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Dr. Rolf Schneider, Peter Thesling

ECB asset purchase program leaves
substantial mark on yields

AUTHORS:

DR. ROLF SCHNEIDER
Tel. +49.69.24431-5790
rolf.schneider@allianz.com

PETER THESLING
Tel. +49.69.24431-5144
peter.thesling@allianz.com

ECB ASSET PURCHASE PROGRAM LEAVES SUBSTANTIAL MARK ON YIELDS

The yields on top-grade long-term government bonds have been headed south for two decades or so. Whereas at the turn of the millennium, ten-year German government bonds still offered yields of around 5.5%, this figure had, at times, fallen to less than 0.1% in April of this year. Although macroeconomic developments – much lower inflation rates and economic growth erring on the moderate side overall – can doubtlessly be held accountable for part of this downward trend, they do not explain why long-term interest rates have been flirting with the zero threshold. The central banks are a weighty player when it comes to determining yields on the bond market. They not only largely determine the interest rate level for short maturities by setting key rates, but, the more they opt to intervene directly in the markets, the more influence they end up exerting over long-term yields, too.

Quantifying the impact that the central banks have on yields has become a trickier business. Whereas prior to the global economic and financial crisis of 2008/2009, key rates were the only monetary policy instrument that could be used to explain long-term yields, unconventional monetary policies are now also extremely significant when it comes to determining yields. The bond purchase programs, in particular, are having a direct impact on long-term interest rates without being accompanied by any variation in key interest rates.

Since 2008, the European Central Bank has taken a whole number of monetary policy measures, or at least kept them up its sleeve to be used if need be, in addition to interest rate policy. An overview is provided in the table below. In the years leading up to 2014, the focus was firmly on the fixed-rate full allotment policy. Any direct tinkering with the bond markets and, as a result, the exertion of direct influence over yields on fixed-income securities was limited in terms of volume. The approach taken by the Federal Reserve was a different ball game entirely. In the period between 2009 and 2014, their bond-purchasing programs were the linchpin of the unconventional US monetary policy. As a result, any impact that bond purchases may have had on German long-term rates is likely to have originated from the international yield context, i.e. the impact that US

ECB: Important monetary measures

Oct 2008	• Fixed-rate full allotment (FRFA) policy
May 2009	• Covered bond purchase programme 1 (CBPP1)
May 2010	• Securities markets programme (SMP)
Oct 2011	• Covered bond purchase programme 2 (CBPP2)
Dec 2011	• Long-term refinancing operations (LTROs)
Sep 2012	• Outright monetary transactions (OMTs)
Jul 2013	• Forward guidance
Jun 2014	• Targeted long-term refinancing operations (TLTROs), negative deposit rate (NDR)
Sep 2014	• Covered bond purchase programme 3 (CBPP3), ABS purchase programme (ABSPP)
Jan 2015	• Public sector purchase programme (PSPP)

yields have on their German counterparts. This situation, however, was fundamentally altered by the ECB's announcement of an extensive bond-purchasing program last fall and the implementation of the program, which kicked off in March of this year. The ECB's Public Sector Purchase Programme (PSPP) would appear to have pushed yields down considerably. It is well worth trying to put a figure on this yield effect in order to be able to estimate the yield increases that can be expected to ensue when the program is wound down.

The section below seeks to address this. The first step we took was to develop an estimate approach for the 2000-2013 period based on monthly data - the approach which is best suited to tracking the development of yields on ten-year German government bonds. This estimate approach then allows us to arrive at a "forecast" for the period leading up to early 2015, with the deviations from the actual yield development allowing us to draw conclusions as to the extent of the yield distortion resulting from the purchase program. The second step in the process involves extending the forecast period up to the most recently available data point (May 2015) and adding two dummy variables (zero-one variables), the first for the period starting when the bond-purchasing program was announced, and the second starting when it was actually launched. The coefficients of the dummy variables then estimate the yield impact of the bond-purchasing program.

We believe that the following factors could explain the long-term yield on German government bonds:

- Economic indicators
- Inflation indicators (increase in consumer prices)
- Central bank interest rate policy
- Unorthodox monetary policy measures
- International yield context (US yields)

When attempts are made to explain long-term interest rates, economic and inflation indicators compete with monetary policy indicators. This is because monetary policy decisions are made based on inflation and the economy. Our investigations showed, however, that monetary policy indicators are by far the dominant factor in explaining long-term interest rates. As a result, a monetary approach taking the international yield context into account provided the best estimate adjustment.

With its key rates, the ECB largely controls interest rates on the interbank market. In recent years, however, money market rates have been lower than the ECB's main financing rate - sometimes considerably so. This is likely due to the ECB's move, in October 2008, to supply commercial banks with unlimited liquidity. So in addition to key interest rates, the money market rates reflect another monetary policy instrument. As a result, we have included the three-month Euribor rate in our estimate approach for German long-term interest rates. As was to be expected, the explanatory contribution made by this rate was much greater than that made by the main refinancing operations rate.

German long-term interest rates are influenced by developments on the international financial markets, with the greatest influence likely to be exerted by the US market. This is what motivated us to include long-term US yields (yields on ten-year US government bonds) in the system for estimating German long-term interest rates. It comes as no surprise to see that these yields are highly significant. This is, however, unlikely to be a one-sided effect (US yields impacting German yields). Rather, we can assume that the effects are part of a two-way process, given that German ten-year government bonds act as the eurozone benchmark and that the eurozone bond market is of a similar volume to its pendant on the other side of the Atlantic.

In addition, the estimate was improved considerably by the inclusion of the short-term interest rate spread (three-month Euribor minus US three-month interbank rate), which shows a highly significant positive coefficient. At first glance, this could give rise to the question as to why an increase in US short-term interest rates, coupled with unchanged EMU short-term interest rates, pushes the yields on German government bonds down. Naturally, however, this is only the case if the increase in US short-term interest rates does not push up the yield on US government bonds, which are also included in the estimate approach. This sort of scenario is seldom likely to materialize. If this exceptional case were to arise, the US yield curve would start to flatten out, because rising short-term interest rates are not accompanied by rising long-term interest rates. This would also be expected, based on the international correlations between yields, to make the German yield curve less steep, which would be associated with a drop in German long-term interest rates.

The "monetary" explanation approach returns estimated values that are astonishingly close to the actual values for the period between 2000 and 2013. Only 3.0% of the spread remains unexplained. The standard deviation comes in at only around 20 basis points.

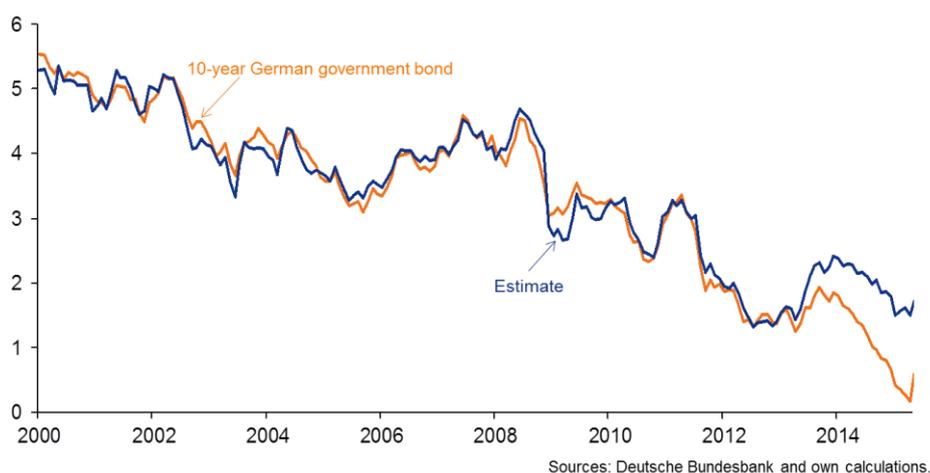
Dependent variable: 10-year German government bonds

Estimation period: 2000M01 to 2013M12

Variable	Coefficient	Std. error	t-statistic
10-year US Treasuries	0.815	0.026	31.057
EURIBOR3	0.164	0.035	4.662
EURIBOR3 - USIBOR3	0.253	0.025	10.105
Coefficient of determination	0.970		
Standard error	0.195		

Abbreviations: EURIBOR3: EU Interbank Offered Rate 3 months
USIBOR3: US Interbank Offered Rate 3 months

Yield on 10-year German government bonds: Estimates and actual values (Estimation until end 2013)



The burning question now is: does the good estimate adjustment continue to apply to the periods covered by the bond-purchasing program/the anticipation of the program in 2014 and 2015? The response is a resounding "no". The gap separating the estimates from the actual values becomes wider and wider, as the graphic above shows. This deviation can be taken as a clear sign that the ECB's quantitative easing policy is having a real impact in terms of pushing yields down.

In order to quantify these effects, we have extended the estimate period up to the most

recently available data point (May 2015). It proved advantageous to include two zero-one variables in the estimate approach: the first with "ones" as of August 2014 to cover the anticipation effects of the bond program, and the second with "ones" as of March 2015 to measure the impact of the program implementation on yields. In addition, it would appear that, since 2013, US long-term interest rates have been having less of an impact on their German counterparts. This potential structural shift is reflected in the much lower US yield coefficient from June 2013 onwards (0.596) compared with the coefficient for the period from 2000 to May 2013 (0.83). Positive economic developments prompted the Fed to announce, at the end of May 2013, that it would be winding down its bond purchases. The Fed's purchase program came to an end in October 2014. So as of June 2013, the policy pursued by the Fed is a very different one to that pursued by the ECB. This offers one explanation for the change in the yield relationship.

The estimate approach for the period from 2000 to May 2015 reveals an estimate adjustment that is a bit better again than the approach for the period leading up to 2013. Only 1.7% of the spread remains unexplained and standard deviation comes in at only around 17 basis points. Based on this estimate, a decision to hike EMU short-term interest rates by 100 basis points, taken in isolation, would push the yield on ten-year German government bonds up by almost 40 basis points. The estimated yield-reducing effect of the bond-purchasing program (anticipation and implementation) equates to around 82 basis points. These estimate results are testimony to the strong impact that monetary policy has on bond market yields.

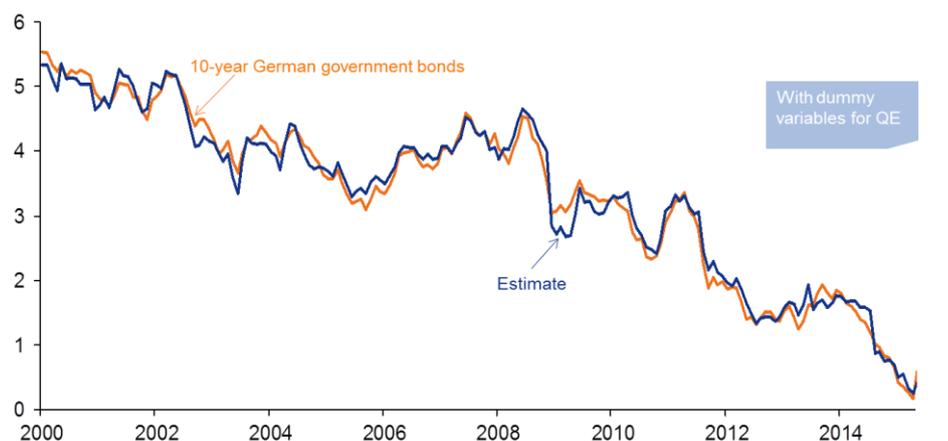
Dependent variable: 10-year German government bonds

Estimation period: 2000M01 to 2015M05

Variable	Coefficient	Standard error	t-statistic
10-year US Treasuries (before June 2013)	0.835	0.020	42.757
10-year US Treasuries (after June 2013)	0.596	0.034	17.608
EURIBOR3	0.138	0.026	5.294
EURIBOR3 - USIBOR3	0.256	0.024	10.630
Effect QE expectations	-0.584	0.109	-5.335
Effect QE announcements	-0.237	0.052	-4.563
Coefficient of determination	0.983		
Standard error	0.173		

Abbreviations: EURIBOR3: EU Interbank Offered Rate 3 months
USIBOR3: US Interbank Offered Rate 3 months

Yield on 10-year German government bonds: Estimates and actual values (Estimation until May 2015)



Sources: Deutsche Bundesbank and own calculations.

The greater the yield-reducing effect of quantitative easing and the zero interest rate policy, the more pronounced the increase in yields could be if monetary policy were to change course. After all, we calculate that, if the bond purchase program ends and the ECB implements a key rate hike of 100 basis points (all other key data remaining unchanged), German long-term yields would likely rise by around 120 basis points. As welcome as interest rates like these would be for savers and to prevent capital misallocation, the financial markets could well turn out to be a turbulent place before this higher level is reached. The volatility on the bond markets in recent weeks could prove to be a taster of things to come. Hopefully the ECB will employ an appropriate degree of tact while communicating the presumably imminent change of course to the markets.

Outlook

The question as to the level at which German long-term rates will settle in the medium term following the end of both the ECB's bond purchases and the zero interest rate policy in the US and Europe is a very interesting one, and one that is extremely relevant from an economic perspective. We want to attempt to answer this question using our explanation approach. At the moment, the dominant view – as vividly illustrated in an article by Martin Wolf (Financial Times, May 19, 2015) – is that, based on historical experience, the equilibrium real interest rate in the global economy will remain at a fairly low level for some time. We share this view, because a number of structural obstacles are likely to stand in the way of dynamic global economic growth for the foreseeable future. Going forward, productivity growth in the industrialized nations is unlikely to surpass 1% a year by any margin to speak of. The US long-term interest rate, which plays a key role in our estimate approach, can be seen as a globally representative rate. We believe that the most plausible yield level from today's perspective is a real US long-term interest rate of 1% in the medium term. We also believe that the Fed is likely to achieve its target of 2% inflation in the medium term. This points to a nominal US long-term interest rate heading towards 3% in 2016/17. In an environment characterized by moderate growth and inflation rates, the Fed will only push key rates up to a level of around 2%. Given that inflation risks in the eurozone are even lower, we predict ECB key rates of only 1.5% in this environment (with a three-month Euribor of just over 1.5%). Taking all these factors together – i.e. in an environment in which economic development is hardly exuberant, but following the end of quantitative easing and the

Outlook: Yield on 10-year German government bonds



Sources: Deutsche Bundesbank and own calculations.

zero interest rate policy on both this and the other side of the Atlantic – our explanation approach returns a yield on ten-year German government bonds of around 2% over the medium term. This level could be seen as a sort of European equilibrium interest rate in the "new normal" environment. Compared with the current yield of 0.5%, this level looks like a hefty jump. Given, however, that we expect inflation rates of 1.5-2% in Germany and the eurozone in the medium term, the real interest rate would remain exceptionally low for the foreseeable future.

APPENDIX

Statistical considerations

As usual, our models are based on the residuals being independent, normally distributed random variables. Both models were subjected to statistical tests to examine this, passing the tests for normality and homoscedasticity. We did, however, find autocorrelation in the error terms, which occurs when the residuals are temporally interdependent. The autocorrelation could be based on the fact that the model does not sufficiently explain the dynamics of the dependent variable, meaning that this dynamic appears in the residuals. Since, however, the autocorrelation could not be resolved even using lagged variables, it is to be suspected that the dynamics cannot be eliminated in the residuals. As a result, we expect that the model was structured correctly. Based on this, we were able to correct the standard deviations that were distorted by the autocorrelation with the help of a special covariance matrix (Newey-West).

Next we addressed the problem associated with the fact that, with the exception of the dummy variables, all variables show a trend which sometimes fluctuates considerably, meaning that it is extremely stochastic in nature. This means that a regression calls for particular caution, because the model can only be interpreted in the event of what is known as "cointegration". Cointegration occurs when there is real correlation between the variables. We were able to demonstrate this very clearly in both models. When interpreting the dummy variables, there is no doubt that it is possible for them to pick up on other effects in addition to QE. If, however, we include other effects in the model, e.g. the difference between Italian and German ten-year government bonds as a variable for the "safe haven" effect, then this results in only a marginal change in the coefficients. This allows us to conclude that our model is capable of quantifying the QE effects.

These assessments are, as always, subject to the disclaimer provided below.

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