Measuring the Effect of the Zero Lower Bound on Yields and Exchange Rates in the U.K. and Germany

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\textit{The views expressed in this presentation are solely those of the authors and do not necessarily represent the views of any other individual in the Federal Reserve System.}
Three Motivating Observations

1. New Keynesian IS curve:

\[ y_t = E_t y_{t+1} - \alpha r_t + \varepsilon_t \]
\[ = -\alpha E_t \sum_{j=0}^{\infty} r_{t+j} + \varepsilon_t \]
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3. The zero lower bound is not a substantial constraint on monetary policy if the central bank can affect longer-term interest rates:
   - Gürkaynak, Sack, and Swanson (2005): 60–90% of the response of 2- to 10-year Treasury yields to FOMC announcements is due to \textit{statement}, not funds rate
2-Year US Treasury Yield $\gg 0$ for Much of 2008–10
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2-Year UK Gilt Yield $\gg 0$ for Much of 2008–10
2-Year German Bund Yield $\gg 0$ for Much of 2008–10
Swanson-Williams (2013)

- Compute the sensitivity of interest rates of various maturities to macroeconomic news in normal times (1993–2006)
- And compare it to the sensitivity of those yields to news when the ZLB may have been a constraint.
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- And a quantitative measure of severity of constraint.
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- And compare it to the sensitivity of those yields to news when the ZLB may have been a constraint.
- Provides an **econometric test** whether a yield was constrained
- And a **quantitative measure of severity** of constraint.

The level of yields alone is not a good measure of ZLB constraint:
- No way to measure severity or statistical significance—e.g., is a 50 bp 2-year Treasury yield constrained or not?
- Crowding out, fiscal multiplier determined by *response* of yields to fiscal policy, not *level* of yields
- Effective lower bound may be $\gg 0$, e.g. 50bp in the UK
Monetary Policy Rates in U.S., U.K., Germany

Graph showing the US Federal Funds Rate Target, UK Bank Rate, and ECB Main Refinancing Rate from Jan-2007 to Jul-2012.
Measuring Sensitivity of Yields, Exch. Rates to News

Measure sensitivity of a given yield (or exchange rate) to news in normal times using a high-frequency regression:

$$\Delta y_t = \alpha + \beta X_t + \varepsilon_t$$
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- regression is at daily frequency
- $\Delta y_t$ denotes one-day change in given yield on date $t$
- $X_t$ is a vector of surprises in macroeconomic data releases (GDP, CPI, unemployment, etc.) on date $t$
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Surprise component of data release: $x_t - E_{t-1} x_t$.

Market expectation of macroeconomic data releases measured by Money Market Services, Bloomberg surveys.
Measuring Time-Varying Sensitivity to News

Time-varying sensitivity version:

$$\Delta y_t = \alpha^i + \delta^i \beta X_t + \varepsilon_t$$

where $\delta^i$ scalar, $i \in 1993, 1994, \ldots, 2012$. 

Assumption: relative responses $\beta$ constant over time

Estimate $\delta^i, \beta$ by nonlinear least squares

Normalize $\delta^i$ so that average $\delta^i$ from 1993–2006 is 1
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- Normalize $\delta^i$ so that average $\delta^i$ from 1993–2006 is 1
Nonlinear Regression Results for $\beta$, 1993–2012

<table>
<thead>
<tr>
<th></th>
<th>6-month UK gilt</th>
<th>2-year UK gilt</th>
<th>10-year UK gilt</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK Average Earnings</td>
<td>2.28 (5.73)</td>
<td>2.90 (5.79)</td>
<td>0.71 (1.59)</td>
</tr>
<tr>
<td>UK GDP (advance)</td>
<td>0.69 (1.39)</td>
<td>3.17 (3.44)</td>
<td>1.21 (2.38)</td>
</tr>
<tr>
<td>UK Manufact. Prod.</td>
<td>0.42 (1.14)</td>
<td>1.10 (3.87)</td>
<td>0.60 (1.24)</td>
</tr>
<tr>
<td>UK PPI</td>
<td>1.00 (2.98)</td>
<td>1.40 (2.48)</td>
<td>1.28 (2.63)</td>
</tr>
<tr>
<td>UK Retail Sales</td>
<td>0.92 (2.94)</td>
<td>1.69 (4.96)</td>
<td>0.70 (1.52)</td>
</tr>
<tr>
<td>UK RPIX</td>
<td>1.48 (5.20)</td>
<td>2.23 (4.33)</td>
<td>1.71 (4.30)</td>
</tr>
<tr>
<td>UK Unemployment</td>
<td>−0.23 (−0.80)</td>
<td>−1.29 (−2.76)</td>
<td>−0.16 (−0.48)</td>
</tr>
<tr>
<td>US Capacity Util.</td>
<td>0.29 (1.02)</td>
<td>1.51 (3.32)</td>
<td>0.90 (1.93)</td>
</tr>
<tr>
<td>US Core CPI</td>
<td>0.62 (1.71)</td>
<td>0.67 (1.86)</td>
<td>0.88 (2.18)</td>
</tr>
<tr>
<td>US GDP (advance)</td>
<td>−0.68 (−1.70)</td>
<td>0.48 (0.92)</td>
<td>−0.82 (−0.97)</td>
</tr>
<tr>
<td>US Initial Claims</td>
<td>−0.08 (−0.61)</td>
<td>−0.63 (−3.79)</td>
<td>−0.64 (−3.10)</td>
</tr>
<tr>
<td>US ISM Manufacturing</td>
<td>1.04 (3.98)</td>
<td>1.57 (5.27)</td>
<td>2.52 (5.92)</td>
</tr>
<tr>
<td>US Nonfarm Payrolls</td>
<td>0.47 (1.81)</td>
<td>1.58 (3.58)</td>
<td>1.60 (3.25)</td>
</tr>
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<td>US Core PPI</td>
<td>0.31 (1.40)</td>
<td>0.77 (2.19)</td>
<td>0.56 (1.43)</td>
</tr>
<tr>
<td>US Ret. Sales ex. autos</td>
<td>0.58 (2.56)</td>
<td>0.96 (2.28)</td>
<td>1.34 (2.62)</td>
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<td>US Unempl. rate</td>
<td>0.27 (0.66)</td>
<td>0.28 (0.67)</td>
<td>1.01 (1.92)</td>
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</tbody>
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# Observations

2592 \hspace{4cm} 2708 \hspace{4cm} 2708

$H_0 : \beta = 0$, $p$-value

$< 10^{-13}$ \hspace{4cm} $< 10^{-16}$ \hspace{4cm} $< 10^{-15}$
Time-Varying Sensitivity $\delta^\tau$, 6-month UK Gilt
Time-Varying Sensitivity $\delta^\tau$, 1-year UK Gilt
Time-Varying Sensitivity $\delta^\tau$, 2-year UK Gilt
Time-Varying Sensitivity $\delta^\tau$, 5-year UK Gilt
Time-Varying Sensitivity $\delta^\tau$, 10-year UK Gilt
Time-Varying Sensitivity $\delta^{\tau}$, 1-year German Bund

(a) 1-year German Bund Yield Sensitivity to News
Time-Varying Sensitivity $\delta^\tau$, 2-year German Bund

(b) 2-year German Bund Yield Sensitivity to News
Time-Varying Sensitivity $\delta^\tau$, 5-year German Bund

(c) 5-year German Bund Yield Sensitivity to News
Time-Varying Sensitivity $\delta^\tau$, 10-year German Bund
Time-Varying Sensitivity $\delta^\tau$, USD/GBP Exchange Rate
Time-Varying Sensitivity $\delta^\tau$, USD/DM-EUR Exch. Rate

(b) USD/DM-EUR Exchange Rate Sensitivity to News
Summary of Results

- Exchange rates largely unaffected by the zero lower bound
- German bunds largely unaffected by zero bound until late 2012
- UK gilts behave in a constrained manner in 2009 and 2012, but largely unconstrained from 2010 to late 2011
Implications for the Fiscal Multiplier

(A) Liftoff expected sooner

(B) Liftoff expected later

This paper: much of pre-2012 period looks like scenario A

(A) liftoff in 4 qtrs. $\Rightarrow$ multiplier same as normal (CER 2011)

(B) liftoff in 8 qtrs. or more $\Rightarrow$ large multiplier (CER 2011)
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B) liftoff in 8 qtrs. or more $\implies$ large multiplier (CER 2011)
This paper: much of pre-2012 period looks like scenario A
Private-Sector Expectations of UK Bank Rate
Conclusions

What we do:

- **Test** whether ZLB is a **significant** constraint on yields, ex. rates
- Measure the **degree** to which yields, ex. rates are constrained

What we find:

- Exchange rates unaffected by the zero lower bound
- German bunds unaffected by the zero bound until late 2012
- UK gilts constrained in 2009, 2012, but largely unconstrained in 2010–11

What we conclude:

- Effectiveness of monetary and fiscal policy in Germany likely close to normal until late 2012
- Effectiveness of monetary and fiscal policy in UK likely close to normal in 2010–11 (but not 2009 or 2012)
UK Gilt Yields, 1993–2012

(a) U.K. Bank Rate and Zero-Coupon Gilt Yields

- 1-Year Gilt
- 2-Year Gilt
- 5-Year Gilt
- 10-Year Gilt
- Bank Rate
German Bund Yields, 1993–2012

(b) German Lombard/Refinancing Rate and Zero-Coupon Bund Yields

- 1-Year Bund
- 2-Year Bund
- 5-Year Bund
- 10-Year Bund
- Lombard/Refinancing Rate
Private-Sector Expectations of UK Libor Rate

Probability of sterling Libor < 75bp in 4 quarters, from options:
Monetary Policy Uncertainty
Regressions of $\delta^\tau$ on Level, Mon. Pol. Uncertainty

(b) Sensitivity Coefficient $\delta^\tau$ for 2-year Gilt and Fitted Values
Symmetric Response to Positive, Negative Shocks

- feasible interest rate path
- shadow interest rate path
Symmetric Response to Positive, Negative Shocks

- Feasible interest rate path
- Shadow interest rate path
- Positive economic surprise
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Macro Data Surprises Pre- and Post-2008

(a) Nonfarm Payrolls Surprises, 1990-2007

(b) Nonfarm Payrolls Surprises, 2008-2012
Cross-currency arbitrage:

\[ s_t = -(i_t - i_t^*) + E_t s_{t+1} + \psi_t, \]

\[ q_t \equiv s_t + p_t^* - p_t \]

\[ q_t = -(i_t - i_t^*) + E_t (\pi_{t+1} - \pi_{t+1}^*) + E_t q_{t+1} + \psi_t. \]
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Solving forward gives:

\[ q_t = E_t \sum_{j=0}^{\infty} \left[ - (i_{t+j} - i_{t+j}^*) + (\pi_{t+j+1} - \pi_{t+j+1}^*) + \psi_{t+j} \right] + \bar{q}. \]