Corporate Governance and Equity Liquidity: analysis of S&P transparency and disclosure rankings

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This paper sets out to investigate the effects of disclosure, and other corporate governance mechanisms, on equity liquidity, arguing that those companies adopting poor information transparency and disclosure practices will experience serious information asymmetry. Since poor corporate governance leads to greater information asymmetry, liquidity providers will incur relatively higher adverse information risks and will therefore offer higher information asymmetry components in their effective bid-ask spreads. The Transparency and Disclosure (T&D) rankings of the individual stocks on the S&P 500 index are employed to examine whether firms with greater T&D rankings have lower information asymmetry components and lower stock spreads. Our results reveal that the economic costs of equity liquidity, i.e. the effective spread and the quoted half-spread, are greater for those companies with poor information transparency and disclosure practices.

Keywords: Corporate governance, transparency and disclosure, asymmetric information costs, liquidity

Introduction

Financial transparency and information disclosure are extremely important elements of good corporate governance. Within those firms where poor financial transparency and information disclosure practices are adopted, managers are more likely to use their information advantage to pursue a private benefit of control, which will ultimately lead to an increase in the agency costs faced by shareholders. As the agency problem worsens, insiders (such as executives or controlling owners) can easily exploit the wealth and rights of small shareholders; it is for this reason that poor corporate governance is associated with bad disclosure practices.

Improving transparency and disclosure practices ultimately leads to better corporate governance, largely because the disclosure practices of a firm can be viewed as effective mechanisms for the protection of the rights of outsiders. Better transparency and disclosure practices can help shareholders to gain a better understanding of firms' management practices, thereby helping to reduce the information asymmetry faced by investors.

Relating this to the equity market, investors are not only willing to pay a higher price to buy stocks in those companies with better information disclosure, but they will also be more willing to trade in them. Conversely, when firms reveal poor corporate governance, liquidity providers (such as market makers or dealers) will take action to protect their prices, broadening the spreads of the affected stocks to compensate for potential losses arising from trading in these equities by informed traders.

The issue of firms' financial transparency and information disclosure has recently gained greater attention, from both market regulators and investors alike, with the ranking institutions, such as Standard & Poor's and Moody's, now using financial

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transparency and information disclosure as one of the criteria for assessing the management capabilities and reputation of firms; indeed, the results of a Transparency and Disclosure Study (the T&D Study) were published by Standard & Poor's on 16 October 2002.[1] This study provides the T&D rankings of firms under three disclosure categories, according to the T&D practices of each firm, and then calculates a final ranking; these final rankings ultimately provide a reference enabling investors to assess the transparency and disclosure practices of any given firm.

Whilst there is an abundance of studies on the effects of corporate governance on equity prices, to the best of our knowledge, few studies have been undertaken on the liquidity costs of poor corporate governance. The purpose of this study is to investigate the simultaneous relationship between corporate governance and equity liquidity, arguing that companies with poor corporate governance will incur both higher agency costs and higher asymmetric information risk. Liquidity providers will broaden the equity spreads of firms exhibiting poor corporate governance, with such price protection action reducing the market liquidity of these equities.

The S&P T&D ranking, which is used in this study as a proxy variable for corporate governance, is employed to examine whether the stocks of firms with higher rankings exhibit better market liquidity. There should, theoretically, be a direct correlation between the T&D ranking and the information asymmetry component, because a lower T&D ranking implies lower disclosure practices, which in turn will lead to liquidity providers facing higher asymmetric information risks.

In response, and so as to compensate for this higher risk, liquidity providers must increase the information asymmetry component of the effective spread. We therefore predict that a stronger negative correlation will exist between the firm's T&D ranking and the information asymmetry component of the effective spread.

Several of the prior works have indicated that simultaneity may exist in the determination of bid-ask spread and a firm's disclosure policy (Dye, 1985; Lang and Lundholm, 1993; Welker, 1995). When managers determine a firm's disclosure policy, they are likely to consider the present market liquidity of the firm's stock; indeed, when liquidity providers quote the bid and ask price of a stock, they will, as a matter of course, refer to the disclosure practices of a firm as an important measure of the degree of information asymmetry.

This study adopts the three-stage least squares (3SLS) method to obtain more efficient

estimates and more robust test results, whilst also employing the generalised method of moments (GMM) estimation method, since this places no restrictions on either the conditional or unconditional variance matrix of the disturbance term. Under the GMM framework, we can obtain the asymptotically efficient estimator without making any additional assumptions, which clearly enables us to obtain the most robust results.

After controlling for firms' trading characteristics and several determinants of disclosure practices, our empirical results from the 3SLS and GMM estimations reveal a significant negative relationship between the T&D rankings and our liquidity measures. The results also reveal a strongly negative relationship between the T&D rankings and the information asymmetry components. These findings are consistent with our hypothesis that better corporate governance is associated with better equity liquidity.

This study has several contributions to make to the financial literature and practices. First of all, we link the concepts of disclosure practice, information asymmetry, the agency problem and corporate governance to equity liquidity, and find that the empirical results are not only statistically significant, but also consistent with our hypothesis that better corporate governance is accompanied by better equity liquidity. Secondly, the potential problem of endogeneity within the T&D ranking is explored by using 3SLS and GMM estimation methods within the study in order to provide more reliable empirical evidence for our examination of the impact of corporate governance on equity liquidity. Thirdly, we estimate the information asymmetry components of the effective spread as a means of measuring the asymmetric information costs demanded by liquidity providers so as to compensate for possible losses arising from informed trading activities.

We find that the T&D rankings have a significant and negative relationship with the information asymmetry component, implying that poorer disclosure practices will lead to lower equity liquidity as a result of the increased asymmetric information costs demanded by liquidity providers, essentially because order processing costs are invariably fixed. Finally, we suggest that investors should be cautious in their use of these rankings as a means of directly assessing the extent of the financial transparency and disclosure practices of a given firm.

The remainder of this paper is organised as follows. A review of the related literature and hypothesis development is undertaken in the next section, followed by an introduction to

the models adopted for our liquidity measures, the control variables used within our dependent variables, and a description of the data and the research methodology adopted for the study. The penultimate section presents the empirical results of our study, followed, in the final section, by some concluding remarks drawn from this research.

Literature review and hypothesis development

Disclosure practices, corporate governance and information asymmetry

The relationship between disclosure practices and corporate governance is already well covered within the prior literature. Lowenstein (1996), for example, argued that good disclosure is an extremely efficient and effective mechanism for ensuring that managers perform better; this implies that firms with better information disclosure may achieve better corporate governance. Healy *et al.* (1999) also suggested that increases in the disclosure ratings are accompanied by increases in firms' stock returns, institutional ownership, analyst following and stock liquidity; their findings reinforce those within the management forecast literature where it is argued that voluntary disclosures are credible.

La Porta *et al.* (1998) went on to suggest that financial transparency has a crucial role to play in corporate governance through the information which it provides to investors, and whilst noting that there were four major corporate governance attributes, with regard to voluntary disclosure, that were provided by listed firms in the Hong Kong stock market, Ho and Wong (2001) subsequently went on to reveal a number of significant relationships. Mitton (2002) used disclosure quality as one of the firm-level corporate governance proxy measures as a means of examining whether corporate governance practices could have some impact on stock price performance.

In their report on S&P T&D methodology, and the T&D study itself, Patel and Dallas (2002) argued that good corporate governance must include a vigilant board of directors, adequate and timely disclosure of financial information, meaningful disclosure about the board and its management processes, and a transparent ownership structure identifying any conflicts of interests between managers, directors, shareholders and other related parties. Financial transparency and disclosure are therefore very basic, but very important, elements of corporate governance, which implies that good corporate governance is associated with good disclosure practices.

The extent of a firm's disclosure practices can affect the quality of its corporate governance by reducing the asymmetric information faced by investors. Botosan (1997) found that the increasing level of disclosure by firms can reduce the information asymmetry between managers and investors, and thus reduce the cost of a firm's equity capital. Lang and Lundholm (1999) indicated that higher levels of disclosure should lead to a lower cost of capital by reducing both the information risk and the transaction costs. Patel and Dallas (2002) also showed that both the composite and annual basis T&D rankings had a negative relationship with market risk, whilst Leuz *et al.* (2003) pointed out, in particular, that strong and well-enforced outsider rights could limit the acquisition of private control benefits by insiders, and as a consequence, may mitigate the insiders' incentives to manage accounting earnings, largely because there would be little to conceal from other traders.

Since the disclosure practices of firms can be viewed as mechanisms for the effective protection of outsider rights, in terms of helping shareholders to gain a better understanding of the firm's management, they can also prevent managers from using their information advantage to pursue a private benefit of control. Consequently, the agency cost will be reduced in those firms with better financial disclosure practices, and it is within these firms that better corporate governance will be established. Accordingly, we argue that if the S&P T&D rankings are able to provide an accurate description of the disclosure practices of firms, those firms with higher T&D rankings will have better disclosure practices, accompanied by lower asymmetric information risk and better corporate governance.

Corporate governance and market liquidity

It is widely accepted that corporate governance is an important factor in financial market development, firm value, the concentration of ownership and many other different aspects of firm performance.[2] Hauswald and Marquez (2006) provided one of the most recent studies on these specific issues, presenting a theoretical model in which it was argued that by promoting greater transparency, firms' disclosure policies fostered external scrutiny, and thus increased activity in the market for corporate control. There have, nevertheless, been very few studies which have set out with the overall aim of investigating the impact of corporate governance on the equity liquidity of firms.

Within the prior empirical literature, Heflin *et al.* (2005) investigated the relationship be-

tween disclosure policy and market liquidity using Financial Analysts Federation (FAF) reports and effective spreads. Having found that effective spreads and disclosure policy ratings were inversely related, they argued that a policy of enhanced financial disclosure was related to improved market liquidity. Similarly, Brown and Hillegeist (2006) examined the ways in which disclosure quality was related to long-run information asymmetry. Their analyses indicated that disclosure by firms was negatively related to the average level of information asymmetry. Accordingly, the first hypothesis proposed in our study is:

> Hypothesis 1: The equities of those firms with better disclosure practices (better corporate governance) will have relatively better market liquidity.

Stoll (1978a, 1978b) modelled the source of the spreads in the spirit of Demsetz (1968) by analysing the cross-sectional relationship between a stock's proportional quoted half-spreads and the trading characteristics of the firm, and found that this relationship had changed little over time, remaining strong. It was subsequently further argued by Lin et al. (1995) that demanders of immediacy services rarely received prices which were less favourable than the prevailing quotes on the NYSE. Therefore, the effective spread, which is defined as the absolute value of the difference between the trade price and the quote midpoint just prior to the trade, is viewed as a more precise and better measure of a firm's market liquidity. Following on from these prior works, this study uses both the quoted half-spread and the effective spread as proxies for the market liquidity of firms.

The information asymmetry component is a compensation arising from the asymmetric information risk faced by liquidity providers. Since it is difficult to determine who the informed traders are, the providers of liquidity cannot prevent the losses incurred when they actually trade with an informed trader. Effective spread must therefore include an appropriate information asymmetry component in order to compensate for this risk of loss, thereby enabling liquidity providers to maintain their operations against informed trading activities. We follow the model developed by Lin et al. (1995) to calculate the information asymmetry component of the effective spread, and then use this as a measure of the immediate transaction costs arising from a firm's asymmetric information risk.

Extending the prior research of Welker (1995) and Brockman and Chung (2003), this study uses the S&P T&D rankings as proxies

for firms' disclosure practices, arguing that the ranking could be an effective measure of the corporate governance and asymmetric information risk perceived by both market makers and dealers. In addition to using the quoted bid-ask spread, we use the effective spread, a more precise measure of a firm's liquidity, along with the adverse information component of the effective spread, to examine the relationship between the disclosure practices of firms and their market liquidity levels.

If S&P T&D ranking is indeed a good proxy for the disclosure practices of firms, we expect that those firms with higher T&D rankings will have smaller quoted spreads, effective spreads and information asymmetry components, implying that some association does exist between good market liquidity and good corporate governance.

Corporate governance proxy variable: S&P T&D rankings

This study uses the Transparency and Disclosure (T&D) rankings, provided by the S&P Transparency and Disclosure study, as a proxy for the disclosure practices of firms. Patel and Dallas (2002) identify 98 disclosure items, classified into three broad categories:

1. Ownership structure and investor rights;
2. Financial transparency and information disclosure; and
3. Board and management structure and process.

Their study indicates whether these individual items are disclosed, focusing mainly on annual reports as the primary source of information disclosure. They also consider other forms of regulatory filings as an additional source of corporate disclosure. Their study therefore evaluates firms' disclosure patterns, based initially upon annual reports alone (annual basis), and secondly on annual reports, 10-Ks and other proxy statements (composite basis). Each ranking within the three categories is evaluated on both bases, from which the final rankings are then calculated.

A number of recent studies have provided compelling evidence to show that a firm's T&D ranking could be a good proxy for corporate governance. In her examination of the relationship between corporate governance, transparency and financial disclosure, Mallin (2002) noted that surveys of investor opinions placed significant emphasis on the importance of transparency and disclosure in a good corporate governance system. She therefore

argued that transparency and disclosure were key attributes of any model of good corporate governance.

Cheng *et al*. (2003) used the T&D rankings as proxies for corporate governance in their investigation of the effects of both the level of the rankings and the differential rankings between composite and annual report rankings on three market metrics, market beta, risk-adjusted abnormal returns and earnings response coefficients surrounding the announcement date.[3] The results revealed that the release of the S&P T&D rankings brought new information to the market, with the rankings affecting shareholder wealth in a manner consistent with the rankings measuring the strength of corporate governance.

In their investigation of the relationship between corporate governance and valuation using Credit Lyonnais Securities Asia (CLSA) and S&P score data, Durnev and Kim (2005) found a significant correlation between the CLSA composite index and the S&P aggregate score. Their findings indicated that those companies which scored high on corporate governance under the CLSA scoring system also scored high on disclosure under the S&P scoring system. They also demonstrated a positive correlation between the S&P T&D rankings and the strength of corporate governance in emerging countries.

In this study, we also regard the S&P T&D ranking as a good proxy for corporate governance, and use both the annual basis T&D final ranking (AFR) and the composite basis T&D final ranking (CFR) to examine whether firms with higher S&P T&D rankings have better equity liquidity.

The simultaneity of equity spread and firms' disclosure practices

Several of the prior studies, both theoretical and empirical, have indicated that simultaneity may exist in the determination of bid-ask spread and a firm's disclosure policy. Dye (1985), for example, designed a theoretical model in which the information asymmetry between managers and investors could influence firms' disclosure policies, whilst Lang and Lundholm (1993) analysed the determinants of voluntary disclosure policy, arguing that there was simultaneity in the determination of both bid-ask spread and disclosure practices.

Welker (1995) suggested that disclosure policy choice could be influenced by the level of information asymmetry between management and uninformed investors, as well as other determinants of bid-ask spreads. Heflin

et al. (2005) tested for a simultaneous relationship between disclosure policy and effective spreads using a two-stage least squares (2SLS) instrumental variable procedure, and found that relative effective spreads were inversely related to disclosure policy ratings.

Durnev and Kim (2005) investigated the relationship between valuation (Tobin's Q) and S&P transparency rankings, also using a three-stage least squares (3SLS) method, because of the problem of endogeneity in the regression analysis. By controlling for the simultaneity between governance and valuation, they concluded that better governance within firms would lead to higher valuation, whilst Brown and Hillegeist (2006) went on to use a three-stage least squares instrumental variable estimation procedure to examine the simultaneous relationship between disclosure quality and information asymmetry. Following these works, we develop our second hypothesis, as follows:

> *Hypothesis 2: The determination of spread and firms' disclosure practices will be simultaneous.*

If simultaneity does indeed exist, employing the OLS estimation procedure will generate inconsistent estimates, rendering the inferences invalid. Accordingly, we utilise the determinants of the disclosure practices and the spread, as instrumental variables, to construct a system of simultaneous equations, and employ the 3SLS method to estimate and test the coefficients within these equations.

We also use a more robust estimation method, the general method of moments (GMM), to estimate and test the simultaneous equations. If the coefficient of our liquidity measure (the quoted spread, effective spread or information asymmetry component) does not demonstrate any strong explanatory capability with regard to disclosure practices, we can argue that no simultaneity exists in the determination of the spread and disclosure practices.

Data and research methodology

The data

Since the Patel and Dallas (2002) report on the S&P T&D study provided only the T&D rankings for the constituent firms in the S&P 500 index, these are necessarily the companies that make up the sample for this study. We use the annual basis T&D final ranking (AFR) and the composite basis T&D final ranking (CFR) as proxies for a firm's corporate governance. Since the S&P T&D study report was

published on 16 October 2002, we take the whole trading days for 2002 as our study period.

A number of empirical studies, including Huang and Stoll (1996) and Barclay *et al.* (1999), have compared dealer and auction markets, such as the NASDAQ and the NYSE. Based upon these (and other) studies, Stoll (2000) noted that the empirical evidence indicated that market design appeared to have some effect on spread. In particular, spreads in the dealer markets were wider than those in the auction markets, largely because dealers within the dealer markets may have more market power; the main reason for this is the expectation that dealers, or market makers, with stronger market power will increase their revenue by widening the spreads.

In order to eliminate this distinction between the constituent stocks on the S&P 500 index, we choose only those stocks listed on the NYSE. Under such a condition, our sample size becomes 424 stocks. For the same reason, the intraday data used to estimate and calculate our liquidity measures are based upon those transactions and quotes taking place in the NYSE only.

The daily intraday transaction and quote data for these 424 stocks were obtained from the Trade and Quote (TAQ) database, along with the daily number of trades, daily dollar volume and closing prices of each stock.[4] In addition, each stock's daily returns (without dividends) were taken from the CRSP database in order to calculate the standard deviation on the returns for the previous year. Finally, the accounting data used to calculate the other selected variables in this study were all obtained from the Compustat database. After calculating the values of all of the selected variables, we then deleted those firms for which any of the variables had missing values, thereby further reducing our sample size to 341.

Measures of liquidity and the information asymmetry component

In addition to the measures of equity liquidity, such as the quoted half-spread (QSP) and the proportional quoted half-spread (PSP), we consider the effective spread, which is defined as the absolute value of the one-half signed effective spread:

$$\text{ESP}_{i,t} = |z_{i,t}| = |P_{i,t} - Q_{i,t}| \qquad (1)$$

where $P_{i,t}$ is the trade price for the trade in firm i, at time t, and $Q_{i,t}$ is the prevailing quote midpoint for the transaction in firm i, at time t. Our model of the information asymmetry component of spread is based on Lin *et al.* (1995):

$$Q_{i,t+1} - Q_{i,t} = \lambda_{i,t} z_{i,t} + \varepsilon_{i,t+1} \qquad (2)$$

$$z_{i,t+1} = \theta_{i,t} z_{i,t} + \eta_{i,t+1} \qquad (3)$$

where $Q_{i,t}$ is the prevailing quote midpoint for the transaction in firm i, at time t, and $z_{i,t}$ is the one-half signed effective spread, defined as the transaction price minus the prevailing quote midpoint, with $z_{i,t} < 0$ for a sell order, and $z_{i,t} > 0$ for a buy order. Van Ness *et al.* (2001) indicated that the idea of this model was that both bid and ask quotes at time $t + 1$ would have quote revisions of λz to reflect any potential adverse information revealed by the trade at time t. Since λ reflects the quote revision in response to a trade as a fraction of the effective spread, it can be viewed as the information asymmetry component of the effective spread.

In addition to quote data, we also need intraday transaction data in order to effectively estimate the model for the effective spread and information asymmetry component. Following the procedure of Lin *et al.* (1995), the transaction time and trade price are identified for each transaction, along with the prevailing bid and ask prices.[5]

After obtaining the transaction data with prevailing quotes, we estimate Equation (2) under the OLS method so as to obtain the daily estimate of the information asymmetry component, $\hat{\lambda}$, for each equity in our sample, using all transaction data with prevailing quotes during each day, and then calculating the annual average information asymmetry component for each firm.[6]

In order to obtain the real cost of the asymmetric information risk induced by informed trading, we multiply each stock's annual average information asymmetry component by the annual average of its effective spread, with our measure of the asymmetric information cost of the effective spread being defined as:

$$\text{INF}_{i,} = \hat{\lambda}_{i,} \times \text{ESP}_{i,.} \qquad (4)$$

The effective spreads and the relative effective spreads are calculated from the transaction data with prevailing quotes. For each security in our sample, the dollar effective spread and the relative effective spread are first computed for each transaction during the normal daily transaction time, followed by calculation of the daily averages for each trading day during our study period. Finally, the annual averages are then calculated, using these daily averages.

The determinants of equity liquidity and disclosure practices

In order to construct a system of simultaneous equations for our liquidity measure, as well as the S&P T&D ranking for the 3SLS and GMM estimations, we need to specify the liquidity measure and T&D final ranking models.

The determinants of the liquidity measure

It has been suggested in many of the prior cross-sectional studies on spreads (for example, Welker, 1995; Lin *et al.*, 1995; Stoll, 2000; Van Ness *et al.*, 2001; Brockman and Chung, 2003; Agrawal *et al.*, 2004; and others) that any empirical analyses should control for a number of spread determinants, other than disclosure policy, with the closing price, daily dollar volume, return volatility, number of trades per day and market value being the most common determinants of spread adopted in these studies.

Stoll (2000), in particular, modelled the source of the spread, and found that the closing price, daily dollar volume, return volatility, number of trades per day and market value were all significantly related to the proportional quoted half-spread. Stoll found that these variables could explain over 65 per cent of the cross-sectional variance in the proportional quoted half-spread. Therefore, along with the T&D ranking, we follow Stoll (2000) to use the closing price of the stock (CLP), daily dollar volume (DOLVOL), return standard deviation (RETSTD), number of trades (N) and market value (MKV) as our preliminary candidates for control variables in the liquidity measures (i.e. the proportional quoted half-spread, the quoted half-spread, the effective spread, the relative effective spread and the information asymmetry component).

In accordance with the empirical evidence provided by Stoll (2000), as well as the other aforementioned studies, we predict that any increase in the dollar volume, the number of trades and the market value will lead to an increase in equity liquidity and a lowering of the spread. The return volatility of a stock reflects the risk of any price change in that stock; thus, we predict that higher return volatility will be associated with a higher spread.

The definitions of the control variables in the liquidity measures are described as follows:

CLP_i = the closing price average of all trading days for firm i during the study period.

$DOLVOL_i$ = the daily dollar volume average of all trading days for firm i during the study period.

$RETSTD_i$ = the standard deviation of the daily returns of stocks in firm i during the previous year.

N_i = the average daily number of trades in firm i during the study period.

MKV_i = the average monthly market value of firm i during the study period.

Furthermore, price acts as a control for the effect of discreteness, and is an additional proxy for risk, insofar as low price stocks tend to be riskier (Stoll, 2000). We therefore predict that price will be positively related to the quoted half-spread, the effective spread and the information asymmetry component, whilst being negatively related to the proportional quoted half-spread, and the relative effective spread, since the quote midpoint, the denominator used to calculate these two measures, is highly correlated to the closing price.

The determinants of disclosure practice

The determinants of disclosure practice used in this study relate mainly to those of Lang and Lundholm (1993), Welker (1995) and Ho and Wong (2001). Lang and Lundholm (1993) found that both market-adjusted return and firm size were positively correlated to disclosure policy, which in turn had a negative association with return standard deviation and the return-earnings correlation.

Following on from these findings, Welker (1995) used share price, security offering, market-adjusted return and the return standard deviation as the determinants of disclosure practice. Ho and Wong (2001) subsequently went on to test a theoretical framework relating four major corporate governance attributes to the extent of voluntary disclosure provided by firms listed on the Hong Kong stock market. Ho and Wong followed several of the prior works which had focused on investigations into voluntary disclosure decisions, using firm size (Chow and Wong-Boren, 1987), assets-in-place (Hossain *et al.*, 1994), financial leverage (Bradbury, 1992) and profitability and industry type (Meek *et al.*, 1995) as the control variables in their empirical models.

Thus, following on from these studies, our preliminary candidates for control variables in the disclosure practices of firms are: firm size (SIZE), return standard deviation (RETSTD), closing price (CLP), assets-in-place (AIP), financial leverage (LEV), profitability (PROFIT) and a dummy variable for industry type. The empirical findings of the aforementioned studies suggest that firm size, price, assets-in-place and profitability are positively related to the disclosure practices of firms, and

that return volatility and financial leverage have a negative correlation with the quality of the firms' disclosure. The control variables for disclosure practices which have not yet been defined are as follows:

$SIZE_i$ = the total assets of firm i at the end of 2002.

AIP_i = the ratio of the net book value of fixed assets to total assets for firm i at the end of 2002.

LEV_i = the ratio of total debt to total equity for firm i at the end of 2002.

$PROFIT_i$ = the return on capital employed at the end of 2002.

$D1_i$ = 1, when the firm's S&P Industry Index Code is between 700 and 719 (the Financials group), otherwise 0.

$D2_i$ = 1, when the firm's S&P Industry Index Code is between 900 and 921 (Information Technology group), otherwise 0.

Simultaneous equation model

We first calculate the variance inflation factors (VIFs) for the control variables of the liquidity measures and those of the disclosure practices of firms. The VIFs measure the extent to which multicollinearity exists in the selected explanatory variables; any explanatory variables with higher VIFs will have a more serious multicollinearity problem and a greater likelihood of affecting the estimation regression results. Following calculation of the VIFs, we find that those of daily dollar volume (DOLVOL), market value (MKV) and daily number of trades (N) are greater than those of the other control variables.

By omitting any two of the variables, the VIFs of all the independent variables of the liquidity measures will be lower than 2, thereby indicating that the multicollinearity problem is solved. Since the OLS coefficient estimates of both market value and daily number of trades are less significant than those of daily dollar volume, and since the latter is used much more frequently in the microstructure literature than market value and daily number of trades, we omit these two variables, whilst retaining the daily dollar volume within the equity liquidity equation.

Thus, the control variables of our liquidity measure are now the closing price (CLP), daily dollar volume (DOLVOL) and the previous year's return standard deviation (RETSTD). The VIFs of the predetermined control variables of the disclosure practices of firms are all less than 2, which indicates that no serious multicollinearity problem exists in the selected control variables.

The second step is to filter out any inadequate instrumental variables for the 3SLS and GMM instrumental variable estimations. Wooldridge (2002) indicated that a key condition for instrumental variable estimation was that once all the other exogenous variables in all equations had been netted out, the selected additional instruments for an endogenous variable must have some partial correlation.[7]

The results of the first-stage regression on all of the liquidity measures reveal that the three control variables, CLP, DOLVOL and RETSTD, have a partially strong correlation with our liquidity measures. For the S&P T&D final rankings, the results of the first-stage regressions reveal that only SIZE and AIP are partially correlated with the composite basis final rankings, and that SIZE, AIP and RETSTD are partially correlated with the annual basis final rankings. Therefore, after excluding any inadequate instrumental variables from the equations, our simultaneous equation systems can be constructed as follows:

$$Liquidity_i = \alpha_{10} + \alpha_{11}CFR_i + \alpha_{12}\ln DOLVOL_i \\ + \alpha_{13}CLP_i + \alpha_{14}RETSTD_i + \varepsilon_{1,i}$$
$$CFR_i = \alpha_{20} + \alpha_{21}Liquidity_i + \alpha_{22}\ln SIZE_i \\ + \alpha_{23}AIP_i + \varepsilon_{2,i} \tag{5}$$

$$Liquidity_i = \beta_{10} + \beta_{11}AFR_i + \beta_{12}\ln DOLVOL_i \\ + \beta_{13}CLP_i + \beta_{14}RETSTD_i + u_{1,i}$$
$$AFR_i = \beta_{20} + \beta_{21}Liquidity_i + \beta_{22}\ln SIZE_i \\ + \beta_{23}AIP_i + \beta_{24}RETSTD_i + u_{2,i} \tag{6}$$

where $\ln DOLVOL_i$ and $\ln SIZE_i$ are the logarithms of $DOLVOL_i$ and $SIZE_i$; $Liquidity_i$ represents the liquidity measure, and can be replaced by any of our liquidity measures, the effective spread (ESP) or the information asymmetry component (INF).[8]

Empirical results and analysis

Summary statistics and correlations

Table 1 presents the descriptive statistics of our five liquidity measures and their control variables. Our sample period runs from 1 January to 31 December 2002, giving a total of 252 trading days. The mean of the quoted half-spread (QSP) is 2.2046 cents per share, with a range of about 3.522 cents. The mean of the proportional quoted half-spread (PSP) is 0.0716 per cent, ranging between 0.0281 per cent and 0.3220 per cent. The average effective spread (ESP) is 1.6166 cents, with a range of about 2.9434 cents, and represents approximately 73 per cent of the quoted half-spread.

The finding that the average ESP is less than the average PSP is consistent with the

Table 1: Descriptive statistics of the four selected liquidity measures and their control variables

Variables	Mean	SD	Minimum	Maximum
QSP (cents)	2.2046	0.0060	0.7839	4.3059
PSP (%)	0.0716	0.0362	0.0281	0.3220
ESP (cents)	1.6166	0.0046	0.6652	3.6069
INF (cent)	0.6577	0.2170	0.2172	1.3402
CLP	38.0115	18.7849	4.5627	121.7333
DOLVOL (millions)	66.6429	80.4993	4.4059	610.3353
RETSTD	0.0264	0.0098	0.0138	0.0768

The sample comprises of a total of 341 S&P 500 index constituent stocks listed on the NYSE between 1 January and 31 December 2002.
QSP = the quoted half-spread; PSP = the proportional quoted half-spread; ESP = the effective spread; INF = the dollar value of the information asymmetry component of the effective spread; CLP = the closing price; DOLVOL = the daily dollar volume; and RETSTD = the return standard deviation in the previous year.

Table 2: Pearson correlation coefficients of the four selected liquidity measures and their control variables

Variables	QSP	PSP	ESP	INF	CLP	DOLVOL	RETSTD
QSP	1						
PSP	−0.4015**	1					
	(<0.0001)						
ESP	0.9694**	−0.4732**	1				
	(<0.0001)	(<0.0001)					
INF	0.9668**	−0.4278**	0.9441**	1			
	(<0.0001)	(<0.0001)	(<0.0001)				
CLP	0.8107**	−0.6738**	0.8834**	0.8010**	1		
	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)			
DOLVOL	−0.0281	−0.3437**	0.1328**	−0.09032**	0.3494**	1	
	(0.6045)	(<0.0001)	(0.0141)	(0.0959)	(<0.0001)		
RETSTD	−0.3301**	0.6798**	−0.3123**	−0.3643**	−0.4590**	−0.0107	1
	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(0.8445)	

The sample comprises of a total of 341 S&P 500 index constituent stocks listed on the NYSE between 1 January and 31 December 2002.
*Indicates that the coefficient estimate is statistically significant at the 0.05 level; **indicates that the coefficient estimate is statistically significant at the 0.01 level.
Figures in parentheses are *p*-values.

argument of Lin *et al*. (1995).[9] The INF of the effective spread has an average value of 0.6577 cents, ranging between 0.2172 cents and 1.3402 cents; the CLP for our sample is approximately US$38.01, with a range of between US$4.56 and US$121.73; DOLVOL has a mean of US$66.64 million, with a sample range between US$4.41 million and US$610.33 million; and RETSTD has an average value of about 0.0264, with the sample ranging between 0.0138 and 0.0768.

The Pearson correlation coefficients of our five liquidity measures, and their control variables, are presented in Table 2. One issue which immediately draws our attention is the fact that INF, QSP and ESP all have a strongly positive correlation, implying that the higher asymmetric information costs induce higher equity spread, given that order processing costs are largely fixed.

The descriptive statistics of the S&P T&D final rankings, and their control variables, are presented in Table 3. The mean of the composite basis T&D final rankings (CFR) is 7.55, with a range of between 7 and 9, whilst the mean of the annual basis T&D final rankings (AFR) is 4.78, with a range of between 1 and 8. Taking note of the difference between these two rankings, AFR has a lower mean but greater range, whilst CFR has a higher mean but smaller

Table 3: Descriptive statistics of the two S&P T&D final rankings and their control variables

Variables	Mean	Std Dev	Minimum	Maximum
CFR	7.5455	0.5161	7.0000	9.0000
AFR	4.7771	0.9986	1.0000	8.0000
SIZE (millions)	39,391	107,730	669	887,515
AIP (%)	30.5985	23.2217	0.0000	93.2126
RETSTD	0.0264	0.0098	0.0138	0.0768

The sample comprises a total of 341 S&P 500 index constituent stocks listed on the NYSE between 1 January and 31 December 2002.
CFR = the composite basis S&P T&D final ranking; AFR = the annual basis S&P T&D final ranking; SIZE = the firm's total asset at the end of 2002; AIP = the assets-in-place defined as the book value of fix asset divided by total asset; and RETSTD = the return standard deviation in prior year.

Table 4: Pearson correlation coefficients of the two S&P T&D final rankings and their control variables

Variables	CFR	AFR	SIZE	AIP	RETSTD
CFR	1				
AFR	0.2880**	1			
	(<0.0001)				
SIZE	0.0329	0.0565	1		
	(0.5444)	(0.2979)			
AIP	0.1841**	0.1423**	−0.2635**	1	
	(0.0006)	(0.0085)	(<0.0001)		
RETSTD	−0.0680	−0.1700**	−0.0494	0.0332	1
	(0.2102)	(0.0016)	(0.3631)	(0.5407)	

The sample comprises of a total of 341 S&P 500 index constituent stocks listed on the NYSE between 1 January and 31 December 2002.
CFR = the composite basis S&P T&D final ranking; AFR = the annual basis S&P T&D final ranking; SIZE = the firm's total asset at the end of 2002; AIP = the assets-in-place defined as the book value of fix asset divided by total asset; and RETSTD = the return standard deviation in prior year.
*Indicates that the coefficient estimate is statistically significant at the 0.05 level; **indicates that the coefficient estimate is statistically significant at the 0.01 level.
Figures in parentheses are *p*-values.

range. This characteristic is consistent with the argument of Patel and Dallas (2002), who suggested that the annual basis rankings, which focus only on a firm's annual reports, could be regarded as the extent of a firm's voluntary disclosure; conversely, the composite basis rankings, which include annual reports, 10-Ks and other proxy statements, may be regarded as regulatory disclosure practices. Thus, as a result of the strict laws on investor protection in the US, as well as the stringent disclosure regulations, the firms reveal consistently higher rankings on a composite basis, along with smaller differences between the firms' composite basis rankings, than in their annual basis rankings.

Table 4 presents the Pearson correlation coefficients of the S&P T&D final rankings, and their control variables. SIZE and AIP reveal positive correlations to both composite and annual basis T&D final rankings, although the positive correlation between SIZE and these two rankings is insignificant. RETSTD has a significantly negative correlation with the annual basis T&D final rankings, but has an insignificantly negative correlation with the composite basis T&D final rankings. This finding is consistent with the results of the first-stage regression.

We argue that the reason that return volatility presents greater explanatory power – as regards the annual basis final rankings vis-à-

vis the composite basis final rankings – is that the annual basis final rankings are much more closely related than the composite basis final rankings to the true extent of a firm's voluntary disclosure practices.

OLS, 3SLS and GMM estimation results

This section presents the results of the effective spread and the two S&P T&D final rankings, beginning with an examination of the relationship between the effective spread and the S&P T&D rankings by applying the 3SLS and GMM estimation methods.[10] The estimation results of ESP and the two S&P T&D final rankings are reported in Tables 5 and 6, both of which show that the empirical results are similar to those of QSP and the two S&P T&D final rankings.[11]

CFR and AFR reveal significantly negative relationships with effective spread under the 3SLS and GMM estimations of the first equation, with the results once again supporting our hypothesis that the stocks of firms with higher T&D rankings have relatively lower effective spreads. This finding is consistent with the results of Heflin *et al*. (2005), who investigated the relationship between the FAF scores and the effective spreads.

We also find that the negative relationships between ESP and the two final rankings are not statistically significant in the first equation under the OLS estimation. Moreover, the simultaneous estimation of the second equation shows that ESP has insignificant relationships with the two final rankings, indicating that there is little probability of any simul-

Table 5: OLS, 3SLS and GMM estimation results of the effective spread and composite basis S&P T&D final ranking

	Prediction	OLS	3SLS	GMM
Panel A: Equation 1				
Intercept		3.1752**	5.3428**	5.3952**
		(<0.0001)	(<0.0001)	(<0.0001)
CFR	−	−0.0218	−0.3508**	−0.3302**
		(0.2255)	(0.0001)	(0.0002)
CLP	+	0.0274**	0.0260**	0.0260**
		(<0.0001)	(<0.0001)	(<0.0001)
lnDOLVOL	−	−0.1533**	−0.1307**	−0.1428**
		(<0.0001)	(<0.0001)	(<0.0001)
RETSTD	+	9.6523**	8.5048**	8.6485**
		(<0.0001)	(<0.0001)	(<0.0001)
Adj. R^2		0.8651	0.7276	0.7453
No. of obs.			341	
Panel B: Equation 2				
Intercept		6.4060**	6.0807**	6.3222**
		(<0.0001)	(<0.0001)	(<0.0001)
ESP	−	−0.0713	−0.0889	−0.0948
		(0.2398)	(0.1701)	(0.1299)
lnSIZE	+	0.0484**	0.0654**	0.0546**
		(0.0175)	(0.0007)	(0.0046)
AIP	+	0.0044**	0.0031**	0.0036**
		(0.0004)	(0.0062)	(0.0001)
Adj. R^2		0.0469	0.0405	0.0451
No. of obs.			341	

The empirical results show that under 3SLS and GMM estimations, in the first equation, the composite basis T&D ranking is significantly and negatively correlated with the effective spread. In the second equation, the effective spread does not reveal any significant negative correlation to the composite basis T&D ranking, indicating that simultaneity may not exist in the determination of spread and disclosure practice.
*Indicates that the coefficient estimate is statistically significant at the 0.05 level; **indicates that the coefficient estimate is statistically significant at the 0.01 level.
Figures in parentheses are *p*-values.

Table 6: OLS, 3SLS and GMM estimation results of the effective spread and annual basis S&P T&D final ranking

	Prediction	OLS	3SLS	GMM
Panel A: Equation 1				
Intercept		2.9877**	3.7785**	3.6907**
		(<0.0001)	(<0.0001)	(<0.0001)
AFR	−	0.0039	−0.2222**	−0.2025**
		(0.6752)	(<0.0001)	(0.0005)
CLP	+	0.0275**	0.0260**	0.0258**
		(<0.0001)	(<0.0001)	(<0.0001)
lnDOLVOL	−	−0.1536**	−0.1259**	−0.1275**
		(<0.0001)	(<0.0001)	(<0.0001)
RETSTD	+	9.8913**	4.5792**	5.9191**
		(<0.0001)	(0.0172)	(0.0094)
Adj. R^2		0.8646	0.6275	0.6662
No. of obs.			341	
Panel B: Equation 2				
Intercept		2.8441**	2.5891**	2.6474**
		(0.0048)	(0.0089)	(0.0037)
ESP	−	−0.0468	−0.1580	−0.1898
		(0.7033)	(0.2327)	(0.0984)
lnSIZE	+	0.0975*	0.1214**	0.1182**
		(0.0132)	(0.0011)	(0.0004)
AIP	+	0.0072**	0.0044*	0.0054**
		(0.0022)	(0.0293)	(0.0044)
RETSTD	−	−17.8539**	−19.0721**	−16.9998*
		(0.0018)	(0.0010)	(0.0116)
Adj. R^2		0.0582	0.0503	0.0507
No. of obs.			341	

The empirical results show that under 3SLS and GMM estimations, in the first equation, the annual basis T&D ranking is significantly and negatively correlated with the effective spread. In the second equation, the effective spread does not reveal any significant negative correlation to the annual basis T&D ranking, indicating that simultaneity may not exist in the determination of spread and disclosure practice.
*Indicates that the coefficient estimate is statistically significant at the 0.05 level; **indicates that the coefficient estimate is statistically significant at the 0.01 level.
Figures in parentheses are *p*-values.

taneity existing in the determination of ESP and disclosure practices. All of the ESP control variables present significant coefficient estimates, with signs that are consistent with our expectations. The signs of the coefficient estimates of the CFR and AFR instruments are as predicted, with each of these being statistically significant at common confidence levels.

Information asymmetry cost estimation results

The ESP information asymmetry component represents the asymmetric information costs faced by market liquidity providers when trading with informed traders, and therefore reflects the market's perception of the firm's asymmetric information risk. Furthermore, since the S&P T&D rankings measure the extent of a firm's corporate governance, we predict that they will be directly related to the firm's asymmetric information risk. In this section, therefore, we examine the relationship between the dollar value of the information asymmetry component and the S&P T&D rankings by applying 3SLS and GMM estimations to determine whether better corporate governance is associated with better equity liquidity.

Table 7 presents the simultaneous estimation results of the dollar value of INF and

Table 7: OLS, 3SLS and GMM estimation results of the information asymmetry component and composite basis S&P T&D final ranking

	Prediction	OLS	3SLS	GMM
Panel A: Equation 1				
Intercept		2.3224**	3.6756**	3.6636**
		(<0.0001)	(<0.0001)	(<0.0001)
CFR	−	−0.0040	−0.2119**	−0.1964**
		(0.6338)	(<0.0001)	(<0.0001)
CLP	+	0.0130**	0.0123**	0.0121**
		(<0.0001)	(<0.0001)	(<0.0001)
lnDOLVOL	−	−0.1266**	−0.1119**	−0.1175**
		(<0.0001)	(<0.0001)	(<0.0001)
RETSTD	+	3.5719**	2.8859**	2.8957**
		(<0.0001)	(<0.0001)	(<0.0001)
Adj. R^2		0.8692	0.6215	0.6592
No. of obs.			341	
Panel B: Equation 2				
Intercept		6.2964**	5.8641**	6.0649**
		(<0.0001)	(<0.0001)	(<0.0001)
INF	−	−0.0378	−0.0984	−0.1376
		(0.7746)	(0.4862)	(0.3174)
lnSIZE	+	0.0490*	0.0718**	0.0633**
		(0.0197)	(0.0003)	(0.0013)
AIP	+	0.0045**	0.0027*	0.0034**
		(0.0002)	(0.0145)	(0.0003)
Adj. R^2		0.0432	0.0297	0.0364
No. of obs.			341	

The empirical results show that under 3SLS and GMM estimations, in the first equation, the composite basis T&D ranking is significantly and negatively correlated with the information asymmetry component. In the second equation, the information asymmetry component does not reveal any significant negative correlation to the composite basis T&D ranking, indicating that simultaneity may not exist in the determination of spread and disclosure practice.
*Indicates that the coefficient estimate is statistically significant at the 0.05 level; **indicates that the coefficient estimate is statistically significant at the 0.01 level.
Figures in parentheses are *p*-values.

CFR, whilst Table 8 presents the results of the dollar value of INF and AFR.

We find that both CFR and AFR have significantly negative relationships with INF in the first equation under both 3SLS and GMM estimations, but that under the OLS estimation, this negative partial relationship has no statistical significance. Furthermore, under all three estimation methods, INF does not reveal any significant relationship with either CFR or AFR in the second equation, indicating once again that there is little probability of any simultaneity existing within the determination of INF, CFR or AFR. It should be noted that this result is more robust than that reported in the Brown and Hillegeist

(2006) study, within which the wrong sign was produced in the simultaneous equations estimation.

The significantly negative relationships between INF, CFR and AFR in the first equation, under both the 3SLS and GMM estimations, again provides support for our hypothesis that firms with better disclosure practices will demonstrate better corporate governance and that their stocks will have lower information asymmetry. Since the T&D rankings are proxy variables for corporate governance, there may be some measurement error in the two S&P T&D final rankings with regard to the extent of firms' disclosure practices and information asymmetry, which is the

Table 8: OLS, 3SLS and GMM estimation results of the information asymmetry component and annual basis S&P T&D final ranking

	Prediction	OLS	3SLS	GMM
Panel A: Equation 1				
Intercept		2.2846**	2.7353**	2.7148**
		(<0.0001)	(<0.0001)	(<.0001)
AFR	−	0.0014	−0.1329**	−0.1253**
		(0.7462)	(<0.0001)	(<0.0001)
CLP	+	0.0130**	0.0123**	0.0119**
		(<0.0001)	(<0.0001)	(<0.0001)
lnDOLVOL	−	−0.1267**	−0.1098**	−0.1106**
		(<0.0001)	(<0.0001)	(<0.0001)
RETSTD	+	3.6304**	0.6446	1.1547
		(<0.0001)	(0.5280)	(0.3692)
Adj. R^2		0.8692	0.4919	0.5333
No. of obs.			341	
Panel B: Equation 2				
Intercept		2.6666*	2.3048*	2.6203**
		(0.0136)	(0.0303)	(0.0076)
INF	−	0.0212	−0.1993	−0.3552
		(0.9385)	(0.5049)	(0.1706)
lnSIZE	+	0.1000*	0.1283**	0.1165**
		(0.0144)	(0.0009)	(0.0008)
AIP	+	0.0074**	0.0037	0.0046**
		(0.0017)	(0.0576)	(0.0090)
RETSTD	−	−16.9902**	−18.2533**	−16.5135*
		(0.0039)	(0.0023)	(0.0165)
Adj. R^2		0.0578	0.0457	0.0460
No. of obs.			341	

The empirical results show that under 3SLS and GMM estimations, in the first equation, the annual basis T&D ranking is significantly and negatively correlated with the information asymmetry component. In the second equation, the information asymmetry component does not reveal any significant negative correlation to the annual basis T&D ranking, indicating that simultaneity may not exist in the determination of spread and disclosure practice.
*Indicates that the coefficient estimate is statistically significant at the 0.05 level; **indicates that the coefficient estimate is statistically significant at the 0.01 level.
Figures in parentheses are *p*-values.

likely cause of the inconsistent OLS estimation results in the first equation of the simultaneous system.

Conclusions

Poor disclosure practice within a firm is accompanied by poor corporate governance and higher levels of asymmetric information risk; as a result, liquidity providers will tend to broaden the equity spread of those firms exhibiting poor corporate governance, since such price-protection action will have the effect of reducing the market liquidity of the stock. In this study, we have used S&P T&D rankings as a proxy variable for corporate governance, subsequently employing this in our examination of whether the stocks of those firms with higher rankings have better market liquidity.

The empirical evidence supports our hypothesis that the stocks of those companies with better corporate governance have better market liquidity, with both the composite and annual basis T&D final rankings having significantly negative partial effects on the quoted half-spread and the effective spread. We also find that the two T&D final rankings have a significant and negative relationship with the information asymmetry component of the effective spread, which implies that better dis-

closure practices can reduce the asymmetric information risk perceived by the market, and thereby lower the spread of the equity by reducing the asymmetric information costs demanded by liquidity providers as a means of compensating for any potential losses arising from informed trading activities.

Furthermore, we find that the T&D rankings have a significant and negative relationship with the information asymmetry component, implying that poorer disclosure practices will lead to lower equity liquidity, as a result of the increased asymmetric information costs demanded by liquidity providers, essentially as a result of order processing costs being largely fixed.

Finally, the results of our study have some important implications for corporate governance; we suggest that managers should endeavour to conform to the various disclosure regulations and investor protection codes by disclosing, to the best of their ability, all the information they possess on the firm. When a firm is able to provide better levels of transparency and disclosure, the information asymmetry and agency problems will be effectively mitigated, and the quality of the firm's corporate governance will be improved immensely. Consequently, the firm will have a smaller information asymmetry component, along with a smaller effective spread and quoted spread, which implies that its stocks will have better market liquidity.

Notes

1. The T&D study focused on several issues, such as which companies were providing the most extensive disclosure in their basic corporate filings, and which companies had disclosed above and beyond what the law requires. See Patel and Dallas (2002) for a detailed description.
2. See La Porta *et al*. (1997, 1998, 1999, 2000), Conyon and Peck (1998), Himmelberg *et al*. (1999), Vafeas (1999), Johnson *et al*. (2000), Mitton (2002), Gompers *et al*. (2003), Alves and Mendes (2004), Brown and Caylor (2004), Klapper and Love (2004), Lee and Yeh (2004), Cremers and Nair (2005) and Nelson (2005). A theoretical model of comparative corporate governance is also provided by John and Kedia (2003).
3. Patel and Dallas (2002) argued that whilst transparency and disclosure were key components of corporate governance, T&D rankings were not proxies for corporate governance; nevertheless, they still found that the rankings revealed some interesting relationships between transparency and

disclosure and a firm's market risk, capitalisation and price to book ratio.

4. Our sample equity data comprised of 301,845,521 intraday quotes, and 146,630,782 transactions, obtained from the TAQ database. We use these data to calculate and estimate our measures of equity liquidity and the information asymmetry component.
5. After identifying the prevailing quotes for each trade and deleting any transaction data without prevailing quotes, we were left with a total of 127,217,081 transactions with prevailing quotes for use in this study.
6. Following Lin *et al*. (1995) and Van Ness *et al*. (2001), the logarithms of the transaction price and the quote midpoint are used to yield a continuously compounded rate of return for the dependent variable, and a relative spread for the independent variable. This transformation can generate estimates of the information asymmetry components as a percentage of the effective spread, and thereby reduce the problem of price discreteness.
7. See Wooldridge (2002), Chapters 5 and 6.
8. The values of QSP_i, ESP_i and INF_i are so small that the estimated coefficients of the control variables of these liquidity measures are also very small; we therefore multiply the measures by 100, and in consequence, "cents" becomes the unit of measurement.
9. Lin *et al*. (1995) argued that demanders of immediacy services rarely receive prices which were less favourable than the prevailing quotes on the NYSE.
10. Having carried out the Hausman test for endogeneity of AFR, the results confirm that AFR is not exogenous. For the purpose of saving space, these results are omitted; they are, however, available upon request.
11. The analysis was also carried out for the proportional quoted half spread and quoted half spread. Since the results are quite similar, they are omitted for the purpose of saving space.

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