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GRADUALISM, TRANSPARENCY AND THE IMPROVED OPERATIONAL FRAMEWORK: A LOOK AT OVERNIGHT VOLATILITY TRANSMISSION

by Silvio Colarossi[*] and Andrea Zaghini[**]

Abstract

This paper proposes a possible way of assessing the effect on interest rate dynamics of changes in the decision-making approach, in the communication strategy and in the operational framework of a central bank. Through a GARCH specification we show that the US and the euro area displayed a limited but significant spillover of volatility from money market to longer-term rates. We then checked the stability of this phenomenon in the most recent period of improved policy-making and found empirical evidence to show that the transmission of overnight volatility along the yield curve had entirely vanished.

JEL Classification: E4, E5, G1

Keywords: monetary policy, yield curve, GARCH.

Contents

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1.Introduction[1]

The perception of central bank actions by the public is as important as the actions themselves. Indeed, how the monetary policy decision-making process is understood and the way expectations about future moves are formed directly influence the effectiveness of the monetary policy itself. Eventually, the success of current changes in official rates in affecting spending decisions by households and investment by firms depends almost entirely on the impact of such changes on other financial markets' prices and yields, such as longer-term interest rates, equity prices and exchange rates, which in turn depend on the expectations about future developments in official rates.

Central banks, while pursuing their mandate, are always looking for the most effective procedures and trying to reduce uncertainty associated with policy decisions. To this end, especially since the early 1990s, important changes in the conduct of monetary policy have been implemented: (i) an increase in the amount of information regularly released to the public; (ii) a move towards gradualism in policy action; (iii) improvements in monetary policy operational frameworks and clearer implementation rules.

Central banks are making an effort to provide all the information about the strategy, the final and intermediate targets and the time horizon in an open, clear and timely manner. This approach was adopted to influence private sector expectations, and is driven by the idea that a broad knowledge of the decision-making process by the public would make the job of the monetary policy authority easier (Woodford, 2005). Another way in which the monetary authority has tried to influence expectation formation is by establishing certain patterns of behaviour (Bernanke, 2004). Under a gradualist regime, the central bank leads market participants to anticipate that changes in the policy rate will be followed by further adjustments in the same direction. Finally, operational frameworks have undergone important changes to avoid an additional source of noise in the communication and

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implementation of the monetary policy stance. Since the implementation of monetary policy decisions typically takes place through the steering of very short-term interest rates, high volatility in money market rates may potentially obscure the signalling power of the policy stance. In particular, central banks are concerned about the possible weakening of liquidity management "neutrality". A liquidity policy is "neutral" whenever the monetary policy stance is determined by the decisions taken by the competent policy-making body with respect to official rates, rather than influenced by the liquidity conditions management (Furfine, 2003; Clews, 2005).

There is a broad agreement that enhanced operational procedures together with better communication strategies and increased transparency have improved the predictability of central banks decisions, reduced the volatility in the money market and enhanced the signalling content of very short-term rates (Hilton, 2005; Issing, 2005). Less firm evidence is available concerning the consequences of the increased monetary policy predictability (Stock and Watson, 2002; Demiralp and Jordà, 2004; Swanson, 2006). In this paper we focus on a specific aspect that, in our opinion, is well suited to the task, even if in an indirect way. To gauge the effects of improved monetary policy-making on interest rates, we analyse the transmission of volatility along the yield curve. More specifically, we first assess the extent to which volatility is transmitted from policy instrument rates to longer maturities. In line with the previous literature, we find that some volatility spillover is indeed present, both in the US and in the Euro area, over an extended time span. Next, we check whether this volatility transmission is stable over time, or whether structural changes can be detected in conjunction with episodes of policy reform.

In principle, the spillover of volatility from the overnight rate to longer maturities may be viewed as a market flaw. Higher volatility may translate into term premia, thereby increasing equilibrium levels of nominal and real long-term rates and disturbing the transmission mechanism of monetary policy impulses. In this regard, the policy trends mentioned above should have a dampening effect on volatility transmission, improving monetary policy effectiveness. A reduction in the volatility transmission is here used as an indicator of the enhanced effectiveness of the monetary policy and thus of the effectiveness of the implemented changes. According to this intuition, we find that volatility transmission declined to the point that it has completely vanished in recent years. Overall, our findings are consistent with the idea that improvements in the monetary policy framework may be responsible for the changes in the volatility transmission.

The paper is structured as follows: Section 2 provides the overnight rate modelling; Section 3 documents the volatility transmission along the yield curve; Section 4 assesses the evolution of the pass-through mechanism in the most recent period of improved policy-making; and Section 5 outlines the conclusions.

2. The overnight market

Our empirical strategy is the following. In this section and the next we identify satisfactory statistical models for the interest rates at various maturities and we test for the presence of volatility transmission from the shortest end of the yield curve (the overnight market) to longer maturities. We stop our time horizon just before the financial turmoil triggered by the US subprime mortgage crisis in the summer of 2007. In the following section we then assess whether the changes in the monetary policy operational procedures and in the way communication with the public is managed may have had an impact on these models (i.e., generated some structural instability).

A first lesson that can be drawn from the empirical literature is that several methods are used to measure volatility, each with advantages and shortcomings. However, in recent years the conditional-volatility modelling (ARCH and its variants) has quickly gained importance and is nowadays one of the most commonly used tools in applied financial research.[2] Thus, along the line of empirical studies on the same topic, we adopt the following GARCH model for the US and the euro area overnight interest rates:

$$(1) \qquad \Delta r_t = \theta + \rho(r-o)_{t-1} + \sum_j \varphi_j \Delta r_{t-j} + \sum_j \eta_j \Delta o_{t-j} + \omega DX_t + \varepsilon_t$$

$$(2) \qquad \sigma^2{}_t = \nu + \alpha\varepsilon^2{}_{t-1} + \beta\sigma^2_{t-1} + \gamma\varepsilon^2_{t-1}S^-_{t-1} + \psi DX_t .$$

[2] See Bollerslev (1986) for the seminal contribution. As for the most recent empirical contributions see Demiralp et al. (2006), Bali and Wu (2006) for the US, while for the euro area see Perez-Quiros and Rodriguez Mendizabal (2006), Nautz and Offermanns (2008). Prati et al. (2003) and Bartolini and Prati (2006) provide cross-country studies of the different behaviour of overnight markets in several industrialized economies including the US and the euro area.

In the mean equation (1) r_t denotes the nominal overnight interest rate, o_t is the official interest rate, DX_t is a matrix of calendar dummies. In the variance equation (2) the dummy variable S_t, which takes the value 1 if ε_t<0 and 0 otherwise, allows for a different reaction of volatility to positive and negative surprises.

Table 1: Estimation results for overnight markets

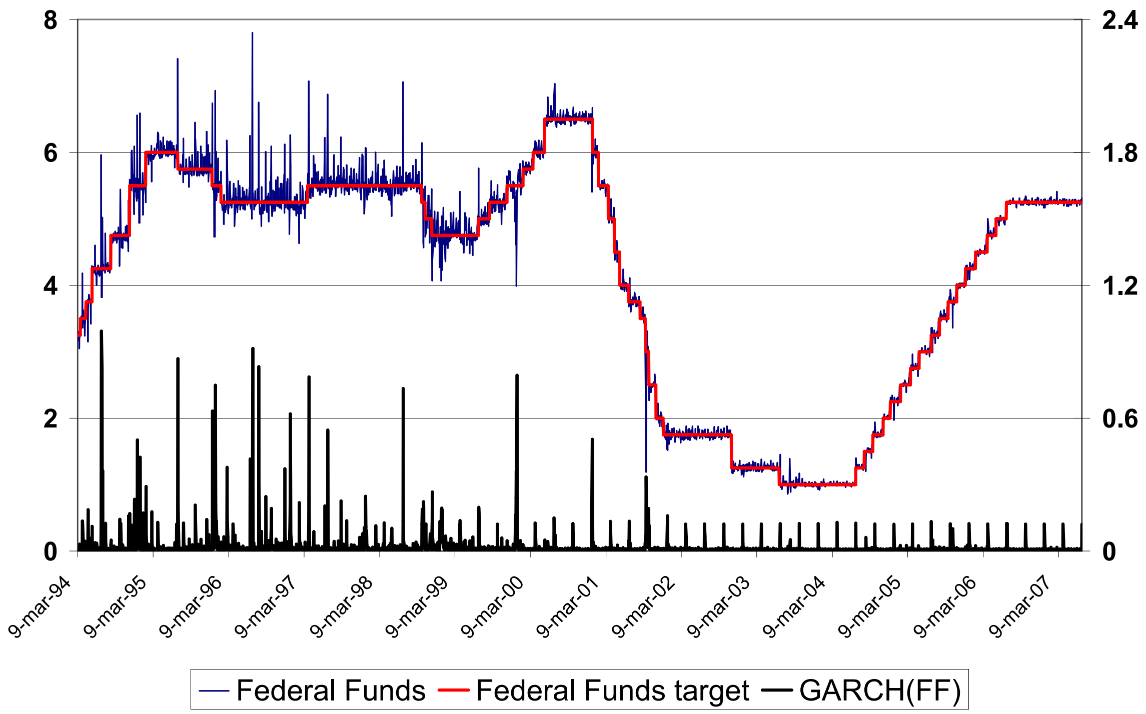
Fed Funds					
θ	-0.0030	***	ν	0.0010	***
ρ	-0.7843	**	α	0.4271	***
φ_1	0.0901	***	β	0.1953	***
φ_2	0.0859	***	γ	0.2204	***
φ_3	0.1095	***	ψ_{EM}	0.0069	***
η_0	0.5155	***	ψ_{EQ}	0.1126	***
ω_{EM}	0.0876	***	ψ_{EEEMP}	0.0011	***
ω_{BM}	0.0369	***	ψ_{EEMP}	0.0033	***
ω_{EQ}	0.1352	***	ψ_{EMP}	0.0074	***
ω_{EY}	-0.4627	***			
ω_{EEEMP}	0.0250	***			
ω_{EMP}	0.0123	**			
$\omega_{9/11/2001}$	-0.7315	***			
EONIA					
θ	0.6092	***	ν	0.0025	***
ρ	-0.2771	***	α	0.2249	***
φ_1	-0.0343	*	β	0.3154	***
η_0	0.5002	***	ψ_{EM}	0.0018	***
ω_{EM}	0.0406	***	ψ_{BM}	-0.0045	***
ω_{EQ}	0.0369	***	ψ_{EEEMP}	0.0019	**
ω_{EMP}	-0.0261	***	ψ_{EEMP}	0.0429	***
			ψ_{EMP}	0.0021	*

NOTE: Daily observations. Sample period: 1.3.1994 - 29.6.2007 for the US and 1.1.1999 - 29.6.2007 for the euro area. One, two and three asterisks denote statistical significance at 90%, 95% and 99%, respectively.

We modelled the overnight rate in differences, since each rate turned out to be an I(1) variable, and introduced as Error Correction Term (ECT) the spread between the overnight and the official rate. We also added several dummy variables to take into account calendar effects (end of month, quarter and year) and maintenance period effects both in the mean and variance equation. The conditional variance process together with the conditional mean specification were jointly estimated using the maximum likelihood technique.[3]

Regarding the US overnight market, we use the Federal Funds effective rate (FF) as the endogenous variable and the Funds target as the official rate. The latter rate has been publicly announced since February 1994, while in the preceding years, the FOMC did not formally target the Funds rate. Accordingly, our sample of daily data starts in March 1994 and ends in June 2007. The development in the Federal Funds effective rate and in the target rate are reported in Figure 1 together with the estimated conditional volatility. In the mean equation, the impact effect of a 1 percentage point change in the target rate on the overnight rate is 0.52 points (Table 1). Thereafter, the remaining differential between official and overnight interest rates is removed at the very fast rate of 78 per cent per period (the ECT coefficient).

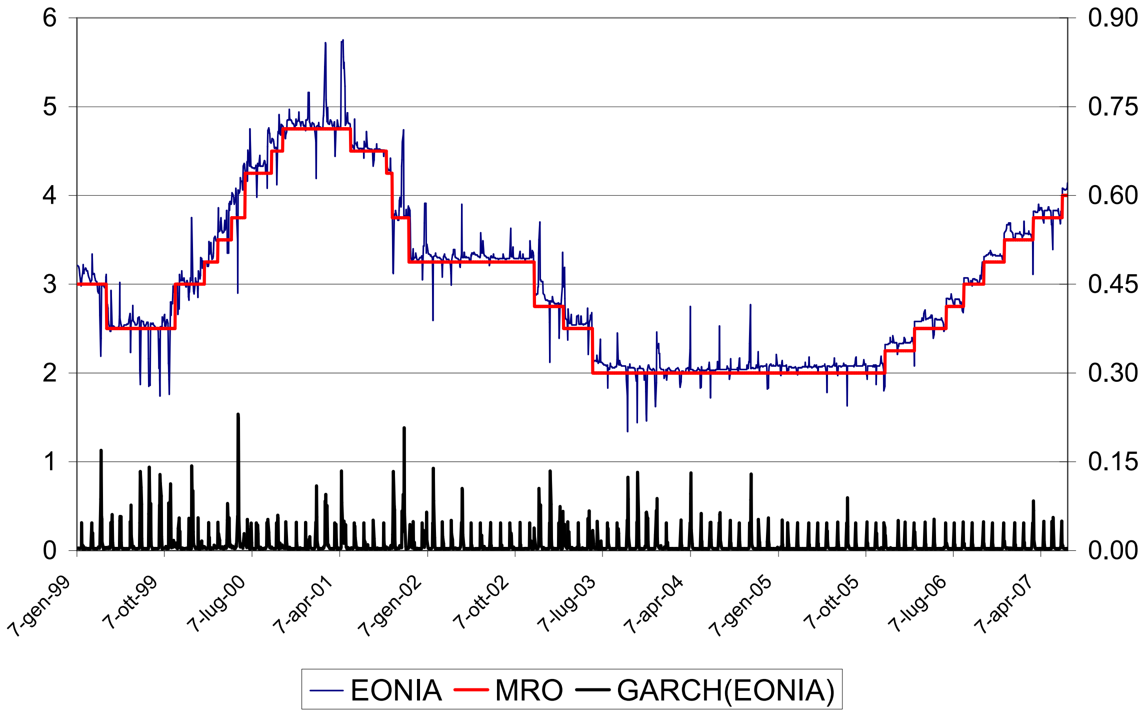
Figure 1: US overnight rates and estimated volatility



[3] We tried several specifications to detect the number of lags of both official and overnight rates. In the final regression we maintained only variables whose estimated coefficient was significantly different from zero. See Table A1 and A2 in the Appendix for the exact data definition and dummy specification.

On the final business day of each month – the high-payment-flow days – we detect an increase of both conditional mean and volatility. With reference to the other calendar day effects, we find that the parameter on the end-quarter dummy is strongly positive while that at year end is significantly negative. In addition, evidence of a positive effect is found on the last days of the maintenance period. A dummy variable valued 1 in the days after the terrorist attack of 11 September 2001 takes into account the extraordinary changes in the FF rate in those days, while, the coefficient γ turns out to be significant, suggesting evidence of asymmetric effects in volatility.[4] The average estimated volatility over the whole period is 1.7 basis points.

Figure 2: Euro area overnight rates and estimated volatility



As regards the euro area overnight market, we rely on the EONIA rate (Euro OverNight Index Average), while we consider the rate on the MROs (Main Refinancing

[4] The diagnostic statistic LM2 did not detect any residual heteroskedasticity up to the fifth order. The stability condition of the GARCH model is satisfied ($\alpha + \beta < 1$) and the non negativity of the conditional variance is ensured by the positive value of v, α and β.

Operations) as the official rate.[5] Our sample period ranges from January 1999 to June 2007. The mean-variance model appears reasonably well-specified: the diagnostic test for ARCH effects (LM2) up to the fifth order is easily satisfied and most parameter values turned out to be as expected. In the mean model, the impact effect of a change of 1 percentage point in the official interest rate is half a point on the overnight rate (Table 1). Thereafter, any remaining differential between the official and the overnight interest rate is eradicated at the rate of 28 per cent per period. Most likely due to window-dressing effects, on the last day of the month and of the quarter, the EONIA rate increases by around 4 basis points. As for the variance equation, an increase in volatility is detected in the last days of the maintenance period and at the end of the month. Figure 2 depicts the development of both the EONIA and the MRO rate over time together with the estimated conditional volatility from the system (1)-(2). The average estimated volatility is 1.1 basis points, slightly less than that of the US overnight market.

3. Volatility transmission along the yield curve

The volatility in the overnight market is usually interpreted as "technical" volatility mainly due to banks' liquidity management, i.e. it is not directly related to the monetary policy stance of the central bank, thus abrupt changes in that market should be related mainly to liquidity shocks. However, the communication policy of the central bank and possible changes in the monetary policy strategy may affect market behaviour. Misunderstandings of policy intentions and surprises regarding the decisions about the official rates may have significant impact on the overnight market. In addition, there is the risk that the volatility in the daily money market is unwarrantedly transmitted to longer-term rates, which are relevant to real economic decisions such as firms' investment and households' consumption. This is why, among other reasons, monetary authorities try to stabilize volatility at the very short-end of the yield curve and to be as transparent as possible in the management of its decision-making process.

[5] For MROs held through variable rate tenders we took the minimum bid rate, i.e. the lower limit at which counterparties may submit bids.

In order to assess the existence of volatility transmission across maturities, we introduce the conditional variance derived from the overnight GARCH model as an exogenous variable in the estimates of the volatility model at longer maturities. This procedure implicitly assumes that overnight volatility is not Granger-caused by longer-term interest rate innovations and thus that the transmission may go in one direction only (Ayuso et al.; 1997).[6] In addition, the conditional variance is introduced as an explanatory variable also in the mean equation of each maturity to check for a possible direct effect of the volatility on the level of interest rates. Then, equations (1) and (2) become:

$$(3) \qquad \Delta r_t^i = \theta^i + \rho^i (r^i - o)_{t-1} + \sum_j \varphi_j^i \Delta r_{t-j}^i + \sum_j \eta_j^i \Delta o_{t-j} + \omega^i DX_t + k^i \sigma_t^{2,on} + \varepsilon_t^i$$

$$(4) \qquad \sigma^{2,i}{}_t = \nu^i + \alpha^i \varepsilon^{2,i}{}_{t-1} + \beta^i \sigma_{t-1}^{2,i} + \lambda^i \sigma_t^{2,on} + \psi^i DX_t$$

where r^i denotes the nominal interest rate with maturity i = 1-month, 3-month, 12-month, 5-year and 10-year and the suffix *on* stands for the overnight market.

The focus of the exercise is on the coefficient λ^i. Positive values of the coefficient would be consistent with the hypothesis that higher variance in the overnight market translates into higher variance of longer rates. For the FED Funds the coefficient is positive and significant in the variance equation of each maturity (Table 2). As for the other coefficients, at longer maturities the level of interest rates are less affected by calendar and maintenance period days. The ECT coefficient is significant only for the 1-month maturity, in addition it is much smaller than in the overnight model suggesting a significantly slower adjustment to official rate changes. There are no volatility transmission effects in the mean equation in any of the markets under analysis (k^i is not significantly different from zero), implying that the determination of the yields at longer maturities does not depend on the (conditional) volatility in the FED Funds rate.

By looking at the 1-month market we can see that the pass-through is relatively small (0.0014). However, the magnitude of the estimated λ^i is not a direct measure of the economic

[6]In this respect Cassola and Morana (2006) only find limited backward transmission of volatility.

significance of the volatility transmission, since the volatility of the overnight market is usually much larger than that of longer rates.[7]

Table 2: Volatility transmission from the Fed Funds rate

	1-month		*3-month*		*12-month*		*5-year*		*10-year*	
θ	0.0028	**	0.0013		0.0016	**	0.0008		0.0001	
ρ	-0.0247	***								
φ_1	0.0941	***	0.1245	***	0.0329	*	0.0539	***	0.0519	***
φ_2	0.7465	**								
η_0	0.0632	***	0.0951	***	0.0401	**				
ω_{EM}							-0.0229	***	-0.0215	***
ω_{EY}							0.0310	*	0.0258	*
$\omega_{9/11/2001}$	0.1926	***	-0.1114	***						
k	0.0014		-0.0137		0.0028		-0.0125		0.0007	
v	0.0010	***	0.0001	***	0.0000	**	0.0000		0.0000	*
α	0.0675	***	0.0854	***	0.0502	***	0.0371	***	0.0317	***
β	0.6053	***	0.8477	***	0.9313	***	0.9500	***	0.9558	***
λ	0.0014	***	0.0013	***	0.0005	***	0.0005	***	0.0006	***
ψ_{EM}	0.0024	***	0.0009	***	0.0010	***	0.0011	***	0.0006	**
ψ_{BM}	-0.0011	***								
ψ_{EQ}	-0.0003	***	-0.0002	***	-0.0006	**				
ψ_{EY}	0.0000	***								
$ELAST_{SR}$	0.0113	***	0.0064	***	0.0013	***	0.0008	***	0.0009	***
$ELAST_{LR}$	0.0286	***	0.0786	***	0.0565	***	0.0584	***	0.0760	***

NOTE: Daily observations. Sample period: 1.3.1994 - 29.6.2007. One, two and three asterisks denote statistical significance at 90%, 95% and 99%, respectively.

In the bottom panel of Table 2 we report two adjusted measures of this pass-through. The first is the average impact elasticity, $ELAST_{SR} = \lambda^i \frac{\bar{\sigma}^{2,on}}{\bar{\sigma}^{2,i}}$, i.e. the impact elasticity computed at the sample average of both volatilities. The second is the average equilibrium elasticity, computed as $ELAST_{LR} = \frac{\lambda^i}{1-\beta^i}\frac{\bar{\sigma}^{2,on}}{\bar{\sigma}^{2,i}}$. These elasticities give the percentage increase in the variance of rate *i* due to a 1 per cent increase in the variance of the overnight rate, when both variances are at the average level. In particular, the equilibrium elasticity is more important for assessing the impact of a permanent shift in the volatility of the FED

[7] See Figures 3 and 4 in the next section for a comparison of market volatility levels across maturities.

Funds. According to these values, the pass-through rate is around 1.1 per cent for the 1-month at impact and much smaller at longer maturities. The adjustment in equilibrium is somewhat stronger, ranging between 2.8 and 7.8 per cent.

For the euro area the evidence is similar to that of USA: there is a statistically significant transmission of volatility from the EONIA to longer-term rates, with the only exception of the 10-year benchmark rate (Table 3), though the volatility pass-through is quantitatively limited. The impact elasticity for the 1-month market is just above 1 per cent, while that of the other maturities is even smaller. The equilibrium elasticity suggests again a stronger impact in the long-run: between 2.4 and 9.7 per cent. The similarity between the euro area and the US overnight markets is confirmed by looking at the absolute transmission of the volatility: the pass-through coefficients and the elasticities are of comparable magnitude.

Table 3 Volatility transmission from the EONIA rate

	1-month		*3-month*		*12-month*		*5-year*		*10-year*	
θ	-0.0011		0.0013		0.0009	*	0.0003		0.0003	
φ_1	0.2335	***	0.2466	**	0.1118	***	-0.0106	*	-0.0103	*
η_0	0.1688	***	0.1396	***	0.1316	***	0.0664	**	0.0365	*
ω_{EM}	0.0012	*								
κ	0.0125		-0.0277		0.0049		-0.0011		0.0129	
ν	0.0005	***	0.0003	***	0.0000	***	0.0001	*	0.0000	*
α	0.1003	***	0.1265	***	0.0500	***	0.0434	***	0.0249	***
β	0.5634	***	0.5692	***	0.9355	***	0.9516	***	0.9671	***
λ	0.0012	**	0.0008	***	0.0007	***	0.0011	*	0.0005	
ψ_{EM}	-0.0011	***	-0.0006	***	0.0003	***	0.0006	***	0.0004	**
ψ_{EY}									0.0003	**
ψ_{EMP}	-0.0002	**	-0.0005	***						
$ELAST_{SR}$	0.0107	**	0.0037	***	0.0036	***	0.0022	*	0.0010	
$ELAST_{LR}$	0.0245	**	0.0284	***	0.0562	***	0.0971	*	0.0933	

NOTE: Daily observations. Sample period: 1.1.1999 - 29.6.2007. One, two and three asterisks denote statistical significance at 90%, 95% and 99%, respectively.

Summing up, the above evidence suggests that a limited part of the volatility at the short-end of the yield curve is transmitted to longer rates. As already mentioned, the volatility in the overnight rate is mostly related to the daily management of banks' liquidity while longer-term rates reflect broader expectations about future monetary policy and macroeconomic developments. Thus, at least theoretically, there should not be any volatility spillover along the yield curve, especially at the 5- and 10-year horizon.

Our findings are broadly consistent with the previous (limited) empirical literature. Relying on an EGARCH over the period between January 1999 and November 2003, Alonso and Blanco (2005) find a significant transmission of the EONIA volatility to the 1-month and 3-month rates, but not to the 12-month rate. Over a more recent horizon, Nautz and Offermanns (2008) suggest that only the overnight volatility due to non-seasonal effects is transmitted along the yield curve. For the US, Abad and Novales (2004) and Lee (2006) hint at a limited volatility transmission which is often statistically significant at the usual probability levels within the 12-month horizon.

4. A structural break test

As mentioned in the Introduction, in the most recent period, since the start of the new century, changes in operational procedures, improved transparency, better communication and a trend towards gradualism in monetary policy decisions has led to more efficient policy making and reduced volatility in money markets. In this section we would like to assess whether this widespread improvement in the monetary policy framework has also had an impact on the "undesired" transmission of overnight interest rate volatility along the yield curve. Table 4 shows the chronology of the most important changes in the conduct and communication of monetary policy, which in principle may have had an influence on the volatility of the overnight market.[8]

In order to evaluate whether a change in the estimates and patterns documented in previous sections has indeed occurred, we followed the testing procedure described by Andrews (1993) and Andrews and Ploberger (1994). In particular, the procedure is fit to

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[8] The analysis of the effectiveness of each change in the operational framework or about the innovations in policy management goes beyond the scope of this paper. For a survey on the topic and a measurement of the improvement in transparency over time due to adjustments in the communication strategy and the operational framework of 9 major central banks see Eijffinger and Geraats (2006). See instead Board of Governors of the Federal Reserve System (2005) and European Central Bank (2005) for a detailed description of the actual operational framework of the two central banks.

detect a structural break in the level of the volatility when the timing of the break is unknown. More precisely, we introduced a dummy *B(j)* that equals 0 if $t \leq j$ and 1 otherwise in equation (4) and then we tested the null hypothesis that the coefficient of *B(j)* is 0 over all potential break dates *j*, $j \in [T_1, T_2]$, with $T_1 = [0.15T]$, and $T_2 = [0.85T]$ by means of standard LR(*j*) statistics. Finally, we computed the *average-LR* and the *sup-LR* test statistics. The asymptotic distributions of the tests are non standard and depend on the number of coefficients that are allowed to break and on the fraction of the sample that is examined. The point at which the LR(*j*) statistic hits the maximum is an estimate of the break date.

Table 4: Most significant recent policy-making changes

Federal Reserve System	
August 1994	Description of the state of the economy and detailed rationale for policy action after FOMC decisions
May 1999	The statement about the economic outlook is released even after no change in FFT
January 2000	Addition of a "balance of risk" to the economic outlook indicating the most likely future interest rate action
March 2002	Release of votes of individual FOMC members
January 2003	Revision of the discount window lending program
September 2003	Introduction of an explicit comment about likely future path of the policy
November 2006	Reduction of operational complexities in the maintenance of the SOMA portfolio
European Central Bank	
June 2000	MROs conducted as variable rate tenders with minimum bid rate
November 2001	One meeting for the monetary policy discussions and decisions instead of two
May 2003	Revision of the monetary policy strategy
March 2004	Introduction of a new operational framework
May 2004	ECB approves the gradual introduction of a "Single List" in the collateral framework

The recursive test for a structural break in the overnight volatility for both the US and the euro area has a hump-shaped plot, suggesting: 1) a strong rejection of the null hypothesis of no structural change in the overnight volatility; 2) the existence of a single break over the time span under consideration. As regards the time of the structural break, the peak of the test is in July 2000 for the US and July 2003 for the euro area. Both dates are close to a change in the policy-making framework of the central bank. For the US the break is not far from the introduction by the FED of an explicit "balance of risks" to the economic outlook in the post-meeting statement (January 2000), while for the euro area the break is just after the monetary policy strategy revision announced in May 2003.

Figure 3: Mean of conditional variance in the USA

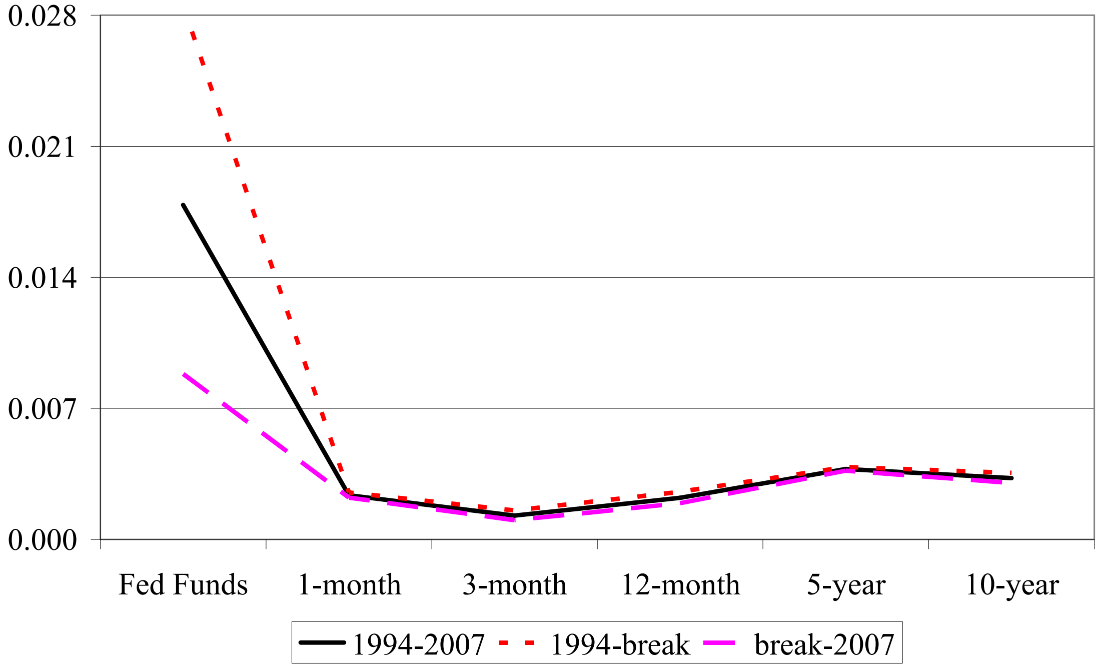
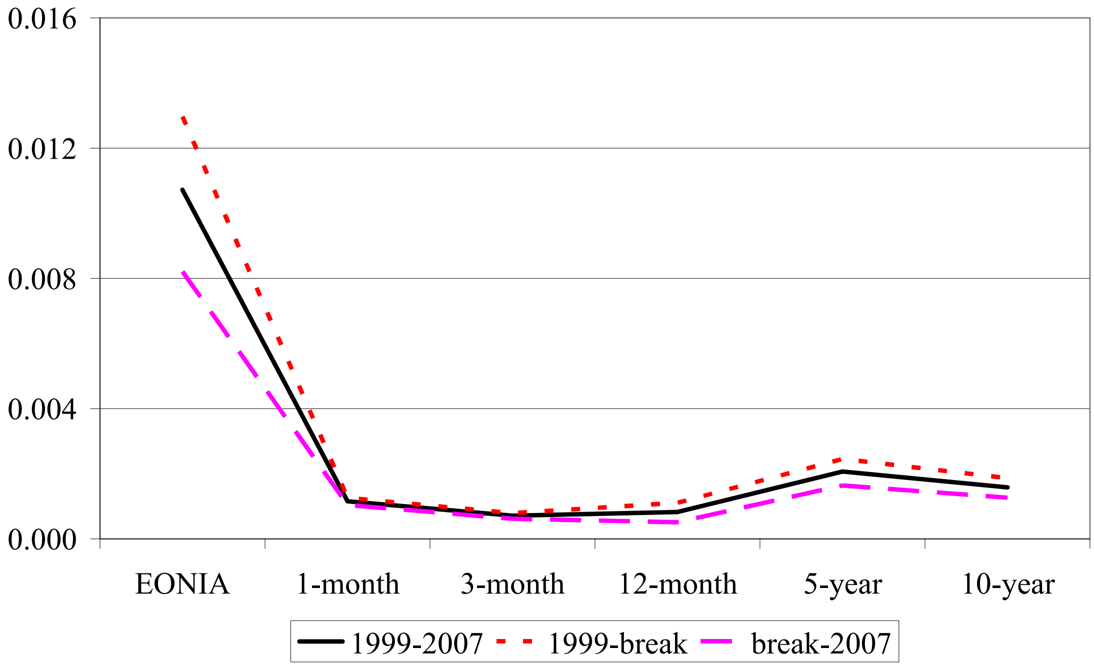


Figure 4: Mean of conditional variance in the Euro area



Figures 3 and 4 depict the pattern of volatility in each market for both the economies under analysis over the whole horizon, before the break and after the break. It is evident that the volatility has significantly decreased in the second half of the sample, especially in the overnight markets. Consistently with the findings of Ayuso et al. (1997) for some European countries and Alonso and Blanco (2005) for the euro Area, the U-shaped pattern of the volatility across maturities up to 12 months is maintained after the break. In addition, the curve is snake-shaped overall due to the reduction of volatility at the 10-year horizon (Piazzesi, 2005).

Needless to say, the aspect we would like to assess is whether the volatility transmission from the money market has changed after the break in the overnight volatility level. To check for the change, we introduce a *duBREAK* step-dummy in our regressions and consider the conditional overnight volatility derived from the model assuming the structural break.[9] Specifically, for all rates we leave equation (3) unchanged and we model volatility as follows:

$$(5) \quad \sigma^{2,i}{}_{t} = \nu^{i} + \alpha\varepsilon^{2,i}{}_{t-1} + \beta^{i}\sigma^{2,i}_{t-1} + \lambda^{i}_{0}\sigma^{2,on}_{t} + \lambda^{i}_{1} duBREAK\,\sigma^{2,on}_{t} + \delta duBREAK + \psi^{i} DX\,.$$

A significant value of λ^{i}_{1} would suggest a change in the volatility spillover across markets. In particular, a positive (or negative) value would hint at an increased (or reduced) pass-through, while the non-significance of the estimate would point to an unchanged framework.

Tables 5 gives the estimation results for both economies and for each market. The remarkable result is that the volatility transmission from the overnight market has strongly diminished in the second half of the sample in all markets for both currencies. The coefficient of the multiplicative dummy is always negative and significantly different from zero in each specification (including the 10-year euro area bond), while the coefficient λ^{i}_{0} is

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[9] The estimates of equations (1)-(2) for the overnight markets obtained assuming one break (in July 2000 for the US and in July 2003 for the euro area) are reported in Table A3 in the Appendix. Of course other parameters of the GARCH model may have significantly varied after the break, however, given the focus of the analysis on the volatility transmission and the simplicity of the model, we allow for the possibility of a change in the transmission coefficient only. Nevertheless, we do control for a change in the level of volatility by introducing an *ad hoc* dummy (*duBREAK*).

always significant and usually larger than the corresponding estimate over the overall sample (see Table 3), suggesting that indeed in the first part of the sample the transmission was stronger. In addition, the Wald test never rejects the null hypothesis that the sum of the transmission coefficients is zero thus suggesting that volatility transmission has completely vanished in the most recent period.

Table 5: Structural changes in volatility transmission

	Federal Funds									
	1-month		*3-month*		*12-month*		*5-year*		*10-year*	
ν	0.0010	***	0.0031	***	0.0002	***	0.0005	***	0.0001	***
α	0.0175	***	0.5585	***	0.0347	***	0.0425	***	0.0310	***
β	0.5781	***	0.4373	***	0.9214	***	0.9351	***	0.9563	***
λ_0	0.0018	***	0.0022	**	0.0007	***	0.0011	***	0.0007	***
λ_1	-0.0017	***	-0.0035	**	-0.0003	**	-0.0007	**	-0.0010	**
δ	-0.0002	***	-0.0002	***	-0.0001		0.0000		0.0000	
	EONIA									
	1-month		*3-month*		*12-month*		*5-year*		*10-year*	
ν	0.0005	***	0.0001	***	0.0000		0.0000	**	0.0000	*
α	0.1271	**	0.1174	***	0.0511	***	0.0421	***	0.0231	***
β	0.4706	***	0.7202	***	0.9261	***	0.9519	***	0.9670	***
λ_0	0.0034	***	0.0020	***	0.0012	***	0.0011	**	0.0008	*
λ_1	-0.0032	**	-0.0017	***	-0.0016	***	-0.0014	**	-0.0009	*
δ	-0.0005	**	-0.0001	***	0.0000		0.0000		0.0000	

Daily observations. Sample period: 1.3.1994 - 29.6.2007 for the USA and 1.1.1999 - 29.6.2007 for the euro area. One, two and three asterisks denote statistical significance at 90%, 95% and 99%, respectively.

Of course the underlying causes of the better functioning of the money market cannot be determined with certainty since many factors may have concurred in the final outcome and the improvement is likely to have been gradual rather then directly linked to a single episode. However, our results are fully consistent with the hypothesis that an improved general framework of monetary policy decision-making has contributed to the vanishing of an undesired volatility spillover across maturities. Table 5 shows that for some markets the dummy variable for a break in the level of volatility is non-significantly different from zero at the usual confidence levels, thus suggesting that the vanishing of the volatility pass-through is independent of a possible reduction of volatility in each market. This in turn suggests that it might be a phenomenon attributable to a different source from the "good luck" hypothesis or the supposed improved ability of the economic system as a whole to withstand shocks. What we suggest is that more gradual and transparent behaviour on the part of central banks has enabled financial agents to operate in a more efficient way.

5. Conclusion

The efficient functioning of the overnight market plays a key role in the financial structure of most world economies and in how monetary policy is conducted. On the one hand, overnight rates are the anchor for the term structure of interest rates; on the other hand, the operating procedures of central banks are designed to affect the supply and demand of liquidity reserves between credit institutions. Thus, volatility transmission along the yield curve may weaken the signalling power of the monetary policy stance. Also the transmission mechanism of monetary policy impulses may be hampered by a large volatility spillover from overnight to longer-term rates.

In order to maintain a low level of volatility, central banks have devised various ways to influence, directly and indirectly, the liquidity conditions in the overnight market. In the last two decades, we have witnessed an overall increase in the transparency of central banking, improved communication strategies and a gradual approach in the decision-making process. Further, the operational framework has undergone a series of improvements in order to maintain a “neutral” liquidity policy, i.e. the monetary policy stance has to be determined only by the decisions taken by the central bank concerning the official rates. Since the monetary authority’s operational rules have a clear influence on the functioning of the overnight market, any change in the framework may affect the dynamics of the short-end of the yield curve. Thus, the behavioural features of interbank markets need not be taken as given by policy-makers, but can be expected to respond readily and predictably to changes in institutional arrangements (Prati et al.; 2003). This in turn implies that the analysis of possible structural breaks in the transmission of volatility along the yield curve might be used as a good indicator of the consequences of the adopted measures in monetary policy management.

By relying on a common empirical framework for the US and the euro area we showed that the conditional overnight volatility is a significant explanatory variable in the volatility equation of a GARCH model for the 1-month, 3-month, 12-month, 5-year and 10-year rates over the period ending in June 2007. Even though the volatility transmission is likely to be larger on some particular days of the calendar or in the maintenance period, we found that overall the transmission reflected an inadequate understanding of central banks' decision-making process or insufficient communication to the financial markets and the public at large. In addition, an imperfect design of the operational framework could allow financial market expectations about future policy decisions interfere with the standard overnight dynamics. Splitting the sample in order to isolate the most recent period of improved policy-making, we showed that the volatility pass-through has entirely disappeared in both economies. Although our exercise is not a direct test of the effectiveness of the changes in both monetary policy strategy and the operational framework, our results are consistent with the significant positive effects of the move towards a more open, efficient and gradual approach in policy-making devised by the two central banks.

In our empirical analysis we explicitly took into account the reduction in the volatility which occurred across a wide range of financial assets and markets by means of an *ad hoc* dummy variable, however we are aware that other factors other than the improved monetary policy framework might be at work. In this regard, a number of empirical and theoretical studies suggests that financial volatility may be counter cyclical and linked to macroeconomic volatility. At least until the summer of 2007, the prolonged period of "moderation" in macroeconomic developments may have contributed to the subdued volatility in a broad spectrum of interest rates. In addition, improvements in financial markets (the growth in transaction volumes in the cash market and the rapid spreading of credit risk transfer instruments) is another circumstance which is often quoted as a likely contributor to the dampening of volatility (BIS, 2006).

All in all, our results are in line with the current findings of the empirical literature on monetary policy conduct. In particular, the improvement in private sector forecasts of short-term interest rates (Swanson, 2006; Bauer et al., 2006), the reduced macroeconomic and financial volatility (Cecchetti et al., 2006; BIS, 2006) and the increased predictability of central bank decisions (Bernoth and von Hagen, 2004; Wilhelmsen and Zaghini, 2005; Ehrmann and Fratzscher, 2007) are all aspects that may be directly or indirectly linked to the new era of accountability, transparency and gradualism.

Appendix

Table A1

Data definition

	Policy rate	*Overnight*	*1-month*	*3-month*	*12-month*	*5-year*	*10-year*
USA	Federal funds target rate	Federal funds effective rate	LIBOR US dollar 1-month	LIBOR US dollar 3-month	LIBOR US dollar 12-month	yield on the 5-year Treasury benchmark	yield on the 10-year Treasury benchmark
Euro area	rate on the main refinancing operations[1)]	EONIA	EURIBOR 1-month	EURIBOR 3-month	EURIBOR 12-month	yield on the 5-year German government benchmark	yield on the 10-year German government benchmark

1) For MROs held through variable rate tenders we took the minimum bid rate (the lower limit at which counterparties may submit bids).
Source: Datastream

Table A2

Dummy specification

EM	End of month
BM	Beginning of month
EQ	End of quarter
EY	End of year
EMP	End of maintenance period
EEMP	One day before the end of the maintenance period
EEEMP	Two days before the end of the maintenance period
9/11/2001	Last three days of the maintenance period including 11 September 2001 and the first day of the following maintenance period

Table A3

Estimation results for the overnight market with a structural break

Fed Funds					
θ	-0.0014	*	ν	0.0080	***
ρ	-0.7628	***	α	0.4025	***
φ_1	0.0835	***	β	0.0718	***
φ_2	0.0672	***	γ	-0.0459	
φ_3	0.0871	***	ψ_{EM}	0.0017	**
η_0	0.5430	***	ψ_{EQ}	0.1931	***
ω_{EM}	0.0679	***	ψ_{EEEMP}	0.0004	**
ω_{BM}	0.0228	***	ψ_{EEMP}	0.0020	***
ω_{EQ}	0.2381	***	ψ_{EMP}	0.0030	***
ω_{EY}	-0.4907	***	*duBREAK*	-0.0072	***
ω_{EEEMP}	0.0167	***			
ω_{EMP}	0.0092	**			
$\omega_{9/11/2001}$	-0.6650	***			
EONIA					
θ	0.2233	**	ν	0.0086	***
ρ	-0.2924	***	α	0.2632	***
φ_1	-0.0213	*	β	0.4602	***
η_0	0.5312	***	ψ_{EM}	0.0098	***
ω_{EM}	0.0300	***	ψ_{BM}	-0.0124	***
ω_{EQ}	0.0347	***	ψ_{EEEMP}	0.0043	***
ω_{EMP}	-0.0183	*	ψ_{EEMP}	0.0671	**
			ψ_{EMP}	0.0055	**
			duBREAK	-0.0028	***

NOTE Daily observations. Sample period: 1.3.1994 - 29.6.2007 for the US and 1.1.1999 - 29.6.2007 for the euro Area. One, two and three asterisks denote statistical significance at 90%, 95% and 99%, respectively.

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