Financial Regulation and the World's Most Important Number: LIBOR Reporting Behavior during the Credit Crisis

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PRELIMINARY DISCUSSION DRAFT PLEASE DO NOT CITE OR QUOTE WITHOUT PERMISSION

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1. Introduction

To many observers, the scandal unfolding since mid-2012 involving the widespread and recurrent manipulation the London Interbank Offering Rate (LIBOR) may go down as one of the most significant and far reaching events associated with the global credit crisis. Raw numbers appear to bear this impression out: By most estimates, an estimated US\$ 350 trillion worth of notional value in global financial contracts – ranging from mortgages to credit cards to corporate debt securities to countless financial derivatives – hinge critically upon LIBOR rates to govern the cash flow positions and other obligations of contractual counterparties. Since nearly the very inception of the benchmark rate a quarter century ago, explosive network externalities have allowed LIBOR to realize and preserve the aspirations originally articulated by its creator, the British Bankers Association: To become the "world's most important number" – *the* central Archimedean point of reference for financial markets worldwide.

But accompanying these sizeable stakes lurked comparably bigger problems. In June 2012, the British Financial Services Authority (FSA) (the regulatory overseer of first instance for LIBOR), joined with the CFTC and US Department of Justice to impose a half-billion dollars' worth of penalties on Barclays PLC (one of LIBOR's core reporting banks) for a systematic and longstanding practice of manipulating its LIBOR reporting submissions. In the months since, it has become clear that that the detected missteps at Barclays were but the tip of a substantially deeper and wider iceberg. Regulatory penalties of similar magnitudes have since been levied against two other significant participants, UBS and Royal Bank of Scotland,² and dozens remain under investigation across multiple jurisdictions. In all, over twenty participant banks are now alleged to be caught up in the scandal, subject either to regulatory enforcement, criminal investigations, civil litigations, or some combination thereof. The scandal is now thought to have been so broad as to involve asset of coordinated practices *between* banks (not just within them), resulting in some additional allegations of racketeering and/or antitrust violations.³

It is generally believed that the LIBOR scandal played out over two distinct "phases" of misreporting. The first phase, which unfolded largely during the early 2000s (before the advent of the financial crisis), involved a pattern or practice where a participating bank would "shade up" or "shade down" its reported cost of capital in order to distort resulting LIBOR benchmark so as to benefit the bank's financial derivatives position. For example, if Bank X currently were a net holder of "floating" positions in LIBOR-denominated interest rate swaps, its derivatives position would benefit from increases in the posted LIBOR rate, and the bank might make a profit by "shading up" its reported cost of debt capital, incrementally nudging the LIBOR average along with it. If, on the other hand, Bank X were a net "fixed" position holder, it would have an incentive to shade down its position.

² See FSA (2012a). In late December 2012, Swiss banking giant UBS became the second entity to be caught up in the scandal, incurring a regulatory penalty of approximately \$1.5 billion for a record of LIBOR and EURIBOR manipulations similar to Barclays'. See FSA (2012b). In February 2013, yet a third regulatory penalty of approximately \$600 million was levied against the Royal Bank of Scotland. See FSA (2013).

³ US v. Alexander et al., 12 MAG 3229 (Magistrate Court for SDNY) (available at <u>http://www.justice.gov/ag/Hayes-Tom-and-Darin-Roger-Complaint.pdf</u>).

In the second phase, banks are alleged to have systematically reported their cost of debt so as to dampen – perhaps somewhat ironically – public media coverage and/or regulatory scrutiny related to the bank's solvency. This latter incentive is thought to have become particularly prominent beginning sometime in mid- to late 2006, as banks began to worry that reporting a high cost of short-term debt capital might induce media, investors, clients and regulators to fear that the banks were in financial distress, possibly inviting heavy scrutiny or even nationalization.

This paper focuses on the second asserted "phase" of the LIBOR scandal – i.e., the period involving interaction between public scrutiny, economic uncertainty, and the reports of participating LIBOR banks. I advance the (tentative) thesis that LIBOR participants' distorted public reports may have reflected -- at least in part -- a concern about managing the reactions of banking regulators (as well as other outside watchdogs, such as the financial press) during episodes of economic "uncertainty" (as opposed to risk). Specifically, I posit that such watchdogs (in contrast to the banks themselves or other private market participants) are particularly susceptible to financial "uncertainty", and that this susceptibility may have amplified the consequences of systemic risk during the Financial Crisis.

My argument goes something as follows: Relative to sophisticated private actors and financial market participants, banking regulators and other watchdogs are more are significantly more apt to respond pro-actively to moments of economic crisis / uncertainty. When such moments of uncertainty arise, such watchdogs are substantially more predisposed to scrutinize banks than are other market actors, possibly even moving (or otherwise advocating) to shut troubled banks down.

Anticipating such pro-active oversight, I argue, banks were incentivized to distort their own reporting behavior, becoming more centrally interested in keeping watchdogs at bay than in other plausible economic objectives – in this case, by "massaging" their LIBOR disclosures they make themselves look healthier than they actually were.

To explore (and test) this intuitive claim, I analyze actual daily LIBOR reports submitted by individual panelist banks between 2006 and 2010 (roughly the years coinciding with the second phase of the crisis). Working from a baseline of asset pricing models conventionally used in finance, I demonstrate that realized LIBOR spreads over treasury rates, including the reports of individual LIBOR panelist banks, appear consistently to be inversely related to a plausible measure of ambient economic "uncertainty" (as opposed to risk) at the time of the report. In other words, as ambient uncertainty increased, banks issued reports that gave the appearance that they were *safer*, not riskier, relative to government benchmarks.

The metric I utilize for capturing economic uncertainty is the *variance risk premium* (or VRP) – i.e., the extent to which <u>implied</u> / <u>anticipated</u> market volatility exceeds <u>realized</u> market volatility. Within behavioral finance, the VRP is increasingly identified as a credible metric for discerning between conventional risk (where probabilistic behavior is well known) and uncertainty / ambiguity (where it is not).⁴

To the extent my hypothesis enjoys empirical support, I conjecture that the practice described above is of questionable normative desirability. On the one hand,

⁴ For more on the distinction between risk and uncertainty in the financial markets context, see the discussion in Talley (2009).

it seems desirable on *a priori* grounds for regulators and watchdogs to become proactive when overseeing the solvency of too-big-to-fail financial institutions. Private market participants likely have inadequate incentives to provide sufficient financial discipline acting alone. At the same time, however, a pro-active regulatory watchdog is only as effective as the quality of information it watches. My analysis suggests that the quality of the information at the disposal of regulators and other watchdogs eroded considerably at the very point where accurate information was most likely to be critical. Consequently, I posit, the pro-active goals of regulators – when translated through the lens of strategic private actors – ultimately proved at least partially self-defeating, causing regulators to be less informed (and thus less effective) than they aspire to be.

My analysis proceeds as follows. Part 2 of this paper describes the institutional framework under which LIBOR is computed. Part 3 turns to the empirical enterprise, demonstrating within an asset pricing framework that both LIBOR spreads over treasury rates and individual banks' reported credit spreads are consistently negatively correlated with ambient economic uncertainty (as measured by the VRP). Part 4 concludes, interpreting the findings of the empirical exercise in the context of current ongoing reforms of the LIBOR rate-setting process.

2. A Brief LIBOR Primer

Before outlining my conceptual approach and empirical findings, it is perhaps appropriate to provide some background on the calculation and distribution of LIBOR. LIBOR was originally developed in the mid 1980s in response

to Forward Rate Agreements and other financial instruments that adjusted according to an actively evolving interest rate benchmark, and which were increasingly traded on global securities and OTC markets. LIBOR and its predecessor, BBA Interest Settlement Rates (BBAIRS), were — perhaps ironically in hindsight — meant to ensure greater objectivity and transparency by achieving uniformity that could be applied to many diverse contracts.

The basic mechanics of LIBOR as it is calculated today are relatively simple. Perhaps the first thing to note is that LIBOR is not a single interest rate, but rather it represents a series of them – 150 rates in all – each representing a "truncated" average of borrowing costs reported by major commercial banks across ten different currencies and fifteen distinct "tenors" (i.e., time horizons, or maturities). The reports from the panelist banks within each LIBOR currency/tenor rate are meant to reflect what the banks pay other banks for short-term borrowing over that specified time period (e.g., for managing liquidity). Specifically, the solicited LIBOR rate from each panelist bank (for each currency / tenor combination) is defined as "the rate at which an individual contributor panel bank could borrow funds, were it to do so by asking for and then accepting interbank offers in reasonable market size just prior to 11:00 London time." (The current definition has been in effect since 1988; prior to this point, LIBOR asked each panel bank to evaluate and disclose the cost of capital of a hypothetical "prime bank" rather than its own). Thus, each LIBOR rate explicitly requires panelist banks to evaluate and report their own cost of borrowing on that day, for that currency / tenor combination.

Nevertheless, even under the current definition, there is still ample room for speculation and guesswork on behalf of individual banks. For example, reporting banks are not required to harvest (or report on) specific data or processes to generate their report. Moreover, it is entirely possible that on any given reporting day, the bank will have been inactive in some markets, particularly for less deeply traded currencies / tenors.

As of mid-2013, LIBOR submissions are collected from 23 banks chosen by the BBA based on three criteria: (1) scale of market activity, (2) reputation, and (3) perceived expertise in the currency concerned. Due especially to this third desideratum, the number of banks submitting interest rates towards the calculation of LIBOR for a specific currency ranges from 6 (Swedish Krona) to 18 (for USD). According to the BBA, any bank trading in the London market can apply to be on the panel for a specific currency. The BBA conducts a review of contributing banks every six months, from which the FX & MMC, as part of its advisory duties to the BBA, assesses whether the contributing bank still meets the criteria for its selection.

The contributing banks for each currency panel are shown (as of 2013) in Table 1 below.

[INSERT TABLE 1 HERE]

As the table suggests, while some banks participate in the panel for every currency (e.g. Barclays), others participate in as few as two (e.g. BNP Paribas). Similarly, contributing banks vary in size and complexity and ownership structure. However,

given the requirement that a contributing bank maintain a sizable scale of market activity, most if not all contributing banks are sufficiently large and complex to have billions of dollars of outstanding trades that turn on the slightest movement of several LIBOR rates.

Contributing banks must submit their rates between 11:00am and 11:10am London time to Thomson Reuters (officially titled the Designated Distributor for the purpose of this process). Thomson Reuters corrects evident errors, and computes a "trimmed" mean of the reports. The trimming process differs based on the number of banks that have submitted estimated costs of borrowing for a given currency. For currencies with 15-18 contributing banks (including the USD), the top and bottom four submissions are removed from the mean calculation.⁵ The effect is to exclude extreme reports from affecting the reported mean rate. All remaining reports make up the components of an equally-weighted mean, regardless of each bank's size or market share.

As an artifact of the trimming process, should once a bank's reported cost of debt becomes "too" extreme, it no longer factors into the resulting LIBOR average. Nevertheless, the banks' individual reports – for each currency / tenor dyad – are publicly observable to banking regulators. Consequently, even if an individual reporting bank were extra-marginal in the determining the aggregated rate, it still might have an incentive to manipulate its report if so doing substantially altered the scrutiny accorded it by bank regulators and other watchdogs.

⁵ For currencies with 11-14 contributing banks, the top and bottom three submissions are removed. For currencies with 8-10 contributing banks, the top and bottom two submissions are removed. For currencies with 6-7 contributing banks, the single top and single bottom submission is removed.

3. Empirical Analysis

This section turns to the empirical enterprise more focally, using asset pricing models from finance to assess how reporting behavior of LIBOR banks interacted with ambient measures of economic uncertainty during the Financial Crisis.

To conduct this analysis, I extracted reporting data of banks from the Bloomberg database, which tracks the daily reports by individual panelist banks to BBI/Reuters. The data analyzed below run from January 2006 through December 2010. I chose this interval because it most closely corresponds to the second alleged "phase" of the LIBOR scandal, where banks are thought to have distorted their reports primarily out of fears of appearing in distress. Although daily reports from banks were collected for all currencies and tenors, in what follows I concentrate on US Dollar denominations, representing daily reports from each bank in tenors ranging from overnight to one year.

Figure 1 below depicts the individual submissions of member banks for the six-month tenor of USD LIBOR, as well as the resulting LIBOR announced rate (under the variable name "FIXING"). As can be seen from the figure, of the 18 banks currently participating in USD LIBOR, only 15 were participants during some fraction of the period studied, and only 14 were represented throughout the period in question. (Societe General became a USD LIBOR member only towards the end of the study period.) The analysis that follows therefore concentrates on the subset of current US LIBOR participants that were active during the studied time periods.

As one cans see from the Figure, the gross rates reported by each bank exhibit considerable correlation across banks, and indeed the reported rates tend to track many other interest rate measures over this period.



Consequently, rather than concentrating on reported *gross* rates, the analysis below will concentrate instead on *spreads* between reported LIBOR rates and US Government treasuries. Table 2 below reports summary statistics on these spreads for a selected subset of USD LIBOR tenors. As can be seen from the table, the magnitude differences of these spreads is quite small in percentage terms (usually less than one basis point), and – unlike other rate spreads – these can frequently take on negative values.

[INSERT TABLE 2 HERE]

In order to investigate whether the advent of ambient economic uncertainty predict rate manipulation, I utilize an identification strategy based on garden variety, baseline asset pricing models from finance. Specifically, I proceed under the null hypothesis that panelist banks' daily reports -- as well as the aggregated LIBOR daily rate -- behave as financial assets according to conventional asset pricing models (such as CAPM, or multi-factor models such as Fama & French (1993), or Carhart (1997)). I estimate the following specification:

$$R_i - r_f = \alpha + \beta_{i1} Z_1 + \dots + \beta_{ik} Z_k + \gamma_i W, \tag{1}$$

where $(R_i - r_f)$ represents the spread of the rate of return on asset *i* over the "risk-free" rate treasury rate, $\{Z_1...Z_k\}$ represents a vector of risk factors specific to the underlying asset pricing specification,⁶ and *W* represents a measure of ambient economic uncertainty/ambiguity (as opposed to risk) in the economy – described in more detail below.

If this specification is correct, then any observed variation in LIBOR-treasury spreads should be captured by variations in the underlying asset pricing risk factors (but nothing else). In terms of equation (1), this would imply that the estimated coefficient γ_i should be statistically indistinct from zero. On the other hand, if the addition of a factor related to economic ambiguity / uncertainty also carries

⁶ For example, the CAPM uses a single factor – the spread between the market return and the risk-free rate. The Fama-French 3-factor model adds two additional factors related to the return spreads high- to low market-to-book firms, as well as large- to small cap issuers.

explanatory power, it may be consistent (depending on the sign of the estimated coefficients) with the hypothesis that banks engaged in strategic rate manipulations in response to pro-active regulatory watchdogs during episodes of economic uncertainty, as posited above.

Therefore, in addition to the conventional "risk" factors that are typically present in asset pricing models (all of which are thought to capture classical Bayesian risk quite ably), I introduce a proxy for ambient economic uncertainty/ambiguity (as distinct from risk). As noted in the introduction, the measure I will employ is the so-called "variance risk premium" (or VRP). The VRP is an analytic derivative of CBOE's VIX index (sometimes known in the popular press as the "fear" index). VIX is a measure of anticipated volatility associated with the S&P 500 Index, as implied by the prices of a basket of puts and calls on that index.

The VRP, in turn, is computed by taking the difference between *anticipated* volatility (as reflected by VIX) and the *realized* volatility of the index over an ensuing period. Consequently, the VRP is meant to capture the extent to which the market has over- or under-anticipated the volatility that eventually obtains. By differencing out realized volatility, the VRP delivers something more purely identifiable as a proxy for ambient economic uncertainty. Indeed, a growing body of recent work in behavioral finance suggests that the VRP is a legitimate means to benchmark economic uncertainty -- as opposed to risk -- in financial markets (Carr & Wu 2009). While far from perfect, the VRP may be the best proxy for pure market uncertainty that we have available.

In what follows I will generally utilize a retrospective measure of the VRP – i.e., something that market participants could observe at the same time as other variables in Equation (1). Specifically, for each date *t*, I compute the VRP by taking the lagged value of VIX twenty trading days prior *(t-20)*, and differencing off the average realized volatility of the S&P 500 over ensuing 20-day period. As a check on robustness, I have also considered in unreported regressions a 30-day lagged measure of VRP, as well as 20- and 30-day *forward*-looking measures of VRP (which capture the difference between VIX in period *t* and future realized volatilities in the S&P). Each of these robustness checks produces extremely similar results, and I therefore will not reproduce them below.

Before proceeding to an overview of the results, it is necessary to flag a significant caveat related to the propriety of using conventional asset pricing models from finance (as in Equation (1)) to assess bank reporting behavior within a context of economic ambiguity/uncertainty. It is important to note that standard asset pricing models were developed in and predicated upon assumptions that securities are traded in environments of Bayesian risk, but not uncertainty. To my knowledge, there is still no consensus approach for estimating asset pricing models in environments of economic uncertainty / ambiguity; and it is possible that standard approaches in finance are not well calibrated for such explorations. Nevertheless, there are intuitive grounds for believing that conventional asset pricing models are at least a good starting point: for even if economic ambiguity affects securities market pricing in a manner different than risk, the effects of ambiguity are plausibly capitalized into (and reflected by) the asset pricing factors, such as the equity risk

premium within a CAPM framework, or the various Fama-French factors. (However, nothing in the analysis that follows will be able to test this assertion directly).

Nevertheless, Table 3 below attempts to engage this caveat indirectly, reporting on a baseline set of calibrating regressions in which I estimate the daily stock return spreads for each of the eleven publicly-traded bank holding companies in the 2006-10 USD LIBOR panel. (All equity returns data are taken from the CRSP database.) For each bank, the table reports on estimated coefficients under both a CAPM specification and a Fama-French-Carhart four-factor specification (Carhart 1997). Also included in the table is the return on an equally weighted index of these eleven equity securities. As illustrated in the Table, the equity returns of the panelist banks display greater risk than the market-wide average (with an average CAPM β value of 1.72). Overall, conventional asset pricing models from corporate appear to perform as advertised.⁷

[INSERT TABLE 3 HERE]

Now consider Table 4, which replicates Table 3 but also includes the lagged (20-day) VRP as a right-hand-side variable. Very little changes in this specification, and in particular, note that the VRP has little-to-no explanatory power in these specifications. Specifically, note that the VRP enters with no consistent sign, and it is

⁷ The total sample size is slightly larger in Tables 3 and 4 than in the other regression results below, due to data coverage differences between Bloomberg and CRSP.

not statistically significant from zero for ten of the eleven banks, as well as for the index. Overall, then, Table 4 suggests that the VRP does not appear to contribute much explanatory heft beyond conventional factors in predicting pricing behavior of equity securities for the banks in question. (Moreover, these results are robust to the alternative VRP measures described above, where nearly identical results obtain.)

[INSERT TABLE 4 HERE]

The above calibrations provide some confidence that (a) financial market returns associated with capital claims on bank holding companies are well captured by standard asset pricing models in finance; and (b) factors related to economic uncertainty (at least the variance risk premium) do not appear to contribute appreciable explanatory power to the conventional set of asset pricing factors.

With these calibrations in hand, consider now a similar approach as in Tables 3 and 4, but one that fixes the dependent variable to be the spread of the LIBOR fixing rate (i.e., the trimmed average across all reporting banks) over US Treasuries. Tables 5 and 6 below report, respectively, on CAPM and Fama-French-Carhart specifications for each tenor of the USD-denominated LIBOR.

[INSERT TABLES 5 AND 6 HERE]

Note that the goodness of fit is much less impressive for these regressions than for Tables 3 and 4 – an observation that should not be terribly surprising. Indeed, because LIBOR rates purportedly reflect the cost of capital for safe short-term borrowing (rather than equities), LIBOR rates tend to track "risk free" US Treasury yields much more closely than do equity returns. It bears noting, in fact, that a LIBOR rate frequently proxies for risk-free rates within at least some asset pricing applications (or at least it used to be utilized as a risk-free proxy before the current scandal). This observation is reflected in Table 5, for example, where the β on LIBOR is small in magnitude, and thus statistically indistinct from zero. Nevertheless, if the underlying asset pricing models are working as theory would predict, the various right-hand-side factors in Tables 5 and 6 *should still* have more consistent explanatory power than any other factor in predicting LIBOR-Treasury spreads.

As Tables 7 and 8 demonstrate, this prediction is not borne out when the VRP is included as a control. Unlike Table 4, where the VRP had little (if any) predictive power, in Tables 7 and 8, the estimated coefficient on lagged, 20-day VRP is consistently and significantly negative for tenors greater than one week. In other words, as ambient economic uncertainty (as measured by the VRP) grows, the LIBOR – Treasuries spread consistently shrinks. Moreover, bearing in mind the measuring units of the VRP relative to LIBOR spreads (the standard deviation of VRP is between six and seven orders of magnitude greater than that of the LIBOR spreads), the estimated coefficients appear to represent economically significant magnitudes as well.

This pattern appears consistent with a hypothesis (floated above) that banks strategically manipulated their reports anticipating the response of pro-active regulators / other watchdogs to signs of financial distress. This consistent pattern, moreover, appears to recur regardless of whether the VRP is measured with a 20- or 30-day lag, or with 20- or 30- day lead. (These robustness regressions are available from the author).

[INSERT TABLES 7 AND 8 HERE]

The analysis thus far utilizes concentrates on the resulting LIBOR rate itself as a dependent variable, which recall is a trimmed average of reports from individual banks. It is also possible to conduct a more granular investigation on the component parts of this average, represented by the reports of the banks themselves. Tables 9 through 12 below therefore re-work the above analysis, but they instead estimate equation (1) at the level of individual panelist banks. To simplify presentation of the results, I proceed using a single four-factor asset pricing model specification (Carhart 1997), which is a generalization of both CAPM and the Fama-French model. Each of the tables reports on a different tenor of USD LIBOR: Overnight (Table 9); one month (Table 10); three month (Table 11); and six month (Table 12). Note that even when measured at the individual bank level, a notably consistent story to the one above emerges. The VRP appears to have modest predictive power in the overnight rate specifications, but it significantly and

consistently predicts *lower* spreads in all other of the aforementioned tenors (as well as every other tenor studied longer than one week).

On inspection of the last three regressions, moreover, one can entertain a statistical "Battle of the Banks" of sorts, comparing the magnitude of the predictive effect that the VRP has on reported rates at the individual bank level. Here, it is interesting to note that the negative coefficient on the VRP (what I interpret as measuring the greatest proclivity to distort reported cost of capital) appears strongest for Barclays, which was the first bank to be ensnared in the LIBOR reporting scandal in 2012. The effect is also strong (albeit slightly less pronounced) for Royal Bank of Scotland and UBS – two additional banks already embroiled in the scandal.

[INSERT TABLES 9, 10, 11, 12 HERE]

Put together, these results suggest that— contrary to the predictions of conventional asset pricing models as well as the behavior of bank equity returns — LIBOR reporting behavior was consistently intertwined with a plausible measure of ambient uncertainty present in the economy. While not predicted by standard finance models, this statistical relationship is consistent with the account of rate manipulation by panelist banks described above. That is, the results above are consistent with the thesis that panelist banks strategically low-balled their LIBOR reports at moments of severe economic uncertainty in a manner that would cause

pro-active regulators / watchdogs to underestimate the extent of the panelist bank's distress.

4. Discussion and Conclusion

The foregoing analysis presents empirical evidence that is consistent with one form of manipulation of LIBOR reporting: strategic "shading" by banks attempting to elude the scrutiny of regulators or other financial market watchdogs at moments of maximal economic uncertainty. To the extent that this hypothesis is correct, the analysis above would bear on some of the reforms that have been proposed (and to some lesser extent implemented) in response to the LIBOR scandal. At the same time, my preferred explanation of my empirical findings is far from exclusive, and there may be other consistent accounts of this data that have distinct normative / prescriptive implications. This section briefly addresses each of these considerations in turn.

Consider first the policy implications that my preferred interpretation of the data would have for potential reforms of the LIBOR reporting process. Two considerable policy costs of this type of manipulation are the distortions it introduces to both (a) the resulting LIBOR rates themselves, and the vast sums of contracts tied to them; and (b) the reliability of information available to bank regulators overseeing participant banks. How would the host of policy reforms recommended by numerous commentators (and particularly Wheatley 2012) respond to these potential welfare costs?

Perhaps the most concrete proposal put forth by Wheatley (2012) is the transfer of the administration of LIBOR away from the BBA and towards an "independent" private regulator, a move that was largely completed in late 2012. Although this transition may partially allay fears that LIBOR manipulation was rampant and coordinated by the BBA (a conjecture that is potentially consistent with the data presented above), movement of rate-setting authority to a third party would not directly address a key problem in oversight: the asymmetry of information between banks and watchdogs. One of the reasons that LIBOR reports were (arguably) so focal is that they were among the best measuring sticks of bank distress available to regulators and other observers. It is unclear whether the administration of the rate through a third party – even if objective – will alleviate that asymmetry. In fact, it could grow worse.

Another proposal put forward is to step up various forms of liability for LIBOR reporting fraud. Existing legal duties (and prospective penalties / damages) under securities, racketeering and antitrust law already arguably do some of this work, though *sui generis* forms of liability are already in the works. These prospective reforms more concretely engage some of the dangers highlighted above, in that they are intended to increase the marginal cost of rate manipulation through LIBOR fixings. Whether such measures are successful at doing so, however, remains to be seen. Just as above, an effective liability trigger requires legal actors to identify cleanly when a participant bank has engaged in rate manipulation. It is not obvious that courts (acting after the fact) will be in an appreciably better position to make

that call than regulators (acting in real time). In both cases, the oversight entity is operating at a distinct informational disadvantage.

In addition, however, the imposition of enhanced liability risk on LIBOR panelists must confront the reality that panelist banks currently participate <u>voluntarily</u> in the LIBOR fixings process. The introduction significant uncompensated liability exposure – costs not borne by non-participant banks or any of the rest of us who use LIBOR – seem likely to induce some (if not most) member banks to disassociate, unless they are either (a) paid up-front for their participation, or (b) required to participate. Designing such financial and regulatory terms in a fair and incentive compatible way is a task that deserves considerably more attention than it has thus far garnered.⁸

A third proposal of the Wheatley Review – thus far not implemented – is to "warehouse" away from public / regulatory view the rates reported by individual banks for a defined period after their submission, currently proposed as three months (Wheatley Review 2012, at page 38). The evident rationale behind such a proposal is two-fold. First, it would theoretically dampen the banks' ability to strategically engineering their submissions to manipulate announced rate (e.g., since they will not immediately learn how extreme their daily reports were within the survey). Second, it arguably dampens member banks' incentive to manipulate the rate because they fear sending signals about their solvency to outside watchdogs, regulators, or an overeager press.

⁸ More precisely, the Wheatley Review suggests that banks be required to submit to LIBOR as a condition for participation in the market, but it ultimately deems compelled participation unnecessary at this stage. (Wheatley Report 2012, at page 39)

As to the first point, I am skeptical that the warehousing proposal will prevent banks from expending efforts to determine statistically whether and when their reports influence predictable movements in the index; consequently, the warehousing efforts may be ineffectual. As for the second point, there is some reason to think that shielding the daily reports of banks from immediate 3rd party scrutiny may help to dampen banks strategic incentives to misreport – clearly a positive. On the other hand, depriving banking regulators or other watchdogs from rapid access to relevant information will also impair their abilities to act quickly in the face of a crisis – a clear negative. Thus, while the warehousing proposal may have some value, designing its parameters entails a tricky process of trading off marginal costs and benefits that are themselves difficult to observe and measure.

A final, more drastic proposal for LIBOR reform is to abandon the survey substantially or completely, and instead utilize other observable market rates (such as swap rates) as a replacement for LIBOR (or at least as a way to audit its accuracy). A key advantage of this approach is that the observable substitute rates are set by actual transactions (rather than an opaque and manipulable survey response). A downside is that any candidate market indicative itself may stray from core fundamentals, or may reflect characteristics that go beyond the creditworthiness of the banks (a factor that may matter significantly to some investors). For example, as the recent financial crisis has demonstrated, swap markets and short term credit markets are themselves susceptible to systemic liquidity and pricing risks. Moreover, government bonds can also be affected by such systemic risks, as investors flock to the apparent safety of treasuries in times of crisis, driving

down treasury yields to artificially low levels. Thus, identifying the reliability and likely biases among various market indicatives will likely prove to be enormously challenging for all but a few tenor/currency combinations.

I close by offering a final caveat. Like many empirical exercises, the analysis above is likely susceptible to multiple interpretations beyond the one that I prefer. For example, one might plausibly argue that even if the above analysis suggests strategic behavior by banks, it is but only half of the story. As many commentators have speculated, government regulators worldwide may have been complicit the practice of "shading down" LIBOR reports in order to calm the nerves of an increasingly skittish public. To the extent that panelist banks conspired (explicitly or implicitly) with regulators, it suggests that a stronger role for post-hoc litigation exposure may be warranted. Another potential (and stronger) criticism of the above exercise is that it bases its identification strategy on conventional asset pricing frameworks, which – while enduringly popular – do not attempt to model the effects of either ambiguity/uncertainty or strategic behavior. To the extent this criticism is warranted, it suggests that a more comprehensive approach to modeling is desirable before meaningful inferences can be made from available data. In this light, then, the analysis above represents little more than a starting point (although a material one) for future work. Such further theoretical work is valuable and beneficial, however, given the scope, magnitude, and likely duration of this crisis.

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LIBOR Panelist Banks as of 2013 Source: British Bankers Association

	Bank of America	Bank of Tokyo-Mitsubishi UFJ Lta	Barclays Bank plc	BNP Paribas	Citibank NA	Credit Agricole CIB	Credit Suisse	Deutsche Bank AG	HSBC	JP Morgan Chase	Lloyds Banking Group	Rabobank	Royal Bank of Canada	Société Générale	Sumitomo Mitsui Banking Corporation	The Norinchukin Bank	Scotland Group	UBS AG	Abbey National plc	Mizuho Corporate Bank	Bank of Nova Scotia	Canadian Imperial Bank of Commerce	Commonwealth Bank of Australia
AUD (Australian \$)			х					x	х	х	х						х						x
CAD (Canadian \$)			x					x	х		х		х	х			х				x	х	
CHF (Swiss Franc)			х		х		х	х	х	х	х			х			х	х					
DKK (Danish Krone)			х					х	х	х	х						х						
EUR (Euro)		x	x		x		x	x	х	х	х	x	x	x			х	x	x	x			
GBP (Sterling)		х	х	х	х	х		х	х	х	х	х	х	х			х	х	х	х			
JPY (Japanese Yen)		x	x			x		x	х	х	х				х	x	х	х		x			
NZD (New Zealand \$)			x					x	х	х	х						х						x
SEK (Swedisk Krona)			х					x	х	x	x						x						
USD (US \$)	x	x	x	х	х	x	х	х	х	х	х	x	x	х	х	x	х	х					

 TABLE 2
 SELECT REPORTING SPREADS OVER TREASURIES (BY BANK)

Variable	Ν	Mean	Std. Dev.	Min	Max
BARCLAYS					
O/N - rf	1147	0.0000120	0.0000213	-0.0000360	0.0002170
1Week - rf	1147	-0.0000149	0.0000290	-0.0000782	0.0001132
1Month - rf	1147	-0.0000131	0.0000301	-0.0000780	0.0000937
3Month - rf	1147	-0.0000087	0.0000322	-0.0000773	0.0000963
6Month - rf	1147	-0.0000045	0.0000347	-0.0000780	0.0000898
12Moth - rf	114/	0.0000023	0.0000404	-0.0000811	0.0000882
BOA O/N ef	1147	0.0000116	0.0000308	0.0000390	0.0001095
1Week of	1147	0.0000115	0.0000208	-0.0000380	0.0001983
1 Week - rr	1147	-0.0000155	0.0000282	-0.0000785	0.0000937
3Month rf	1147	0.00000140	0.0000207	0.0000735	0.0000885
6Month - rf	1147	-0.0000051	0.0000337	-0.0000775	0.0000780
12Moth - rf	1147	-0.0000005	0.0000378	-0.0000808	0.0000763
BTMU					
O/N - rf	1147	0.0000122	0.0000198	-0.0000352	0.0001985
1Week - rf	1147	-0.0000145	0.0000290	-0.0000785	0.0000871
1Month - rf	1147	-0.0000126	0.0000298	-0.0000780	0.0000898
3Month - rf	1147	-0.0000084	0.0000319	-0.0000772	0.0000963
6Month - rf	1147	-0.0000045	0.0000342	-0.0000780	0.0000832
12Moth - rf	1147	0.0000000	0.0000380	-0.0000808	0.0000736
CITIBANK					
O/N - rf	1147	0.0000105	0.0000180	-0.0000380	0.0001425
1Week - rt	1147	-0.0000158	0.0000279	-0.0000/85	0.0000845
1Month - rf	1147	-0.0000142	0.0000285	-0.0000780	0.0000806
SMonth - rr	1147	-0.0000097	0.0000308	-0.0000772	0.0000832
12Moth rf	1147	-0.0000055	0.0000337	-0.0000780	0.0000780
CR SUISS	114/	-0.0000000	0.0000377	-0.0000011	0.0000750
O/N - rf	1147	0.0000116	0.0000200	-0.0000360	0.0002170
1Week - rf	1147	-0.0000150	0.0000287	-0.0000785	0.0000937
1Month - rf	1147	-0.0000133	0.0000295	-0.0000780	0.0000937
3Month - rf	1147	-0.0000089	0.0000316	-0.0000772	0.0000937
6Month - rf	1147	-0.0000047	0.0000343	-0.0000779	0.0000806
12Moth - rf	1147	0.0000005	0.0000387	-0.0000811	0.0000767
DEUTSCHEBANK					
O/N - rf	1147	0.0000103	0.0000189	-0.0000388	0.0001613
1Week - rf	1147	-0.0000167	0.0000271	-0.0000788	0.0000754
1Month - rf	1147	-0.0000146	0.0000283	-0.0000780	0.0000780
3Month - rf	1147	-0.0000096	0.0000311	-0.0000772	0.0000885
6Month - rf	1147	-0.0000056	0.0000336	-0.0000779	0.0000740
12Moth - rt	114/	-0.0000018	0.0000370	-0.0000810	0.0000/2/
HSBC O/N of	1147	0.0000120	0.0000217	0.0000321	0.0007528
1Week rf	1147	0.0000150	0.0000217	-0.0000321	0.0002338
1 Week - II 1 Month - rf	1147	-0.0000131	0.0000286	-0.0000782	0.0000780
3Month - rf	1147	-0.0000098	0.0000307	-0.0000772	0.0000832
6Month - rf	1147	-0.0000058	0.0000334	-0.0000777	0.0000727
12Moth - rf	1147	-0.0000015	0.0000371	-0.0000806	0.0000723
IPMCHASE					
O/N - rf	1147	0.0000104	0.0000193	-0.0000388	0.0001913
1Week - rf	1147	-0.0000164	0.0000271	-0.0000785	0.0000675
1Month - rf	1147	-0.0000146	0.0000280	-0.0000780	0.0000727
3Month - rf	1147	-0.0000102	0.0000301	-0.0000772	0.0000780
6Month - rf	1147	-0.0000059	0.0000329	-0.0000780	0.0000688
12Moth - rf	114/	-0.0000013	0.0000369	-0.0000811	0.0000661
LLOYDS	1147	0.0000117	0.0000101	0.0000370	0.0001725
U/N - m	1147	0.0000116	0.0000191	-0.0000360	0.0001725
1 Week - ff 1 Month of	1147	-0.0000156	0.0000280	-0.0000785	0.0000740
3Month - rf	1147	-0.0000140	0.0000200	-0.0000730	0.0000819
6Month - rf	1147	-0.0000048	0.0000339	-0.0000780	0.0000727
12Moth - rf	1147	-0.0000001	0.0000379	-0.0000812	0.0000723
NORIN					
O/N - rf	1147	0.0000129	0.0000209	-0.0000341	0.0002720
1Week - rf	1147	-0.0000144	0.0000290	-0.0000785	0.0001002
1Month - rf	1147	-0.0000127	0.0000296	-0.0000780	0.0000858
3Month - rf	1147	-0.0000083	0.0000317	-0.0000772	0.0000898
6Month - rf	1147	-0.0000044	0.0000342	-0.0000776	0.0000780
12Moth - rf	1147	0.0000003	0.0000382	-0.0000805	0.0000750
RB SCOT					
O/N - rf	1147	0.0000142	0.0000222	-0.0000321	0.0003083
I Week - rr	1147	-0.0000146	0.0000289	-0.0000785	0.0001171
3Month - rf	1147	-0.0000133	0.0000295	-0.0000782	0.0000937
6Month - rf	1147	-0,0000040	0.0000350	-0.0000781	0.0000845
12Moth - rf	1147	0.0000012	0.0000395	-0.0000811	0.0000806
RABOBANK					
O/N - rf	1147	0.0000106	0.0000174	-0.0000380	0.0001047
1Week - rf	1147	-0.0000160	0.0000272	-0.0000782	0.0000609
1Month - rf	1147	-0.0000145	0.0000281	-0.0000780	0.0000701
3Month - rf	1147	-0.0000098	0.0000305	-0.0000772	0.0000701
6Month - rf	1147	-0.0000055	0.0000334	-0.0000777	0.0000701
12Moth - rf	1147	-0.0000008	0.0000374	-0.0000811	0.0000688
KB CANADA		0.0000140	0.0000105	0.0000310	0.0004700
U/N - rt	1147	0.0000119	0.0000195	-0.0000360	0.0001799
i week - rt	114/	-0.0000154	0.0000283	-0.0000780	0.0000885
3Month of	114/	-0.0000137	0.0000289	-0.0000780	0.0000832
6Month - rf	1147	-0.0000090	0.0000341	-0.0000772	0.0000806
12Moth - rf	1147	-0.0000001	0.0000380	-0.0000811	0.0000754
SOC GEN	28				
O/N - rf	457	0.0000041	0.0000043	-0.0000029	0.0000111
1Week - rf	458	0.0000023	0.0000044	-0.0000040	0.0000085
1Month - rf	458	0.0000031	0.0000043	-0.0000029	0.0000104
3Month - rf	458	0.0000079	0.0000077	-0.0000022	0.0000264
6Month - rf	458	0.0000159	0.0000112	0.0000027	0.0000418
12Moth - rf	458	0.0000277	0.0000111	0.0000113	0.0000512
UBS					
O/N - rf	1147	0.0000114	0.0000191	-0.0000368	0.0001725
1Week - rf	1147	-0.0000155	0.0000282	-0.0000786	0.0000871
1Month - rf	1147	-0.0000139	0.0000289	-0.0000780	0.0000845
3Month - rf	1147	-0.0000093	0.0000313	-0.0000773	0.0000898
owonth - rt	114/	-0.0000050	0.0000342	-0.0000/80	0.0000793

t statistics in parentheses * p<0.05 ** p<0.01 *** p<0.001"

Asset Pricing Model Calibration of Publicly Traded BHC equities

CAPM (One Factor) and Fama-French-Carhart (Four Factor) models

Dep Var: Reporting Bank Daily Stock Returns over Treasury Rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	BAR	CLAYS	B	OA	BT	MU	CITI	BANK	CR S	SUISS	DEU	FSCHE
mktrf	1.948***	1.434***	2.014***	1.010***	1.097***	1.044***	2.017***	1.104***	1.682***	1.488***	1.798***	1.518***
	(13.40)	(11.11)	(15.55)	(15.33)	(21.25)	(17.43)	(12.11)	(8.98)	(24.86)	(17.85)	(18.59)	(14.87)
smb		-0.0312 (-0.12)		-0.759*** (-5.07)		-0.0886 (-0.73)		-0.706** (-3.05)		-0.206 (-1.27)		-0.0914 (-0.47)
hml		1.473*** (5.21)		2.713*** (15.38)		-0.0446 (-0.36)		2.234*** (7.72)		0.657*** (3.39)		0.905*** (5.06)
umd		-0.421*** (-3.60)		-0.957*** (-9.01)		-0.165* (-2.51)		-1.008*** (-7.23)		-0.113 (-1.65)		-0.174* (-2.13)
constant	0.000140	0.0000951	-0.000227	-0.000239	-0.000646	-0.000655	-0.000939	-0.000965	0.000105	0.000120	-0.0000958	8-0.000103
	(0.13)	(0.09)	(-0.24)	(-0.37)	(-1.12)	(-1.14)	(-0.86)	(-1.08)	(0.18)	(0.21)	(-0.17)	(-0.19)
N	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259
R-sq	0.3998	0.4610	0.4685	0.7465	0.4187	0.4236	0.4005	0.5964	0.6240	0.6462	0.6520	0.6889
Adj R-Sq	0.399	0.459	0.468	0.746	0.418	0.422	0.400	0.595	0.624	0.645	0.652	0.688
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	JPMO	CHASE	LLC	DYDS	R.B.S	SCOT	RYL	. CAN	UB	S AG	Eq Wtd	Portfolio
mktrf	1.647***	1.019***	1.820***	1.329***	2.135***	1.807***	1.077***	0.943***	1.784***	1.439***	1.722***	1.281***
	(14.89)	(12.59)	(9.74)	(8.65)	(11.04)	(8.59)	(20.17)	(16.00)	(19.83)	(18.31)	(21.95)	(24.96)
smb		-0.0536 (-0.33)		-0.102 (-0.41)		-0.636 (-1.61)		-0.0667 (-0.64)		-0.392* (-2.53)		-0.280** (-3.12)
hml		1.941*** (10.24)		1.183*** (3.45)		0.752 (1.32)		0.162 (1.44)		0.864*** (4.02)		1.165*** (10.72)
umd		-0.434*** (-5.34)		-0.539** (-3.15)		-0.289 (-1.79)		-0.242*** (-4.94)		-0.378*** (-4.94)		-0.434*** (-8.44)
constant	0.000373	0.000330	-0.000211	-0.000262	-0.000971	-0.000938	0.000340	0.000319	-0.000439	-0.000432	-0.000220	-0.000234
	(0.56)	(0.63)	(-0.18)	(-0.24)	(-0.55)	(-0.53)	(0.88)	(0.85)	(-0.65)	(-0.68)	(-0.47)	(-0.64)
N	1259	1259	1259	1259	807	807	1259	1259	1259	1259	1259	1259
R-sq	0.5458	0.7244	0.3299	0.3827	0.3925	0.4129	0.6056	0.6294	0.5810	0.6368	0.7241	0.8351
Adj R-Sq	0.399	0.459	0.468	0.746	0.418	0.422	0.400	0.595	0.624	0.645	0.652	0.688

Asset Pricing Model Calibration of Publicly Traded BHC equities CAPM (One Factor) and Fama-French-Carhart (Four Factor) models

Dep Var: Reporting Bank Daily Stock Return Spreads over Trasury Rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	BARC	LAYS	BC	DA	BT	MU	CITIE	BANK	CR S	UISS	DEU	ISCHE
mktrf	1.950***	1.431***	2.035***	1.024***	1.104***	1.051***	2.033***	1.114***	1.694***	1.498***	1.796***	1.511***
	(12.87)	(10.70)	(15.30)	(15.45)	(21.08)	(17.35)	(12.30)	(9.29)	(24.19)	(17.53)	(17.74)	(14.36)
smb		-0.0331 (-0.12)		-0.749*** (-5.02)		-0.0829 (-0.68)		-0.698** (-3.01)		-0.199 (-1.22)		-0.0966 (-0.51)
hml		1.478*** (5.21)		2.681*** (15.09)		-0.0620 (-0.51)		2.211*** (7.63)		0.635** (3.29)		0.921*** (5.07)
umd		-0.419*** (-3.58)		-0.971*** (-9.13)		-0.172** (-2.63)		-1.018*** (-7.43)		-0.122 (-1.77)		-0.167* (-2.05)
VRP (20d Lag)	-0.0000239	0.0000214	-0.000211	-0.000122	-0.0000596	-0.0000664	-0.000155	-0.0000878	-0.000110	-0.0000850	0.0000283	0.0000612
	(-0.17)	(0.18)	(-1.73)	(-1.76)	(-0.94)	(-1.05)	(-1.06)	(-0.86)	(-1.28)	(-0.99)	(0.31)	(0.75)
_cons	0.000207	0.0000352	0.000368	0.000103	-0.000477	-0.000469	-0.000501	-0.000719	0.000417	0.000358	-0.000176	-0.000275
	(0.17)	(0.03)	(0.35)	(0.15)	(-0.77)	(-0.76)	(-0.44)	(-0.81)	(0.62)	(0.54)	(-0.25)	(-0.42)
N	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259
R-sq	0.3998	0.4610	0.4718	0.7476	0.4195	0.4246	0.4021	0.5968	0.6257	0.6472	0.6521	0.6894
adj. R-sq	0.399	0.459	0.471	0.747	0.419	0.422	0.401	0.595	0.625	0.646	0.652	0.688
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	JPMC	HASE	LLO	YDS	R.B.S	SCOT	RYL	CAN	UBS	5 AG	Eq Wtd	Portfolio
mktrf	1.670***	1.037***	1.822***	1.327***	2.140***	1.808***	1.085***	0.952***	1.794***	1.447***	1.710***	1.272***
	(14.37)	(12.20)	(9.53)	(8.37)	(11.05)	(8.67)	(20.08)	(16.14)	(18.95)	(17.91)	(22.77)	(25.17)
smb		-0.0402 (-0.25)		-0.104 (-0.43)		-0.635 (-1.64)		-0.0597 (-0.58)		-0.387* (-2.51)		-0.276** (-3.03)
hml		1.900*** (9.88)		1.186*** (3.42)		0.750 (1.32)		0.141 (1.25)		0.847*** (4.14)		1.163*** (10.71)
umd		-0.452*** (-5.56)		-0.538** (-3.14)		-0.290 (-1.78)		-0.252*** (-5.10)		-0.385*** (-5.01)		-0.434*** (-8.42)
VRP (30d Lag)	-0.000218*	-0.000157*	-0.0000172	0.0000137	-0.0000456	-0.00000666	-0.0000800	-0.0000819	-0.0000937	-0.0000654	-0.279	-0.204
	(-2.00)	(-2.05)	(-0.13)	(0.11)	(-0.23)	(-0.03)	(-1.63)	(-1.61)	(-0.71)	(-0.59)	(-1.19)	(-1.14)
_cons	0.000990	0.000771	-0.000163	-0.000300	-0.000823	-0.000917	0.000566	0.000548	-0.000174	-0.000249	0.000317	0.000157
	(1.23)	(1.28)	(-0.13)	(-0.25)	(-0.40)	(-0.45)	(1.33)	(1.30)	(-0.19)	(-0.31)	(0.48)	(0.33)
N	1259	1259	1259	1259	807	807	1259	1259	1259	1259	1259	1259
R-sq	0.5519	0.7276	0.3299	0.3828	0.3926	0.4129	0.6077	0.6317	0.5820	0.6373	0.7250	0.8356
adj. R-sq	0.551	0.726	0.329	0.380	0.391	0.409	0.607	0.630	0.581	0.636	0.725	0.835

t statistics in parentheses * p<0.05 ** p<0.01 *** p<0.001"

Asset Pricing Model Estimation of LIBOR Rate

Market Model (One Factor)

Dep Var: LIBOR Fixing Rate USD

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	O/N Spread	1W Spread	2W Spread	1Mo Spread	2Mo Spread	3Mo Spread	4Mo Spread	5Mo Spread
mktrf	-0.0000904	-0.000118	-0.000119	-0.000117	-0.000123	-0.000126	-0.000118	-0.000111
	(-1.42)	(-1.87)	(-1.81)	(-1.66)	(-1.60)	(-1.58)	(-1.47)	(-1.37)
Const.	0.0000118***	-0.0000153***	-0.0000147***	-0.0000138***	-0.0000110***	-0.00000920***	-0.00000766***	-0.00000621***
	-20.04	(-18.45)	(-17.50)	(-16.16)	(-12.40)	(-10.00)	(-8.07)	(-6.37)
Ν	1147	1147	1147	1147	1147	1147	1147	1147
R-sq	0.0053	0.0045	0.0044	0.0042	0.0042	0.0042	0.0034	0.0029
adj. R-sq	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.002
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
	6Mo Spread	7Mo Spread	8Mo Spread	9Mo Spread	10Mo Spread	11Mo Spread	12Mo Spread	
mktrf	-0.000106	-0.000103	-0.0000995	-0.000097	-0.0000943	-0.0000924	-0.0000901	
	(-1.30)	(-1.25)	(-1.22)	(-1.18)	(-1.15)	(-1.12)	(-1.09)	
Const.	-0.00000491***	-0.00000410***	-0.00000332**	-0.00000258*	-0.0000018	-0.00000105	-0.000000247	
	(-4.89)	(-4.02)	(-3.20)	(-2.44)	(-1.67)	(-0.95)	(-0.22)	
Ν	1147	1147	1147	1147	1147	1147	1147	
R-sq	0.0025	0.0023	0.002	0.0019	0.0017	0.0016	0.0014	
adj. R-sq	0.002	0.001	0.001	0.001	0.001	0.001	0.001	

t statistics in parentheses

* p<0.05

*** p<0.001"

** p<0.01

Asset Pricing Model Estimation of LIBOR Rate Fama-French-Carhart Model (Four Factor)

Dep Var: LIBOR Fixing Rate USD

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	O/N Spread	1W Spread	2W Spread	1Mo Spread	2Mo Spread	3Mo Spread	4Mo Spread	5Mo Spread
mktrf	-0.000118	-0.000182*	-0.000181*	-0.000171	-0.000177	-0.000184	-0.000179	-0.000175
	(-1.81)	(-2.15)	(-2.01)	(-1.71)	(-1.68)	(-1.69)	(-1.67)	(-1.64)
smb	-0.000202	0.0000556	0.0000657	0.0000411	0.0000596	0.0000727	0.0000881	0.000102
	(-1.25)	-0.33	-0.38	-0.22	-0.3	-0.35	-0.43	-0.5
hml	0.000311	0.0000902	0.0000761	0.0000294	-0.0000591	-0.0000936	-0.000129	-0.000154
	-1.89	-0.48	-0.4	-0.15	(-0.28)	(-0.44)	(-0.60)	(-0.71)
umd	0.000108	-0.0000942	-0.0000976	-0.000107	-0.000161*	-0.000189*	-0.000219*	-0.000240**
	-1.89	(-1.45)	(-1.48)	(-1.54)	(-2.08)	(-2.30)	(-2.52)	(-2.66)
Const.	0.0000118***	-0.0000153***	-0.0000147***	-0.0000138***	-0.0000111***	-0.00000921***	-0.00000767***	-0.00000623**
	-19.99	(-18.38)	(-17.43)	(-16.09)	(-12.35)	(-9.97)	(-8.06)	(-6.36)
N	1147	1147	1147	1147	1147	1147	1147	1147
R-sqd	0.0173	0.0071	0.0069	0.0063	0.0074	0.0082	0.0084	0.0086
adj. R-sq	0.014	0.004	0.003	0.003	0.004	0.005	0.005	0.005
	(9) 6Mo Spread	(10) 7Mo Spread	(11) 8Mo Spread	(12) 9Mo Spread	(13) 10Mo Spread	(14) 11Mo Spread	(15) 12Mo Spread	
mktrf	-0.000172 (-1.61)	-0.000169 (-1.58)	-0.000166 (-1.56)	-0.000164 (-1.55)	-0.000162 (-1.52)	-0.000161 (-1.51)	-0.000159 (-1.49)	
smb	0.000113 -0.55	0.000121 -0.59	0.000128 -0.63	0.000136 -0.66	0.000144 -0.7	0.000151 -0.74	0.000159 -0.78	
hml	-0.000177 (-0.81)	-0.000188 (-0.86)	-0.000198 (-0.91)	-0.000208 (-0.95)	-0.000218 (-0.99)	-0.000227 (-1.02)	-0.000235 (-1.05)	
umd	-0.000256** (-2.73)	-0.000263** (-2.76)	-0.000270** (-2.79)	-0.000277** (-2.82)	-0.000283** (-2.83)	-0.000290** (-2.85)	-0.000296** (-2.86)	
Const.	-0.00000492*** (-4.89)	-0.00000412*** (-4.03)	-0.00000334** (-3.21)	-0.00000260* (-2.45)	-0.00000182 (-1.69)	-0.00000107 (-0.97)	-0.000000274 (-0.24)	
N	1147	1147	1147	1147	1147	1147	1147	
R-sqd	0.0086	0.0085	0.0084	0.0084	0.0083	0.0082	0.0081	
auj. K-sq	0.005	0.005	0.005	0.005	0.005	0.005	0.005	

t statistics in parentheses

* p<0.05 ** p<0.01 *** p<0.001"

Market Model (One Factor) with 20day lagged VRP

Dep Var: LIBOR Fixing Rate USD

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	O/N Spread	1W Spread	2W Spread	1Mo Spread	2Mo Spread	3Mo Spread	4Mo Spread	5Mo Spread
mktrf	-0.000106	-0.000133*	-0.000144*	-0.000160*	-0.000178**	-0.000185**	-0.000175*	-0.000166*
	(-1.66)	(-2.11)	(-2.25)	(-2.48)	(-2.61)	(-2.62)	(-2.44)	(-2.28)
VRP (20d Lag)	-0.000390	-0.000373	-0.000624*	-0.00107***	-0.00137***	-0.00147***	-0.00142***	-0.00137***
	(-1.47)	(-1.49)	(-2.45)	(-3.88)	(-4.90)	(-5.16)	(-4.92)	(-4.70)
Const.	0.0000125***	-0.0000146***	-0.0000135***	-0.0000117***	-0.00000842***	-0.00000639***	-0.00000495***	-0.00000359**
	(13.26)	(-14.19)	(-13.02)	(-10.99)	(-7.75)	(-5.77)	(-4.38)	(-3.12)
Ν	1147	1147	1147	1147	1147	1147	1147	1147
R-sq	0.0102	0.0068	0.0107	0.0219	0.0308	0.0327	0.0284	0.0250
adj. R-sq	0.008	0.005	0.009	0.020	0.029	0.031	0.027	0.023
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
	6Mo Spread	7Mo Spread	8Mo Spread	9Mo Spread	10Mo Spread	11Mo Spread	12Mo Spread	
mktrf	-0.000160*	-0.000152*	-0.000145	-0.000138	-0.000132	-0.000126	-0.000120	
	(-2.17)	(-2.04)	(-1.92)	(-1.82)	(-1.71)	(-1.62)	(-1.53)	
VRP (20d Lag)	-0.00133***	-0.00123***	-0.00112***	-0.00102**	-0.000932**	-0.000840*	-0.000745*	
	(-4.47)	(-4.06)	(-3.63)	(-3.24)	(-2.91)	(-2.57)	(-2.24)	
Const.	-0.00000237*	-0.00000175	-0.00000117	-0.000000623	-1.65e-08	0.000000562	0.00000118	
	(-2.01)	(-1.46)	(-0.96)	(-0.50)	(-0.01)	(0.44)	(0.90)	
Ν	1147	1147	1147	1147	1147	1147	1147	
R-sq	0.0221	0.0185	0.0152	0.0123	0.0101	0.0081	0.0064	
adj. R-sq	0.020	0.017	0.013	0.011	0.008	0.006	0.005	

t statistics in parentheses

* p<0.05 ** p<0.01 *** p<0.001"

Fama-French-Carhart Model (Four Factor) with 20day lagged VRP

Dep Var: LIBOR Fixing Rate USD

-	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	O/N Spread	1W Spread	2W Spread	1Mo Spread	2Mo Spread	3Mo Spread	4Mo Spread	5Mo Spread
mktrf	-0.000131*	-0.000194*	-0.000201*	-0.000206*	-0.000223*	-0.000233*	-0.000227*	-0.000221*
	(-2.00)	(-2.34)	(-2.36)	(-2.30)	(-2.41)	(-2.46)	(-2.41)	(-2.34)
smb	-0.000198	0.0000594	0.0000721	0.0000522	0.0000739	0.0000880	0.000103	0.000116
	(-1.24)	(0.36)	(0.43)	(0.30)	(0.42)	(0.48)	(0.56)	(0.63)
hml	0.000304	0.0000830	0.0000638	0.00000809	-0.0000865	-0.000123	-0.000158	-0.000181
	(1.87)	(0.46)	(0.35)	(0.04)	(-0.46)	(-0.63)	(-0.80)	(-0.91)
umd	0.000109	-0.0000926	-0.0000948	-0.000102	-0.000155*	-0.000183*	-0.000212*	-0.000234**
	(1.91)	(-1.43)	(-1.46)	(-1.51)	(-2.07)	(-2.30)	(-2.53)	(-2.67)
VRP (20d Lag)	-0.000371	-0.000360	-0.000613*	-0.00106***	-0.00137***	-0.00146***	-0.00141***	-0.00136***
	(-1.46)	(-1.45)	(-2.42)	(-3.86)	(-4.87)	(-5.12)	(-4.88)	(-4.66)
Const.	0.0000125***	-0.0000147***	-0.0000135***	-0.0000117***	-0.00000844***	-0.00000641***	-0.00000497***	-0.00000362**
	(13.46)	(-14.20)	(-13.01)	(-10.97)	(-7.74)	(-5.77)	(-4.39)	(-3.13)
Ν	1147	1147	1147	1147	1147	1147	1147	1147
R-sq	0.0191	0.0073	0.0091	0.0165	0.0311	0.0362	0.0353	0.0341
adj. R-sq	0.017	0.005	0.009	0.019	0.029	0.032	0.029	0.026
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
	6Mo Spread	7Mo Spread	8Mo Spread	9Mo Spread	10Mo Spread	11Mo Spread	12Mo Spread	
mktrf	-0.000216*	-0.000210*	-0.000203*	-0.000198*	-0.000193*	-0.000189	-0.000184	
	(-2.28)	(-2.19)	(-2.11)	(-2.04)	(-1.96)	(-1.90)	(-1.83)	
smb	0.000126	0.000134	0.000140	0.000146	0.000153	0.000160	0.000167	
	(0.68)	(0.72)	(0.75)	(0.78)	(0.81)	(0.83)	(0.86)	
hml	-0.000203	-0.000212	-0.000221	-0.000228	-0.000236	-0.000244	-0.000250	
	(-1.01)	(-1.05)	(-1.08)	(-1.10)	(-1.12)	(-1.15)	(-1.16)	
umd	-0.000250**	-0.000257**	-0.000265**	-0.000273**	-0.000279**	-0.000286**	-0.000293**	
	(-2.74)	(-2.77)	(-2.80)	(-2.82)	(-2.83)	(-2.85)	(-2.85)	
VRP (20d Lag)	-0.00132***	-0.00122***	-0.00112***	-0.00101**	-0.000927**	-0.000835*	-0.000741*	
	(-4.43)	(-4.02)	(-3.60)	(-3.20)	(-2.88)	(-2.54)	(-2.22)	
Const.	-0.00000240*	-0.00000179	-0.00000121	-0.000000658	-5.24e-08	0.000000525	0.00000114	
	(-2.03)	(-1.49)	(-0.99)	(-0.53)	(-0.04)	(0.41)	(0.87)	
Ν	1147	1147	1147	1147	1147	1147	1147	
R-sq	0.0328	0.0295	0.0261	0.0233	0.0209	0.0188	0.0168	
adi P sa	0.024	0.020	0.017	0.014	0.012	0.010	0.009	

t statistics in parentheses

* p<0.05 ** p<0.01 *** p<0.001"

Market Model (One Factor) with 20day lagged VRP (By Bank)

OVERNIGHT RATE (USD)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	BARCLAYS	BOA	BIMU	CITIBANK	CR SUISS	DEUTSCHE	HSBC	JPMCHASE	LLOYDS	NORIN B	R.B.SCOT	RABOBANK	RYL CAN	UBS AG
mktrf	-0.000164*	-0.000123	-0.000126*	-0.000101	-0.000127	-0.000102	-0.000162*	-0.0000780	-0.000111	-0.000140	-0.000182*	-0.0000849	-0.000129*	-0.000116
	(-2.21)	(-1.74)	(-1.98)	(-1.88)	(-1.95)	(-1.72)	(-2.20)	(-1.35)	(-1.84)	(-1.89)	(-2.24)	(-1.73)	(-1.98)	(-1.89)
smb	-0.000222	-0.000221	-0.000189	-0.000151	-0.000213	-0.0000889	-0.000157	-0.000198	-0.000172	-0.000259	-0.000238	-0.000138	-0.000198	-0.000194
	(-1.23)	(-1.37)	(-1.16)	(-1.40)	(-1.30)	(-0.84)	(-0.78)	(-1.43)	(-1.18)	(-1.26)	(-0.94)	(-1.59)	(-1.33)	(-1.41)
hml	0.000354	0.000287	0.000344*	0.000268*	0.000331*	0.000279	0.000379	0.000208	0.000261	0.000298	0.000351	0.000258*	0.000272	0.000267
	(1.89)	(1.68)	(2.08)	(2.03)	(2.02)	(1.90)	(1.95)	(1.39)	(1.72)	(1.72)	(1.78)	(2.25)	(1.76)	(1.78)
umd	0.000110	0.000116	0.000113*	0.000100	0.000118*	0.000109*	0.000116	0.000106	0.000101	0.000104	0.0000966	0.000101*	0.0000982	0.000101
	(1.79)	(1.89)	(1.98)	(1.95)	(2.00)	(2.00)	(1.85)	(1.91)	(1.91)	(1.78)	(1.57)	(2.11)	(1.75)	(1.83)
VRP (20d Lag)	-0.000643*	-0.000353	-0.000356	0.0000145	-0.000285	0.0000940	-0.000709**	0.0000141	-0.000264	-0.000596*	-0.000859**	0.000175	-0.000398	-0.000254
	(-2.30)	(-1.34)	(-1.41)	(0.07)	(-1.13)	(0.45)	(-2.60)	(0.06)	(-1.13)	(-2.05)	(-2.79)	(0.88)	(-1.60)	(-1.08)
Const.	0.0000133***	0.0000124***	0.0000129***	0.0000106***	0.0000122***	0.0000102***	0.0000144***	0.0000104***	0.0000121***	0.0000141***	0.0000159***	0.0000103***	0.0000128***	0.0000120***
	(13.11)	(12.63)	(14.00)	(13.56)	(13.15)	(12.66)	(14.22)	(11.79)	(13.94)	(13.46)	(14.41)	(13.95)	(14.05)	(13.73)
Ν	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147
R-sq	0.0316	0.0199	0.0218	0.0151	0.0213	0.0133	0.0307	0.0126	0.0169	0.0288	0.0388	0.0154	0.0218	0.0184
adj. R-sq	0.027	0.016	0.018	0.011	0.017	0.009	0.026	0.008	0.013	0.025	0.035	0.011	0.018	0.014

t statistics in parentheses

="* p<0.05 ** p<0.01 *** p<0.001"

Market Model (One Factor) with 20day lagged VRP (By Bank)

ONE-MONTH RATE (USD)

	(1) DADCLANC	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11) D D CCOTT	(12)	(13)	(14)
	BARCLAYS	вол	BIMU	CITIBAINK	CK 50155	DEUISCHE	HSBC	JPMCHASE	LLOYDS	NOKIN B	K.B.SCO1	KADODANK	KYL CAN	UBS AG
mktrf	-0.000249**	-0.000204*	-0.000222*	-0.000197*	-0.000220*	-0.000195*	-0.000200*	-0.000187*	-0.000196*	-0.000215*	-0.000210*	-0.000169*	-0.000203*	-0.000208*
	(-2.59)	(-2.29)	(-2.38)	(-2.24)	(-2.35)	(-2.26)	(-2.28)	(-2.23)	(-2.24)	(-2.35)	(-2.27)	(-2.01)	(-2.29)	(-2.31)
smb	0.0000336	0.0000463	0.0000627	0.0000530	0.0000478	0.0000538	0.0000486	0.0000455	0.0000466	0.0000638	0.0000528	0.0000471	0.0000549	0.0000595
	(0.18)	(0.27)	(0.35)	(0.31)	(0.26)	(0.32)	(0.29)	(0.29)	(0.28)	(0.36)	(0.30)	(0.29)	(0.32)	(0.35)
hml	0.0000488	0.0000276	0.0000247	0.00000667	0.0000122	0.0000121	0.0000150	0.0000100	0.00000766	0.00000598	-0.0000112	-0.0000135	0.000000795	0.00000154
	(0.24)	(0.15)	(0.13)	(0.04)	(0.06)	(0.07)	(0.09)	(0.06)	(0.04)	(0.03)	(-0.06)	(-0.08)	(0.00)	(0.01)
umd	-0.000104	-0.0000973	-0.000116	-0.000104	-0.000101	-0.000101	-0.000101	-0.0000937	-0.0000976	-0.000110	-0.000118	-0.000109	-0.000107	-0.000107
	(-1.49)	(-1.46)	(-1.65)	(-1.56)	(-1.45)	(-1.52)	(-1.51)	(-1.44)	(-1.47)	(-1.59)	(-1.69)	(-1.65)	(-1.57)	(-1.57)
VRP (20d Lag)	-0.00146***	-0.000960***	-0.00114***	-0.000958***	-0.00117***	-0.000927***	-0.00103***	-0.000834**	-0.000972***	-0.00116***	-0.00110***	-0.000825**	-0.00105***	-0.00107***
	(-4.92)	(-3.51)	(-4.06)	(-3.55)	(-4.11)	(-3.44)	(-3.79)	(-3.17)	(-3.59)	(-4.12)	(-3.92)	(-3.22)	(-3.81)	(-3.90)
Const.	-0.0000103***	-0.0000122***	-0.0000104***	-0.0000123***	-0.0000110***	-0.0000128***	-0.0000121***	-0.0000130***	-0.0000121***	-0.0000105***	-0.0000111***	-0.0000129***	-0.0000117***	-0.0000119***
	(-9.01)	(-11.42)	(-9.45)	(-11.69)	(-10.00)	(-12.22)	(-11.42)	(-12.58)	(-11.43)	(-9.60)	(-10.21)	(-12.61)	(-10.91)	(-11.09)
Ν	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147
R-sq	0.0379	0.0207	0.0257	0.0205	0.0268	0.0199	0.0226	0.0172	0.0207	0.0262	0.0243	0.0160	0.0231	0.0243
adj. R-sq	0.034	0.016	0.021	0.016	0.023	0.016	0.018	0.013	0.016	0.022	0.020	0.012	0.019	0.020

t statistics in parentheses

="* p<0.05 ** p<0.01 *** p<0.001"

Market Model (One Factor) with 20day lagged VRP (By Bank) THREE-MONTH RATE (USD)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	BARCLAYS	BOA	BTMU	CITIBANK	CR SUISS	DEUTSCHE	HSBC	JPMCHASE	LLOYDS	NORIN B	R.B.SCOT	RABOBANK	RYL CAN	UBS AG
mktrf	-0.000267**	-0.000231*	-0.000238*	-0.000222*	-0.000244*	-0.000236*	-0.000225*	-0.000210*	-0.000222*	-0.000234*	-0.000240*	-0.000204*	-0.000228*	-0.000234*
	(-2.59)	(-2.47)	(-2.43)	(-2.40)	(-2.48)	(-2.49)	(-2.43)	(-2.39)	(-2.40)	(-2.45)	(-2.43)	(-2.30)	(-2.42)	(-2.47)
smb	0.0000660	0.0000892	0.0000859	0.0000902	0.0000764	0.0000894	0.0000831	0.0000808	0.0000867	0.0000880	0.0000806	0.0000791	0.0000887	0.0000926
	(0.33)	(0.50)	(0.45)	(0.51)	(0.40)	(0.48)	(0.47)	(0.48)	(0.49)	(0.48)	(0.43)	(0.46)	(0.49)	(0.51)
hml	-0.0000970	-0.000114	-0.000113	-0.000126	-0.000113	-0.000119	-0.000117	-0.000115	-0.000129	-0.000119	-0.000137	-0.000134	-0.000135	-0.000128
	(-0.46)	(-0.59)	(-0.56)	(-0.66)	(-0.56)	(-0.61)	(-0.62)	(-0.64)	(-0.68)	(-0.61)	(-0.68)	(-0.74)	(-0.70)	(-0.66)
umd	-0.000181*	-0.000181*	-0.000183*	-0.000184*	-0.000180*	-0.000181*	-0.000180*	-0.000174*	-0.000185*	-0.000185*	-0.000197*	-0.000183*	-0.000187*	-0.000188*
	(-2.21)	(-2.30)	(-2.26)	(-2.33)	(-2.24)	(-2.29)	(-2.30)	(-2.27)	(-2.34)	(-2.30)	(-2.38)	(-2.34)	(-2.33)	(-2.34)
VRP (20d Lag)	-0.00178***	-0.00139***	-0.00150***	-0.00137***	-0.00154***	-0.00154***	-0.00142***	-0.00119***	-0.00135***	-0.00145***	-0.00155***	-0.00126***	-0.00143***	-0.00147***
	(-5.84)	(-4.96)	(-5.06)	(-4.94)	(-5.29)	(-5.38)	(-5.05)	(-4.41)	(-4.82)	(-4.99)	(-5.23)	(-4.68)	(-5.02)	(-5.13)
Const.	-0.00000524***	-0.00000674***	-0.00000550***	-0.00000705***	-0.00000590***	-0.00000660***	-0.00000704***	-0.00000787***	-0.00000682***	-0.00000556***	-0.00000571***	-0.00000740***	-0.00000628***	-0.00000650***
	(-4.48)	(-6.12)	(-4.81)	(-6.44)	(-5.20)	(-5.95)	(-6.44)	(-7.38)	(-6.22)	(-4.92)	(-4.99)	(-6.92)	(-5.63)	(-5.83)
Ν	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147
R-sq	0.0480	0.0344	0.0365	0.0335	0.0390	0.0397	0.0354	0.0277	0.0323	0.0349	0.0386	0.0293	0.0351	0.0367
adj. R-sq	0.044	0.030	0.032	0.029	0.035	0.035	0.031	0.023	0.028	0.031	0.034	0.025	0.031	0.033

t statistics in parentheses

="* p<0.05 ** p<0.01 *** p<0.001"

Market Model (One Factor) with 20day lagged VRP (By Bank) SIX-MONTH RATE (USD)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	BARCLAYS	BOA	BTMU	CITIBANK	CR SUISS	DEUTSCHE	HSBC	JPMCHASE	LLOYDS	NORIN B	R.B.SCOT	RABOBANK	RYL CAN	UBS AG
mktrf	-0.000239*	-0.000216*	-0.000221*	-0.000214*	-0.000221*	-0.000216*	-0.000213*	-0.000193*	-0.000208*	-0.000218*	-0.000226*	-0.000195*	-0.000213*	-0.000217*
	(-2.37)	(-2.29)	(-2.30)	(-2.27)	(-2.29)	(-2.28)	(-2.30)	(-2.17)	(-2.22)	(-2.29)	(-2.29)	(-2.13)	(-2.24)	(-2.26)
smb	0.000102	0.000131	0.000126	0.000129	0.000130	0.000113	0.000119	0.000120	0.000113	0.000128	0.000121	0.000120	0.000128	0.000131
	(0.52)	(0.71)	(0.66)	(0.70)	(0.69)	(0.62)	(0.66)	(0.70)	(0.63)	(0.69)	(0.63)	(0.67)	(0.69)	(0.70)
hml	-0.000197	-0.000187	-0.000199	-0.000200	-0.000203	-0.000206	-0.000193	-0.000196	-0.000208	-0.000204	-0.000218	-0.000203	-0.000212	-0.000208
	(-0.92)	(-0.93)	(-0.97)	(-1.00)	(-0.99)	(-1.03)	(-0.98)	(-1.03)	(-1.05)	(-1.01)	(-1.04)	(-1.03)	(-1.06)	(-1.02)
umd	-0.000257**	-0.000246**	-0.000251**	-0.000248**	-0.000252**	-0.000242**	-0.000241**	-0.000241**	-0.000249**	-0.000252**	-0.000269**	-0.000249**	-0.000253**	-0.000255**
	(-2.73)	(-2.72)	(-2.74)	(-2.74)	(-2.74)	(-2.67)	(-2.68)	(-2.74)	(-2.74)	(-2.75)	(-2.83)	(-2.77)	(-2.77)	(-2.76)
VRP (20d Lag)	-0.00161***	-0.00130***	-0.00134***	-0.00128***	-0.00135***	-0.00144***	-0.00134***	-0.00102***	-0.00122***	-0.00132***	-0.00138***	-0.00108***	-0.00129***	-0.00133***
	(-5.18)	(-4.36)	(-4.47)	(-4.34)	(-4.47)	(-4.86)	(-4.58)	(-3.65)	(-4.16)	(-4.40)	(-4.47)	(-3.83)	(-4.33)	(-4.43)
Const.	-0.00000143	-0.00000257*	-0.00000194	-0.00000280*	-0.00000211	-0.00000284*	-0.00000318**	-0.00000391***	-0.00000250*	-0.00000185	-0.00000133	-0.00000346**	-0.00000232	-0.00000247*
	(-1.17)	(-2.19)	(-1.63)	(-2.39)	(-1.77)	(-2.43)	(-2.74)	(-3.46)	(-2.13)	(-1.55)	(-1.10)	(-3.03)	(-1.96)	(-2.08)
Ν	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147
R-sq	0.0365	0.0276	0.0285	0.0272	0.0287	0.0318	0.0291	0.0206	0.0252	0.0279	0.0291	0.0217	0.0271	0.0282
adj. R-sq	0.032	0.023	0.024	0.023	0.024	0.028	0.025	0.016	0.021	0.024	0.025	0.017	0.023	0.024

t statistics in parentheses

="* p<0.05 ** p<0.01 *** p<0.001"