Controllability and Persistence of Money Market Rates along the Yield Curve: Evidence from the Euro Area

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Abstract
Controllability of longer-term interest rates requires that the persistence of their deviations from the central bank’s policy rate (i.e. the policy spreads) remains sufficiently low. This paper applies fractional integration techniques to assess the persistence of policy spreads of euro area money market rates along the yield curve. Independently from anticipated policy rate changes, there is strong evidence for all maturities that policy spreads exhibit long memory. We show that recent changes in the operational framework and the communication strategy of the ECB have significantly decreased the persistence of euro area policy spreads and, thus, have enhanced the central bank’s influence on longer-term money market rates.

Keywords: Long memory and fractional integration; controllability and persistence of interest rates; new operational framework of the ECB

JEL classification: C22, E43, E52

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1 Introduction

Longer-term interest rates are essential channels for the transmission of monetary policy. A reliable link between longer-term rates and the central bank’s key policy rate is therefore of crucial importance. By managing market’s expectations of the future path of interest rates, central banks ensure that policy spreads, i.e. the deviations of market rates from the policy rate, are small and that their volatilities remain well contained. However, if policy spreads are too persistent, the lasting impact of shocks would impede the transparency of policy signals and the central bank’s impact on longer-term rates. Therefore, the effectiveness of monetary policy should also be reflected in the persistence of policy spreads. This paper applies fractional integration techniques to the policy spreads of euro area money market rates to investigate the persistence and, thereby, the controllability of interest rates along the yield curve.

According to Balduzzi et al. (1998), the persistence of U.S. policy spreads increases with the maturity of the underlying money market rate implying a diminishing controllability of interest rates along the yield curve. Assuming that policy spreads are integrated of order zero (I(0)), they estimate persistence by means of standard autocorrelation functions. This approach, however, can lead to biased results if the policy spread is not I(0) but exhibits long memory. In fact, Hassler and Nautz (2008) and Cassola (2007) find that the spread between the euro overnight rate Eonia and the ECB’s policy rate is fractionally integrated of order \( d \approx 0.25 \). Both contributions suggest that the ECB’s impact on the Eonia might be weaker than expected.

The controllability and persistence of longer-term rates depend on the predictability and communication of monetary policy. Unclear policy signals about future interest rate decisions should lead to larger forecast errors and more persistent policy spreads. In March 2004, the ECB improved its communication strategy and its operational framework for monetary policy implementation, see

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1 Central banks increasingly use key policy rates or interest rate targets for the overnight rate to signal the monetary policy stance. Examples are the Fed’s target for the Federal Funds Rate and the ECB’s minimum bid rate preannounced in its weekly main refinancing operations.

2 There is a growing literature on the persistence of macroeconomic and financial time series rejecting the dichotomy of I(0) versus I(1) processes in favor of fractional orders of integration. Recent examples include contributions on the changing persistence of inflation (Kumar and Okimoto (2007)), GDP and unemployment (Gil-Alana (2002)), and the term structure of interest rates (Lardic and Mignon (2004)). Another strand of the literature emphasizes the relevance of fractionally integrated GARCH (FIGARCH) models for analyzing the dynamics of volatilities of interest rates (Duan and Jacobs (2008)) and returns (Wu and Shieh (2007)).
European Central Bank (2004b). In fact, the volatility of the Eonia has declined significantly under the new framework, see Colarossi and Zaghini (2007) and Nautz and Offermanns (2008). In this paper, we will use the introduction of the ECB’s new framework as a natural experiment to test for the influence of institutional changes on the persistence of euro area money market interest rates along the yield curve.

While market expectations of future policy rates influence longer-term rates on a continuous basis, policy rates are changed in steps at certain occasions, typically during regular central bank meetings. As Balduzzi et al. (1998) already noticed, the timing of anticipated policy rate changes leads to persistent deviations of longer-term interest rates from the policy rate. In this case, persistent deviations of longer-term rates from the current policy rate would reflect the central bank’s policy signals and should not be misinterpreted as a lack of control.

Typically, adjusting observed policy spreads for the effect of prevailing rate change expectations is not an easy task. In our application, however, we can exploit a specific feature of the euro area money market, i.e. the existence of a well developed Overnight Indexed Swap (OIS) market. Eonia swap rates are the main instrument for speculating on and hedging against interest rate movements and therefore give a very good approximation for market’s expectations of future rate changes over the duration of the swap (European Central Bank, 2007, p.26). Using Eonia swap rates for various maturities, our analysis is based on the so-called OIS spreads which can be interpreted as interest rate spreads adjusted for expected policy rates changes. During the recent financial turmoil, OIS spreads have become a major tool to assess the behavior of longer term money market rates, see e.g. Taylor and Williams (2008).

The paper is organized as follows. Section 2 describes the data, discusses the role of rate change expectations for the behavior of policy spreads along the money market yield curve, and introduces an expectations-adjusted policy spread based on Eonia swap rates. Section 3 briefly recalls the fractional integration approach for measuring persistence and presents first empirical results on the policy spread persistence for the whole sample period. Section 4 sheds more light on the relation between policy spread persistence and monetary policy implementation. In particular, we investigate whether the recent reform in the ECB’s operational framework has influenced the persistence of policy spreads. Section 5 summarizes the main results and concludes.
2 Policy Spreads and Interest Rate Expectations

2.1 Data

Our empirical analysis is based on daily data of euro area money market rates (Euribor) with 14 different maturities ranging from 1 week up to 12 months. For each maturity, the corresponding policy spread is defined as the difference between the market rate and the ECB’s key interest rate, i.e. the minimum bid rate of the main refinancing operations (MROs). The sample starts at June 27, 2000, when the minimum bid rate was introduced and it ends on July 30, 2007.\(^3\) Empirical models of the European overnight rate Eonia have to account for marked calendar effects including the large peaks and troughs at the end of the reserve maintenance period, see e.g. Nautz and Offermanns (2008). For Euribor rates in contrast, a particular adjustment is not required since calendar effects play only a minor role for longer-term rates.\(^4\)

Figure 1: Euribor (1 month), minimum bid rate, and policy spread

\(^3\)Our sample does not include interest data affected by the liquidity crisis starting in early August 2007. Since then, policy spreads between the unsecured Euribor rates and the minimum bid rate have widened dramatically due to sharply increased liquidity risk.

\(^4\)We only found a significant end-of-reserve-maintenance-period effect for the 1-week Euribor. However, adjusting the interest rate accordingly does not affect our results in a significant way.
bid rate together with the resulting policy spread\footnote{Policy spreads for the complete set of maturities are shown in Figure 6 in the appendix.}. At first sight, the Euribor follows the policy rate rather closely. However, there are also longer periods of persistent deviations where the policy spread increased steadily even though the minimum bid rate stayed constant. Some but not all of these movements in the policy spread can be explained ex post by prospective changes of the policy rate. In particular, since 2005 correctly anticipated interest rate decisions of the ECB have led repeatedly to persistent deviations of the Euribor from the current policy rate starting exactly one month before the policy rate actually changed. In this case, persistent deviations of the market rate from the current policy rate are a direct consequence of the central bank’s clear communication of the future policy stance and do not indicate a loss of the central bank’s control over money market rates. In the following, we account for the effect of interest rate expectations by constructing an expectations-adjusted policy spread based on Eonia swap rates.

2.2 Interest Rate Expectations and OIS Spreads

In the euro area, market’s expectations on future policy rates are reflected in the Eonia swap market, where swap contracts with all Euribor maturities are traded to speculate on and hedge against future interest rate movements. The Eonia swap market is one of the most important derivative market segments in the euro area (European Central Bank, 2007, p.25)\footnote{Since the market for Eonia swaps developed only in 1999 (European Central Bank, 2004a, p.32), only a few studies focusing on these interest rates are available (see e.g. Cassola (2007), Durré et al. (2003) and Durré (2007)).}. The swap contract involves two parties, one paying a fixed rate (the swap rate) and one paying a variable rate (the average Eonia over the maturity of the swap). Therefore, Eonia swap rates, $OIS_t(k)$, are natural proxy variables for market’s expectations in period $t$ of the average Eonia ($\frac{1}{k} \sum_{i=0}^{k-1} E_t r_{t+i}$) and, thereby, of the average policy rate over the swap’s duration ($k$):

$$OIS_t(k) \approx \frac{1}{k} \sum_{i=0}^{k-1} E_t r_{t+i} \tag{1}$$

More precisely, the swap rate can be interpreted as the average short-term rate that the market expects to prevail for the next $k$ days in the absence of risk and liquidity considerations. All deviations of the Euribor rate from the current policy rate which are due to anticipated future policy rate changes must be revealed in the swap rate. Therefore, subtracting the swap rate $OIS_t(k)$ from the
corresponding Euribor \( r_t(k) \) leads to the *OIS spread* which can be interpreted as the expectations-adjusted policy spread,

\[
OIS\text{spread}_t(k) = r_t(k) - OIS_t(k).
\]  

(2)

If the policy rate \( r^*_t \) is expected to be constant over the swap’s maturity \( k \), \( OIS_t(k) \) will be very close to \( r^*_t \) and \( OIS\text{spread}_t(k) \) will coincide with the unadjusted policy spread \( r_t(k) - r^*_t \). According to Taylor and Williams (2008), OIS spreads are the most reliable measure of expectations-adjusted policy spreads.

During the recent financial turmoil, OIS spreads have been increasingly used to assess the unusual behavior of longer term money market rates.

Figure 2: Minimum bid rate and OIS spread

![Figure 2: Minimum bid rate and OIS spread](image)

Right scale: Minimum bid rate (bold line) in percentage points.
Left scale: OIS spread defined as spread between Euribor 1 month and Eonia swap rate 1 month (expectations-adjusted policy spread) in percentage points.

Figure 2 shows the one-month OIS spread, i.e. the policy spread adjusted for expected changes of the policy rate revealed by the one-month Eonia swap rate. Note that the OIS spread does not display the large expectation-driven peaks of its unadjusted counterpart, compare Figure 1.

\(^7\)For example, the spread between the unsecured (Euribor) and the secured money market rate (Eurepo) can be distorted by tax considerations and costs related to providing collateral on the secured rate.

\(^8\)Similar results are obtained for OIS spreads for all 14 maturities under consideration, see Figure 7 in the appendix.
Figure 3: Mean and volatility of policy spreads along the yield curve

Data: June 27, 2000 – July 30, 2007
rombs: Spread between Euribor and minimum bid rate in percentage points (policy spread); quads: OIS spread between Euribor and Eonia swap of the corresponding maturity in percentage points (expectations-adjusted policy spread).

Figure 3 summarizes descriptive statistics of policy spreads along the yield curve. Similar to the findings of Balduzzi et al. (1998) obtained for U.S. data, mean and standard deviation of unadjusted policy spreads in the euro area increase almost linearly with the maturity of the money market rate. At first sight, this indicates that the influence of the central bank on interest rates weakens
with their maturity. However, the corresponding OIS spreads reveal that this is not necessarily true. For all maturities, expectations-adjustment has not only significantly decreased the mean and the standard deviation of policy spreads. Both, mean and standard deviation of OIS spreads remain also nearly constant along the yield curve.

2.3 Unit Root Tests

Stationarity and persistence of interest rates is usually examined by means of standard unit root tests, as the ADF-test, where the null hypothesis "the interest rate is I(1)" is tested against the alternative that it is I(0). Alternatively, KPSS-tests can be used where null and alternative hypotheses are reversed. We applied both types of tests to our set of 14 OIS spreads.

<table>
<thead>
<tr>
<th>Euribor maturity</th>
<th>ADF: $H_0 = I(1)$</th>
<th>KPSS: $H_0 = I(0)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 week</td>
<td>−22.09***</td>
<td>0.41*</td>
</tr>
<tr>
<td>2 week</td>
<td>−14.34***</td>
<td>0.47**</td>
</tr>
<tr>
<td>1 month</td>
<td>−12.95***</td>
<td>0.15</td>
</tr>
<tr>
<td>2 month</td>
<td>−10.37***</td>
<td>0.34</td>
</tr>
<tr>
<td>3 month</td>
<td>−7.54***</td>
<td>0.54**</td>
</tr>
<tr>
<td>4 month</td>
<td>−9.25***</td>
<td>0.61**</td>
</tr>
<tr>
<td>5 month</td>
<td>−8.74***</td>
<td>0.76***</td>
</tr>
<tr>
<td>6 month</td>
<td>−7.84***</td>
<td>0.59**</td>
</tr>
<tr>
<td>7 month</td>
<td>−6.50***</td>
<td>0.79***</td>
</tr>
<tr>
<td>8 month</td>
<td>−5.79***</td>
<td>0.87***</td>
</tr>
<tr>
<td>9 month</td>
<td>−9.09***</td>
<td>0.74***</td>
</tr>
<tr>
<td>10 month</td>
<td>−7.52***</td>
<td>0.73**</td>
</tr>
<tr>
<td>11 month</td>
<td>−8.35***</td>
<td>0.67**</td>
</tr>
<tr>
<td>12 month</td>
<td>−19.82***</td>
<td>0.38*</td>
</tr>
</tbody>
</table>

Notes: spread between Euribor and Eonia swap rate of the corresponding maturity for June 27, 2000 – July 30, 2007 (OIS spreads). For the ADF-test t-statistics and for the KPSS-test LM-statistics are given. Stars denote significance at the 1%, 5% and 10% significance level (***, **, *). The lag length for the ADF-test (with constant) is chosen according to the Schwarz-information criterion and the bandwidth choice for the KPSS-test follows the Newey-West criterion using a Bartlett kernel.

The results shown in Table 1 lead to highly contradictory conclusions. While the ADF-tests uniformly imply that policy spreads are I(0), this assumption is
strongly rejected by the KPSS-tests for most maturities. Apparently, modeling the persistence of European policy spreads in the I(0)/I(1) dichotomy is too restrictive. In the remainder of the paper, we therefore allow for a fractional order of integration \(0 \leq d \leq 1\) as a more general measure for the persistence of a time series.

The empirical literature on overnight rate dynamics typically assumes that the corresponding policy spread is I(0), see e.g. Würtz (2003), Pérez Quirós and Rodríguez Mendizábal (2006) and Nautz and Offermanns (2007). For the euro area, this assumption has been challenged by recent empirical evidence. Cassola (2007) as well as Hassler and Nautz (2008) found the Eonia spread, i.e. the ECB’s policy spread with respect to the overnight rate, to be fractionally integrated with \(d \approx 0.25\). Similar results are obtained for various euro area interest rates of one week maturity, see Cassola and Morana (2007). Following this line of research, we apply fractional integration techniques to estimate the persistence of policy spreads along the money market yield curve. Before doing so, let us briefly recall the distinguishing features of fractionally integrated, long memory processes.

3 Fractional Integration and the Persistence of Policy Spreads

3.1 Fractional Integration

A fractionally integrated process \(y_t\) is defined as

\[
(1 - L)^d y_t = x_t, \quad t = 1, \ldots, T
\]

where \(y_t\) is a purely stochastic process without deterministic components, \(L\) is the lag operator and the fractional differences \((1 - L)^d\) are given by binomial expansion. If \(x_t\) is a stationary and invertible ARMA process, then \(y_t\) is called an ARFIMA process, fractionally integrated of order \(d\). \(y_t\) is stationary as long as \(d < 0.5\) and it displays long memory for \(d > 0\). Long memory implies a form of serial dependence and persistence that cannot be captured by traditional ARMA processes. Specifically, for large lags \(h\), the autocorrelation function \(\rho_y(h)\) of a fractionally integrated process is given by:

\[
\rho_y(h) \sim \rho h^{2d-1}.
\]

It follows that \(\rho_y(h) \to 0\) as long as \(d < 0.5\). However, for \(d > 0\) the rate of convergence is so slow that the serial correlation coefficients are not summable because of their extremely low decay.
The order of integration \( d \) determines the persistence of \( y_t \). This can be shown by inverting \( (1 - L)^d \) and expanding the ARMA polynomials to obtain the Wold representation in terms of shocks \( \varepsilon_t \) (with impulse response function \( c_j \)):

\[
y_t = (1 - L)^{-d} x_t = \sum_{j=0}^{\infty} c_j \varepsilon_{t-j}, \quad \text{with} \quad c_j \sim c_j^{d-1}.
\]

For \( 0.5 \leq d < 1 \), \( y_t \) is non-stationary but in contrast to a random walk still mean reverting because the impact of past shocks dies out: \( c_j \to 0 \). For \( 0 < d < 0.5 \), \( y_t \) is stationary but still exhibits long memory, since shocks die out so slowly that the impulse response function is not summable.\(^9\) Using fractional integration techniques to assess the persistence of policy spreads avoids the rigorous distinction between I(0) and I(1) processes and allows for substantially lower decays in the autocorrelation functions. Modeling policy spreads as I(0) variables when the true data generating process does exhibit long memory may give rise to misleading conclusions regarding its persistence, see Sun (2006).

### 3.2 Estimating the Order of Fractional Integration

The order of integration of \( y_t \) is determined by semiparametric techniques where \( d \) is estimated without further specification or estimation of ARMA components in \( x_t \), see Eq.\(^3\). Specifically, the periodogram \( I(\lambda) \) is used as the spectral estimator evaluated at frequency \( \lambda \). Close to \( \lambda = 0 \), the periodogram is dominated by the order of integration \( d \). Therefore, \( I(\lambda_j) \) is evaluated at the so-called harmonic frequencies,

\[
\lambda_j = \frac{2\pi j}{T}, \quad j = 1, 2, \ldots, m, \quad m \frac{T}{T} \to 0,
\]

where the bandwidth \( m \) has to increase more slowly than the sample size \( T \). In the following, the bandwidth \( m \) is chosen optimally according to Henry (2001).\(^10\)

The literature proposes various estimation procedures for the order of integration. In this paper, we employ the local Whittle estimator \( \hat{d}_{LW} \) that minimizes the Whittle function \( R(d) \),

\[
R(d) = \log \left( \frac{1}{m} \sum_{j=1}^{m} \frac{I(\lambda_j)}{\lambda_j^{-2d}} \right) - \frac{2d}{m} \sum_{j=1}^{m} \log(\lambda_j).
\]

\(^9\)For further aspects of fractional integration, see e.g. Baillie (1996).

\(^{10}\)Specifically, assuming \( x_t \) in Eq.\(^3\) to be an AR(1) process \( (1 - aL)x_t = \varepsilon_t \), we obtain the optimal \( m \) by \( m^{opt} = \left( \frac{4}{\pi} \right)^{4/5} \left( \frac{T^{4/5}}{\tau} \right)^{2/5} \), where \( \tau = \frac{a(1 - a)}{1 - a^2} \), see Hassler and Nautz (2008). We will choose \( d^* = 0 \), this parameter not being known a priori.
Following Robinson (1995), the local Whittle estimator has the advantage of being more efficient than e.g. the log-periodogram estimator introduced by Geweke and Porter-Hudak (1983). It remains consistent for \( d \) close to one and is distributed asymptotically normal for \( d < 0.75 \), see Velasco (1999), i.e.

\[
t_{LW} = 2\sqrt{m}(\hat{d}_{LW} - d) \sim N(0, 1).
\]  

(5)

Note that our main findings do not depend on the choice of the estimator. Results obtained for the log-periodogram estimator by Geweke and Porter-Hudak (1983) and the exact local Whittle estimator by Shimotsu and Phillips (2005) are not reported but are available on request.

### 3.3 The Persistence of Expectations-Adjusted Policy Spreads

Figure 4 summarizes our results regarding the persistence and the long memory properties of the policy spreads along the money market yield curve. According to the 95% confidence intervals of the estimated order of fractional integration all policy spreads exhibit long memory (\( d > 0 \)). However, adjusting for rate change expectations strongly reduces the persistence of policy spreads for all maturities. In sharp contrast to the results found without expectations adjustment, tests on the order of fractional integration do not reject the stationarity of policy spreads, compare Table 2. In line with Haldrup and Nielsen (2007), we found that deviations of Euribor rates from the current policy rate due to anticipated future policy rate changes artificially drive the fractional integration parameter above 0.5.
Figure 4: The persistence of policy spreads along the yield curve

(a) Order of fractional integration of policy spreads without expectations adjustment

(b) Order of fractional integration of expectations-adjusted policy spreads (OIS spreads)

Notes: Sample June 27, 2000 – July 30, 2007. The figure shows estimates for $\hat{d_{LW}}$ and asymptotic 95% confidence intervals.
(a) Spread between Euribor and minimum bid rate (policy spread).
(b) Spread between Euribor and Eonia swap of the corresponding maturity (OIS spread).
Table 2: Stationarity of OIS spreads: Evidence from the fractional order of integration

<table>
<thead>
<tr>
<th>Maturity</th>
<th>1 week</th>
<th>2 week</th>
<th>1 month</th>
<th>2 month</th>
<th>3 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \hat{d} )</td>
<td>0.1125</td>
<td>0.1316</td>
<td>0.3717</td>
<td>0.5019</td>
<td>0.4934</td>
</tr>
<tr>
<td>( [0.041] )</td>
<td>( [0.059] )</td>
<td>( [0.046] )</td>
<td>( [0.053] )</td>
<td>( [0.055] )</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maturity</th>
<th>4 month</th>
<th>5 month</th>
<th>6 month</th>
<th>7 month</th>
<th>8 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \hat{d} )</td>
<td>0.4311</td>
<td>0.4190</td>
<td>0.4477</td>
<td>0.4699</td>
<td>0.4790</td>
</tr>
<tr>
<td>( [0.054] )</td>
<td>( [0.053] )</td>
<td>( [0.052] )</td>
<td>( [0.054] )</td>
<td>( [0.054] )</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maturity</th>
<th>9 month</th>
<th>10 month</th>
<th>11 month</th>
<th>12 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \hat{d} )</td>
<td>0.4009</td>
<td>0.4696</td>
<td>0.4289</td>
<td>0.3209</td>
</tr>
<tr>
<td>( [0.048] )</td>
<td>( [0.048] )</td>
<td>( [0.048] )</td>
<td>( [0.047] )</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Spread between Euribor and Eonia swap of the corresponding maturity for June 27, 2000 – July 30, 2007 (OIS spread). The bandwidth \( m \) for the local Whittle estimation is chosen optimally according to Henry (2001). Standard errors, given in brackets, indicate that \( H_0 = d \leq 0.5 \) cannot be rejected in favor of \( H_1 = d > 0.5 \) at any conventional significance level.

4 Monetary Policy Implementation and the Persistence of Policy Spreads

In March 2004, the ECB changed its operational framework to enhance the communication and the effectiveness of monetary policy (European Central Bank, 2003, p.41). Under the new framework, a synchronization of the reserve maintenance periods, MROs and interest rate decisions has eliminated the disturbing impact of anticipated policy rate changes on current money market rates. Moreover, the ECB has improved its communication to the market by providing more detailed information on its liquidity management (European Central Bank, 2004b, p.82).

A number of contributions have analyzed the consequences of these institutional changes for the overnight rate. For example, Nautz and Offermanns (2008) and Jardet and Le Fol (2007) show that the volatility of the overnight rate has been reduced significantly under the new framework. Colarossi and Zaghini (2007) find that the ECB’s reform even has affected the transmission of overnight rate volatility to longer-term rates. Focusing on the persistence of policy spreads, we investigate the consequences of the ECB’s new operational framework from
a different perspective. If the persistence of policy spreads can be related to the controllability of interest rates, the improved efficiency of the new framework should have helped to decrease the persistence of OIS spreads.

Figure 5: The persistence of OIS spreads along the yield curve

Notes: Spread between Euribor and Eonia swap of the corresponding maturity (OIS spread). The figure shows estimates for $\hat{d}_{LW}$ and asymptotic 95% confidence intervals, see Velasco (1999). The bandwidth $m$ for the local Whittle estimation is chosen optimally according to Henry (2001).
(a) before the framework change (June 27, 2000 – March 8, 2004)
(b) after the framework change (March 9, 2004 – July 30, 2007).

To test for the impact of the ECB’s new operational framework on the persistence of OIS spreads, we estimate the order of fractional integration for the
periods before and after March 2004 separately. Figures 6a and 6b indicate that the persistence of policy spreads is strongly affected by the ECB’s operational framework and the communication strategy. As expected, the estimated order of integration is smaller under the new framework for all maturities. Under the old framework, the order of integration of policy spreads with longer maturities remains close to $d = 0.5$. In particular, non-stationarity ($d \geq 0.5$) cannot be rejected for most maturities, see Table 3. In contrast, under the new framework policy spreads still exhibit long memory ($d > 0$) but non-stationarity ($d \geq 0.5$) can be rejected in most cases.

The results obtained from the fractional integration analysis confirm the notion that the communication of monetary policy has substantially improved under the new framework. The lower persistence of policy spreads reveals that the controllability of longer-term money market interest rates was enhanced considerably under the ECB’s new operational framework.
Table 3: Stationarity of OIS spreads before and after the introduction of the new framework: Evidence from the order of fractional integration

<table>
<thead>
<tr>
<th>Policy spread maturity</th>
<th>Order of integration ($\hat{d}$) under the old framework</th>
<th>Order of integration ($\hat{d}$) under the new framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 week</td>
<td>0.1164***</td>
<td>0.1373***</td>
</tr>
<tr>
<td></td>
<td>[0.054]</td>
<td>[0.053]</td>
</tr>
<tr>
<td>2 week</td>
<td>0.1076***</td>
<td>0.1436***</td>
</tr>
<tr>
<td></td>
<td>[0.083]</td>
<td>[0.073]</td>
</tr>
<tr>
<td>1 month</td>
<td>0.3365***</td>
<td>0.4256</td>
</tr>
<tr>
<td></td>
<td>[0.057]</td>
<td>[0.090]</td>
</tr>
<tr>
<td>2 month</td>
<td>0.5342</td>
<td>0.3812**</td>
</tr>
<tr>
<td></td>
<td>[0.069]</td>
<td>[0.065]</td>
</tr>
<tr>
<td>3 month</td>
<td>0.4916</td>
<td>0.3399**</td>
</tr>
<tr>
<td></td>
<td>[0.071]</td>
<td>[0.070]</td>
</tr>
<tr>
<td>4 month</td>
<td>0.4335</td>
<td>0.2617***</td>
</tr>
<tr>
<td></td>
<td>[0.074]</td>
<td>[0.052]</td>
</tr>
<tr>
<td>5 month</td>
<td>0.4523</td>
<td>0.2203***</td>
</tr>
<tr>
<td></td>
<td>[0.070]</td>
<td>[0.054]</td>
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<tr>
<td>6 month</td>
<td>0.4548</td>
<td>0.1967***</td>
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<tr>
<td></td>
<td>[0.067]</td>
<td>[0.064]</td>
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<td>0.4868</td>
<td>0.1849***</td>
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<tr>
<td></td>
<td>[0.069]</td>
<td>[0.063]</td>
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<td>8 month</td>
<td>0.5097</td>
<td>0.1964***</td>
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<tr>
<td></td>
<td>[0.069]</td>
<td>[0.061]</td>
</tr>
<tr>
<td>9 month</td>
<td>0.4315</td>
<td>0.2155***</td>
</tr>
<tr>
<td></td>
<td>[0.062]</td>
<td>[0.060]</td>
</tr>
<tr>
<td>10 month</td>
<td>0.4861</td>
<td>0.1267***</td>
</tr>
<tr>
<td></td>
<td>[0.063]</td>
<td>[0.057]</td>
</tr>
<tr>
<td>11 month</td>
<td>0.4802</td>
<td>0.1783***</td>
</tr>
<tr>
<td></td>
<td>[0.062]</td>
<td>[0.059]</td>
</tr>
<tr>
<td>12 month</td>
<td>0.3132***</td>
<td>0.1738***</td>
</tr>
<tr>
<td></td>
<td>[0.062]</td>
<td>[0.059]</td>
</tr>
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</table>

Notes: Spread between Euribor and corresponding Eonia swap rate for June 27, 2000 – July 30, 2007 (OIS spread). The bandwidth $m$ for the local Whittle estimation is chosen optimally according to Henry (2001). Standard errors are given in brackets. Stars denote that the null hypothesis of non-stationarity $H_0 = d \geq 0.5$ is rejected at the 1%, 5% or 10% significance level (***, **, *) in favor of the alternative hypothesis of stationarity $H_1 = d < 0.5$. 


5 Concluding Remarks

The ability of a central bank to influence longer-term money market rates by managing market’s expectations about the future interest rate path is of crucial importance for monetary policy being effective. So far, the controllability of market rates has typically been assessed by the mean and the volatility of policy spreads defined as the deviation of the market rate from the central bank’s key policy rate. Advancing on e.g. Balduzzi et al. (1998) and Hassler and Nautz (2008), this paper argued that the central bank’s control over longer-term rates should also be reflected in the persistence of policy spreads along the yield curve. If policy spreads are highly persistent, the lasting impact of shocks may impede the transparency of policy signals and, thus, the central bank’s impact on longer-term rates.

We employed fractional integration techniques to estimate the persistence of policy spreads corresponding to Euribor rates with maturities ranging from 1 week to 12 month. For each maturity, we found that euro area policy spreads exhibit long memory $(d > 0)$. This result is confirmed for expectations-adjusted policy spreads (OIS spreads) where the effects of anticipated policy rate changes have been accounted for. Although stationarity $(d \leq 0.5)$ of expectations-adjusted policy spreads cannot be rejected even for longer maturities, the strong evidence in favor of long memory suggests that the ECB’s control of longer-term money market rates might be weaker than expected.

The ECB’s new operational framework introduced in March 2004, allowed us to shed more light on the link between the persistence of policy spreads and the transparency and predictability of monetary policy. Our results indicate that the persistence of policy spreads has significantly declined under the new framework. In particular, the non-stationarity of policy spreads $(d \geq 0.5)$ can only be rejected after the ECB’s policy reform. Apparently, by decreasing the persistence of policy spreads along the yield curve, the improved operational framework has increased the central bank’s impact on longer-term money market interest rates.

Before the recent financial turmoil, OIS spreads were typically small and controllability and persistence of longer term money market rates seemed not to be a big issue. Since then, however, OIS spreads have increased to record levels of more than 100 basis points. In line with the predictions of our empirical analysis, OIS spreads have been very persistent during the turmoil and central banks experienced great difficulties to bring OIS spreads back to normal, see e.g.
Taylor and Williams (2008).

In the current paper, we analyzed the persistence of policy spreads along the money market yield curve for each maturity separately. Yet, interest rates with different maturities should not be independent. For example, a widely used test of the expectations hypothesis of the term structure applies cointegration analysis assuming interest rates to be I(1), see e.g. Shiller and McCulloch (1990). However, in case of fractional integration, standard cointegration tests might not be the adequate tool for modeling common long-run trends between interest rates. Following e.g. Cassola and Morana (2007) and Lardic and Mignon (2004), further research using fractional cointegration techniques might improve our understanding of interest rate dynamics along the yield curve.

References


A Figures

Figure 6: Euribor, minimum bid rate, and policy spread

(a) Euribor 1 week

(b) Euribor 2 week

(c) Euribor 1 month

(d) Euribor 2 month
Figure 6

(e) Euribor 3 month

(f) Euribor 4 month

(g) Euribor 5 month

(h) Euribor 6 month

(i) Euribor 7 month

(j) Euribor 8 month
Figure 6

(k) Euribor 9 month  (l) Euribor 10 month

(m) Euribor 11 month  (n) Euribor 12 month

Figure 7: Minimum bid rate and OIS spread

(a) OIS Spread 1 week
(b) OIS Spread 2 week
(c) OIS Spread 1 month
(d) OIS Spread 2 month
(e) OIS Spread 3 month
(f) OIS Spread 4 month
Figure 7

(g) OIS Spread 5 month

(h) OIS Spread 6 month

(i) OIS Spread 7 month

(j) OIS Spread 8 month

(k) OIS Spread 9 month

(l) OIS Spread 10 month
Figure 7

(right) OIS Spread 11 month


(left) OIS Spread 12 month
