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

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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 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

![Graph showing 2-Year German Bund Yield significantly greater than 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
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:

\[ \Delta y_t = \alpha + \beta X_t + \varepsilon_t \]
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:

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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, unemploymenet, etc.) on date \( t \)
- \( \varepsilon_t \) denotes effects of other news and other factors on yields
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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, \( i \in 1993, 1994, \ldots, 2012 \).
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
### 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>
<tr>
<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>
</tr>
<tr>
<td>US Unempl. rate</td>
<td>0.27 (0.66)</td>
<td>0.28 (0.67)</td>
<td>1.01 (1.92)</td>
</tr>
</tbody>
</table>

# Observations

- 6-month UK gilt: 2592
- 2-year UK gilt: 2708
- 10-year UK gilt: 2708

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

- 6-month UK gilt: $< 10^{-13}$
- 2-year UK gilt: $< 10^{-16}$
- 10-year UK gilt: $< 10^{-15}$
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 $\delta^T$, 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

-1 0 1 2 3 4 5

Time-Varying Sensitivity $\delta^\tau$, 10-year German Bund

(d) 10-year German Bund Yield Sensitivity to News
Time-Varying Sensitivity $\delta^\tau$, USD/GBP Exchange Rate
Time-Varying Sensitivity $\delta^\tau$, USD/DM-EUR Exch. Rate
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
Implications for the Fiscal Multiplier

(A) Liftoff expected sooner
(B) Liftoff expected later

A) liftoff in 4 qtrs. $\Rightarrow$ multiplier same as normal (CER 2011)
B) liftoff in 8 qtrs. or more $\Rightarrow$ large multiplier (CER 2011)
Implications for the Fiscal Multiplier

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

Next quarter
Three quarters ahead
Two quarters ahead
Federal Reserve "mid-2013" announcement

Percent

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
Probability of sterling Libor < 75bp in 4 quarters, from options:
Time-Varying Sensitivity, 10-year UK Indexed Gilt
Time-Varying Sensitivity, 5-year UK Indexed Gilt
Regressions of $\delta^T$ on Level, Mon. Pol. Uncertainty

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

Graph showing the feasible interest rate path and the shadow interest rate path over time (t). The feasible interest rate path starts at -i₀ and increases as time progresses, while the shadow interest rate path shows a different trajectory.
Symmetric Response to Positive, Negative Shocks

- Feasible interest rate path
- Shadow interest rate path
- Positive economic surprise
Symmetric Response to Positive, Negative Shocks

- feasible interest rate path
- shadow interest rate path
- positive economic surprise
- negative economic surprise

Graph showing the response of interest rates to positive and negative economic surprises.
Symmetric Response to Positive, Negative Shocks

- **Feasible Interest Rate Path**
- **Shadow Interest Rate Path**
- **Symmetric Response**
- **Positive Economic Surprise**
- **Negative Economic Surprise**
Symmetric Response to Positive, Negative Shocks
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:

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