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Author(s):
Iris Biefang-Frisancho Mariscal and Peter Howells

Centre for Global Finance
Bristol Business School
University of the West of England
Coldharbour Lane
Bristol BS16 1QY

Telephone: 0117 32 83906
Email: cgf@uwe.ac.uk
Website: http://www.uwe.ac.uk/bbs/research/cgf/

Interest rate pass-through and risk

Iris Biefang Frisancho-Mariscal and Peter Howells
Centre for Global Finance
Bristol Business School

One of the most striking features of the financial crisis that began in the autumn of 2007 has been the associated upheaval in conventional interest rate spreads. In the UK, this is most frequently symbolised by the widening (and increased volatility) of the spread between 3-month Libor and the Bank of England's policy rate. This paper uses a vector error correction model to look at the way in which the recent crisis has affected a wide range of interest rate spreads. We look for changes in the coefficient on the policy rate (the 'pass-through') and at changes in the speed of adjustment to changes in the policy rate, since both are important for policy. We find, as others have done, that the conventional behaviour of almost all spreads is swept away after August 2007. By developing a model which incorporates measures of counterparty and liquidity risk, we show that market rates are now subject to *additional* influences, but except for secured loans, still incorporate the effects of changes in the policy rate much as they did before the crisis. This contrasts with the widely-held view that the relationship between policy and money market rates in particular has been severely disrupted by the crisis.

For secured loans, however, there is evidence that the mark-up has risen while at the same time the policy pass-through has fallen since August 2007. The same applies to deposit rates, albeit to a lesser extent, with the result that the sharp reduction in policy rate since the end of 2007 has had a larger effect on deposit than loan rates.

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Corresponding author:
Prof. P G A Howells
peter.howells@uwe.ac.uk

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I. Introduction

One of the most striking features of the financial crisis that began in the autumn of 2007 has been the associated upheaval in conventional interest rate spreads. In the UK, this was most frequently symbolised by the widening of the spread between 3-month Libor and the Bank of England's policy rate, since a very wide range of financial products were (and still are) priced by reference to 3-month Libor. In 2001, when we last looked at this issue (Biefang-Frisancho Mariscal and Howells 2002), 3-month Libor was around 20 basis points above the policy rate (in October 2001 Libor was actually *below* the policy rate). This differential persisted with very small variations until August 2007 when it increased to 70bp. In early 2008 the spread was around 80bp and in October it jumped to 150bp. Given that LIBOR is the basis for setting so many market rates, these jumps were 'as if' the central bank had increased the policy rate by 50bp and then by another 100bp within the space of a month. Given the Bank of England's preference for adjusting the policy rate by 25bp and spreading the changes over an extended period of time, these jumps in the spread were equivalent to inconceivably large policy shocks.[1] Since the transmission mechanism of monetary policy in most regimes relies upon changes in interest rates (ECB, 2004; Bank of England, 1999), that mechanism has been disrupted by recent events.

But there is more of interest here than what has happened to the *level* of short-term interest rates. What the episode brings home to us is a timely reminder that in economics it is *relative* prices that matter. While this piece of wisdom is driven home to every first year student it is, strangely, overlooked when it comes to macroeconomic policy discussions where it is the *level* rather than the structure of interest rates that often attracts attention. Yet it must be the case that the policymaker expects (or at least hopes) for a particular set of interest rate spreads from any policy change. In our earlier (2002) paper, for example, we pointed out that *if* the policymaker were concerned with the rate of growth of money and credit, then the desired outcome of an increase in the policy rate would be to raise loan rates by more than the increase in deposit rates (a widening of the loan-deposit spread). In the closing months of 2008 UK policymakers hoped that unprecedentedly large cuts in the policy rate would help to stimulate spending, through a reduction in the cost of credit, positive wealth effects, a fall in the exchange rate and other well-known channels. Looking at the cost of credit, however, a moment's careful thought would tell us that the true cost is not the loan rate in isolation; rather it is the loan-deposit spread since the decision to borrow should depend upon the cost of the loan relative to the cost of drawing on existing liquid assets. And the loan-deposit spread actually *widened* recently when banks slashed savings rates, as can be seen at the very end of Figure 1.

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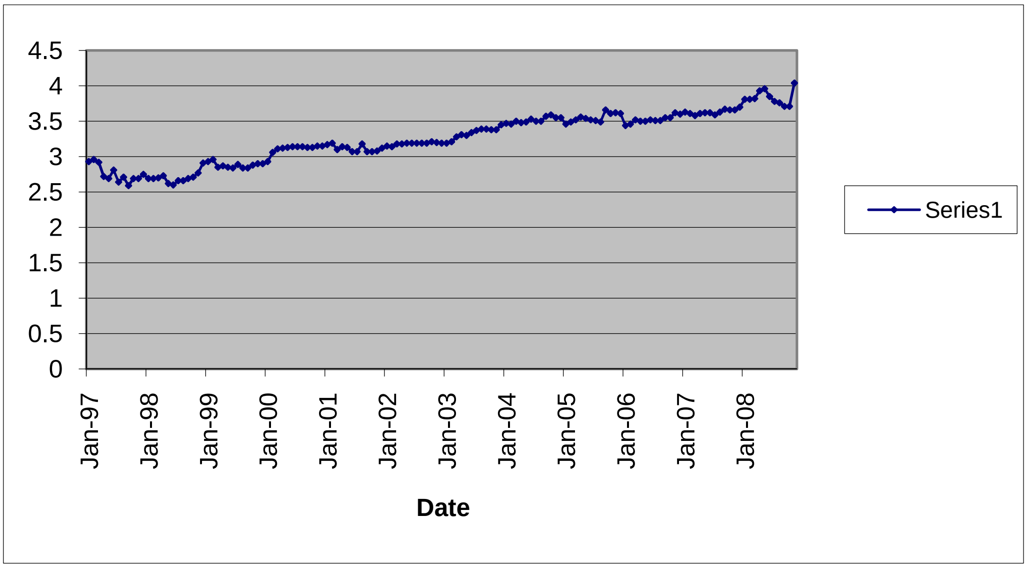
[1] Not quite 'inconceivable' since the Bank of England's emergency 150bp cut in the policy rate on 4 December 2008.

Furthermore, as we showed in our earlier (2002) paper, spreads will alter as the result of differential speeds of adjustment. Heffernan (1997), for example, showed that money market rates adjust more rapidly than the 'administered' rates of banks and building societies in response to a change in the policy rate. Hence, while these adjustments are taking place, there will be changes to spreads which may last for some time after the policy shock.

Figure 1: SVR mortgage rate minus time deposit rate



For all these reasons it seems a worthwhile endeavour to examine what exactly has happened to a range of interest rate relationships in the current upheaval and to see the extent to which long-run relationships may have been disturbed. Partly for data reasons, our investigation spans the period from January 1997 which gives us a ten year period of 'normality' with which to compare recent events.

We start, in section II with a brief review of what we already know about interest behaviour. The empirical tests are detailed in section III where we use a conventional vector error correction model. The data are discussed in section IV while the analysis and results are in section V. Our summary and conclusions are in section VI.

II. Policy and market rates

Given that it is market rates[2] (not the official rate itself) which affect agents' behaviour, it is not surprising that the transmission of interest rate changes through the money markets and beyond has received quite a lot of empirical attention over the years. In the 1990s, for example, Dale (1993) and Dale and Haldane (1993) for the Bank of England looked at the effect of a change in official rates on market rates. The emphasis in the former was on the impact on

[2] Since we are talking about a number of interest rates that can be aggregated into categories with similar names, a moment's clarification of terminology may be useful. In the following discussion, we shall refer to the official rate of interest, set by the central bank, as the *policy* rate. '*Market* rates' refers to all other rates, i.e. rates which are influenced in some way by private economic agents. Within this category we shall sometimes refer to '*money market* rates' which are rates determined in markets for tradeable securities, such as bills and certificates , in contrast to '*administered or retail* rates' which are those typically faced by households and set by financial institutions.

market rates differentiated by maturity while the latter differentiated by type of instrument. In both cases the findings were that the impact on market rates was quite varied. For example, the effect decayed with term to maturity (short-term rates responded more than long rates) and also decayed as the instrument was priced more by administrative decision and less by a continuous market (so mortgage loan rates and deposit rates responded more sluggishly than commercial paper and bill rates).

Also in the 1990s, Shelagh Heffernan looked at the pricing of a range of bank products following anecdotal evidence of bank and building society failure to pass on interest rate cuts to loan customers. Heffernan (1993) showed that the retail banking market was one of complex imperfect competition with sluggish loan and deposit rate adjustment. Interestingly (in the light of current developments) this study used Libor to proxy the official rate. More recently (1997) she used an error correction approach to explore the short- and long-run responses of rates on a number of banking products to changes in the policy rate. The model was initially estimated for seven different retail bank products using data from four large clearing banks, a number of smaller banks and five large building societies, covering the period (at longest) May 1986-January 1991. On average, adjustments of chequing accounts and mortgages were 37 per cent complete within a month, but much slower for personal loans. The imperfect competition, noted in the 1993 paper was one reason for the slow response, reinforced by administrative costs.

Our own 2002 paper used a vector autoregressive error correction model to investigate the links between the policy rate and each of 3-month Libor, a bank deposit rate and a short-bond rate. This showed that while a policy rate change was fully reflected in the other rates eventually (there were no *lasting* effects on relative rates) the speeds of adjustment varied substantially and some effects took a year to work themselves out. It also suggested that adjustments had become more rapid following the financial deregulation of the 1980s.

What all these investigations show is that any change in the official rate takes time to work its full effect on some market rates and therefore that there is a period of ‘disequilibrium’ during which interest rate relativities are disturbed.

The recent upheavals themselves have spawned a number of studies. In one of these (IMF, 2008) the authors looked at the recent stress in bank funding markets in the UK, US and the eurozone. One of their hypotheses is that the dislocation between policy and interbank rates has caused more stress for UK and US banks because of their more marked recent structural shift in funding towards money market instruments as against traditional or ‘core’ deposits. Hence, much of their discussion focuses upon the relationship between money market rates and ‘core deposit rate’ (rather than policy rate). The study begins in 1998 and until the summer of 2007 findings are not very different from what one would expect from the earlier studies above. In the long-run, there is a close relationship between policy rate and money market rates, although adjustment time varies with instrument. The linkage is loosest (and adjustment longest) for bank-administered borrower financing (e.g. mortgage) rates. The linkage is weakest for high yield corporate bonds. From the summer of 2007, however, there is a big increase in money market spreads and in forecast errors. The disruption appears to be greatest for the USA. The paper goes on to discuss the causes of high interbank spreads (and their variances) in the recent period and finds that this is largely due to systemic distress risk. This analysis of the causes of widening spreads leads the authors to the conclusion that the effectiveness of the rate of interest as policy instrument has been substantially damaged.

> ...from mid-2007 the forecast errors for the three-month Libor jumped substantially at the same time as the extraordinary increase in money market spreads and the collapse of the structured credit market in response to subprime mortgage market distress ... The larger forecast errors for the near-bank financing rates (ABS and U.S. agency MBS yields) and a widening of forecast confidence intervals after the summer of 2007 is evidence of a dramatic alteration in the predictability of interest rate transmission. These results suggest that the early linkages of interest rate transmission in the United States have been impeded by the financial turmoil. (IMF, 2008, p.95)

This view of the policy implications of the crisis has wide popular support. References to the need for alternative or additional policy instruments have littered the financial press since mid-1980. But, the IMF is not alone amongst serious investigations in drawing this conclusion (see for example, also Rogers, 2009)

Another group of studies focuses on the 'pass-through', that is, on the way in which a change in the official rate is 'passed through' ultimately to a range of market rates. Typical of these is a recent investigation by de Bondt (2005) who estimates a two-stage model in which the bank loan rate is set as a mark up on the marginal cost of funds averaged across the eurozone. The policy rate is proxied by EONIA and different market rates are selected as representing the relevant marginal cost of funds for the rates on various bank products on the basis of their correlation with the product in question. The findings, briefly, were that the pass-through from the official rate to market rates at the short end of the yield curve (less than three months) was virtually complete and instantaneous. The pass-through from market rates to bank products, however, is much slower – typically about 50 per cent complete after a month for loans. But deposit rates are very sticky, having adjusted by only 40 per cent even after three months. The de Bondt study, of course pre-dates the recent upheavals and is mainly concerned with the effect on pass-through of the earlier movement to a single currency. He finds that the effects are more rapid since 1999. This conclusion is drawn by comparing the results with a substantial number of earlier, single country, studies (summarised in de Bondt on pp.41-2).

More recently, we have seen the emergence of a literature which tries to identify the role of credit and liquidity risk in the recent upheavals in market (usually Libor) rates. This literature includes Bank (2007), Taylor and Williams (2008), ECB (2008), Michaud and Upper (2008), Segoviano (2008), Segoviano and Goodhart (2008) and Button, Pezzini and Rossiter (2010) amongst others. We draw upon some of this work as we explain in section IV.

III. Methodology

We are here concerned with the relationship between the policy rate and a selection of market rates from January 1997 until July 2010 for the UK. Within this period, there are two distinct sub-periods, namely a period of 'normality' from January 1997 to July 2007 (hereafter, the 'earlier period') and secondly the period since August 2007 to the present (hereafter the 'later period')[3]. In order to compare the differences in the pass-through during these two periods, we

[3] The later period consists of crisis and post-crisis period.

first estimate a conventional two-dimensional vector error correction model (VECM) over the sample period before August 2007 and then over the entire period from January 1997 until July 2010. For the entire period, the VECM will be slightly modified to account for the change in banks' risk perception during the financial crisis.[4] We first turn to the earlier period, for which the two-dimensional VECM is defined as:

$$\phi(L)\Delta y_t = c + \theta(L)\Delta x_t - \gamma[y_{t-k} - \beta x_{t-k} - \alpha] + \varepsilon_t \qquad (1)$$

with y_t and x_t standing for any of the market rates and the policy rate, respectively. This model estimates β as the long-run pass-through in response to a policy rate change, the speed of adjustment to equilibrium, γ, and the average mark-up α over the policy rate or, more precisely, the percentage point difference between the market and the policy rate.[5] An estimated value of the slope parameter β equal to one would indicate a complete pass-through of the policy rate to the market rate in the long-run. Values of β below unity would indicate less than complete pass-through in the long-run, while an estimated slope parameter of greater than one, although statistically possible, is difficult to interpret economically. It would suggest that the market rate responds by more than the official rate in the long-run. Overshooting has a sensible economic interpretation in the short-run, since agents believe that more policy rate changes may be on their way, particularly when central banks smooth interest rates, but it generally cannot be justified economically in the long-run.

Empirical studies (as summarized in section II) which covered various geographical areas and estimation methods, conducted before the financial crisis, concluded that even when there is sluggishness in the adjustment of administered rates and the long-run pass-through is incomplete, the relationship between market and policy rates was stable. Market rates broadly followed movements in the policy rate. The financial crisis led to massive write-downs and losses by (UK) banks, which in turn put substantial pressure on banks' solvency ratios and gave rise to a general loss of confidence in the banking sector and, importantly, also among banks themselves. One of the consequences was the disruption of the functioning of the money markets which was reflected in the persistent widening of the spread between Libor and overnight index swap (OIS) rates. As many bank loan and deposit rates are based on money market rates, the disruption of the normally close relationship between Libor and OIS rates potentially impaired the transmission of monetary policy rate changes and market rates. Following the literature of recent models of arbitrage-free pricing, Taylor and Williams (2009) show that the spread between Libor and OIS measures liquidity constraints and counterparty risk premia. Libor measures the interest rate on unsecured loans and is a function of expectations of average future overnight rates and risk factors over the term. The overnight

[4] Error correction models are conventionally used to estimate the pass-through (IMF, 2008 for US and European interest rate pass-through; Hofmann and Mizen , 2004 for UK banks; Sorensen and Werner, 2006 using panel unit root and cointegration tests; ECB, 2009)

[5] In relation to bank rates, the mark-up α can be interpreted as representing a host of factors (apart from the policy rate) such as bank efficiency, credit risk, market structure, degree of risk aversion, interest rate risk etc. Studies that explicitly model the mark-up of retail interest rates are for instance Maudos *et al* (2004), Leuvenstein *et al* (2008)

index swap (OIS) measures the average expected overnight interest rates and involves little counterparty risk since no money is exchanged until maturity. [6] There is interest rate risk concerning the future path on interest rates. Since OIS is the average of the overnight interest rates expected until maturity, subtracting OIS from Libor removes interest rate expectations. Thus the spread between Libor and OIS measures liquidity and counterparty risks and it is considered as an indicator of the health of banks (Thornton, 2009).

Liquidity risk can be measured as the spread between term-Libor and the term-certificates of deposit (CD) rates (Taylor and Williams, 2009). The CD market is the market where non-banks lend to banks. As long as lenders are not liquidity constrained, banks can use the CD market to obtain liquidity. If the CD market is liquid, competition for funds will lead to similar rates on both, Libor and CD markets, provided that borrowers are of the same credit quality. Vice versa, if there is no liquidity in the market for CDs, the interest rate is unaffected and the spread between Libor and CD rate widens since competition for funds concentrates on the Libor market. The graph A2 in the appendix shows 3-month CD and corresponding Libor rates. Both rates are moving very closely together suggesting no liquidity constraints (see also Michaud and Upper (2008), Taylor and Williams (2009), Thornton (2009)). Consequently, the Libor-OIS spread will also be interpreted as a measure of counterparty risk.

In order to test for robustness of results for the later period, we use an additional spread that measures counterparty risk. The Libor-Repo spread is the spread between unsecured and secured lending on the interbank market. Repurchase agreements are backed by government bonds and thus are a form of secured lending. The greater the risk of non-payment of a loan, the greater is *ceteris paribus*, the spread between unsecured (Libor) and secured lending (repo).

In view of this discussion, equation (1) is modified to incorporate the change in the risk environment during the crisis period as:

$$\phi(L)\Delta y_t = c + \theta(L)\Delta x_t + \zeta(L)\Delta z_t - \gamma[y_{t-k} - \beta x_{t-k} - \rho z_{t-k} - \alpha] + \varepsilon_t \qquad (2)$$

where z_t is either a measure of the Libor-OIS or the Libor-Repo spread.

Since the issue of the paper is to compare interest rate pass-through during the normal and the crisis periods, the dynamic equation corresponding to (2) is slightly modified to incorporate potential differences in instant pass-through and changes in volatility:

$$\Delta y_t = c + \delta_1 \Delta x_t + \delta_2 D \Delta x_t - \gamma_1 u_{t-1} + \sum_{i=1}^{n} \theta_i \Delta x_{t-i} + \sum_{i=1}^{n} \phi_i \Delta y_{t-i} + \sum_{i=0}^{n} \zeta_i \Delta z_{t-i} + \varepsilon_t$$
$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \qquad (3)$$

Here u_{t-1} denotes the deviation from the long-run equilibrium in the previous period (the error correction term) based on equation (2). *D* is a dummy variable which is equal to one in the pre-crisis period and zero otherwise. The difference of the coefficients $(\delta_1 - \delta_2)$ measures the difference in short-run immediate pass-through in the later period compared to the pre-crisis period. The aim is to find out whether banks delayed policy rate changes pass-through during the crisis relative to the normal period. During the crisis, policy rate fell and banks may have

[6] The OIS rate is the rate on a derivative contract on the overnight rate (SONIA in the UK). In this contract, two parties agree that one will pay the other a rate of interest that is the difference between the OIS rate and the geometric average of the overnight rate.

passed-through the policy rate fall more sluggishly to lending rates, for example, in order to mitigate losses incurred during the crisis. We include the dummy variable only in the equations for retail interest rates. The GARCH(1,1) model was estimated to account for changes in volatility over the sample period 1997 to 2010 which was significantly higher during the crisis and to obtain more accurate measures of the estimated covariance matrix.

IV Data

We use a wide selection of interest rates at a monthly frequency over the period from January 1997 until July 2010. Our sample thus covers two distinct periods, the 'normal' and crisis period. The interest rates have been selected to represent a wide range of lending/borrowing behaviour ranging from household overdraft, mortgage and deposit rates as well as long-term government and corporate finance. Because of its importance in the setting of other rates we have also included 3-month Libor and various other money market rates to compare their behaviour over the crisis. The precise list of rates and the source of the data is given in Table 1.

Table 1: Selected interest rates and sources
Jan 1997 until July 2010

Variable	*Code/Source[1]*	*Abbreviation*
Policy rate (2- week repo)	IUMAGR2W	pol
SONIA	IUMASOIA	Sonia
1-week Libor	IUMAVKA	LIBOR1W
1-month Libor	IUMAVNEA	LIBOR1M
3-month Libor	IUMAAMIJ	LIBOR3M
6-month Libor	IUMAVSMA	LIBOR6M
1-year Libor	IUMAVYRA	LIBOR1Y
3-month CD rate	IUMAVCDA	CD3M
Household sight deposit	IUMTHAK	Access
Household time deposit	IUMWTTA	TD
Household fixed rate bond	IUMWTFA	Hbond
5-yr government bond yield	IUMASNZC	Gov5
Corporate bond yield (long term)	Datastream – UKMCRPB(IR)	corpbond
Fixed 2-year mortgage 75% LVT	IUMBV34	Mortg2Y
Fixed 3-year mortgage 75% LVT	IUMBV37	Mortg3Y
Fixed 5-year mortgage 75% LVT	IUMBV42	Mortg5Y
2-year discounted mortgage	IUMBV48	Dismortg
Standard variable rate mortgage	IUMTLMV	SVmortg
Household overdraft	- IUMODTL	Overdr
£5,000 unsecured household loan	IUMBX67	Loan5Y
£10,000 unsecured household loan	IUMHPTL	Loan10Y
Repo 3-months	IUMAGR3M	Repo3
Overnight Index Swap	GBP3MOIS.ICAP.Reuters	OIS

Notes: [1] All data are from Bank of England interactive database, unless stated otherwise. Loan5Y starts only from January 2005 and OIS starts from July 2000.

The policy rate, set by the monetary policy committee, changes in steps and infrequently. For this reason we have chosen to proxy the policy rate by using 2-week gilt repo rate (pol). This is because the Bank of England's money market operations have involved the use of 2-week gilt repo deals for most of the period.[7]

V. Empirical Analysis

Figures A1 to A14 (A1a to A14a) show the time series of and the spreads between the interest rates and the policy rate. All money market rates and most retail rates (except those for unsecured loans) move closely together with the policy rate in the period before the crisis. At the very short end of the yield curve, money market rates continue to follow the policy rate during the crisis, but this changes when maturity is beyond one month. Bond yields and retail rates have diverted persistently from the policy rate since the crisis.

Before testing for cointegration, variables are tested for stationarity.[8] Conventional unit root tests found that interest rates are integrated of order one.[9] Table 2 shows the results of the cointegration tests between the various market rates and the policy rate. In the pre-crisis period we find cointegration between all interest rates except for yields on household bonds,[10] interest rates on discounted mortgages and unsecured loans. An explanation for the detachment of loan from policy rates is given by the Stiglitz-Weiss (1981) model. Accordingly, loan rates may be subject to the phenomenon of endogenous default. The Stiglitz-Weiss model predicts that raising loan rates will increase default so that loan rates will never exceed an 'efficiency' interest rate at which net income from loan rates will be maximised. Consequently, banks will decide carefully whether to raise loan rates in response to increases in the policy rate because of the increased probability of default and the ensuing loss of profitability. Similarly, banks may not reduce loan rates in response to a reduction in the policy rate, because profits will fall while the probability of default will decrease. The loss of profit in case of default may be greater for unsecured than for secured loans since there is no collateral which may compensate for at least part of the potential default and thus unsecured loan rates may be even more detached from the policy rate than secured loans.

When testing over the entire period, cointegration ceases for all rates, except for those at the very short end of the yield curve (such as Sonia and one-week Libor) and the 5-year government bond yield (see the last column of Table 2).

Before discussing the results of the cointegrating coefficients over the earlier period, we test whether equation (2) provides cointegrating vectors and thus (statistically) valid long-run coefficients for the entire sample period. The two credit risk spreads Libor-OIS and the spread between 3-month Libor and 3-month Repo rate are denoted as LIBOROIS and CrRisk, respectively. They are shown in figures A15 and A16 in the appendix. Both spreads are quite low and principally flat until the financial crisis. They then rise dramatically and eventually

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[7] Seven day repos since May 2006

[8] By definition, bounded variables should be stationary. However, within a sample, they can appear as non-stationary either due to weak mean reversion or to the low power of unit root tests (Hofmann and Mizen, 2004).

[9] Augmented Dickey Fuller tests were applied for both periods, pre-crisis and entire period. The test results can be obtained from the author upon request.

[10] Household bonds are fixed-interest, fixed-term deposits for maturities in excess of one year.

flatten out. The Libor-OIS spread, however, remains elevated in comparison to its pre-crisis level.[11]

The results of the cointegration tests are shown in Table A1 in the appendix. All vectors are cointegrated and Table 3 below shows the estimated cointegrating vectors.[12]

Table 3 is constructed in three column blocks: the first shows the estimated cointegrating coefficients of the earlier period (January 1997 to July 2007), based on equation (1). The second and third column blocks cover the whole period and depict the estimated cointegrating coefficients of equation (2). The second column block includes the Libor-Repo spread denoted as CrRisk and the third column block shows the estimated coefficients with the Libor-OIS spread.

First, we turn to the discussion of the results of the pre-crisis period (cols. 1 and 2). Overall, we find that market rates follow the policy rate (with the exception of the corporate bond rate). In particular, money market rates show a complete long-run pass-through with coefficients all close to one (col. 1).[13] Money market rates also do not show any mark-up over the policy rate during the earlier period. Generally, for the other market rates, the pass-through is not complete. For those rates, the size of the pass-through coefficient varies from zero (for corporate bonds) to one (for some of the mortgage rates). All these rates have a positive mark-up over the policy rate (col. 2) with the mark up showing some relationship to risk and/or term. The exception is the rate on time deposits which shows a negative mark-up. For large, long-term, time deposits this might be a bit surprising but for 'retail' time deposits is probably what we would expect. The data does not allow us to disaggregate the series. Furthermore, there is not enough evidence to distinguish whether there is a difference in the size of the pass-through coefficients and/or the size of the mark-ups of the deposit and (secured) loan rates. If monetary policy were to affect deposit rates less than loan rates, when for instance, raising the policy rate to reduce demand for credit, then the effect of central bank policy would be greater since the spread between loan and deposit rates would become wider. The pre-crisis results, however, do not suggest such an effect.

[11] Both spreads are non-stationary over this sample period. Unit root tests as well as Johansen cointegration tests between the two rates (Libor-OIS and Libor-Repo, respectively), confirm non-stationarity of the spreads. Again, results can be obtained from the authors upon request.

[12] Excluded are unsecured loans and Access. Figures A12 to A12b show the behaviour of the overdraft and the policy rates over time. Even an 'eyeball' inspection suggests that both rates are not related to each, neither in the earlier nor the later period. Graphs for the remaining unsecured loan rates look similar.

[13] Restrictions of the coefficient to one are not rejected by chi-square test.

Table 2: Cointegration tests of vectors consisting of a market/bank rate and the policy rate.*

Vector	January 1997 to July 2007				January 1997 to July 2010			
	lag	Trace	Max eigenvalue	CV	lag	Trace	Max eigenvalue	CV
	Money market rates							
Sonia	2	31.63***[0.000]	27.68***[0.000]	Y	2	20.00**[0.050]	17.66**[0.031]	Y
LIBOR1W	2	21.506**[0.033]	17.851**[0.024]	Y	2	25.46***[0.009]	22.62**[0.004]	Y
LIBOR1M	2	20.385**[0.048]	16.976**[0.034]	Y	2	18.919*[0.076]	15.92**[0.05]	Y
LIBOR3M	2	22.123**[0.027]	18.936**[0.016]	Y	1	14.72[0.240]	12.625[0.152]	N
LIBOR6M	2	21.616**[0.032]	18.474**[0.019]	Y	1	12.442[0.410]	10.699[0.275]	N
LIBOR1Y	2	21.182**[0.037]	18.153**[0.022]	Y	1	15.576[0.195]	13.877[0.101]	N
CD3M	2	22.437**[0.025]	19.302**[0.014]	Y	1	14.33[0.27]	12.25[0.17]	N
	Deposit rates							
Access	5	17.108[0.129]	11.485[0.218]	N	5	12.647[0.393]	9.776[0.355]	N
TD	6	29.723***[0.001]	24.70***[0.001]	Y	1	12.15[0.14]	9.29[0.40]	N
Hbond	1	15.618[0.193]	12.250[0.172]	N	3	12.900[0.372]	10.100[0.325]	N
	Yields							
Govb5	1	20.26***[0.010]	22.78***[0.000]	Y	1	21.26**[0.03]	19.29***[0.01]	Y
Corpbond	2	19.428*[0.065]	15.1998*[0.064]	Y	3	17.376[0.119]	14.280*[0.08]	Y/N
Secured loan								
Mortg2Y	1	17.921*[0.102]	15.062*[0.067]	Y	1	12.093[0.441]	10.362[0.303]	N
Mortg3Y	1	23.603**[0.017]	19.169**[0.015]	Y	1	16.306[0.160]	13.832[0.103]	N
Mortg5Y	1	21.834**[0.030]	16.791**[0.036]	Y	1	14.771[0.240]	12.425[0.163]	N
DisMortg	2	18.172*[0.095]	11.877[0.193]	Y	3	12.572[0.399]	11.182[0.239]	N
SVMortg	6	52.977***[0.000]	47.244***[0.000]	Y	1	8.80[0.76]	6.55[0.73]	N
Unsecured loan								
Overdr	3	8.821[0.753]	7.673[0.587]	N	2	4.24[0.99]	3.69[0.97]	N
Loan5Y	1	15.0115[0.226]	12.739[0.147]	N	1	4.630[0.988]	3.004[0.991]	N
Loan10Y	1	17.778[0.106]	15.106[0.066]*	N	1	5.358[0.973]	4.370[0.935]	N

*The maximum lag length was 13 and optimum lag length was determined by the Hannan-Quinn criterion, as suggested by Johansen et al (2000).

Table 3: Estimated cointegrating vectors

	Jan 1997 – July 2007		**Jan 1997 – July 2010**			**July 2000 – July 2010[2]**		
Interest rate	*Pass through*	*Mark-up*	*Pass through*	*CrRisk*	*Mark-up*	*Pass through*	*LIBOROIS*	*Mark-up*
	1	2	3	4	5	6	7	8
Money market rates								
SONIA	0.984***	0.123	1.019***	NA	-0.06	NA	NA	NA
	(65.78)	(1.56)	(68.9)		(0.83)			
LIBOR1W	1.014***	-0.022	1.000***	NA	0.002	NA	NA	NA
	(61.35)	(-0.25)	[115.55]		(0.05)			
LIBOR3M	1.029***	0.033	0.982***	0.120***	0.059	1.012***	0.0967***	0.001
	(40.78)	(0.25)	(92.48)	(15.24)	(1.04)	(101.85)	(18.63)	(0.02)
LIBOR6M	1.024***	0.119	0.939***	0.148***	0.281***	0.958***	0.108***	0.275***
	(29.82)	(0.67)	(57.97)	(12.32)	(3.24)	(53.57)	(11.63)	(3.29)
LIBOR1Y	1.003***	0.356	0.864***	0.174***	0.729***	0.859***	0.101***	0.841***
	(18.81)	(1.29)	(28.83)	(7.83)	(4.53)	(24.16)	(6.60)	(6.12)
CD3M	1.021***	0.059	0.974***	0.121***	0.075	1.020***	0.110***	0.060
	(41.92)	(0.47)	(82.95)	(13.76)	(1.19)	(90.00)	(19.55)	(1.13)
Deposit rates								
TD[1]	1.126***	-2.529***	1.140***	-0.535***	-1.086	1.476***	-0.9881***	-1.938
	(28.34)	(-11.52)	(7.38)	(-5.58)	(-1.32)	(4.17)	(-5.79)	(-1.17)
Hbond	0.841***	0.940***	0.661***	0.254***	1.386***	0.640***	0.183***	1.585***
	(10.84)	(2.33)	(14.92)	(8.01)	(5.82)	(13.56)	(8.15)	(7.21)
Yields								
Govb5	0.567***	2.21***	0.497***	NA	2.55***	NA	NA	NA
	(6.49)	(4.90)	(8.13)		(8.51)			
Corpbond	0.036	5.620***	-0.029	0.361***	5.370***	0.003	0.203***	5.593***
	(0.256)	(7.764)	(0.397)	(6.665)	(13.610)	(0.040)	(6.172)	(17.503)
Secured loans								
Mort2Y	0.721***	1.909***	0.455***	0.331***	2.652***	0.4227***	0.3119***	2.844***
	(8.04)	(4.11)	(6.95)	(7.06)	(7.53)	(4.57)	(7.08)	(6.59)
Mortg3Y	0.644***	2.544***	0.337***	0.313***	3.515***	0.307**	0.3144***	3.623***
	(7.27)	(5.55)	(4.64)	(6.05)	(9.04)	(2.91)	(6.26)	(7.37)
Mortg5Y	0.545***	3.089***	0.172	0.412***	4.179***	0.167	0.449***	4.158***
	(4.66)	(5.12)	(1.75)	(5.98)	(8.03)	(1.07)	(5.71)	(5.71)
DisMortg	0.944***	0.422*	0.612***	0.483***	1.278***	0.846***	0.287***	0.627***
	(19.911)	(1.81)	(8.121)	(5.529)	(4.300)	(20.054)	(4.244)	(3.548)
SVMortg	0.957***	2.057***	0.657***	0.226***	3.145***	0.702***	0.211***	2.958***
	(40.49)	(17.37)	(11.10)	(5.04)	(9.90)	(9.41)	(5.65)	(8.49)

Table 3: Estimated cointegrating vectors. Values in () below the coefficients are t-statistics. As before, '***', '**' and '*' denote significance at the 1%, 5% and 10% level, respectively. On the basis of the cointegration tests in Table 3, the risk spread was not included in the vector for SONIA, one-week Libor and the government bond rate. CrRisk is calculated as (LIBOR-Repo)x10. LIBOROIS is defined as the spread between 3-month LIBOR and 3-month OIS multiplied by 10.

[1]The long-run coefficient on policy rate was restricted to one. For the longer period, the null hypothesis was not rejected with $\chi^2(1) = 0.435$ and a probability level of 0.509. For the pre-crisis period, the null was clearly rejected with $\chi^2(1) = 17.16$.

[2] Data on OIS was only available from July 2000.

Turning to the period as a whole, including the crisis (cols. 3 to 8), we find that the divergence between the Libor and OIS and Repo rates affected the extent to which banks fixed interest rates. Coefficients are high and significant and indicate that a one percentage increase in the risk spread is incorporated in the same proportion in the money market rates. Mostly, for the same market rate, the two spread coefficients are of quite similar size and this shows some robustness of the results.[14] Furthermore, during the later period, the association between policy rate and money market rates *has not changed* compared to the earlier period. There is some change with respect to deposit rates and yields, but, the change is highest for secured loans.[15] The long-run pass-through of secured loans is between 30% and 60% greater before the crisis compared to the entire period. This shows a significant fall in long-run responsiveness of loan rates to reductions in the policy rate over the later period (bearing in mind that there were no policy rate rises in the later period). Furthermore, the mark-up over the policy rate has on average risen for all rates, during the crisis – long-term money market rates (6-month and 1-year Libor) show a significant positive mark-up, deposit rates show a moderate increase in the mark-up while for secured loan rates the mark-ups rose over the entire period by about 60% compared to the pre-crisis period. Furthermore, the mark-up over the policy rate has on average risen for all rates, during the crisis – long-term money market rates (6-month and 1-year Libor) show a significant positive mark-up, deposit rates show a moderate increase in the mark-up while for secured loan rates the mark-ups rose over the entire period by about 60% compared to the pre-crisis period. This is consistent with the findings of Button, Pezzini and Rossietr (2010, pp.178-9). In their decomposition of lending rates to households they found the 'residual' element of the loan rate (after allowing for risk and funding cost) became sharply positive after 2008(3). One explanation for this outcome may be that Libor, on which retail interest rates are based, has a significant mark-up over the 6-month and 1-year term when estimated for the entire sample period (compared to no mark-up in the pre-crisis period). While the fall in policy rate since the crisis reduced deposit rates (the pass-though coefficient has not changed and the mark-up has fallen), the reduction in the policy rate pass-through and the simultaneous rise in the mark-up for secured loans since August 2007, increased loan rates relatively more than deposit rates (compared to the pre-crisis period). This has been the subject of much popular comment (and is consistent with our earlier remarks relating to Figure 1). This also suggests that banks have tried to mitigate the losses incurred during the crisis somewhat by increasing their spreads over deposits and increasing their profitability, a point which is made by Button, Pezzini and Rossiter (2010, p.181).. Furthermore, since the aim of monetary policy was to stimulate economic activity, some of the effect of the fall in the policy rate may have been undermined by the widening in the loan-deposit spread.

We turn now to the issue of risk over the whole period (cols. 4 and 7). The effect of counterparty risk in the later period in raising interest rates in general is obvious from both columns. Interestingly, an exception is time deposits where the rise in counterparty risk reduces rates paid on deposits. Compared to the results of the money market, where CD rates increased

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[14] For example, the coefficient on CrRisk and Libor-OIS spread is 0.313 and 0.314 for household bonds, respectively.

[15] For instance, for 6-month Libor, the pass-through coefficient is 1.029 in the pre-crisis period, 1.000 in the entire period when CrRisk measures counterparty risk and 1.012 when the Libor-OIS spread is used. All coefficients are not different from 1. However, for instance, the pre-crisis pass-through coefficient on 3-year mortgage rates is 0.64 and for the entire period, 0.34 (0.31) for the vectors of with CrRisk and LIBOROIS.

with counterparty risk, this may look strange. While banks found it difficult to receive funds on the Libor market, they competed for funds in the CD market so that CD rates followed Libor, where (as our results show) the latter rose in tandem with counterparty risk. Long-term deposit rates are administered by banks and the fall in household deposit rates in response to increased counterparty risk may be another channel through which banks tried to make up for their incurred losses. Another interesting result is that a unit increase in the rate for counterparty risk in money markets raises mortgage rates by three times as much. This cannot be because banks are taking a straightforward opportunity to increase margins in order to repair profits and balance sheets, since this effect is captured in shifts of the intercept. We are here looking at increases in mortgage rates resulting from the increased counterparty risk identified in money markets. One possible interpretation is provided by Drehman, Sorensen and Stringa (2008) who point out that counterparty (or credit) risk and interest risk are not independent of one another since the risk that interest rates may rise contributes to the risk that borrowers may default. Given that the money market spreads are a measure of counterparty (or credit) risk in money markets, a one point increase in the spread suggests that banks have become more nervous about lending to each other through, say, the interbank market. But suppose that banks take a change in that spread as a proxy for a change in credit/counterparty risk more widely. They might do this because other sources of information are scarce or expensive. Or they might do it because money markets indicators of risk lead all others.(A rise in money market spreads occurs <u>before</u> bank borrowers begin to default). Then, a widening of money market spreads is a signal that credit risk generally is on the increase. But, as Drehman *et al* (2008) point out credit/counterparty risk is not independent of interest rate risk. This is because a rise in interest rates causes an increase in the default rate and *vice versa*. Now, in short-term money markets, interest rate risk is minimal (virtually zero) because existing contracts are liquidated before the interest rate change can have much effect (assets and liabilities can be repriced very quickly). But now consider a bank with a stack of mortgages. It knows that household gearing in 2008+ is still quite high. It also knows that many households are managing to service mortgages only because interest rates are generally very low. Because interest rates are very low, the expectation is that future interest rates will rise. Unlike banks in the money market, households cannot protect themselves against this and many will default. In these circumstances an increase in counterparty risk is enhanced ('multiplied') by the substantial interest rate risk.

The results of the dynamic equation (3) are shown in Table 4 below. The error correction terms are significant with no distinctive pattern for categories of interest rates. Instantaneous short-run adjustment in response to changes in the policy rate is complete for all money market rates. Bank rates and yields have instantaneous short-run adjustments well below one and there is no distinctive pattern between adjustments concerning loan or deposit rates. The model was estimated distinguishing between adjustment during normal and later period. There was no significant difference and therefore the results are not reported.

Dynamic equation	Equilibrium error	Pass-through	$\bar{R}^2$	AR(12)	$\chi^2(1)$	ARCH(1)
Money market rates						
dSONIA	-0.335***[0.000]	0.998***[0.000]	0.81	8.284[0.763]	3.322[0.190]	0.009[0.925]
dLIBOR1W	-0.315***[0.000]	0.962***[0.000]	0.87	12.982[0.375]	28.811***[0.000]	0.160[0.689]
dLIBOR3M						
LIBOROIS	-0.098*[0.054]	0.873***[0.000]	0.87	13.844[0.311]	4.965*[0.084]	1.092[0.296]
CrRisk	-0.112**[0.015]	0.785***[0.000]	0.57	9.384[0.670]	3.523[0.172]	0.055[0.815]
dLIBOR6M						
LIBOROIS	-0.171***[0.008]	0.822***[0.000]	0.80	8.530[0.742]	4.240[0.120]	0.002[0.966]
CrRisk	-0.128*[0.082]	0.928***[0.000]	0.78	11.310[0.503]	0.357[0.837]	0.544[0.461]
dLIBOR1Y						
LIBOROIS	-0.154**[0.050]	0.521***[0.000]	0.70	7.610[0.815]	0.540[0.763]	0.266[0.606]
CrRisk	-0.089[0.183]	0.728***[0.000]	0.67	7.698[0.808]	1.282[0.527]	0.565[0.452]
dCD3M						
LIBOROIS	-0.183**[0.011]	0.698***[0.000]	0.88	12.118[0.436]	0.399[0.819]	0.523[0.470]
CrRisk	-0.285***[0.000]	0.815***[0.000]	0.63	5.412[0.943]	4.179[0.124]	1.040[0.308]
Deposit rates						
dTD						
LIBOROIS	-0.110**[0.029]	0.025[0.763]	0.86	17.061[0.147]	1.747[0.417]	0.024[0.877]
CrRisk	-0.737***[0.000]	0.225***[0.000]	0.77	7.747[0.805]	3.319[0.190]	0.184[0.668]
Hbond						
LIBOROIS	-0.258***[0.005]	0.513***[0.000]	0.58	12.680[0.393]	23.715***[0.000]	0.100[0.755]
CrRisk	-0.148*[0.069]	0.443***[0.000]	0.50	15.010[0.241]	4.548[0.103]	0.041[0.839]
Yields						
dGovb5	-0.224**[0.018]	0.287***[0.006]	0.27	6.083[0.912	1.068[0.586]	0.156[0.693]
dCorpbond						
LIBOROIS	-0.350***[0.000]	0.000	0.13	9.608[0.650]	28.144***[0.000]	0.480[0.488]
CrRisk	-0.538***[0.000]	0.000	0.09	8.242[0.766]	28.593***[0.000]	0.004[0.947]
Secured loans						
dMortg2Y						
LIBOROIS	-0.203**[0.043]	0.364***[0.000]	0.25	16.725[0.160]	36.624***[0.000]	0.001[0.973]
CrRisk	-0.157***[0.000]	0.405***[0.000]	0.24	15.390[0.221]	2.335[0.311]	0.009[0.925]
dMortg3Y						
LIBOROIS	-0.199*[0.058]	0.270***[0.006]	0.19	18.072[0.114]	8.525**[0.014]	0.111[0.916]
CrRisk	-0.135*[0.089]	0.270***[0.000]	0.18	17.642[0.127]	13.035***[0.001]	0.072[0.789]
dDismortg						
LIBOROIS	-0.127*][0.070]	0.601***[0.000]	0.50	5.397[0.944]	0.083[0.959]	0.765[0.382]
CrRisk	-0.128*[0.091]	0.585***[0.000]	0.60	7.707[0.808]	11.294***[0.003]	0.026[0.873]
dSVmortg						
LIBOROIS	-0.214***[0.003]	0.140***[0.001]	0.89	10.054[0.611]	0.963[0.618]	0.405[0.524]
CrRisk	-0.299*** [0.002]	0.122*** [0.002]	0.84	14.641 [0.262]	6.050** [0.049]	0.217 [0.642]

Table 4: The second column shows the estimated coefficient with the probability level in [], the column denoted with 'pass-through' depicts the estimated coefficient on instantaneous pass-through with the probability level, AR(12) is the Ljung-Box Q-statistic of order 12 with its probability level, $\chi^2(1)$is the result of the Jarque-Bera normality test and ARCH(1) is the Lagrange multiplier test for autoregressive conditional heteroscedasticity in the residuals and its probability level.

VI Conclusions

The last eighteen months have seen dramatic upheavals in the financial system, with many 'conventional' relationships swept away. This is particularly true for interest rates to the point where the effectiveness of the principal policy instrument has been called into question. Setting aside the problem of the zero lower bound (to which the solution may or may not be quantitative easing) the widely held view is that the policy rate is less able to influence market rates than it has been in more normal times. In particular, it is often stated that there is a breakdown between the policy rate and 3-month Libor in particular which is especially problematic since 3-m Libor forms the basis for the pricing of a wide range of financial claims.

Using monthly data for a wide range of interest rates from January 1997 until July 2010, we estimated two models. The first was a two-dimensional vector error correction model for market and the policy rate for the period before the crisis. The second was an augmented model for the period since August 2007, including measures of counterparty risk as suggested by the recent literature on risk decomposition to account for the changed risk environment since the crisis.

What our results show is that the latter assertion is incorrect while the more general claim that the policy-market rate relationship has been disrupted needs very careful qualification.

Firstly, as regards the policy rate and money market rates (including Libor) we find that the pass-through is largely unchanged by the crisis. Mark-ups have increased (which triggers the zero lower bound problem at higher market rates than before) but the responsiveness of money market rates to policy rate is unchanged.

Secondly, when we look beyond money market rates, the picture is more complex. For secured loans there is evidence that the mark-up has risen while at the same time the policy pass-through has fallen since August 2007. The same applies to deposit rates, albeit to a lesser extent. This introduces a degree of asymmetry into the operation of monetary policy since it means that a reduction in policy rate (for example) widens the loan-deposit spread, with the opposite consequence when the policy rate is raised.

REFERENCES

Bank of England Quarterly Bulletin (1999) 'The Transmission Mechanism of Monetary Policy', May, 3-12.

Bank of England Quarterly Bulletin (2007), 'Markets and Operations', 47 (4), 490-510.

Biefang-Frisancho Mariscal, I and Howells P G A (2002) 'Central banks and market interest rates', *Journal of Post Keynesian Economics,* 24 (4), 569-585

Button R, Pezzini S and Rossiter N (2010) 'Understanding the price of new lending to households', *Bank of England Quarterly Bulletin* (3), 172-182

Dale, S., and Haldane, A.G. (1993) 'Interest Rate Control in a Model of Monetary Policy' Working Paper Series No. 17, Bank of England, London.

Dale, S. (1993) 'Effects of Changes in Official UK Rate upon Money Market Rates Since 1987', *Manchester School, Proceedings of the Money, Macroeconomics and Finance Research Group,* 76–94.

Drehmann M, Sorensen S and Stringa M (2008) 'The integrated impact of credit and interest rate risk on banks: an economic value and capital adequacy perspective' Bank of England Working Paper, no. 339

ECB (2004), *The Monetary Policy of the ECB*, Frankfurt: ECB.

ECB (2008), *Financial Stability Report*, Frankfurt: ECB.

ECB (2009), 'Recent developments in the retail bank interest rate pass-through in the euro area, *Monthly Bulletin*, August, 93-105.

Heffernan, S.A. (1993) 'Competition in British Retail Banking', *Journal of Financial Services Research*, *7* (1), 309–332.

———. (1997) 'Modeling British Interest Rate Adjustment: An Error Correction Approach', *Economica,* 64 (254), 291–231.

IMF (2008) *Global Financial Stability Report*, October (Washington D C: IMF)

Jobst, A.(2006) 'Correlation, Price Discovery and Co-Movement of ABS and Equity', *Derivative Use, Trading & Regulation*, 12 (1-2), 60-101.

Johansen, S, R Mosconi and B Nielson (2000) 'Cointegration analysis in the presence of structural breaks in the deterministic trend', *Econometrics Journal*, 3, 216-249.

Van Leuvensteijn M, C K Sorensen, J A Bikker and A Van Rixtel (2008) 'Impact of bank competition on the interest rate pass-through in the euro area', ECB wp 885

Maudos J and J Fernandez de Guevara (2004) 'Factors explaining the interest margin in the banking sectors of the European Union', *Journal of Banking and Finance*, 28, 2259-2281

Michaud F-L and Upper C (2008), 'What drives interbank rates? Evidence from the LIBOR panel', *Bank for International Settlements* (March) 47-58.

Segoviano M and Goodhart C A E (2008), ‘The Banking Stability Measures’, (unpublished, Washington D C: IMF)

Sorensen C K and T Werner (2006), ‘Bank interest rate pass-through in the euro area – a cross country comparison’, ECB wp 580

Stiglitz, J and A Weiss (1981), ‘Credit rationing in markets with imperfect information’, *American Economic Review*, 71, 393-410

Taylor J and Williams J (2008), ‘A Black Swan in the Money Market’, NBER Working Paper no. 13943, Cambridge MA: NBER

Thornton, DL (2009) ‘What the Libor-Ois spread says’, *Economic Synopses’*, No 24, 1-2.

Appendix

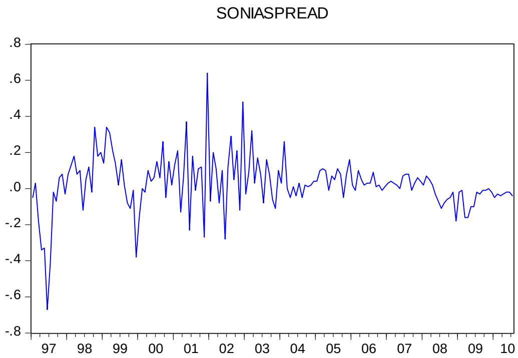


Figure A1: spread between SONIA and the policy rate

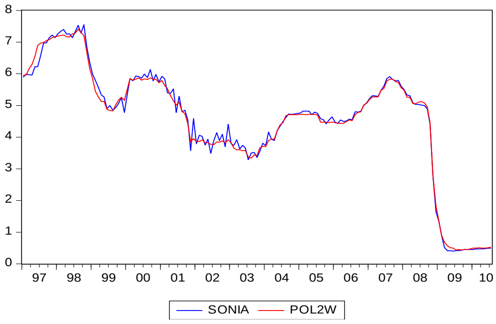


Figure A1a: Sonia and policy rate

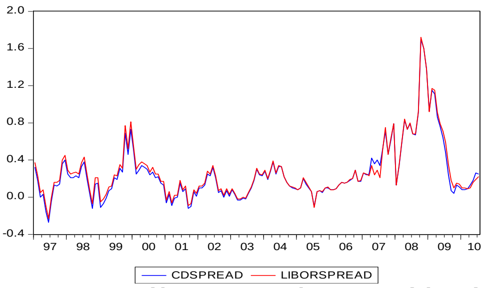


Figure A2: Spread between 3-month LIBOR and the policy rate and Spread between 3-month CD and policy rate

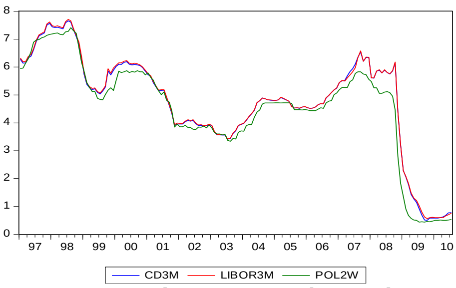


Figure A2a: Policy rate , 3-month CD and 3-month LIBOR

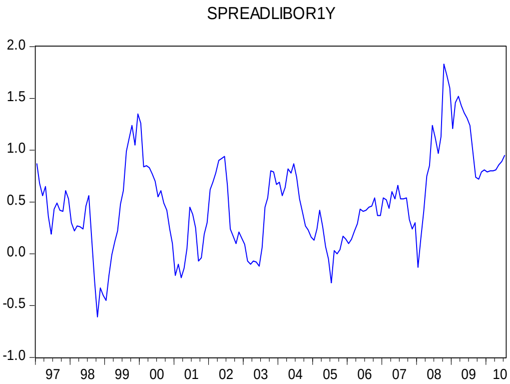


Figure A3: spread between 1-year LIBOR and the policy rate

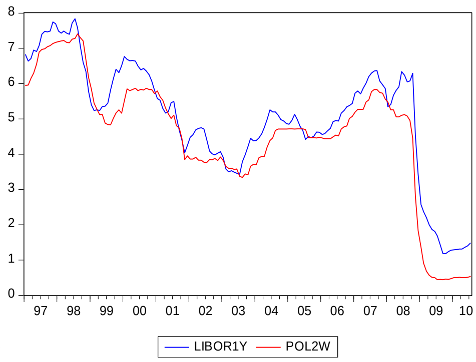


Figure A3a: Policy rate and 1-year LIBOR

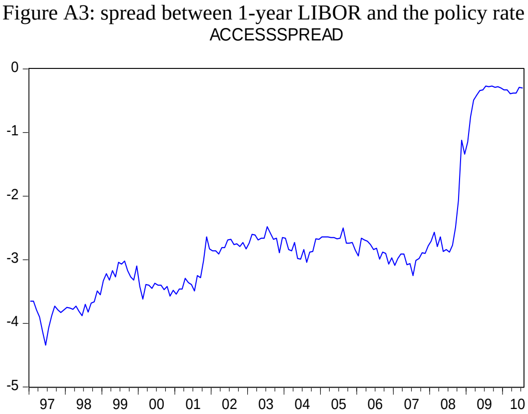


Figure A4: Spread between Access and the policy rate

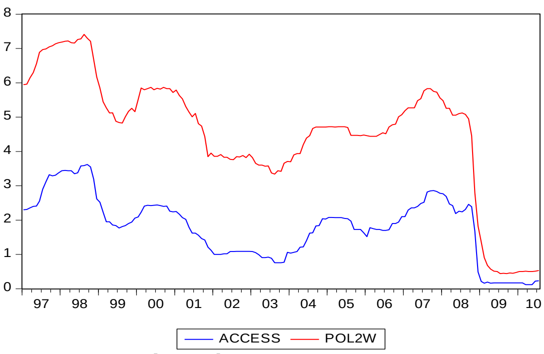
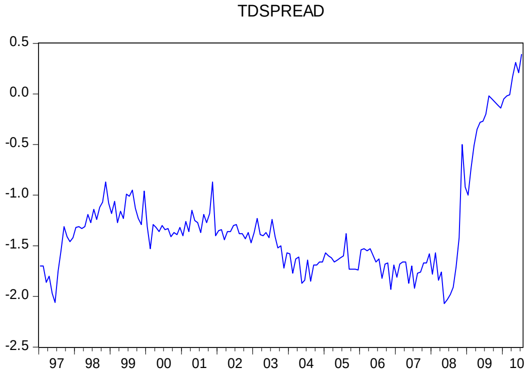


Figure A4a: Policy and Access rate



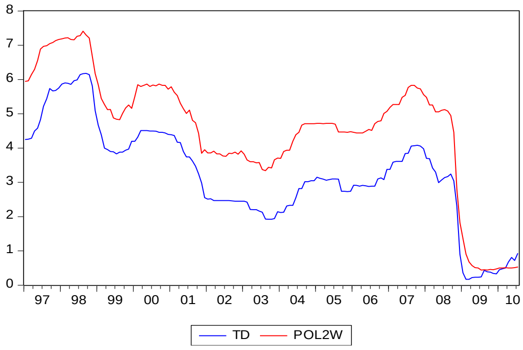
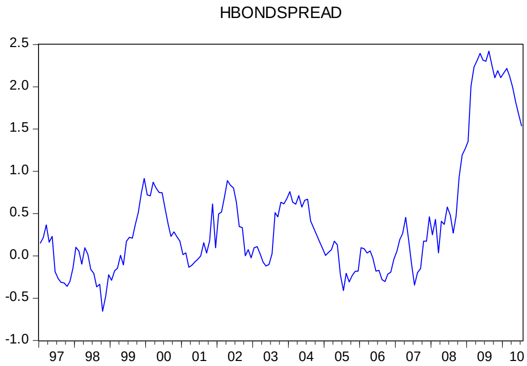


Figure A5: Spread between hshold time deposit and the policy rate

Figure A5a: Policy and hshold time deposit rate



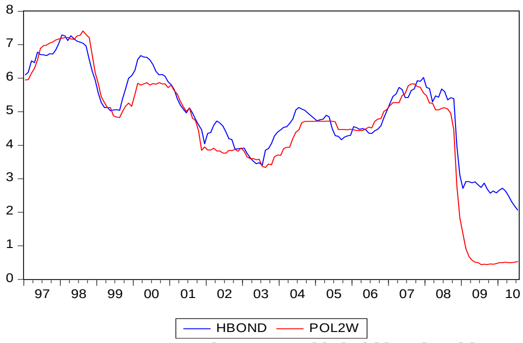
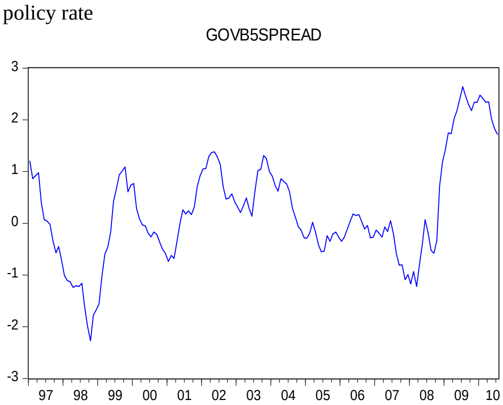


Figure A6: Spread between hshold bond yield and the policy rate

Figure A6a: Policy rate and hshold bond yield



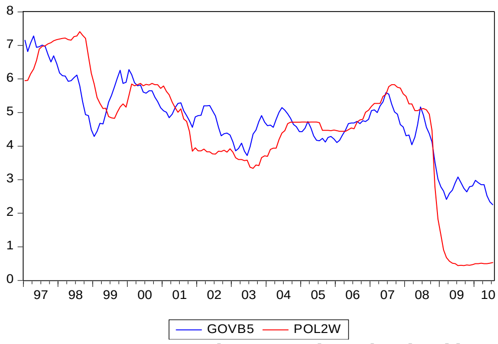
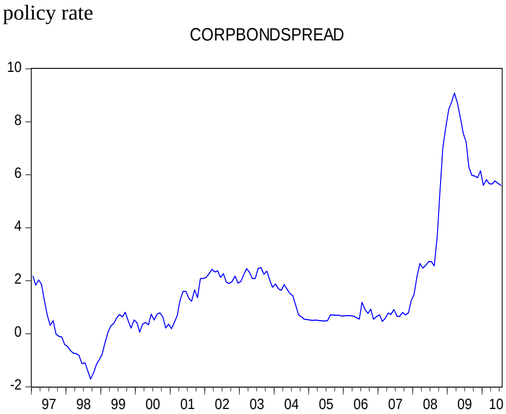


Figure A7: Spread between gov. bond yield and the policy rate

Figure A7a: Policy rate and gov. bond yield



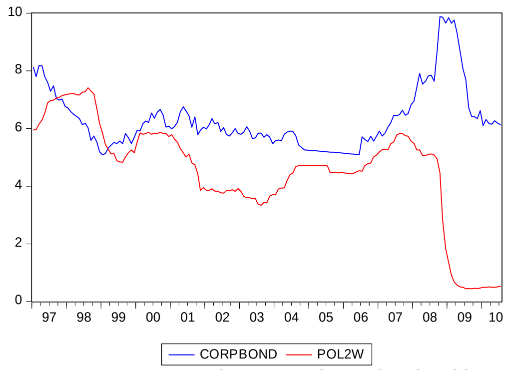
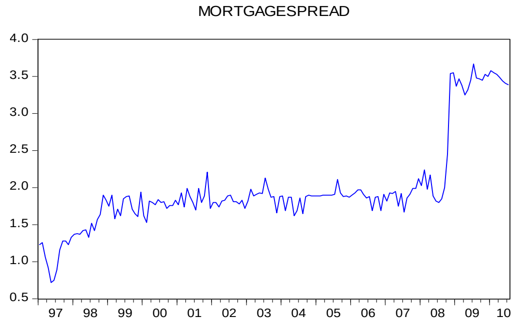


Figure A8: Spread between corp. bond yield and the policy rate

Figure A8a: Policy rate and corp. bond yield



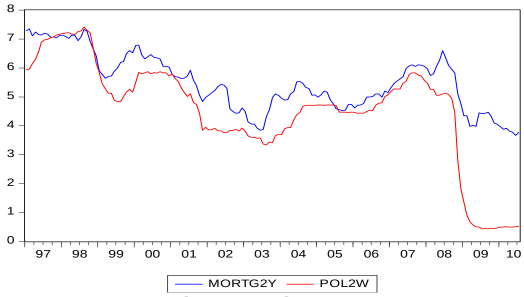
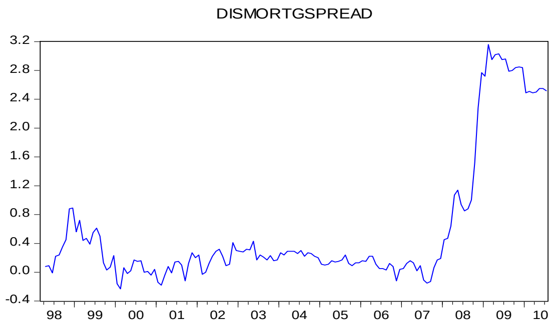


Figure A9: Spread between 2-year mortgage rate and the policy rate

Figure A9a: Policy rate and 2-year mortgage rate



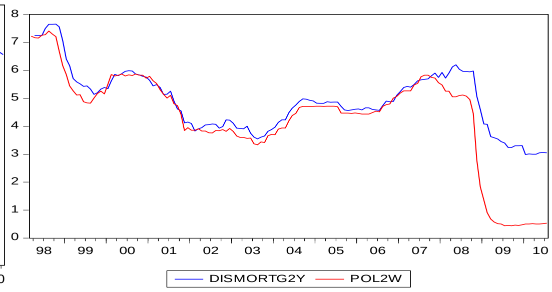
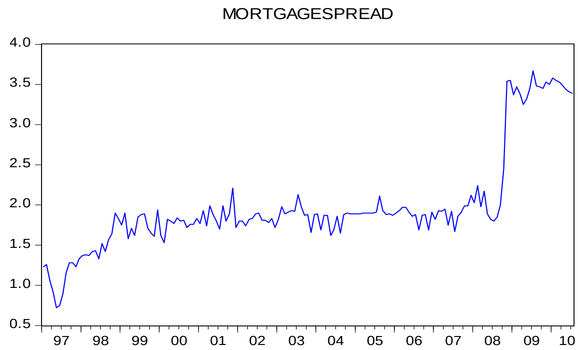


Figure A10: Spread between discounted mortgage rate and the policy rate

Figure A10a: Policy rate and discounted mortgage rate



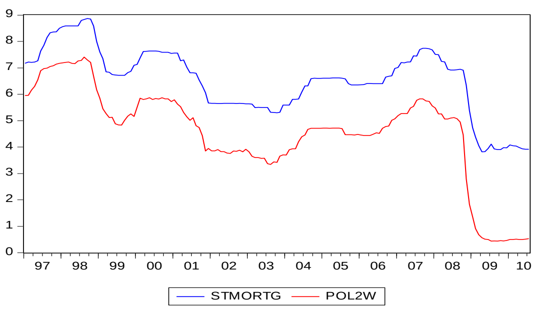
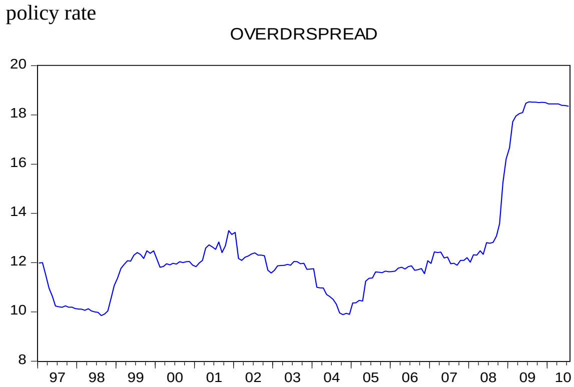


Figure A11: Spread between standard variable mortgage rate policy rate

Figure A11a: Policy rate and standard variable mortgage rate



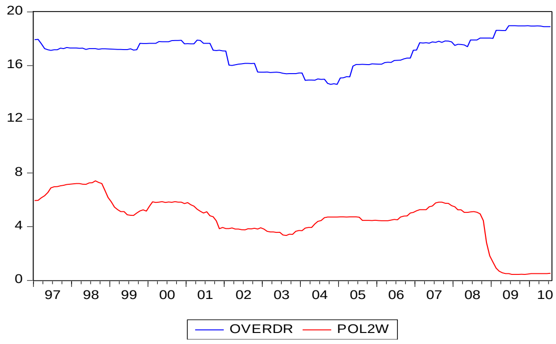


Figure A12: Spread between household overdraft and the policy rate

Figure A12a: Household overdraft and the policy rate

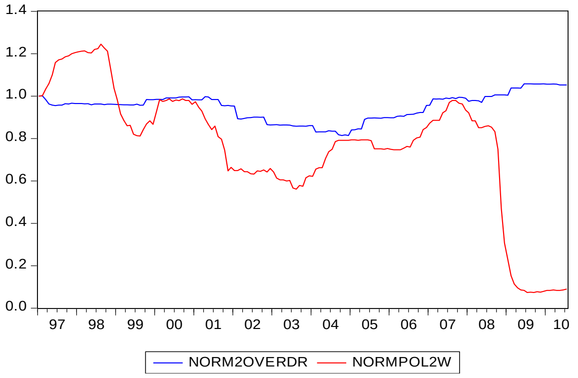


Figure A12b: Household overdraft and the policy rate (normalized)

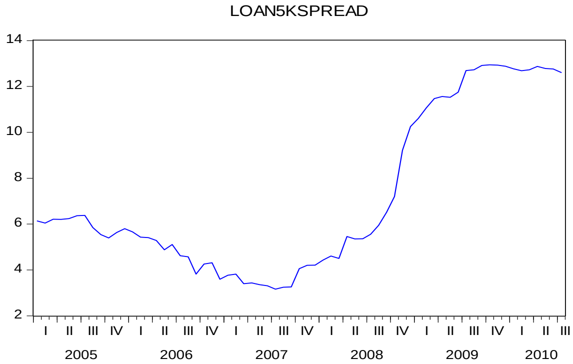


Figure A13: Loan5K rate and the policy rate

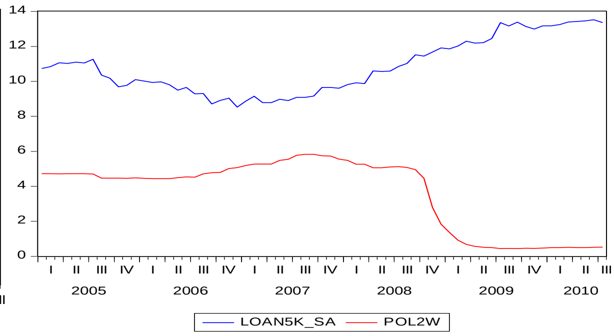


Figure A13a: Spread between Loan5K rate and the policy rate

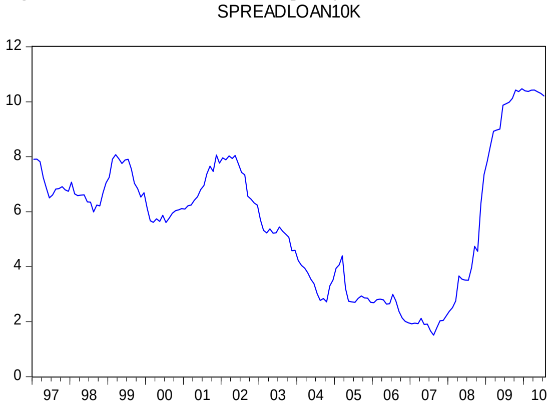


Figure A14: Loan10K rate and the policy rate

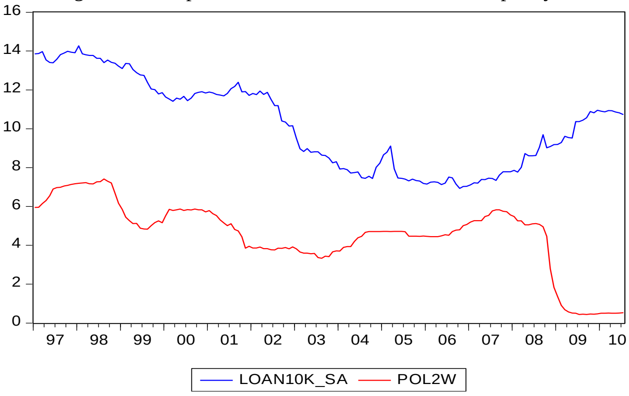


Figure A14a: Loan10K rate and policy rate

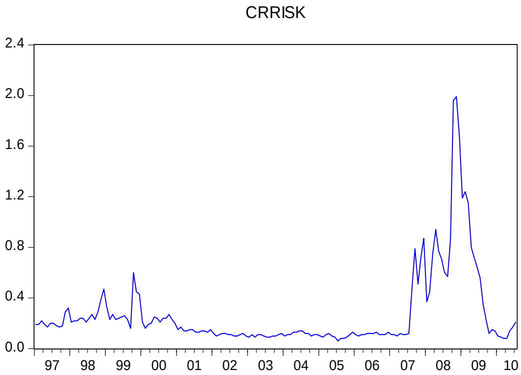


Figure A15: Spread between 3-month LIBOR and 3-month Repo rate

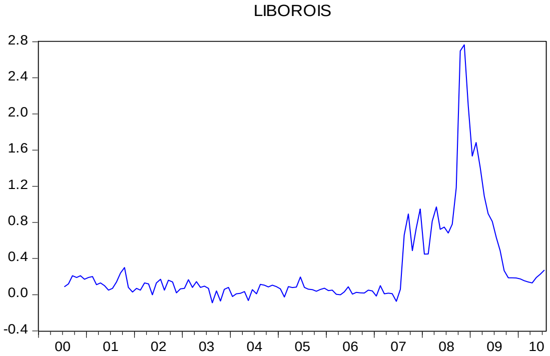


Figure A16: Spread between 3-month LIBOR and 3-month OIS

Vector	Incl. CrRisk				Incl. LIBOROIS[1]							
	lag	Trace	Max eigenv	CV	lag	Trace	Max eigenv	CV				
Money market rates												
LIBOR3M	2	46.471*** [0.002]	31.317*** [0.002]	Y	2	49.775*** [0.001]	33.687*** [0.001]	Y				
LIBOR6M	2	49.137*** [0.001]	34.865*** [0.001]	Y	2	49.129*** [0.001]	32.408*** [0.001]	Y				
LIBOR1Y	2	46.199*** [0.002]	30.575*** [0.003]	Y	2	49.595*** [0.001]	31.726*** [0.002]	Y				
CD3M	2	45.069*** [0.003]	31.151*** [0.002]	Y	2	50.411*** [0.001]	35.286*** [0.001]	Y				
	Deposit rates											
Access	1	40.189** [0.013]	33.267*** [0.001]	Y	1	51.841*** [0.000]	44.548*** [0.000]	Y				
TD	2	33.582* [0.074]	26.803** [0.011]	Y	1	55.472*** [0.000]	43.585*** [0.000]	Y				
Hbond	1	59.794*** [0.000]	47.405*** [0.000]	Y	1	60.830*** [0.000]	46.881*** [0.000]	Y				
	Yields											
Corpbond	3	37.240** [0.029]	22.428** [0.048]	Y	3	34.703* [0.056]	21.800* [0.058]	Y				
Secured loan												
Mortg2Y	1	48.010*** [0.001]	35.063*** [0.000]	Y	1	48.312*** [0.001]	34.562*** [0.001]	Y				
Mortg3Y	1	49.395*** [0.001]	34.441*** [0.001]	Y	1	47.432*** [0.001]	32.755*** [0.001]	Y				
Mortg5Y	1	48.223*** [0.001]	35.352*** [0.001]	Y	1	45.162*** [0.003]	32.592*** [0.001]	Y				
DisMortg	2	35.605** [0.045]	19.099 [0.132]	Y	2	32.381* [0.098]	20.090* [0.099]	Y				
SVMortg	2	36.303** [0.038]	24.940** [0.021]	Y	1	33.047* [0.084]	25.708** [0.016]	Y				

Table A1:Values in [] below the test statistics are probability levels. As before, '***', '**' and '*' denote significance at the 1%, 5% and 10% level, or lower, respectively.