Capital Structure, Derivatives and Equity Market Quality

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ABSTRACT

We examine how the existence of a market for individual equity options, publicly traded corporate bonds or credit default swap (CDS) contracts affects equity market quality for a panel of NYSE listed firms during 2003-2007. We find that firms with listed equity options have more liquid equity and more efficient stock prices. By contrast, firms with traded CDS contracts have less liquid equity and less efficient stock prices, especially when equity markets are in a "good" state (i.e., when there are more liquidity traders, less disagreement and the firm is further away from default). The impact of having a publicly traded bond is more mixed, but is generally negative. Trading activity in related markets, rather than their existence, plays a strong negative role for liquidity but not for price efficiency. Our findings are robust cross-sectionally, in the time series, and after implementing a matched-sample methodology. Taken together, our results imply an overall negative effect of related markets when those markets are tied to debt in a firm's capital structure.

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I. Introduction

Do multiple security markets, representing different claims on the same underlying asset, impact equity market quality? Although this question is not new, it has re-emerged as a central issue of debate among policymakers, academics, and financial market participants. The growth of derivatives markets, hedge funds and multi security trading strategies has brought increasing attention to important questions regarding their impact on liquidity and market efficiency. Credit default swaps (CDS) have been particularly controversial.[1] On one hand, derivatives are valuable hedging tools. They can also provide informed traders with incentives to trade, facilitating price discovery. However, there may be costs as well. For example, prices may become less informative if the new market expands informed traders' strategy sets, making it more difficult for market makers to learn from their trades (as in Biais and Hillion, 1994). Equity markets may also become less liquid if the ability to hedge a position in a related market increases the willingness of risk-averse informed traders to trade, driving out uninformed liquidity traders (as in Dow, 1998). Given the theoretical ambiguity of the impact of derivatives markets on equity market quality, the dominant effect is an empirical question.

The main goal of this paper is to examine the effect of related, traded securities on equity market quality. Using a broad panel of New York Stock Exchange (NYSE) stocks for the period 2003-2007, we examine the impact of individual equity options, publicly traded corporate bonds and credit default swap (CDS) contracts on both liquidity and price efficiency in equity markets. Most related research has focused on the impact of options markets on equity market quality; however, having actively traded debt in a firm's

[1] See e.g., *Testimony Concerning Credit Default Swaps by Erik Sirri, Director, Division of Trading and Markets, U.S. Securities and Exchange Commission, Before the House Committee on Agriculture October 15, 2008*: "The SEC has a great interest in the CDS market because of its impact on the debt and cash equity securities markets and the Commission's responsibility to maintain fair, orderly, and efficient securities markets. These markets are directly affected by CDSs due to the interrelationship between the CDS market and the claims that compose the capital structure of the underlying issuers on which the protection is written. In addition, we have seen CDS spreads move in tandem with falling stock prices, a correlation that suggests that activities in the OTC CDS market may in fact be spilling over into the cash securities markets"

capital structure can also impact market quality. Given that equity can be viewed as a call option on the firm's assets with a strike price equal to the value of the firm's debt (as in Merton (1974)), any information regarding the value of the firm's assets can produce trading incentives in both equity- and debt-linked securities. Moreover, this view of the firm suggests a precise pricing relationship between debt and equity which arbitrageurs should use to identify and correct any mispricings via their trades. In fact, capital structure arbitrage, which involves trading in both equity and credit derivatives, has grown in popularity among hedge funds (see Yu (2006) for an analysis of the profitability of the strategy).

Market quality has several dimensions and we examine a range of measures that have been suggested in the market microstructure literature. Specifically, we divide market quality along two dimensions: liquidity and price efficiency. The liquidity measures that we use are quoted and effective spreads, and are intended to capture trading costs. The price efficiency measures that we use assume that efficient stock prices follow a random walk and are constructed to capture deviations of price movements from this benchmark. Our primary objective is to estimate how the existence of related markets affects all of these characteristics of equity market quality. In our tests, we control for equity market trading and volatility, equity market capitalization, and firm leverage since all of these might impact equity market quality directly. We also conduct analysis using firm fixed effects to rule out the possibility that any related markets findings are due to unobservable firm-specific heterogeneity. In addition, because CDS markets are of particular interest, we control for differences between CDS and non-CDS firms using a matched sample analysis (following Ashcraft and Santos (2009)).

We report several important findings. First, the related markets impact market quality, albeit in different ways. Consistent with prior literature, we find that firms with listed equity options have more liquid equity and more efficient stock prices. By contrast, firms with traded CDS contracts have less liquid equity and less efficient stock prices. The impact of CDS contracts on market quality is very robust, and, in the case of liquidity, is economically larger than the impact of the other markets. The role of publicly traded bonds is more mixed but is generally negative. When we rank the estimated effects of the related markets for liquidity, we find that the impact of CDS markets is generally the most negative, followed by corporate bond markets, and then options (which are generally beneficial). The magnitudes of the effects on stock price efficiency are more similar, although CDS and corporate bond markets tend to play negative roles, while option markets play a positive role. One reason why related markets can have such different implications for equity markets (i.e., generally positive role for equity options and negative role for debt-linked securities) is that that dividing claims to firms' assets via capital structure decisions could increase the complexity associated with analyzing equity. The ability to trade in markets tied to debt may exacerbate this problem. Related markets can impact market quality by their existence alone (e.g., more market participants monitoring different aspects of a firm) or via trading in these markets. We examine both potential mechanisms.

Our second key finding is that trading in both bond and option markets, as opposed to their existence alone, appears to reduce liquidity in the equity market. Unlike its negative impact on liquidity, bond market trading has little incremental impact on price efficiency. On the other hand, and consistent with prior evidence that options markets can be attractive venues for information-based trades (e.g., Easley, O'Hara and Srinivas (1998), Chan, Chung and Fong (2002), Cao, Chen and Griffin (2005) and Pan and Poteshman (2006)), we find some evidence that options market trading plays a positive role for price efficiency.

Finally, our third key finding is due to our identification of a proxy for passive trading activity in the stock, as opposed to speculative or informed trading. We find that passive, multi-security trading is associated with higher equity market quality. This result is useful for two reasons: (1) it suggests that passive trades due to hedging demands are beneficial, rather than destabilizing and (2) it allows us to isolate the impact of speculative/informed trading in the related markets analysis.

To understand the dynamic relationship between related markets and equity market quality we introduce firm fixed effects into our empirical specification. This forces all variation in the related markets variables to be driven by within-firm changes over time in whether such a market exists. The interpretation of the results of these regressions is dynamic (it captures the impact of introducing a market for a related security), rather than cross-sectional as in the initial analysis. Interestingly, we find strong evidence of a negative role for the introduction of debt-linked markets (public bond and CDS) for both stock price efficiency and trading costs. As in the initial analysis, the existence of an options market positively affects both the price efficiency and liquidity dimensions of equity market quality (trading activity in options markets still plays a negative role for liquidity, as in the initial analysis).

This paper's focus on the impact of CDS on equity market quality is new to the literature. Therefore, we take particular care in interpreting the strong, negative CDS results. One potential concern with the credit default swap result is that CDS firms could be different from other firms in that, for example, they are larger than other firms and have credit ratings. Large firms with credit ratings may differ from other firms in ways that are systematically related to equity market quality. To control for potential differences between CDS firms and non-CDS firms, we conduct a matched sample analysis using the propensity score methodology in Rosenbaum and Rubin (1983). We match CDS and non-CDS firms according to Ashcraft and Santos (2009). Even after controlling for selection bias in this way, the main results of a negative role for CDSs on equity market quality remain. Our findings of a strong negative role for CDS in equity markets are in line with very recent work on the informational efficiency of corporate bond markets by Das et al. (2011). In that paper, in which the authors report that bond market informational efficiency deteriorates when CDSs are introduced.

Given the recent interest in CDS markets, we extend the analysis in order to deepen our understanding of the potential mechanisms driving the CDS result. In particular, we examine whether the role of credit default swaps varies with the overall condition of the firm's equity market. We interact the CDS market variable with proxies for: uninformed/liquidity trading in the stock; uncertainty about firm fundamentals; and distance of the firm to default. In all cases, we find that the impact of CDS markets is worse when the firm and its equity market are in a "good" state (i.e., more liquidity traders, less disagreement and greater distance to default). CDS markets are less damaging in "bad" states. Our interpretation of this finding is that there is more speculation in CDS markets when market conditions are favorable and that potentially beneficial informed trading and hedging transactions in CDS are more relevant than speculation during bad times.

Our paper contributes to the theoretical and empirical literature on the impact of related markets for equity market quality. Biais and Hillion (1994) show that when there are asymmetrically informed agents, a related (non-redundant) market can increase price efficiency in that it allows for informative trades, but that it can also reduce price efficiency because it expands the informed agents' set of trading strategies, making it more difficult for market makers to learn from trades. In Dow (1998), speculators can use the related market to hedge risk of their positions in the primary market, leading pure liquidity traders to exit. This can reduce market liquidity. In a more extreme case, Bhattacharya, Reny and Spiegel (1995) describe destructive interference, in which a new securities market causes collapse of the existing market. Given the ambiguous theoretical impact of related markets, prior empirical work has focused on estimating the impact of equity options on equity market quality.[2] There is little work on the impact of traded debt or of debt derivatives on equity market quality. Understanding the roles of these markets can provide a more complete picture of the impact of related securities.

[2]See e.g., DeTemple and Jorion (1990) and Kumar, Sarin, and Shastri (1998) for the impact of options listing on equity market quality. See Easley, O'Hara and Srinivas (1998), Chan, Chung and Fong (2002), Cao, Chen and Griffin (2005) and Pan and Poteshman (2006) for the role of options in price discovery.

Our paper helps fill this gap.

Our research also sheds light on recent findings regarding the relationship between equity market quality and capital structure. Lipson and Mortal (2009) document a link between liquidity and capital structure. They find that firms with more liquid equity have lower leverage and tend to issue new equity rather than debt. Frieder and Martell (2006) report similar findings. Our findings complement these in that we find that the existence of and trading in debt-linked securities markets can be one mechanism by which capital structure choice impacts equity market quality. In particular, we find evidence consistent with a negative role for potentially speculative trading when firms have publicly traded debt. This effect is magnified when there are traded CDS contracts on that debt. Thus, it may not be debt alone that drives the prior findings of a negative relationship between leverage and equity market quality, but rather the multiple venues in which informed traders and speculators execute their trades. Lipson and Mortal (2009) and Frieder and Martell (2006) are the only two papers (to our knowledge) that explicitly examine the interactions between capital structure and equity market liquidity. Ours is the only one to examine potential trade-based links among capital structure, liquidity and price efficiency.

Our research is also relevant to policy-makers, especially given the current debate regarding the role of credit default swaps.[3] It is crucial that policymakers understand both the benefits and costs associated with financial innovation. Because derivatives markets have developed rapidly, there have been few academic studies documenting empirically the dominant effects (and their magnitudes) of having traded CDS contracts. Our results strongly suggest a negative role of CDSs for equity market liquidity and equity market price efficiency. However, we emphasize that our findings identify *one* effect associated with traded CDSs on a firm's debt. This does not rule out other potential benefits (or costs) that CDSs may have. For example, the ability to hedge may be an important

[3]See, for example Stulz (2010) for a discussion of debates regarding CDS markets.

benefit of CDS markets, because it can decrease the cost of supplying capital to firms and increase suppliers' willingness to extend credit. What is important is that each of the potential costs and benefits associated with CDSs be identified and measured. Our analysis takes one step in this direction.

Multi-asset trading strategies are growing in popularity among investors. In fact, *Institutional Investor's* October 2008 issue, "A Guide to Multi-Asset Trading Strategies" is devoted to this subject. In response to demand from investors, there have been recent successful launches of cross-market trading platforms such as *Realtick* and cross-market valuation tools such as *PrimeSource* by NYSE/EuroNext. These cover wide ranges of products, including equities, bonds and derivatives and highlight the potential growing importance of linkages between related markets.

This paper is organized as follows. Section 2 discusses related literature. Section 3 describes the data and market quality variable construction. The empirical methodology and results of the baseline investigation of the impact of option, bond and CDS markets on equity market quality are given in Section 4. Robustness analyses are presented in Section 5. Section 6 concludes.

II. Literature

The idea that related markets can generate liquidity and efficiency externalities underlies much of the analysis in this paper. There is a substantial theoretical literature on the impact of the introduction of a related market on an existing security market (see, e.g., Mayhew (2000) for an excellent survey). Overall, the theoretical effect is ambiguous. The empirical literature has typically sought to answer this question by analyzing linkages between individual options and stock markets. Overall, findings suggest that individual equity options improve equity market quality (DeTemple and Jorion (1990); Kumar, Sarin, and Shastri (1998)) and that these options markets can be preferred venues for informed traders (Easley, O'Hara and Srinivas (1998), Chan, Chung and

Fong (2002), Cao, Chen and Griffin (2005) and Pan and Poteshman (2006)). Using more recent data, however, Muravyev, Pearson and Broussard (2011) find that price discovery takes place in the equity market rather than the option market. There has, however, been little empirical work on the linkages between stock and debt markets. Understanding the impact of trading in debt-linked securities on equity market quality is of particular interest. Under the trade-off theory of capital structure, managers should choose debt levels to balance the costs and benefits of debt. In this context, this paper analyzes both debt and equity linked securities markets.

This paper asks how additional related markets affect market quality in the primary market. Microstructure theory has also examined a closely related question, how fragmentation of order flow for the primary-market securities affect trading costs. Pagano (1989a, 1989b) and others have argued that the consolidation of order flow leads to positive network externalities that benefit traders.[4] On the other hand, Chowdhry and Nanda (1991) analyze a situation where large uninformed traders optimally split orders among market centers. They show that these large traders are better off with competition among markets, because they benefit from the presence of the small traders who only have access to one market. Biais (1993) models fragmented and centralized markets as different auction mechanisms. He shows that both market structures yield identical expected quoted spreads, although quotes are more volatile in a centralized market where participants can observe their competitors' current quotes. In contrast, Bernhardt and Hughson (1997) show that trading costs increase when traders can split orders among market centers. Madhavan (1995) shows that fragmented markets decrease price competition, resulting in less efficient prices. Like the theoretical literature on the impact of related markets for equity market quality, the mixed theoretical implications in this literature motivate further empirical analysis into the effects of fragmenting the flows of orders and, potentially, information.

[4] See O'Hara (1995) and Madhavan (2001) for summaries of theoretical approaches to the fragmentation question.

Although we are unaware of studies that have explicitly examined the role of corporate debt markets on liquidity and overall stock price efficiency, there are a handful of recent papers (e.g., Downing, Underwood and Xing (2009) and Ronen and Zhou (2010)) that examine lead-lag effects in individual stock and corporate bond returns. Overall findings on whether corporate bonds contribute to price discovery are mixed. Corporate bonds are traded over the counter; however many are subject to mandatory trade reporting. The evidence of the impact of the introduction of bond information dissemination on the TRACE system on corporate bond market liquidity (e.g., transaction costs) is more consistent than the price discovery evidence. Bessembinder, Maxwell and Venkataraman (2006), Edwards, Harris and Piwowar (2007), and Goldstein, Hotchkiss and Sirri (2007) all report increases in bond market quality following trade reporting. In addition to its effect on bond markets, the information disseminated on the TRACE system may also have equity market implications.

Corporate debt derivatives markets have received considerable attention in the literature over the past few years. Credit default swaps are essentially insurance on a firm's risky debt. They are useful for hedging and also as a tool for speculating on credit risk. Particularly relevant for our study are the studies of insider trading in credit default swap markets (e.g., Berndt and Ostrovnaya (2007); Acharya and Johnson (2007, 2010)). These papers typically find evidence of informed trading in CDS markets.[5] Insider trading can improve market quality by improving price informativeness; however, it can also decrease it if liquidity traders are driven out of the market. Ashcraft and Santos (2009) examine this issue by studying the impact of CDS trading on firms' debt spreads for a subsample of opaque firms. Contrary to the price discovery hypothesis, they report that CDSs are associated with increased spreads for more informationally opaque firms.

Finally, our paper is related more generally to the literature on related markets and

[5]Researchers have also found that prices in CDS markets are more informative about the issuing companies' credit quality than the prices of bonds (see e.g., Blanco, Brennan, and Marsh (2005)).

cross-market spillovers. Amihud, Lauterbach and Mendelson (2003) examine market fragmentation and the impact of market size on liquidity. When two identical securities of the same company are traded in the market they find that the stock's value is depressed due to fragmentation. A similar argument may explain the interactions among leverage, debt-linked securities and equity market quality that we observe. The market fragmentation that occurs via separate markets for claims across a firm's capital structure may cause a reduction in equity market quality. Spiegel (2008) identifies several important puzzles relating to cross-market liquidity, and in the extreme, poses the question: "Why do some markets exist and not others?" Our evidence regarding the impact of the existence of a related market on the liquidity and efficiency of equities may shed some light on this larger question.

III. Data

A. Sample Construction

We use data from six sources. We begin with all NYSE listed firms from the CRSP/Compustat merged database. We then use the NYSE's Trade and Quote (TAQ) database to construct market quality measures for these firms. Because we are, in part, interested in isolating the potential impact of the ability to trade in related markets on informed traders' activities, we introduce a proxy for passive multi-security trading using program trading information from NYSE's proprietary Consolidated Equity Audit Trail Data (CAUD).[6] Option listing, trading volume and price data are from OptionMetrics. Corporate bond data for all bonds for which trades are publicly disseminated on the FINRA TRACE (Trade Reporting and Compliance Engine) are from TRACE.[7] Finally,

[6]The NYSE account types have been used in a handful of other papers. For example, using the same data set, Kaniel, Saar, and Titman (2007) investigate retail trading and Boehmer and Kelley (2009) look at the relationship between informational efficiency and institutional trading. Boehmer, Jones, and Zhang (2008) analyze differences in the informativeness of short selling across account types.

[7]TRACE collects and distributes transaction information from the over-the-counter corporate bond market for all TRACE-eligible bonds (i.e., publicly traded investment grade, high yield and convertible corporate debt). Dissemination of information for TRACE-eligible bonds was phased in over two years,

we use the CMA Datavision database ("CMA") to identify all firms for which we observe CDS quotes on their debt. Given the wide use of CMA among financial market participants (e.g., it is the source of the CDS data disseminated on Bloomberg[8]), we assume that CDS contracts for which there is quote information in CMA are actually traded. The OptionMetrics, TRACE and CDS data are matched with the CRSP/Compustat database based on 6-digit Cusips; TAQ and CAUD data are matched based on Cusips and, where necessary, ticker identifiers from the TAQ Master File. The sample period covers the years 2003-2007 because TRACE reporting did not begin until July 2002 and our NYSE CAUD data end in 2007. For inclusion in the final sample, we require non-missing data on all variables of interest.

B. Market Quality Measures: Data

We are interested in two dimensions of market quality: liquidity and price efficiency. We examine two measures of trading costs and two price efficiency measures, both of which capture deviations of price movements from a random walk. We use intraday data to construct all variables; however, the liquidity variables are aggregated to the daily level and the stock price efficiency measures are calculated at monthly intervals (due to the relatively large number of transactions required for reliable estimation of the Hasbrouck (1993) efficiency measure, described below).

We rely on the TAQ data to construct all equity market quality measures. We use only trades and quotes that occur during regular market hours. For trades, we require that TAQ's CORR field is equal to zero, and the COND field is either blank or equal to @, *, B, E, J, or K. We eliminate trades with non-positive prices or sizes. We also exclude a trade if its price is greater than 150% or less than 50% of the price of the previous

beginning in July 2002 with just 50 high yield issues as well as all investment grade issues of $1 billion or more. By October 2004, dissemination for all TRACE-eligible bonds was complete.

[8]The Bloomberg historical CDS data has also been used in Das, Hanouna and Sarin (2009).

trade. We include only quotes that have positive depth for which TAQ's MODE field is equal to 1, 2, 3, 6, 10, or 12. We exclude quotes with non-positive ask or bid prices, or where the bid price is higher than the ask price. We require that the difference between bid and ask be less than 25% of the quote midpoint. These filters are the same as those that are applied in Boehmer and Kelley (2009).

For each stock, we aggregate all trades during the same second that execute at the same price and retain only the last quote for every second if multiple quotes are issued. We assume no trade reporting delay and make no time adjustment (Lee and Ready (1991); Bessembinder (2003)).

C. Variable Construction

C.1. Liquidity Measures

The (inverse) liquidity variables capture transactions costs. We compute time-weighted quoted spreads and trade-weighted effective spreads (*QS* and *ES*, respectively) from TAQ as measures of trading costs. Effective spreads are twice the absolute difference between the execution price and the quote midpoint prevailing when the trade is reported. Quoted spreads are the difference between ask and bid prices, weighted by the duration for which a quote is valid. To normalize both *QS* and *ES*, we divide by the closing price of the stock. Lower spreads are interpreted as greater equity market liquidity.

C.2. Efficiency Measures

Hasbrouck (1993) decomposes the (log) transaction price, p_t, into a random walk component, m_t, and a transitory pricing error, s_t, where t represents transaction time:

$$p_t = m_t + s_t$$

Under the assumption that informationally efficient prices follow a random walk, we measure efficiency based on the distance between actual transaction price movements and a random walk.

The unobservable random walk component m_t represents the expectation of security value. Innovations in m_t reflect both new public information and the information content of order flow. The pricing error, s_t, which captures temporary deviations from the efficient price, may arise from the non-information-related portion of transaction costs, uninformed order imbalances, price discreteness, and dealer inventory effects. It is assumed to follow a zero-mean covariance-stationary process but may be serially correlated or correlated with the random walk innovation of the efficient price process. Because the pricing error has a mean of zero, its standard deviation, σ_s, is a measure of its magnitude. Intuitively, σ_s describes how closely transaction prices follow the efficient price over time, and can therefore be interpreted as an (inverse) measure of informational efficiency.

We follow Hasbrouck (1993) and estimate a lower bound for σ_s using a VAR system over $\{r_t, x_t\}$, where r_t is the first difference of p_t and x_t is a vector of explanatory variables whose innovations relate to innovations in m_t and s_t. Specifically, we impose the identification restriction that innovations in s_t must be correlated with $\{r_t, x_t\}$, and obtain the estimate of σ_s from the vector moving average representation of the VAR system (Beveridge and Nelson 1981). The VAR has five lags, and x_t is defined as a three-by one vector of the trade variables: (1) a trade sign indicator, (2) signed trading volume, and (3) the signed square root of trading volume. This structure of x_t allows for a concave relationship between prices and the trade series.

We follow Boehmer and Kelley (2009) and use all trade observations except when reported prices differ by more than 30% from the previous price, which we consider to be erroneous and eliminate from the sample. To sign trades, we assume that a trade is buyer-initiated if the price is above the prevailing quote midpoint (and seller-initiated for the converse). Midpoint trades are not signed, but we include them in the estimation (with $x = 0$). To eliminate overnight price changes, we restart each process at the beginning of each trading day. We estimate σ_s monthly. To assure meaningful estimates in this case, we only include stock-months with at least 200 stock transactions per month.

We use $V(s)$ or "pricing error" to refer to σ_s. *Hasbrouck* is defined as $V(s)$, normalized by $V(p)$, the standard deviation of (log) transaction prices. *Hasbrouck* is our main stock price efficiency measure.

Similar to Boehmer and Kelly (2009) and Choi, Getmansky and Tookes (2009), we construct an alternative efficiency measure based on return autocorrelations. We estimate quote midpoint return autocorrelations ($|AR|$), using 30-minute quote midpoint return data over one-month horizons. We exclude periods without quote changes to avoid using stale quotes in these computations.

Like the *Hasbrouck* measure, $|AR|$ captures deviations of stock prices from a random walk. Low (absolute) return autocorrelations suggest that prices more closely follow a random walk. Both the *Hasbrouck* and $|AR|$ measures look over short horizons (transaction-to-transaction and 30-minute intervals, respectively), as traders are assumed to move very quickly to eliminate pricing errors in NYSE stocks (see Chordia, Roll, and Subrahmanyam, 2005). Unlike the *Hasbrouck* measure, the $|AR|$ measure is sensitive to price changes due to trade reversals and is calculated at uniform intervals that do not depend on trade intensity. We include the $|AR|$ measure for comparison (while the two are generally consistent the *Hasbrouck* measure is more powerful in tests), but rely mainly on the *Hasbrouck* measure in interpreting our results.

C.3. Explanatory Variables

Related Markets

We include three related markets dummies: *tradedoption* is a dummy variable equal to 1 if the firm has listed options during period t, 0 otherwise; *tradedbond* is a dummy variable equal to 1 if the firm's bond information is disseminated on the TRACE system during period t[9]; *tradedcds* is a dummy variable equal to 1 if the firm has a CDS traded on its

[9] The TRACE system reveals information regarding transactions in a firm's publicly traded bonds to all market participants. In this way, TRACE eligibility could impact market quality beyond the

debt, defined as firms for which there are CDS quotes in the CMA data during period t. Of course, related markets can exist without a mechanism for disseminating quote and/or trade information (i.e., private bilateral trades). By "related markets," we refer to markets in which there is substantial trading activity and about which there is sufficiently broad dissemination of information that equity market participants (especially liquidity providers) can analyze. Coefficients on these three dummy variables in the regression analysis are interpreted as the impact of having a related market on the market quality variables.

In extended analysis, we also include trading activity in the option and bond markets (we do not observe trading activity in CDS markets; however, in robustness analysis, we use the number of daily CDS quotes as a proxy for CDS market activity). *lagoptvol* is the (log) sum of the dollar volume of all trades in the firm's listed stock options from OptionMetrics. *lagbondvol* is the (log) sum of the dollar volume of all of the firm's bonds as reported on the TRACE system.[10] Note that for large trades, transaction size is not disseminated on TRACE. We set the value of trades reported as "greater than \$5 million" at their lower bound (\$5M). The idea behind including the trading activity measures is that related markets can impact equity market quality in two ways: (1) they can change incentives for market participants to gather price-relevant information and (2) they can change incentives for market participants to trade on price-relevant information. These information-gathering and trading incentives can have separate effects on market quality.

Control Variables

We control for stock market trading activity using two variables. The first, *lagdvolume*,

potential impact of a firm having debt in its capital structure. See e.g., the discussion of the impact of TRACE on transparency in the corporate bond market Bessembinder and Maxwell (2008). To isolate the impact of the "related market" as distinct from the impact having debt, all regressions control for firms' debt-to-equity ratios.

[10]Because there are zero trade days, *lagoptvol* and *lagbondvol* are calculated as ln(dollar trading activity + \$1).

is the lagged natural log of total daily trading volume as reported on CRSP, times the closing price. The second, *lagprogram*, is the dollar volume of program trading, defined as the (log) sum of institutional buy and sell dollar volume for their program trades, based on the daily NYSE CAUD data.[11]

The NYSE defines program trades as the trading of a basket of at least 15 NYSE securities valued at $1 million or more. Many of these trades are part of index arbitrage strategies, and it is not clear that they represent trading on firm-specific factors. Other program trades may bundle uninformed order flow, perhaps originating from index funds or a broker's retail clients, where the bundling serves as a way to signal the absence of security-specific information. We are interested in the impact of informed and speculative participants in related markets on equity market quality. To differentiate it from uninformed trading we include the *lagprogram* variable as a control for these passive transactions. To our knowledge, this proxy is new to the literature.

Outside of the intuition that program traders are unlikely to trade on firm-specific factors, there are theoretical reasons why we would expect program trades to help identify uninformed multi-security trading. Subrahmanyam (1991) shows that when uninformed traders choose between trading in individual securities or in baskets, the uninformed will have incentives to trade in the baskets. This is because asymmetric information costs are higher in the markets for the individual securities. Similarly, Gorton and Pennacchi (1993) show that basket/index securities can reduce the adverse selection costs paid by uninformed traders, making them better off. While neither model implies no informed

[11]We obtained NYSE's proprietary Consolidated Audit Trail Data (CAUD) for the period January 2000 and August 2007. The CAUD cover nearly all trades executed at the NYSE and show, for each trade, the individual buy and sell orders executed against each other (or market maker interest). Each component is identified by an account type variable that gives some information on trader identity. Several different regulatory requirements include obligations to indicate: orders that are part of program trades, index arbitrage program trades, specialist trades, and orders from market makers in the stock who operate at other trading venues. We focus on program trades, taking the sum of buy and sell share volume for each day and security. We exclude trades that are cancelled or later corrected, trades with special settlement conditions, and trades outside regular market hours. Note that because we define program as the sum of buy and share volume, in order to directly compare the magnitude of this measure to the *lagdvolume* variable, we would divide the sum by 2.

program trades, they both show that trading in such securities will be particularly attractive to uninformed liquidity traders. Indeed, Hasbrouck (1996) finds that while all types of trading have information content, index arbitrage trades (which comprise the majority of program trades in his sample), have significantly smaller information content than other types of orders.

To control for firm size, we include an equity market capitalization variable, *res_mcap*, defined as the portion of equity market capitalization that is orthogonal to dollar volume. We do not include market capitalization directly because the correlation between market capitalization and dollar volume is high, at 0.86; however, our qualitative results regarding the impact of related markets are not sensitive to the market capitalization transformation. We include the firm's debt-to-equity ratio $\frac{debt}{equity}$ to address the potential concern that any findings regarding *tradedbond* or *tradedcds* are capturing the impact of debt in firms' capital structures rather than the related markets. This control is particularly important given recent findings in Lipson and Mortal (2009) that firms with low leverage have more liquid equity. The $\frac{debt}{equity}$ variable is defined as the sum of the firm's long term and current debt outstanding, divided by the end-of-quarter total assets (based on quarterly data for quarter *t-1*, from Compustat). We also control for equity price *lagvolatility*, defined as the lagged square of the daily stock return in CRSP in all regressions.[12] All control variables are winsorized at the 1st and 99th percentiles.

D. Descriptive Statistics

Descriptive statistics for all variables are presented in Table 1. There are 1,707 unique firms, with between 1385 and 1491 firms in the sample each year. There are 1,509,984 daily observations (used in the liquidity analysis) and 65,110 monthly observations (used in the efficiency analysis). We observe related markets for a significant number of

[12] The *lagdvolume*, *res_mcap* and *lagvolatility* variables control for findings in Mayhew and Mihov (2004), who report that firms selected for options listing have high trading volume, market capitalization and volatility.

firms during our sample period: 69% have traded options; 40% have bond information disseminated on the TRACE system; and 16% have a CDS quoted in the CMA data.

IV. Empirical Analysis

A. Methodology

Our goal is to measure the impact of the related markets on equity market quality. Our first regression specification is:

$$\text{Market Quality}_{it} = \alpha + \beta_1 * opt_{it} + \beta_2 * trace_{it} + \beta_3 * cds_{it} + \beta_4 * X_{it} + e_{it} \qquad (1)$$

The coefficients β_1, β_2, and β_3, have straightforward interpretations: they capture the impact of having a listed option, bond on the TRACE system, or CDS on its debt, on the firm's equity market quality. The variables in control vector X are: one-period lagged dollar volume of program trades (*lagprogramtrade*); one-period lagged dollar volume in the stock (*lagdvolume*); contemporaneous stock price *lagvolatility*; and the debt-to-equity ratio of the firm ($\frac{debt}{equity}$).[13] Recall that high values for the market quality measures are associated with low market quality (e.g., large trading costs indicate low liquidity). Therefore, negative estimated coefficients on any of the explanatory variables are interpreted as a positive relationship between the right-hand-side variables and market quality.

In interpreting the related market results (i.e., estimated coefficients on β_1, β_2, and β_3), it is useful to distinguish between the market quality implications of having a related market versus the impact of trading activity in that market. On the one hand, the existence of the related market may provide market participants with incentives to gather more detailed information about the firm, including the links between the firm's equity and the related security. Trading on this information can lead to more informative prices and potentially more liquid markets. On the other hand, an increased likelihood

[13] *lagdvolume* and *lagprogramtrade* are calculated as ln(dollar trading activity in \$000 + .001).

of informed trading can reduce market liquidity and, if the informed trader's trading strategy is sufficiently complicated, prices can become less informative. It is also possible that related markets are more susceptible to noise traders. To understand the potentially distinct roles of the existence of a related market and trading in that market, we also estimate the following equation, which is an extension of (**??**) :

$$\begin{aligned}\text{Market Quality}_{it} &= \alpha + \beta_1 * opt_{it} + \beta_2 * trace_{it} + \beta_3 * cds_{it} \\ &+\beta_4 * lagoptvol_{it} + \beta_5 * lagbondvol_{it} + \beta_6 * X_{it} + e_{it} \qquad (2)\end{aligned}$$

The related markets trading activity variables are *lagoptvol* and *lagbondvol*, the one-period lagged (log) dollar volume in the firm's options and bonds, respectively. The coefficients on these variables allow us to decompose the combined effect of the related market estimated in Equation (**??**) into two components: (1) the market quality effect of having a related market and (2) the impact of trading activity in those markets. This will provide some insight into the mechanisms by which related markets impact equity markets. We do not have data on daily trading activity in CDS markets so are only able to observe the combined impact of the existence of, and trading in CDS contracts.

In all initial regressions, we employ multivariate panel regressions with standard errors clustered at both the time and firm levels. All liquidity measures are calculated using daily data. Because of the large number of trade observations required to estimate the Hasbrouck (1993) measure, the efficiency measures are calculated over monthly intervals. For comparability, we also calculate the |AR| efficiency measure (30-minute return autocorrelations) using data at monthly intervals. In this case, all independent variables are calculated at monthly intervals (i.e., we take monthly averages of daily data).

B. Results

B.1. The Impact of Related Markets on Equity Market Quality

Table 2 shows results from estimating Equations (**??**) and (**??**) for each of the four market quality measures. In the Table, the Equation (**??**) results are in the left-most column under each market quality variable. The most important observation from the results is that the related markets impact both liquidity and market quality, albeit in different ways (depending on the related market). The negative and significant estimated coefficients on the options market dummy (*tradedoption*) indicate that, else constant, traded equity options are associated with significantly improved equity market quality. For example, in the results from Equation (**??**), the estimated coefficient of -0.0002 on the *tradedoption* dummy variable in the *QS* regression suggests that firms with listed options have quoted percentage spreads that are 2 basis points lower than firms without traded options (this represents approximately 10 percent of the mean *QS* of 21 basis points). For firms with traded optioins, the pricing errors (*V(s)*) decrease by 0.29% of total price variance (*V(p)*) (approximately 25 percent of the mean value of 1.18%), suggesting that the prices of these firms more closely follow a random walk.

In contrast to the options markets results, the *tradedbond* results from Equation (**??**) in Table 2 show a negative role for bond markets in both liquidity and efficiency. We find that, all else equal, the overall impact of having bond information disseminated on the TRACE system is associated with greater transaction costs and lower efficiency using the *Hasbrouck* measure (when efficiency is measured according to the $|AR|$ measure, the coefficient is statistically insignificant). It seems that the information on the TRACE system provides a more complex signal about equity value, making learning about equity prices more complicated for market makers (as in Biais and Hillion (1994)).

Finally, the results from Equation (**??**) in Table 2 show strong evidence that having a traded CDS is negatively and significantly related to all measures of liquidity and market efficiency. Moreover, the estimated magnitudes of the impact of *tradedcds* in the liquidity regressions tend to be much greater than the magnitudes of the coefficients on *tradedoption* or *tradedbond* (by factors of 2 or 3). In the efficiency regressions, the magnitudes of the coefficients on *tradedcds* are smaller than the estimated impact of having listed options and typically greater than the impact of *tradedbond*. The implication is that the dominant impact of CDS markets is negative. This is consistent with the mechanisms in Dow (1998) and Biais and Hillion (1994). In Dow (1998), the entry of speculators in primary market due to their ability to hedge in the related market can in turn cause a withdrawal of pure hedging transactions from the equity market. This reduces liquidity. In Biais and Hillion (1994), the additional market can make the inference process for market makers learning from trades more complicated, thereby reducing efficiency.[14]

The estimated coefficients on two of the control variables are worth noting. First, the estimated coefficients on the firm's $\frac{debt}{equity}$ suggest that leverage actually plays a positive role in liquidity, after controlling for the related markets. Thus, it may be that the existence of related markets for trading a firm's credit are an important driver of the the negative role for leverage for liquidity reported in Lipson and Mortal (2009). The estimated coefficients on the program trading volume (*lagprogramtrade*) variable, which we use to proxy for passive multisecurity trading in the stock, also provides insight. Consistent with the idea that these are passive trades, we find strong negative relationships between program trades and all (inverse) market quality measures. It appears that passive trades due to hedging demands have a stabilizing effect on equity prices. This is important, because it helps us isolate the potentially informative component of related markets (and trading in related markets, which we examine in the next section). Our finding regarding program trading complements findings in Hendershott, Jones and Menkveld (2009) that algorithmic trading improves equity market liquidity and quote informativeness.

[14] While we do not study the impact on underlying bonds, the CDS findings are also consistent with the argument in Gorton (2010) that the introduction of CDSs can cause previously non information sensitive debt to become information sensitive, thereby increasing incentives for private information production.

After controlling for passive multi-security trading, *res_mcap* and (log) dollar volume in the stock have a mixed impact on market quality, with a generally negative impact on price efficiency. The coefficients on the equity *lagvolatility* control are similarly mixed and are statistically insignificant.

The results of estimating Equation (**??**) are also presented in Table 2, in the right-most columns under each of the four market quality variables. The related market dummies have similar coefficients as those that we observe from estimating Equation (**??**) except that the existence of a bond market on its own does not have a negative effect on liquidity or efficiency. The negative effect that we observe from that market comes from trading in corporate bonds. Interestingly, the results show that the dominant effect of trading activity in both options and bond markets is negative. Thus, when options traders trade, the positive impact of having an options market shown in Table 2 is substantially dampened. For example, the coefficient of 0.000212 on the *lagoptvol* variable (the natural log of dollar trading volume in options + \$1) in the *QS* regression suggests that the average stock needs just \$51 in options trading volume to outweigh the positive impact of having listed options.[15] Similarly, increases in bond market trading have a negative impact on the market quality measures. We cannot observe trading in CDS contracts. Therefore, it may be that having a CDS market is "good" while trading in that market is "bad"; however, because we do not observe trading in CDS contracts, we cannot disaggregate these individual components as we do for options and bonds.[16] We do, however, continue to provide estimates of the overall impact of the existence of this market. As in the regressions using Equation (**??**), the results of estimating Equation (**??**) strongly suggest a negative role for CDS markets on both equity market liquidity and stock price efficiency.[17]

[15]This required options trading volume of \$51 is nearly four times the average daily dollar volume of options trading for all firms in the sample. Note that depending on moneyness, options prices can be very low.

[16]In robustness analysis, we introduce a proxy for CDS market activity using CDS quotes, to aid in the interpretation.

[17]Because debt-linked securities markets might be relatively more relevant to stock prices when they

To summarize, our initial findings are shown in Table 2. We find a significant, positive role for options markets in equity market quality. CDS and bond markets, on the other hand, are associated with lower quality. Trading activity in both corporate bond and options markets are negatively related to stock market quality. When we rank the estimated effects of the related markets for liquidity, we generally find that the impact of CDS markets is most negative, followed by corporate bond markets, and then options (which have an overall positive effect). For efficiency, CDS and bond markets have more similar negative effects, and the impact of options is overall positive. The negative association between market quality and related markets for debt-linked securities may stem from increased complexities associated with market segmentation when firms have traded debt in the capital structure.

C. Within Firm Analysis: Related Markets and Equity Market Quality

The results of the initial analysis in Table 2 suggest that the equity market quality of firms with listed options, public bonds on the TRACE system and quoted CDS contracts differ from firms without these related markets. We find that the overall impact of having an options market is positive, but that firms with debt in their capital structures, particularly those with CDS contracts on their debt have equity markets with higher transactions costs, and stock prices that are less efficient. One natural extension of the analysis is to examine the impact of the introduction of a related market on equity market quality. Because we have a panel of firms, we are able to exploit the time series properties of the data. In this section, we repeat the analysis in Table 2 and introduce firm fixed effects.[18] This controls for time-invariant firm characteristics, and the related

are declining, the difference in signs of the equity options and CDS/Trace results may be due to their being relevant at different times. In unreported tests, we investigate whether the patterns that we observe are driven by negative stock return days. We find very little difference in the main results on negative versus positive return days.

[18]Rather than clustering standard errors at both firm and time level, standard errors are now clustered at the time level and the model is estimated with firm fixed effects.

markets coefficients are therefore interpreted as the change in market quality after the introduction of a related market. All identification for the related markets coefficients comes from firms for which a related market is added over the sample period. Results of the fixed effects specifications are presented in Table 3 and are analogous to Table 2.

Table 3 shows the impact of adding a related market on market quality. Similar to Table 2, we find a significantly positive effect of the introduction of options on price efficiency (consistent with the evidence in e.g., Easley, O'Hara and Srinivas (1998), Chan, Chung and Fong (2002), Cao, Chen and Griffin (2005) and Pan and Poteshman (2006)). Unlike the cross-sectional results in Table 2, we do not find that the introduction of options markets improves liquidity. While the fixed effects do absorb some potentially interesting variation the data, it is possible that the positive relationship between options markets and liquidity in Table 2 are driven by firm-specific effects. It may also be that the introduction of options markets also involves trading in those markets and the positive impact of adding the options market is wiped out by trading after introduction. Similar to Table 2, we find a significant, negative role for the introduction of bonds and CDS for both liquidity and price efficiency.

Table 3 also incorporates the impact of increases of trading activity in the related markets. Consistent with the results in Table 2, we find that increases in trading activity in the related markets (i.e., both bonds and options) negatively impact equity market liquidity. After separating the effects of introducing an options market from trading activity in that market we again find that the introduction of options markets improves equity market liquidity (while increased trading in options causes a decline in equity market liquidity).

Taken together, these time-series results suggest a potentially important (negative) interaction between the introduction of related markets stemming from debt in firms' capital structures and both stock market liquidity and efficiency.

D. The Impact of CDS Markets: Matched Sample Methodoloy

Given the relatively recent development of and policy interest in CDS markets, we want to be sure that our CDS results are not driven by time-varying differences between CDS and non-CDS firms. Most notably, CDS firms tend to be bigger than other firms and they also have credit ratings. One important observation is that our empirical findings of a strong negative role for CDS in stock market liquidity and price efficiency are the opposite of what one would expect for firms with these characteristics. Moreover, we explicitly control for the dollar volume of trading in a firm's stock (correlated with size) and whether a firm has a bond listed on the TRACE system (i.e., has publicly traded debt and a credit rating). Still, we want to check that our results are robust to explicitly controlling for potential selection bias. Therefore, we repeat the initial analysis using only CDS firms and a matched sample of non-CDS firms. The matched sample is constructed based on the propensity score methodology in Rosenbaum and Rubin (1983). We estimate the probability of having a CDS market with a probit model, using the (one-quarter lagged) covariates from Aschcraft and Santos (2009): equity analyst coverage; log stock market volatility; dummy variable equal to one if the firm has a credit rating; log sales; debt-to-assets; book-to-market; and log equity market trading volume. For each CDS firm, we identify a non-CDS firm with the closest propensity score (making sure that the absolute difference in propensity scores is less than 10% of the CDS firm's propensity score). We are able to find a non-CDS match for 293 out of the 319 CDS firms that we observe during our sample period.

Table 4 is analogous to Table 3, but regressions are based on only CDS firms and the matched sample of non-CDS firms. As in Table 3, all regressions control for time-invariant firm-specific heterogeneity via firm fixed effects. Thus, coefficients are interpreted as the impact of introducing the related market. The main findings of: (1) a negative role for CDS markets; (2) a positive role for options markets and (3) a negative role for trading in both options and bonds are robust in the matched sample analysis. The only finding that is inconsistent with the earlier results is that, similar to options markets, the introduction of traded bond markets appears to improve equity liquidity after we implement the matched sample methodology. It may be that being able to observe trades in a firm's debt makes traders more willing to trade in a firm's equity. But the ranking from Table 3 is preserved: option introductions have better effects on equity market quality than do bond introductions or CDS introductions, in that order. We do not find that introducing bond markets improves efficiency. Like the earlier results, the impact is negative (i.e., the introduction of the bond market actually makes equity prices worse, perhaps because of a more complicated price discovery process).

E. Equity Market Quality Near the CDS Introduction Event

The results from the fixed effects regressions (Tables 3 and 4) provide strong evidence of a decline in equity market quality near the introduction of CDS markets. However, because these regressions use the entire post CDS introduction to estimate the impact of CDS markets, the results do not tell us much about the time horizon over which we might expect quality to decline. In this section, we introduce a second empirical approach in which we isolate the CDS introduction event and examine changes in equity market quality during year t-1 through year t+1 relative to CDS introduction, compared with changes in the matched sample of non CDS firms. That is, we employ fixed effects regressions using data only during the two-year window centered around the CDS introduction event for the CDS and matched sample firms (similar to Table 4). The results are shown in Table 5. Despite the truncated time series, the CDS results are remarkably similar, both qualitiatively, and in magnitude, to those shown in Table 4 (with the exception of the $|AR|$ efficiency measure; however, the coefficient is insignificant in both tables). This suggests not only a negative role for CDS markets in equity market quality after CDS introduction, but that most of the negative impact occurs within a year. The only notable difference in the estimated effect of related markets between Tables 4 and 5 is the estimated impact of options, which becomes insignificant in Table 5. This is not surprising since the Table 5 analysis is centered around the CDS, not option market, introduction event. This means that there should be fewer options introductions during the estimation horizon.

V. Discussion

A. Endogeneity Concerns

We have presented cross-sectional evidence that firms with CDS contracts have less liquid equity and less efficient stock prices. One remaining concern about the analysis is potential endogeneity. It is possible that there is an endogenous relationship between existence of CDS on the firm's debt and both its stock market liquidity and stock price efficiency. It is always challenging to conclusively rule out endogeneity concerns but there are several reasons to believe that these cannot completely explain our results. First, we note that none of our independent variables is contemporaneous- all are lagged with respect to the dependent variables (liquidity and efficiency of the stock prices). Second, while it is still possible that the endogeneity concern could be partly driven by a relevant omitted variable, to the extent that the omitted variable is time invariant, our firm fixed effect results should address this concern. Third, CDS contracts are traded on relatively large firms and unconditionally, firms with CDS contracts have more liquid equity and more efficient stock prices. This is in contrast to the negative effect of existence of CDS market on liquidity and efficiency that we find in the paper. Finally, our propensity score matching based results should ameliorate some of the selection bias concerns that may be relevant in this context.

B. Interpretation of the Role CDS Markets: The State of the Equity Market

Given the recent interest in CDS markets, we extend the analysis to deepen our understanding of the potential mechanisms driving the robust, negative CDS result. In this section, we examine whether the role of credit default swaps varies with the overall condition of the firms' equity markets. As discussed in the introduction, impact of derivatives markets on equity market quality is theoretically ambiguous. In models such as Biais and Hillion (1994) and Dow (1998), related markets can play either a positive or negative role, depending on the models' parameter values. Thus, if market conditions are changing, we might expect the role of CDS markets to change as well.

In the regressions shown in Table 6, we examine three proxies for the firm's equity market conditions: *lagprogramtrade*; *zscore* and *analystdisp*. The *lagprogramtrade* variable, which captures program trading and is interpreted as uninformed liquidity trading in the stock, has been described earlier. *analystdisp* is defined as the standard deviation of analyst earnings forecasts for the firm during quarter $t-1$, from IBES. This variable captures the market's uncertainty about firm fundamentals. *zscore* is the distance to default measure based on Altman (1968), where a higher *zscore* implies a larger distance to default. We interact each of these three variables with CDS market variable to see whether the impact of CDS markets varies with overall equity market conditions.

The results in Table 6 show that, in all three sets of regressions, the impact of CDS markets is worse when the firm and its equity market are in a "good" state (i.e., more liquidity traders, less disagreement and greater distance to default).[19] CDS markets are less damaging in "bad" states. Our interpretation of this finding is that there is more speculation in CDS markets when market conditions are favorable and that speculation subsides during unfavorable times, making the potentially beneficial informed trading and hedging transactions in CDS more relevant than speculation.

[19] Due to zero analyst coverage or coverage by only one analyst, the *analystdisp* regressions have fewer observations. The regressions are run conditional on the availability of 2 or more analyst forecasts.

C. CDS Quotes: A Market Activity Proxy

The recent debates regarding the impact of derivatives markets, particularly CDSs, make the CDS findings in this paper potentially the most useful to policy makers. Unfortunately, our CDS market data are also the most limited. For example, we would ideally observe daily trading activity in CDS since it is natural to ask whether the CDS findings stem from the existence of these related markets or from trading activity in CDS. We do not have trading volume data as we do for equity options and corporate bonds; however, we do know on which days CDSs are quoted in the CMA data and how many quotes are emitted. We use the number of daily quotes to capture variation in CDS market activity. We introduce a *cmanumquote*, defined as the number of CDS quotes which we observe on day t (or month t, for the regressions using efficiency measures), to capture market activity.

Table 7 is analogous to Table 4, with the *cmanumquote* variable added to the analysis. The direct role of having a CDS market remains negative and significant for both spreads and for market efficiency; however, Table 7 also shows that more active CDS markets negatively impacts both dimensions of market quality. As in Table 3, all regressions contain firm fixed effects, and the coefficients are interpreted in terms of changes. Thus, we find that increases in CDS market activity have a strong negative effect on spreads and on price efficiency (captured by the *Hasbrouck* measure), along with a negative direct impact of *tradedcds*, the existence of the related market. These results provide an interesting contrast to the results for options and bonds (in which, once we control for the negative effect of trading activity, the existence of options plays a positive role in both liquidity and efficiency and a positive role in liquidity but a negative role in efficiency for bonds).

One factor that may contribute to these findings, which we offer to future research, is that the structure of CDS markets may make them particularly harmful to equity market quality. In the case of CDS, *both* the existence of and activity in CDS markets negatively impact liquidity and efficiency. The equity options that we study are listed on organized exchanges and, while traded over the counter, the corporate bonds that we examine are subject to trade dissemination rules. In contrast, CDS markets are relatively opaque. This ranking of the opaqueness of the related markets is perfectly correlated with the ranking of the overall negative impact of these markets on equity market quality.

To summarize, introducing a CDS market generally negatively impacts equity market liquidity and price efficiency and this effect tends to be even worse when the CDS market is an actively quoted one. The overall findings support the general interpretation that related markets linked to a firm's debt decrease market quality.

VI. Conclusions

In this paper we analyze the implications of the existence of derivatives and corporate debt markets on the equity market quality. Taken together, the results imply an overall negative effect of related markets when those markets are tied to debt in a firm's capital structure. Consistent with prior literature, we find that firms with listed options have more liquid equity and more efficient stock prices. By contrast, firms with traded CDS contracts have less liquid equity and less efficient stock prices. The impact of publicly traded bonds is more mixed but is generally negative. When we rank the estimated effects of the related markets, we find that the impact of CDS markets is generally most negative, followed by corporate bond markets, and then options which generally have a positive effect. We also observe a consistently negative role for trading activity in bonds as well as options for both efficiency and liquidity.

Our robustness tests provide sharper interpretations of the role for debt linked securities, and CDS markets in particular. We find that the impact of CDS markets is more negative when the firm and its equity market are in a "good" state (i.e., more liquidity traders, less disagreement and greater distance to default). CDS markets play a more positive role in "bad" states. It is possible that there is more speculation in CDS markets when market conditions are favorable and that speculation subsides during unfavorable times. While we emphasize that our analysis focuses on only one potential type of externality associated with related markets, our findings can help inform current policy debates regarding the costs and benefits of derivatives markets, in particular that about CDS markets.

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Table I. Descriptive Statistics

The sample includes all NYSE stocks for the years 2003-2007 for which we have non-missing information for the liquidity, efficiency and control variables. The stock market liquidity statistics are based on daily spread data. QS is defined as the time-weighted average of the quoted spread on the primary exchange divided by the quote midpoint. ES is defined as the trade-weighted average of the effective spread divided by the quote midpoint. The stock market efficiency variables are measured using intraday data over monthly intervals. $Hasbrouck$ is defined as the pricing error variance (based on Hasbrouck (1993)), divided by the standard deviation of intraday (log) transaction prices. $|AR|$ is the absolute value of the 30-minute autocorrelation of quote midpoint returns. These efficiency variables measure the extent to which prices deviate from a random walk. The three related markets dummy variables are *tradedoption*, *tradedbond*, and *tradedcds*. These are set equal to 1 if the firm has a listed option, public bond information on the TRACE system, and a CDS quote in the CMA data on day t, respectively. *lagbondvol* is the (log) sum of the dollar volume of all of the firm's bonds as reported on the TRACE system. *lagoptvol* is the (log) sum of the dollar volume of all of the firm's listed stock options. *cdsnumquote* is the number of daily CDS quotes, from the CMA data. Controls variables are: *lagdvolume*, *lagprogramtrade*, *lagvolatility*. *res_mcap* and $\frac{debt}{asset}$. *ldvolume* is the total daily trading volume as reported on CRSP, times the closing price; *lprogram* is the dollar volume of program trading, defined as the (log) sum of institutional buy and sell dollar volume for their program trades, based on daily summaries of NYSE CAUD data for each stock; volatility is the square of the daily stock return; the values used to calculate *lagdvolume* and *lagprogramtrade* are both measured at period $t-1$ and are in thousands of dollars. *res_mcap* is the portion of equity market capitalization that is orthogonal to dollar volume. $\frac{debt}{asset}$ is the firm's debt-to-asset ratio, defined as the sum of the firm's long term and current debt outstanding, divided by the end-of-quarter total assets (based on quarterly data for quarter t-1, from Compustat). There are 1707 unique firms in the full sample and 1275, 884 and 319 unique firms with listed options, TRACE and CDS respectively.

Table I. Descriptive Statistics (Contd.,)

Descriptive Statistics for Full Sample

	Mean	Median	25^{th} pcntl	75^{th} pcntl	Std. Dev
Stock Market Liquidity Variables (Daily): Trading Costs					
qs	0.0021	0.0011	0.0006	0.0020	0.0040
es	0.0015	0.0008	0.0005	0.0014	0.0029
Stock Market Efficiency Variables (Monthly)					
Hasbrouck	0.0118	0.0084	0.0053	0.0138	0.0132
$\| ar \|$	0.0800	0.0657	0.0309	0.1139	0.0638
Related Markets					
tradedoption	0.6869	1.0000	0.0000	1.0000	0.4637
tradedbond	0.4000	0.0000	0.0000	1.0000	0.4899
tradedcds	0.1633	0.0000	0.0000	0.0000	0.3697
Related Markets Trading Activity					
lagbondvol	3.3131	0.0000	0.0000	0.0000	6.1419
lagoptvol	3.4646	3.0204	0.0000	6.4265	3.5321
cdsnumquote	4.8932	0.0000	0.0000	0.0000	17.8801
Controls					
lagprogramtrade	8.0006	8.5015	7.1330	9.6226	2.7765
lagdvolume	9.0769	9.2763	7.9426	10.5191	2.1472
lagvolatility	0.0005	0.0001	0.0000	0.0003	0.0108
$\frac{debt}{asset}$	0.2616	0.2456	0.1221	0.3685	0.1882
res_mcap	0.0000	-0.0439	-0.5172	0.4759	0.8103

Table II. Related Markets and Equity Market Quality

This table presents the results of regression analyses that estimate the impact of related markets and trading in those markets on equity market quality. The results are based on panel regressions for all NYSE stocks for the years 2003-2007 for which we have non-missing information for the liquidity, efficiency and control variables. The dependent variables are equity market quality measures, which are divided into two groups: liquidity and efficiency. The liquidity measures are quoted and effective spreads (QS and ES, respectively). Efficiency measures are $Hasbrouck$, defined as the pricing error based on Hasbrouck (1993), divided by the standard deviation of intraday log transaction prices, and $\mid AR \mid$, defined as the 30-minute autocorrelation in quote midpoint returns. Explanatory variables are: related market dummies *tradedoption*, *tradedbond*, and *tradedcds* (indicator variables set equal to 1 if the firm has a listed option, bond information on the TRACE system, and CDS quote in the CMA data on day t, respectively); one period lagged dollar volume of trade in the firm's bonds (*lagbondvol*); one period lagged dollar volume of trade in the firm's options (*lagoptvol*); one period lagged dollar volume of program trades (*lagprogramtrade*) in thousands of dollars; one period lagged total dollar volume in the stock (*lagdvolume*) in thousands of dollars; one period lagged volatility (volatility); the portion of equity market capitalization that is orthogonal to dollar volume (*res_mcap*); and the debt-to-asset ratio of the firm ($\frac{debt}{asset}$). Liquidity regressions are based on daily data and t-statistics are calculated using standard errors that are clustered at the day and firm level. Because efficiency variables are calculated over monthly horizons, the independent variables are defined as monthly averages and regressions are based on monthly data. Standard errors for the efficiency regressions are clustered at the year-month-firm level.

	Trading Costs (daily)				*Efficiency (monthly)*			
	QS		ES		$Hasbrouck$		$\mid AR \mid$	
tradedoption	-0.000238**	-0.000834***	-0.000137*	-0.000552***	-0.00292***	-0.00305***	-0.00494***	-0.00580***
	(-3.10)	(-9.40)	(-2.52)	(-8.74)	(-7.77)	(-6.51)	(-5.79)	(-4.54)
tradedbond	0.000282***	0.0000416	0.000197***	0.0000224	0.00153***	0.000744	0.000523	0.000713
	(4.44)	(0.74)	(4.36)	(0.56)	(4.92)	(1.58)	(0.68)	(0.56)
tradedcds	0.000614***	0.000297***	0.000453***	0.000228***	0.00148***	0.00137***	0.00200*	0.00183
	(8.81)	(4.90)	(9.04)	(5.18)	(5.39)	(4.90)	(2.08)	(1.89)
lagprogramtrade	-0.00107***	-0.00101***	-0.000773***	-0.000731***	-0.00616***	-0.00615***	-0.00484***	-0.00474***
	(-11.33)	(-11.01)	(-11.41)	(-11.13)	(-11.56)	(-11.57)	(-9.22)	(-9.26)
lagdvolume	0.0000683	-0.000163	0.0000683	-0.0000940	0.00226***	0.00219***	-0.000389	-0.000665
	(0.81)	(-1.83)	(1.13)	(-1.49)	(4.97)	(4.55)	(-0.70)	(-1.14)
lagvolatility	0.00836	0.00786	0.00655	0.00619	-0.0568	-0.0582	-0.0936	-0.0979
	(1.31)	(1.30)	(1.31)	(1.30)	(-1.59)	(-1.59)	(-1.26)	(-1.30)
$\frac{debt}{asset}$	0.000515*	0.000554*	0.000393*	0.000418**	0.0000950	0.0000298	0.00213	0.00224
	(2.23)	(2.44)	(2.44)	(2.64)	(0.13)	(0.04)	(1.10)	(1.14)
res_mcap	-0.0000519	-0.000166**	-0.0000507	-0.000131**	0.00173***	0.00171***	-0.000147	-0.000187
	(-0.91)	(-2.87)	(-1.25)	(-3.21)	(7.34)	(7.24)	(-0.24)	(-0.31)
lagbondvol		0.0000301***		0.0000223***		0.0000639*		-0.0000205
		(7.69)		(8.01)		(2.41)		(-0.24)
lagoptvol		0.000212***		0.000148***		0.0000372		0.000227
		(13.62)		(13.46)		(0.50)		(1.00)
constant	0.00990***	0.0112***	0.00692***	0.00786***	0.0448***	0.0453***	0.125***	0.127***
	(30.49)	(28.49)	(29.85)	(28.24)	(32.28)	(25.45)	(49.27)	(45.02)
N	1509984	1509984	1509799	1509799	65110	65110	70938	70938
adj. R^2	0.507	0.522	0.485	0.500	0.236	0.236	0.042	0.042

Table III. Within-Firm Analysis of Related Markets and Equity Market Quality

This table presents the results of regressions that estimate the impact of the introduction of related markets and trading in those markets on equity market quality. All regressions include firm fixed effects. The sample consists of all NYSE stocks for the years 2003-2007 for which we have non-missing information for the liquidity, efficiency and control variables. All variables are defined in Table 2. Liquidity regressions are based on daily data and t-statistics are calculated using standard errors that are clustered by day. Because efficiency variables are calculated over monthly horizons, the independent variables are defined as monthly averages and regressions are based on monthly data. Standard errors for the efficiency regressions are clustered at the year-month level.

	Trading Costs (daily)				*Efficiency (monthly)*			
	QS		ES		$Hasbrouck$		$\|AR\|$	
tradedoption	0.000000978	-0.000323***	0.00000486	-0.000228***	-0.00333**	-0.00288**	-0.00847***	-0.00911***
	(0.09)	(-29.00)	(0.60)	(-26.14)	(-3.46)	(-3.03)	(-4.67)	(-5.18)
tradedbond	0.000277***	0.000205***	0.000174***	0.000118***	0.00151***	0.000895*	0.000266	0.000927
	(29.49)	(23.54)	(25.76)	(19.03)	(6.49)	(2.50)	(0.26)	(0.57)
tradedcds	0.000406***	0.000343***	0.000325***	0.000278***	0.00141***	0.00136***	0.00219	0.00223
	(36.91)	(31.84)	(38.04)	(34.04)	(5.40)	(4.95)	(1.70)	(1.67)
lagprogramtrade	-0.000607***	-0.000598***	-0.000442***	-0.000435***	-0.00519***	-0.00521***	-0.00348***	-0.00345***
	(-58.43)	(-58.73)	(-55.27)	(-55.54)	(-10.05)	(-10.11)	(-5.23)	(-5.17)
lagdvolume	-0.000885***	-0.000988***	-0.000632***	-0.000707***	0.00342***	0.00355***	-0.00204*	-0.00221*
	(-51.89)	(-55.58)	(-50.46)	(-53.83)	(6.79)	(6.68)	(-2.03)	(-2.17)
lagvolatility	0.00317	0.00308	0.00292	0.00285	-0.0456	-0.0453	-0.168	-0.168
	(1.17)	(1.16)	(1.21)	(1.20)	(-1.56)	(-1.56)	(-1.28)	(-1.28)
$\frac{debt}{asset}$	-0.0000405	-0.0000355	-0.0000226	-0.0000208	-0.000538	-0.000635	-0.00770	-0.00758
	(-1.59)	(-1.39)	(-1.12)	(-1.03)	(-0.62)	(-0.73)	(-1.76)	(-1.73)
res_mcap	-0.00145***	-0.00152***	-0.00107***	-0.00112***	0.0000996	0.000134	-0.00585***	-0.00591***
	(-55.87)	(-57.78)	(-56.84)	(-58.63)	(0.30)	(0.41)	(-5.29)	(-5.42)
lagbondvol		0.00000817***		0.00000665***		0.0000529*		-0.0000585
		(19.23)		(21.22)		(2.47)		(-0.63)
lagoptvol		0.000106***		0.0000763***		-0.000121		0.000176
		(40.70)		(39.23)		(-1.75)		(0.81)
N	1509984	1509984	1509799	1509799	65110	65110	70938	70938
adj. R^2	0.723	0.725	0.690	0.692	0.373	0.373	0.064	0.063

Table IV. Matched Sample Analysis

This table presents matched sample results of regressions that estimate the impact of the introduction of related markets and trading in those markets on equity market quality. For each firm with a traded CDS contract, we identify a similar non-CDS firm from the sample of all NYSE-listed firms using propensity score methodology in Rosenbaum and Rubin (1983) based on the model in Ashcraft and Santos (2009). Only CDS and matched firms are included in the regression analyses. All regressions contain firm fixed effects. All variables are defined in Table 2. Liquidity regressions are based on daily data and t-statistics are calculated using standard errors that are clustered by day. Because efficiency variables are calculated over monthly horizons, the independent variables are defined as monthly averages and regressions are based on monthly data. Standard errors for the efficiency regressions are clustered at the year-month level.

	Trading Costs (daily)				*Efficiency (monthly)*			
	QS		ES		$Hasbrouck$		$\mid AR \mid$	
tradedoption	-0.000177***	-0.000353***	-0.0000991***	-0.000219***	-0.00191	-0.00105	-0.0142***	-0.0181***
	(-9.72)	(-15.34)	(-6.91)	(-12.02)	(-1.40)	(-0.78)	(-3.83)	(-4.18)
tradedbond	-0.0000762***	-0.000113***	-0.0000538***	-0.0000856***	0.00166***	0.00117***	0.00140	0.00195
	(-11.25)	(-17.69)	(-11.18)	(-18.32)	(6.16)	(4.27)	(1.06)	(0.86)
tradedcds	0.0000968***	0.0000784***	0.0000971***	0.0000823***	0.00138***	0.00134***	0.00111	0.00108
	(13.69)	(11.62)	(17.72)	(15.86)	(4.54)	(4.41)	(0.80)	(0.75)
lagprogramtrade	-0.000458***	-0.000456***	-0.000342***	-0.000341***	-0.00587***	-0.00592***	-0.00252*	-0.00235
	(-28.48)	(-28.55)	(-26.59)	(-26.64)	(-8.17)	(-8.27)	(-2.07)	(-1.93)
lagdvolume	-0.000337***	-0.000390***	-0.000237***	-0.000274***	0.00385***	0.00408***	-0.00165	-0.00284
	(-21.41)	(-23.35)	(-19.40)	(-21.24)	(6.01)	(6.14)	(-1.02)	(-1.74)
lagvolatility	0.0549***	0.0539***	0.0353***	0.0346***	-0.413*	-0.402*	-1.403*	-1.471*
	(7.87)	(7.76)	(10.85)	(10.65)	(-2.03)	(-2.01)	(-2.14)	(-2.27)
$\frac{debt}{asset}$	-0.000345***	-0.000391***	-0.000208***	-0.000244***	-0.00263**	-0.00257**	0.00436	0.00395
	(-11.01)	(-12.23)	(-9.05)	(-10.43)	(-3.10)	(-3.04)	(0.61)	(0.55)
res_mcap	-0.000662***	-0.000683***	-0.000492***	-0.000507***	0.000652	0.000667	-0.00567**	-0.00579**
	(-35.16)	(-36.14)	(-37.35)	(-38.35)	(1.83)	(1.90)	(-3.10)	(-3.23)
lagbondvol		0.00000503***		0.00000446***		0.0000433**		-0.0000556
		(15.95)		(18.16)		(2.91)		(-0.41)
lagoptvol		0.0000392***		0.0000267***		-0.000183*		0.000875
		(18.83)		(17.80)		(-2.47)		(1.91)
N	473767	473767	473754	473754	22004	22004	22248	22248
adj. R^2	0.694	0.696	0.660	0.661	0.432	0.433	0.033	0.033

Table V. Event Analysis: Years t-1 to t+1 Relative to CDS Introduction

This table presents results of regressions that estimate the impact of the introduction of related markets and trading in those markets on equity market quality. The analyses use data from 365 days prior to CDS introduction through 365 days following introduction. For each firm with a traded CDS contract, we identify a similar non-CDS firm from the sample of all NYSE-listed firms using propensity score methodology in Rosenbaum and Rubin (1983). Only CDS and matched firms are included in the regressions. All regressions contain firm fixed effects and all variables are defined in Table 2. Liquidity regressions are based on daily data and t-statistics are calculated using standard errors that are clustered by day. Because efficiency variables are calculated over monthly horizons, the independent variables are defined as monthly averages and regressions are based on monthly data. Standard errors for the efficiency regressions are clustered at the year-month level.

	Trading Costs (daily)				*Efficiency (monthly)*			
	QS		ES		$Hasbrouck$		$\|AR\|$	
tradedoption	0.0000113 (0.30)	-0.0000263 (-0.63)	0.0000745* (2.19)	0.0000498 (1.36)	-0.00126 (-0.87)	0.000335 (0.19)	-0.0126** (-2.94)	-0.0171* (-2.11)
tradedbond	-0.0000713*** (-7.58)	-0.000132*** (-11.39)	-0.0000517*** (-6.74)	-0.000103*** (-10.35)	0.000743 (1.84)	0.000949* (2.42)	0.00320 (1.27)	0.00631* (2.17)
tradedcds	0.0000838*** (7.13)	0.0000771*** (6.89)	0.0000763*** (7.75)	0.0000707*** (7.57)	0.00101* (2.63)	0.000994* (2.62)	-0.00250 (-1.41)	-0.00241 (-1.37)
lagprogramtrade	-0.000603*** (-9.96)	-0.000607*** (-10.03)	-0.000498*** (-9.04)	-0.000501*** (-9.09)	-0.00459** (-3.07)	-0.00463** (-3.11)	-0.00169 (-0.47)	-0.00167 (-0.46)
lagdvolume	-0.000327*** (-5.70)	-0.000335*** (-5.92)	-0.000179*** (-3.50)	-0.000185*** (-3.66)	0.00175 (1.23)	0.00215 (1.40)	-0.000757 (-0.14)	-0.00143 (-0.25)
lagvolatility	0.0368*** (13.88)	0.0363*** (13.76)	0.0207*** (13.69)	0.0204*** (13.51)	-0.793** (-3.26)	-0.768** (-3.27)	-0.746 (-0.37)	-0.693 (-0.35)
$\frac{debt}{asset}$	-0.000857*** (-21.51)	-0.000863*** (-21.49)	-0.000645*** (-21.45)	-0.000650*** (-21.35)	-0.00288 (-1.83)	-0.00266 (-1.77)	-0.000967 (-0.05)	-0.00203 (-0.11)
res_mcap	-0.000780*** (-15.20)	-0.000778*** (-15.38)	-0.000521*** (-11.85)	-0.000519*** (-11.94)	-0.00149 (-1.53)	-0.00140 (-1.41)	-0.00490 (-0.92)	-0.00501 (-0.94)
lagbondvol		0.00000964*** (10.96)		0.00000813*** (10.40)		-0.0000152 (-0.68)		-0.000303 (-1.99)
lagoptvol		0.00000650** (3.07)		0.00000423* (2.48)		-0.000275 (-1.83)		0.000764 (0.96)
N	144986	144986	144986	144986	6884	6884	6913	6913
R^2	0.648	0.649	0.591	0.593	0.491	0.492	0.078	0.078

Table VI. Interpretation: CDS, Proximity to Default (Z score), Disagreement (Analyst Forecast Dispersion) and Uninformed Trading

This table presents results of regressions that estimate the impact of the changes in proximity to default, disagreement, uninformed trading and related markets on equity market quality. For each firm with a traded CDS contract, we identify a similar non-CDS firm from the sample of all NYSE-listed firms using propensity score methodology in Rosenbaum and Rubin (1983). Only CDS and matched firms are included in the regressions. All regressions contain firm fixed effects and all variables are defined in Table 2 with the exception of $zscore$, $analystdisp$, $zscore * cds$, $analystdisp * cds$ and $lprogram * cds$. $zscore$ is the distance to default, using Altman's (1968) measure. Higher $zscore$ means that the firm is further away from default. $analystdisp$ is analyst forecast dispersion, based on quarterly earnings forecasts in IBES. $zscore * cds$, $analystdisp * cds$ and $lprogram * cds$ are interaction variables, where the cds dummy variable is interacted with $zscore$, $analystdisp$ and $lprogram$, respectively. Liquidity regressions are based on daily data and t-statistics are calculated using standard errors that are clustered by day. Because efficiency variables are calculated over monthly horizons, the independent variables are defined as monthly averages and regressions are based on monthly data. Standard errors for the efficiency regressions are clustered at the year-month level.

Table VI. Interpretation: CDS, Proximity to Default (Z score), Disagreement (Analyst Forecast Dispersion) and Uninformed Trading (Contd.,)

	Trading Costs (daily)						*Efficiency (monthly)*					
		QS			*ES*			*Hasbrouck*			| *AR* |	
tradedoption	-0.000289*** (-13.61)	-0.000538*** (-13.33)	-0.000294*** (-11.16)	-0.000179*** (-10.97)	-0.000362*** (-12.25)	-0.000169*** (-7.81)	-0.00128 (-0.95)	-0.00103 (-0.52)	-0.000654 (-0.53)	-0.0179*** (-4.19)	-0.0113* (-2.52)	-0.0189*** (-3.82)
tradedbond	-0.0000720*** (-9.92)	-0.000120*** (-15.42)	-0.000117*** (-17.78)	-0.0000600*** (-10.49)	-0.0000868*** (-16.67)	-0.0000869*** (-17.03)	0.00103*** (4.17)	0.000970** (3.43)	0.00123*** (4.18)	0.00204 (0.90)	0.00145 (0.65)	0.00388 (1.42)
tradedcds	-0.00142*** (-12.25)	0.0000894*** (10.53)	-0.0000465*** (-3.54)	-0.000842*** (-8.57)	0.0000799*** (14.01)	0.0000274** (2.58)	0.00762* (2.51)	0.00118*** (3.80)	0.00196*** (3.91)	-0.00261 (-0.31)	0.00150 (0.77)	0.000698 (0.32)
lagprogramtrade	-0.000506*** (-32.78)	-0.000240*** (-17.70)	-0.000642*** (-28.97)	-0.000372*** (-30.82)	-0.000188*** (-17.18)	-0.000497*** (-26.46)	-0.00588*** (-8.59)	-0.00673*** (-8.11)	-0.00625*** (-8.20)	-0.00248* (-2.02)	-0.00209 (-1.35)	-0.00747*** (-3.85)
lagdvolume	-0.000378*** (-22.93)	-0.000449*** (-25.28)	-0.000281*** (-13.56)	-0.000267*** (-21.09)	-0.000316*** (-24.48)	-0.000181*** (-10.22)	0.00422*** (6.18)	0.00502*** (6.91)	0.00440*** (5.66)	-0.00279 (-1.72)	-0.00330 (-1.51)	0.00299 (1.08)
lagvolatility	0.0534*** (7.69)	0.0558*** (5.74)	0.0488*** (11.03)	0.0343*** (10.50)	0.0344*** (7.49)	0.0347*** (9.07)	-0.368 (-1.87)	-0.463 (-1.81)	-0.458 (-2.00)	-1.499* (-2.27)	-1.419* (-2.15)	-2.573** (-3.10)
$\frac{debt}{asset}$	-0.000318*** (-10.42)	-0.000195*** (-5.80)	-0.000102*** (-3.42)	-0.000199*** (-8.95)	-0.000146*** (-7.52)	-0.000114*** (-5.45)	-0.00289** (-3.34)	-0.00366** (-3.23)	-0.00415*** (-4.18)	0.00411 (0.58)	0.0102 (1.13)	-0.00550 (-0.66)
res_mcap	-0.000663*** (-35.93)	-0.000687*** (-32.39)	-0.000660*** (-32.31)	-0.000494*** (-38.76)	-0.000504*** (-39.21)	-0.000474*** (-29.32)	0.000740* (2.07)	0.000777 (1.89)	0.000821 (1.94)	-0.00579** (-3.23)	-0.00662** (-2.87)	-0.00223 (-0.80)
lagbondvol	0.00000492*** (16.46)	0.00000534*** (15.48)	0.00000679*** (19.00)	0.00000439*** (18.55)	0.00000453*** (17.47)	0.00000583*** (20.52)	0.0000425** (2.83)	0.0000695*** (4.62)	0.0000475** (2.84)	-0.0000552 (-0.40)	0.0000107 (0.08)	-0.000110 (-0.68)
lagoptvol	0.0000342*** (18.90)	0.0000294*** (11.75)	0.0000407*** (18.13)	0.0000237*** (18.11)	0.0000204*** (11.35)	0.0000283*** (17.47)	-0.000164* (-2.28)	-0.000250** (-2.96)	-0.000219* (-2.52)	0.000857 (1.88)	0.000213 (0.35)	0.000851 (1.96)
lagprogram*cds	0.000152*** (13.26)			0.0000937*** (9.62)			-0.000630* (-2.21)			0.000371 (0.45)		
analystdisp		0.000452*** (18.88)			0.000283*** (19.57)			-0.000280 (-0.42)			-0.000267 (-0.05)	
analystdisp*cds		-0.000572*** (-22.16)			-0.000362*** (-23.33)			0.00119 (1.31)			0.00203 (0.27)	
zscore			0.000107*** (20.83)			0.0000795*** (19.29)			-0.000138 (-1.02)			-0.00181 (-1.40)
zscore*cds			0.0000659*** (14.82)			0.0000302*** (8.52)			-0.000292* (-2.30)			0.000251 (0.29)
N	473767	332369	385089	473754	332369	385088	22004	15581	17987	22248	15632	18091
adj. R^2	0.699	0.619	0.700	0.663	0.625	0.674	0.434	0.431	0.430	0.033	0.024	0.033

Table VII. CDS Quote Activity, Related Markets and Equity Market Quality

This table presents the results of regressions that estimate the impact related markets and trading in those markets on equity market quality. *num_cds_quote* is the number of CDS quotes in the CMA data on day t in the liquidity regressions and month t in the efficiency regressions. All other variables are as defined in Table 2. For each firm with a traded CDS contract, we identify a similar non-CDS firm from the sample of all NYSE-listed firms using propensity score methodology in Rosenbaum and Rubin (1983). Only CDS and matched firms are included in the regressions. All regression specifications contain firm fixed effects. Because we control for time-invariant firm characteristics, the related markets coefficients are interpreted as the change in market quality after the introduction of a related market. Liquidity regressions are based on daily data and t-statistics are calculated using standard errors that are clustered at the day level. Because efficiency variables are calculated over monthly horizons, the independent variables are defined as monthly averages and regressions are based on monthly data. Standard errors for the efficiency regressions are clustered at the year-month level.

	Trading Costs (daily)				*Efficiency (monthly)*			
	QS		ES		$Hasbrouck$		$\mid AR \mid$	
tradedoption	-0.000176***	-0.000352***	-0.0000984***	-0.000218***	-0.00187	-0.000938	-0.0141***	-0.0176***
	(-9.68)	(-15.31)	(-6.87)	(-12.00)	(-1.37)	(-0.70)	(-3.79)	(-4.04)
tradedbond	-0.0000773***	-0.000113***	-0.0000545***	-0.0000855***	0.00160***	0.00120***	0.00118	0.00209
	(-11.50)	(-17.70)	(-11.43)	(-18.33)	(5.81)	(4.35)	(0.89)	(0.93)
tradedcds	0.0000865***	0.0000736***	0.0000903***	0.0000798***	0.000962**	0.000937**	-0.000565	-0.000513
	(11.14)	(9.84)	(15.00)	(13.86)	(2.78)	(2.73)	(-0.36)	(-0.32)
lagprogramtrade	-0.000457***	-0.000456***	-0.000342***	-0.000341***	-0.00583***	-0.00589***	-0.00244*	-0.00229
	(-28.46)	(-28.54)	(-26.58)	(-26.63)	(-8.11)	(-8.22)	(-2.01)	(-1.88)
lagdvolume	-0.000338***	-0.000390***	-0.000238***	-0.000275***	0.00378***	0.00405***	-0.00186	-0.00291
	(-21.44)	(-23.35)	(-19.42)	(-21.24)	(5.85)	(6.04)	(-1.14)	(-1.77)
lagvolatility	0.0549***	0.0539***	0.0353***	0.0346***	-0.401	-0.388	-1.358*	-1.420*
	(7.87)	(7.76)	(10.85)	(10.65)	(-1.96)	(-1.93)	(-2.06)	(-2.18)
$\frac{debt}{asset}$	-0.000344***	-0.000390***	-0.000207***	-0.000243***	-0.00260**	-0.00252**	0.00447	0.00411
	(-11.01)	(-12.21)	(-9.04)	(-10.43)	(-3.10)	(-3.02)	(0.63)	(0.58)
res_mcap	-0.000662***	-0.000683***	-0.000492***	-0.000507***	0.000653	0.000675	-0.00564**	-0.00574**
	(-35.21)	(-36.15)	(-37.39)	(-38.36)	(1.83)	(1.91)	(-3.11)	(-3.23)
cdsnumquote	0.000000384***	0.000000189*	0.000000253***	9.88e-08	0.0000117**	0.0000118**	0.0000474	0.0000462
	(4.36)	(2.16)	(3.97)	(1.58)	(3.17)	(3.21)	(1.97)	(1.90)
lagbondvol		0.00000494***		0.00000441***		0.0000357*		-0.0000853
		(16.12)		(18.38)		(2.40)		(-0.63)
lagoptvol		0.0000391***		0.0000267***		-0.000201**		0.000803
		(18.82)		(17.77)		(-2.73)		(1.73)
N	473767	473767	473754	473754	22004	22004	22248	22248
adj. R^2	0.694	0.696	0.660	0.661	0.433	0.434	0.033	0.033