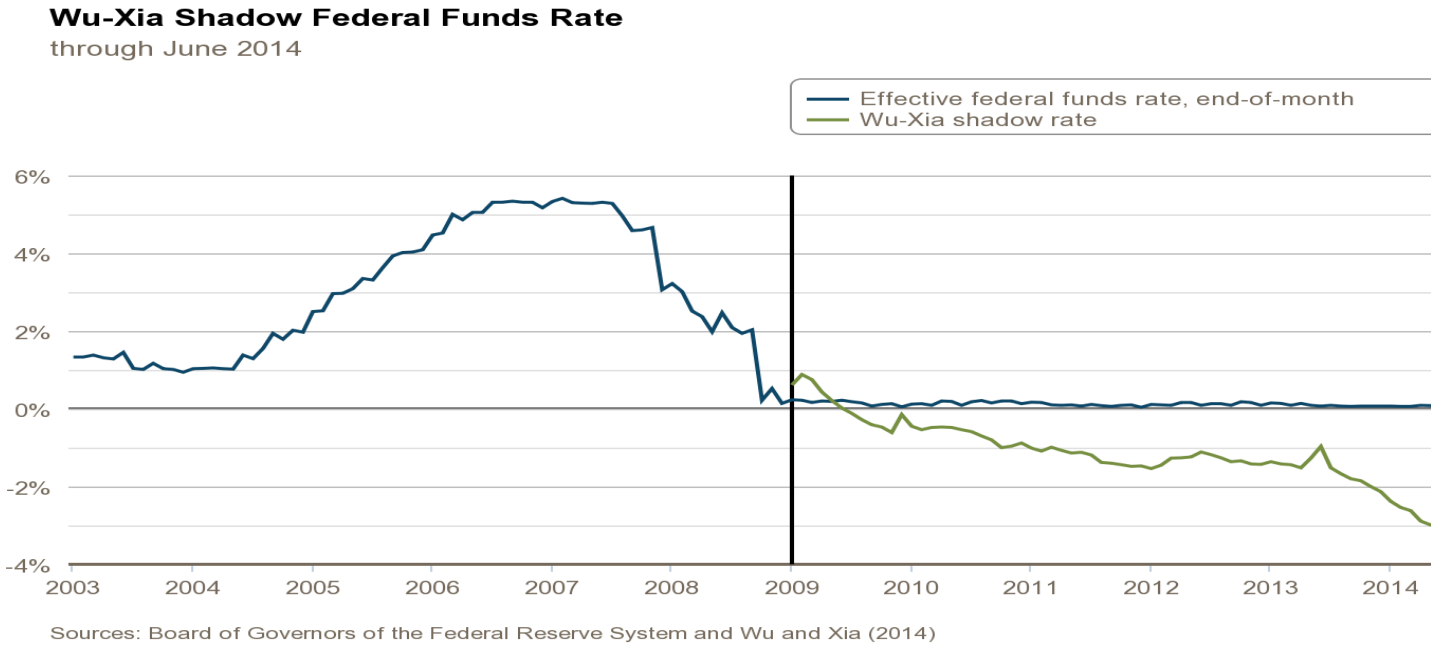
The Shadow Knows the Fed Fund Rate

A recent draft paper by Jing Cynthia Wu and Fan Dora Xia, gaining popularity among the Quant Community, proposes a simple closed-form expression that gives accurate approximate predictions for the yield of any maturity. The analytical approximation proposed converts what would be an extremely complicated quantitative model into one that is very friendly. But, perhaps the most impactful result of the Wu-Xia model is that using a single factor-augmented vector autoregression (FAVAR), the shadow rate calculated by their model shows similar dynamic correlations with macroeconomic variables of interests from periods after 2008 as accurately as the Fed Funds rate indicated with data prior to the Great Depression (See Figure 1).

With this new model it may now be possible to measure the effects of monetary policy at the ZLB, and to use the Fed Fund Rate in vector autoregressive models (VARM), as well as stochastic general equilibrium models to predict the impact of monetary policy on the macroeconomy.

The WU-Xia Model shows that the Feds unconventional policy pushed the shadow rate negative in 2009, and continued declining even as the actual Fed Funds Rate was set at zero bound (Figure 1). According to Wu & Xia the Fed's successful lowering of the shadow rate since 2009 can be credited with lowering unemployment rate by 0.13% relative to expectations absent the measures.

Briefing: The Shadow Knows the Fed Fund Rate



While the effectiveness of the Fed's Unconventional monetary policy is validated by this model, the question of its efficiency still remains, given the limited benefit achieved after such massive stimulus was provided which raised the Fed's Balance Sheet to over $4 Trillion Dollars in assets. This may also indicate the effective limits of even the most extreme monetary policy absent coordinated supportive fiscal policies.

Current estimates of the Fed Shadow Policy Rate show a level of minus three percent, an extremely low level conforming to extensive Fed accommodations not seen since 2007, just before the global financial crisis. The difference is that in 2007 the Fed Funds Rate was 5.25 percent, which left plenty of lee way to cut interest rates and reduce the impact of the financial crisis. A current shadow rate of -3% does not leave much wiggle room to act in the event of an economic shock. The reduced field of options available to the Feds is of particular concern given an economy that, even with unprecedented monetary stimulus, can barely grow at an anemic 2% GDP rate and a geopolitical environment bursting with poitential global economic shocks. These conditions may evidence the markets' lack of expectations for normalization of Fed Policy near term, or why the FOMC does not appear in a hurry to normalize rates anytime soon either.

References:

Black, Fisher (1995), "Interest Rates as Options" *Journal of Finance 50, 1371 – 1376.*

Friedman, Milton (1957), "The Permanent Income Hypothesis" A Theory of the Consumption Function, Princeton University Press, Pages 20-37. http://www.nber.org/chapters/c4405

Wu, Jing Cynthia; Xia, Fan Dora (2014), "Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound" First Draft http://www.faculty.chicagobooth.eduljing.wu/research/data/WX.html