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## Insider Trading, Informed Trading, and Market Making: Liquidity of Securities Markets in the Zero-Sum Game

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INSIDER TRADING, INFORMED TRADING, AND  
MARKET MAKING: LIQUIDITY OF SECURITIES  
MARKETS IN THE ZERO-SUM GAME

STANISLAV DOLGOPOLOV\*

ABSTRACT

*This Article reexamines the nexus of relationships among informed transactions, information asymmetry, and liquidity of securities markets in the context of public policy debates about insider trading and its regulation. The Article analyzes this nexus, with the emphasis on recent empirical studies and developments in the securities industry, from a variety of perspectives and considers the validity of the alleged link between insider trading—as opposed to other forms of informed trading—and market liquidity as a justification for the existence of regulation.*

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TABLE OF CONTENTS

INTRODUCTION .....	3
I. THE NATURE OF MARKET MAKERS' LOSSES FROM INSIDER TRADING AND THE SIGNIFICANCE OF INVENTORY MANAGEMENT IN VARIOUS MARKETS .....	7
II. THE DISTINCTION BETWEEN INSIDER TRADING AND OTHER FORMS OF INFORMED TRADING.....	12
III. THE IMPORTANCE OF DISENTANGLING INFORMED TRADING, INFORMATIONAL ASYMMETRY, AND UNCERTAINTY .....	21
IV. BID-ASK SPREAD DECOMPOSITION STUDIES .....	23
V. THE CONNECTION AMONG ESTIMATES OF THE PROBABILITY OF INFORMED TRADING AND BID-ASK SPREADS AND THEIR COMPONENTS .....	35
VI. VARIOUS MECHANISMS FOR PROVIDING LIQUIDITY .....	41
VII. THE EXAMINATION OF UNREGULATED SECURITIES MARKETS AND THE IMPACT OF INSIDER TRADING REGULATION ON MARKET LIQUIDITY .....	45
VIII. THE SIGNIFICANCE OF FIRM CHARACTERISTICS .....	51
CONCLUSION.....	54

## INTRODUCTION

The nexus of relationships among informed transactions, information asymmetry, and liquidity of securities markets is an important part of public policy debates about insider trading and its regulation.<sup>1</sup> The alleged harm of insiders' transactions on superior information to market makers, entities that provide liquidity in securities markets,<sup>2</sup> and, as a result, to other traders in the form of lower market liquidity<sup>3</sup> is frequently cited as an economic cost of insider trading<sup>4</sup> and used to justify regulation.<sup>5</sup> The

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<sup>1</sup> See Stanislav Dolgoplov, *Insider Trading and the Bid-Ask Spread: A Critical Evaluation of Adverse Selection in Market Making*, 33 CAP. U. L. REV. 83 *passim* (2004) [hereinafter Dolgoplov, *Insider Trading and the Bid-Ask Spread*]; Stanislav Dolgoplov, *Risks and Hedges of Providing Liquidity in Complex Securities: The Impact of Insider Trading on Options Market Makers*, 15 FORDHAM J. CORP. & FIN. L. 387 *passim* (2010) [hereinafter Dolgoplov, *Risks and Hedges of Providing Liquidity*].

<sup>2</sup> The boundaries of the term "market maker" are blurry and go beyond market participants designated, or recognized as such, by trading venues and specialized over-the-counter dealers. See, e.g., Concept Release on Equity Market Structure, Exchange Act Release No. 61,358, 75 Fed. Reg. 3594, 3607 (Jan. 14, 2010) [hereinafter SEC's Concept Release on Equity Market Structure] ("The use of certain strategies by some proprietary firms [engaging in high-frequency trading] has, in many trading centers, largely replaced the role of specialists and market makers with affirmative and negative obligations."); John Cassidy, *Hedge Clipping*, NEW YORKER, July 2, 2007, at 28, 33 ("Basically, [several top-performing hedge funds] are the largest market-making firms in the world .... [engaged] in sucking up tick-by-tick data, processing all those data, and converting them into second-by-second positions in thousands of spreads worldwide. It's just algorithmic market-making.") (quoting Harry Kat, Professor of Risk Management, City University London).

<sup>3</sup> The original argument about the adverse impact of informed trading, including insider trading, on market liquidity caused by an additional cost to market makers was made in Walter Bagehot [Jack L. Treynor], *The Only Game in Town*, FIN. ANALYSTS J., Mar.–Apr. 1971, at 12, 13–14. However, a much earlier source made the diametrically opposite argument: such transactions should *decrease* bid-ask spreads by creating additional market activity. F. LAVINGTON, THE ENGLISH CAPITAL MARKET 248, 260 (1921).

<sup>4</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 105; see also *Illegal Insider Trading: How Widespread Is the Problem and Is There Adequate Criminal Enforcement?: Hearings Before the S. Comm. on the Judiciary*, 109th Cong. 62 (2006) [hereinafter *Illegal Insider Trading Hearings*] (prepared testimony of John C. Coffee, Adolf A. Berle Professor of Law, Columbia University Law School) ("As informed traders increase their trading upon asymmetric information, bid/asked spreads are likely to widen on all stocks .... [Hence,] insider trading causes the cost of equity capital to rise, and this in turn has a macro-economic effect on GNP, employment, and the economy as a whole."); Merritt B. Fox, *Why Civil Liability for Disclosure Violation When Issuers Do Not Trade?*, 2009 WIS. L. REV. 297, 312–13 ("Since market makers and specialists have difficulty knowing whether they are dealing with ... inside-information-informed traders or with uninformed outsiders, they cover the expected costs of being on

analysis of the alleged link between informed trading and different dimensions of market liquidity, such as bid-ask spreads and market depths, has produced an avalanche of empirical studies, such as efforts to quantify the “adverse selection” component of bid-ask spreads and analysis of event and cross-country data,<sup>6</sup> and even experimental research.<sup>7</sup> These studies have examined a variety of trading venues, notably the New York Stock Exchange (NYSE), the American Stock Exchange (AMEX), NASDAQ, the London Stock Exchange (LSE), and the Stock Exchange of Hong Kong (HKSE). On the other hand, the line between insider trading and other forms of informed trading in these studies was frequently blurry.

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the other side of trades with informed traders through the bid/ask spread they offer all traders.”); M. Todd Henderson, *Insider Trading and CEO Pay*, 64 VAND. L. REV. 505, 512 (2011) (“Specialists making markets in a firm’s stock in which insiders might be trading will increase the bid-ask spread to compensate for the risk that they are trading at an informational disadvantage, and this will reduce liquidity and raise the firm’s cost of capital.”); Jonathan R. Macey & Maureen O’Hara, *From Markets to Venues: Securities Regulation in an Evolving World*, 58 STAN. L. REV. 563, 589 (2005) (“[I]nsider trading increase[s] the transaction costs of trading to specialists, market makers, and investors by widening the bid-ask spread ....”).

<sup>5</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 90 & nn.35–36, 106–07 & nn.112–15; see also *Illegal Insider Trading Hearings*, *supra* note 4, at 95 (prepared testimony of Jonathan Macey, Sam Harris Professor of Corporate Law, Yale University) (arguing that “insider trading increases the transaction costs of investing; particularly by increasing the bid-asked spreads .... [which is one of the reasons why] regulation of insider trading protects investors and, in doing so, encourages the development of high quality capital markets”); Laura Nyantung Beny, *Insider Trading Laws and Stock Markets Around the World: An Empirical Contribution to the Theoretical Law and Economics Debate*, 32 J. CORP. L. 237, 261–62 (2007) (viewing the alleged harm imposed on market makers by insider trading as a potential explanation for the correlation between more stringent insider trading regulation and greater market liquidity); Aaron Gilbert et al., *Insiders and the Law: The Impact of Regulatory Change on Insider Trading*, 47 MGMT. INT’L REV. 745, 763 (2007) (arguing that insider trading regulation leads to “a significant reduction of the microstructure effects of insider trading [including lower bid-ask spreads]” and stressing “the positive economic spin-offs a healthy financial market brings”).

<sup>6</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, *passim*; Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, *passim*.

<sup>7</sup> See Robert Bloomfield, *Quotes, Prices, and Estimates in a Laboratory Market*, 51 J. FIN. 1791, 1806 (1996); Jan Pieter Krahn & Martin Weber, *Marketmaking in the Laboratory: Does Competition Matter?*, 4 EXPERIMENTAL ECON. 55, 80–81 (2001); Charles R. Schnitzlein, *Call and Continuous Trading Mechanisms Under Asymmetric Information: An Experimental Investigation*, 51 J. FIN. 613, 614 (1996); Andreas Oehler et al., *Do Insiders Contribute to Market Efficiency? Informational Efficiency and Liquidity of Experimental Call Markets with and Without Insiders* 15 (n.d.) (unpublished manuscript) (on file with author), available at <http://www.econstor.eu/dspace/bitstream/10419/22490/1/bafifo11.pdf>.

Insiders' transactions on superior information can take forms other than purchases and sales of equity securities. Numerous empirical studies suggest the existence of informed trading, a significant portion of which probably consists of insider trading, in the form of equity short selling<sup>8</sup> and transactions in equity options, debt instruments, single stock futures, and credit default swaps.<sup>9</sup> Overall, there is little evidence that insider trading has posed a significant concern for equity market makers,<sup>10</sup> apart from occasional references that these market participants may want to identify specific orders based on inside information in order to engage in price

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<sup>8</sup> See Ronald Anderson et al., *Family Controlled Firms and Informed Trading: Evidence from Short Sales*, J. FIN. (forthcoming) (manuscript at 30–32) (on file with author), available at <http://www.afajof.org/afa/forthcoming/7865.pdf>; Ekkehart Boehmer et al., *Which Shorts Are Informed?*, 63 J. FIN. 491, 524–25 (2008); Stephen E. Christophe et al., *Short-Selling Prior to Earnings Announcements*, 59 J. FIN. 1845, 1873–74 (2004); Hemang Desai et al., *An Investigation of the Informational Role of Short Interest in the Nasdaq Market*, 52 J. FIN. 2263, 2286 (2002); Bidisha Chakrabarty & Andriy Shkilko, *Information Leakages in Financial Markets: Evidence from Shorting Around Insider Sales 27–28* (Mar. 17, 2008) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1083795>.

<sup>9</sup> See Viral V. Acharya & Timothy C. Johnson, *More Insiders, More Insider Trading: Evidence from Private Equity Buyouts*, 98 J. FIN. ECON. 500, 500 (2010) (credit default swaps, debt instruments, and equity options); Turan G. Bali & Armen Hovakimian, *Volatility Spreads and Expected Stock Returns*, 55 MGMT. SCI. 1797, 1811 (2009) (equity options); Charles Cao et al., *The Information Content of Option-Implied Volatility for Credit Default Swap Valuation*, 13 J. FIN. MKTS. 321, 339–40 (2010) (credit default swaps and equity options); Melanie Cao & Jason Wei, *Option Market Liquidity: Commonality and Other Characteristics*, 13 J. FIN. MKTS. 20, 46 (2010) (equity options); Charles Collver, *Measuring the Impact of Option Market Activity on the Stock Market: Bivariate Point Process Models of Stock and Option Transactions*, 12 J. FIN. MKTS. 87, 103–04 (2009) (equity options); Martijn Cremers & David Weinbaum, *Deviations from Put-Call Parity and Stock Return Predictability*, 45 J. FIN. & QUANTITATIVE ANALYSIS 335, 337–38 (2010) (equity options); Bartley R. Danielsen et al., *Single Stock Futures as a Substitute for Short Sales: Evidence from Microstructure Data*, 36 J. BUS. FIN. & ACCT. 1273, 1291 (2009) (single stock futures); Richard Roll et al., *O/S: The Relative Trading Activity in Options and Stock*, 96 J. FIN. ECON. 1, 2, 16 (2010) (equity options); Kildeep Shastri et al., *Information Revelation in the Futures Market: Evidence from Single Stock Futures*, 28 J. FUTURES MKTS. 335, 347 (2008) (single stock futures); Andrew Ang et al., *The Joint Cross Section of Stocks and Options 39–40* (Nov. 16, 2010) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1533089> (equity options); Lars Norden, *Credit Derivatives, Corporate News, and Credit Ratings 28–29* (Oct. 18, 2008) (unpublished manuscript) (on file with author), available at [http://www.bundesbank.de/download/vfz/konferenzen/20081211\\_ffm/paper\\_norden.pdf](http://www.bundesbank.de/download/vfz/konferenzen/20081211_ffm/paper_norden.pdf) (credit default swaps); Xing Zhou, *Information-Based Trading in the Junk Bond Market 22–24* (n.d.) (unpublished manuscript) (on file with author), available at [http://www.cis.upenn.edu/~mkearns/finread/junk\\_bond.pdf](http://www.cis.upenn.edu/~mkearns/finread/junk_bond.pdf) (debt instruments and equity options).

<sup>10</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, *passim*.

discrimination—for instance, via non-firm quotes—or to follow the lead.<sup>11</sup> Analogously, there are only a few episodes documenting real harm to equity market makers from insider trading, which, nevertheless, do not clearly indicate the existence of a consistent practice of widening bid-ask spreads for *all* trades in response to insider trading.<sup>12</sup> On the other hand, this type of harm is evident from the position taken by options market makers and the options industry.<sup>13</sup> These observations raise the question about the nature of harm imposed by insider trading on market makers, and the magnitude of the social cost caused by lower liquidity of equity markets<sup>14</sup> or derivatives markets.<sup>15</sup> Another important consideration is the

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<sup>11</sup> See, e.g., Bernard Attard, *Making a Market. Jobbers of the London Stock Exchange, 1800–1986*, 7 FIN. HIST. REV. 5, 18 (2000) (quoting an unnamed equity market maker on his likely responses to suspected insider trading by a specific customer).

<sup>12</sup> See, e.g., RANALD C. MICHIE, *THE LONDON STOCK EXCHANGE: A HISTORY* 358 (1999) (describing an incident in 1949 when equity market makers were harmed by transactions of insiders affiliated with dog race track companies based on information obtained from a government official that “the wartime ban on mid-week dog racing was to be relaxed”).

<sup>13</sup> See Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, *passim*.

<sup>14</sup> Although the link between greater liquidity of equity markets and increased firm value is not entirely uncontroversial, there are several asset pricing and corporate governance-related rationales for this relationship. See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 100–02 & nn.99–106; see also Yakov Amihud & Haim Mendelson, *Liquidity, the Value of the Firm, and Corporate Finance*, J. APPLIED CORP. FIN., Spring 2008, at 32; Vivian W. Fang et al., *Stock Market Liquidity and Firm Value*, 94 J. FIN. ECON. 150 (2009).

<sup>15</sup> A comprehensive survey of empirical studies of the impact of derivatives on markets in underlying assets, including evidence pertaining to equity options, suggested that “the introduction of derivatives does not destabilize the underlying market .... [and] tends to improve the liquidity and informativeness of markets.” Stewart Mayhew, *The Impact of Derivatives on Cash Markets: What Have We Learned?*, at i (Feb. 3, 2000) (unpublished manuscript) (on file with author), available at <http://media.terry.uga.edu/documents/finance/impact.pdf>. The theoretical underpinning is that derivatives can “complete” the market in question, pushing it closer to Pareto efficiency, and improve price discovery by processing additional information. See Richard Roll et al., *Options Trading Activity and Firm Valuation*, 94 J. FIN. ECON. 345, 345–46 (2009); Stephen A. Ross, *Options and Efficiency*, 90 Q.J. ECON. 75 *passim* (1976); Mark Rubenstein, *An Economic Evaluation of Organized Options Markets*, 2 J. COMP. CORP. L. & SEC. REG. 49, 52–53, 56–57 (1979). For more direct empirical evidence suggesting that *active* options markets increase firm value, see Roll et al., *supra*, at 349. Compare Ramesh P. Rao & Christopher K. Ma, *The Effect of Call-Option-Listing Announcement on Shareholder Wealth*, 15 J. BUS. RES. 449, 461 (1987) (documenting *negative* excess equity returns associated with announcements of the introduction of exchange-traded standardized options and *positive* excess equity returns associated with the commencement of trading of such options and arguing that this phenomenon is attributed to the expectation that such instruments would destabilize equity trading in the future and additional demand stimulated by additional

extent to which this social cost can be effectively controlled via regulatory means.

This Article reexamines, with the emphasis on recent empirical studies and developments in the securities industry, the nexus of relationships among informed transactions, information asymmetry, and liquidity of securities markets in the context of public policy debates about insider trading and its regulation. The topics covered are: (1) the nature of market makers' losses from insider trading and the significance of inventory management in various markets; (2) the distinction between insider trading and other forms of informed trading; (3) the importance of disentangling informed trading, informational asymmetry, and uncertainty; (4) bid-ask spread decomposition studies; (5) the connection among estimates of the probability of informed trading and bid-ask spreads and their components; (6) various mechanisms for providing liquidity; (7) the examination of unregulated securities markets and the impact of insider trading regulation on market liquidity; and (8) the significance of firm characteristics. The Article concludes by examining the alleged link between insider trading and market liquidity as a justification for the existence of regulation based on the weight of empirical evidence, stressing the importance of the distinction between insider trading and other types of informed trading, and suggesting directions for future empirical research.

#### I. THE NATURE OF MARKET MAKERS' LOSSES FROM INSIDER TRADING AND THE SIGNIFICANCE OF INVENTORY MANAGEMENT IN VARIOUS MARKETS

The idea that market makers are harmed by insider trading—or informed trading more generally—has an intuitive appeal:

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risk-return combinations), with Bartley R. Danielsen & Sorin M. Sorescu, *Why Do Option Introductions Depress Stock Prices? A Study of Diminishing Short Sale Constraints*, 36 J. FIN. & QUANTITATIVE ANALYSIS 451, 451 (2001) (documenting *negative* excess equity returns associated with the commencement of trading of exchange-traded standardized options and explaining this phenomenon by the mitigation of constraints on short selling), and with Stewart Mayhew & Vassil Mihov, *Short Sale Constraints, Overvaluation, and the Introduction of Options* 21 (Oct. 7, 2005) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=544245> (finding that the commencement of trading of exchange-traded standardized options does not produce *negative* excess equity returns). *But see* Bartley R. Danielsen et al., *Reassessing the Impact of Option Introductions on Market Quality: A Less Restrictive Test for Event-Date Effects*, 42 J. FIN. & QUANTITATIVE ANALYSIS 1041, 1061 (2007) (arguing that “previous studies have misinterpreted ex ante changes as option introduction effects” and “[i]n most cases, market quality, as measured by spreads, trading volume, and volatility, peaks before the option listing date”).

In many markets, any insider *always* trades directly with a market maker—or at least preempts him from making a favorable trade—because the latter, as a marginal trader, absorbs with his capital *all* immediate order imbalances, and this argument appears to demonstrate the existence of actual losses inflicted on market makers.<sup>16</sup>

It follows that insider trading may be harmful to such dimensions of market liquidity as bid-ask spreads, as a proxy for compensation to a market maker for providing liquidity,<sup>17</sup> and market depths, as a proxy for the extent of liquidity offered by a market maker.<sup>18</sup>

On the other hand, market makers do not passively absorb order imbalances; instead, they actively manage their inventories and target some preferred inventory level in equity markets<sup>19</sup> or some market-neutral posi-

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<sup>16</sup> Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, at 395.

<sup>17</sup> Some trading venues also allow market makers to collect special rebates for executed transactions by posting “passive” orders—typically at the expense of access fees borne by traders submitting “aggressive” orders—and such rebates in this pricing model, which is known as “maker-taker” or “make-or-take,” serve as another method of compensating market makers for providing liquidity in addition to profits from bid-ask spreads. See SEC’s Concept Release on Equity Market Structure, *supra* note 2, at 3598–99, 3608; MICHAEL DURBIN, ALL ABOUT HIGH-FREQUENCY TRADING 57–58 (2010).

<sup>18</sup> See Dominique Dupont, *Market Making, Prices, and Quantity Limits*, 13 REV. FIN. STUD. 1129, 1130 (2000) (a formal model finding that “the theoretical dealer adjusts the depth proportionally more than the bid-ask spread in response to changes in the degree of informational asymmetry” caused by the presence of informed trading).

<sup>19</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 110–16 & nn.123–58; Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, at 395 & n.24, 400 & n.41. For general sources on inventory management by equity market makers, see M.F.M. OSBORNE, THE STOCK MARKET FROM A PHYSICIST’S POINT OF VIEW 48–51 (1977); Pamela C. Moulton, *Inventory Effects*, in 2 ENCYCLOPEDIA OF QUANTITATIVE FINANCE 976 *passim* (Rama Cont ed., 2010). For empirical evidence on equity market markets’ inventory management, see Carole Camerton-Forde et al., *Time Variation in Liquidity: The Role of Market-Maker Inventories and Revenues*, 65 J. FIN. 295, 325–26 (2010) (evidence from the NYSE); Oliver Hansch, *The Cross-Sectional Determinants of Inventory Control and the Subtle Effects of ADRs*, 28 J. BANKING & FIN. 1915, 1931 (2004) (evidence from the LSE); Terrence Hendershott & Mark S. Seasholes, *Market Maker Inventories and Stock Prices*, 97 AM. ECON. REV. (PAPERS & PROC.) 210, 214 (2007) (evidence from the NYSE); Bülent Köksal, *Participation Strategy of the NYSE Specialists to the Posted Quotes*, 21 N. AM. J. ECON. & FIN. 314, 329–30 (2010) (evidence from the NYSE); Narayan Y. Naik & Pradeep K. Yadav, *Do Dealer Firms Manage Inventory on a Stock-by-Stock or a Portfolio Basis?*, 69 J. FIN. ECON. 325, 349–50 (2003) (evidence from the LSE); Sigridur Benediktsdottir, *An Empirical Analysis of Specialist Trading Behavior at the New York Stock Exchange* 3–4 (Bd. of Governors of the Fed. Reserve Sys., Int’l Fin. Discussion Paper No. 876, 2006), available at <http://www.federalreserve.gov/pubs/ifdp/2006/876/ifdp876.pdf> (evidence from the NYSE).

tion in options markets<sup>20</sup>—and hence control their risk exposure to price movements.<sup>21</sup> Furthermore, informed trading does not necessarily create order imbalances<sup>22</sup> or push a market maker away from his preferred level of risk exposure.<sup>23</sup> More generally, the impact of informed trading on market makers is ambiguous because intervening inventory management-related transactions may take place during the time gap between the informed transaction in question and the recognition of this piece of information by the market.<sup>24</sup> Of course, the maximum harm is inflicted when the relevant piece of information, holding its price impact constant, is immediately disclosed to, or otherwise absorbed by, the market. It follows that market makers are likely to be significantly harmed by trading on short-lived information because of various complications with offsetting such transactions and inferring their information content. However, this scenario does not necessarily characterize true insider trading on the basis of “soft” or “hard” information, as it often takes place days or weeks—if not longer—in advance.

The magnitude of the harm inflicted by informed trading largely depends on the ease of inventory management—and hence market liquidity—and insider trading in particular is of real concern for specific types of market makers.<sup>25</sup> One category consists of market makers of equity blocks, as this market is inherently less liquid, although it is also less anonymous and more reliant on reputation.<sup>26</sup> Another category represents options market makers because they “trade multiple options with different

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<sup>20</sup> See Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, at 403–07 & nn.53–74.

<sup>21</sup> One key factor is that risk exposure of market makers may be magnified in several instances. For options market makers, this situation may arise because of the leveraged nature and other attributes of the risk profile of options. *See id.* at 399, 408–09. Another consideration is that an equity market maker may short sell shares of stock that he does not own. *See* DURBIN, *supra* note 17, at 56. In this case, the exposure of this market participant is also magnified—with a theoretical possibility of unlimited losses. For the recent regulatory restrictions on short selling activities of both equity and options market makers, see Amendments to Regulation SHO, Exchange Act Release No. 61,595, 75 Fed. Reg. 11,232 (Feb. 26, 2010) (to be codified at 17 C.F.R. pt. 242).

<sup>22</sup> Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 111.

<sup>23</sup> *Id.* at 113.

<sup>24</sup> *Id.* at 110–11.

<sup>25</sup> Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, *passim*.

<sup>26</sup> *See id.* at 396 & n.26; *see also* Hendrik Bessembinder & Kumar Venkataraman, *Does an Electronic Stock Exchange Need an Upstairs Market?*, 73 J. FIN. ECON. 3, 31–32 (2004) (examining block trades on the Paris Bourse intermediated by upstairs brokers, which can act as either agents or principals, and arguing that these market participants certify certain orders as uninformed).

expiration dates and strike prices, which are less liquid and more leveraged than underlying securities, face limitations of dynamic and static hedging of options as nonlinear derivatives, and assume additional risk by *creating* options instead of *trading* from their inventories.”<sup>27</sup> As one executive of a leading options market making firm has noted, “[i]n some markets, insider trading is so bad that we have given up making markets for options on smaller stocks altogether.”<sup>28</sup>

The countervailing force for market makers is the potential value of observing order flow to infer informed trading ahead of the market.<sup>29</sup> As an illustration, one study concluded that, “[o]nce [informed] traders have been identified ... the market maker [on the Boston Options Exchange enters into] ... a subsequent trade in the same option and adopts positions that follow the informed trader.”<sup>30</sup> This advantage, probably largely eroded in many markets because of recent technological and institutional changes,<sup>31</sup> depends on the percentage of total order flow observed by the market maker in question and transparency of transactions in real time to other market participants.<sup>32</sup> There is some empirical evidence that certain types of market makers are informed traders as proxied by their profits from position-taking, in addition to their gains from providing liquidity via realized bid-ask spreads.<sup>33</sup> Since many of these examples come from mar-

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<sup>27</sup> Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, at 408. For a recent study that provides empirical evidence that informed trading has a clear effect on liquidity of options markets in contrast to equity markets, see Cao & Wei, *supra* note 9, at 45–46.

<sup>28</sup> Thomas Peterffy, Chairman & Chief Exec. Officer, Interactive Brokers Grp., Speech Before the International Options Market Association 3 (Apr. 12, 2005), [http://www.interactivebrokers.com/en/general/about/commentLetters/IOA\\_Speech.pdf](http://www.interactivebrokers.com/en/general/about/commentLetters/IOA_Speech.pdf).

<sup>29</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 116 & nn.159–62.

<sup>30</sup> Nabil Khoury et al., *PIP Transactions, Price Improvement, Informed Trades and Order Execution*, 16 EUR. FIN. MGMT. 211, 226 (2010).

<sup>31</sup> See, e.g., Letter from Greg Tusar, Managing Dir., Goldman Sachs Clearing & Execution, L.P. & Matthew Lavicka, Managing Dir., Goldman, Sachs & Co., to Elizabeth M. Murphy, Sec’y, U.S. Sec. & Exch. Comm’n 7 (June 25, 2010), *available at* <http://www.sec.gov/comments/s7-02-10/s70210-243.pdf> (“[C]hanges in the business models of many exchanges and advancements in technology have eliminated or reduced the value of the special time and place privileges traditionally enjoyed by specialists and registered market makers ...”).

<sup>32</sup> Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 116–18 & nn.162–69.

<sup>33</sup> See Amber Anand & Avaniidhar Subrahmanyam, *Information and the Intermediary: Are Market Intermediaries Informed Traders in Electronic Markets?*, 43 J. FIN. & QUANTITATIVE ANALYSIS 1, 26–27 (2008) (evidence from equity trading on the Toronto Stock Exchange); Michael F. Ferguson & Steven C. Mann, *Execution Costs and Their*

kets other than equities and equity options, it is likely that such trading profits largely arise from the exploitation of informational advantages that are not based on observing true insiders' transactions.<sup>34</sup> Some empirical evidence even indicates that certain market makers do not gain or lose money on position-taking,<sup>35</sup> but these seemingly contradictory results may be explained by institutional and regulatory differences, such as affirmative and negative obligations of market makers.<sup>36</sup>

There is some empirical evidence that market makers profit from observing insiders' transactions. For instance, one study analyzed registered

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*Intraday Variation in Futures Markets*, 74 J. BUS. 125, 157 (2001) (evidence from foreign currency, interest rate, and commodity futures trading on the Chicago Mercantile Exchange); Alex Frino et al., *Local Trader Profitability in Futures Markets: Liquidity and Position Taking Profits*, 30 J. FUTURES MKTS. 1, 17 (2010) (evidence from interest rate, government securities, and equity index futures trading on the Sydney Futures Exchange); Alexander Kurov & Dennis J. Lasser, *Price Dynamics in the Regular and E-Mini Futures Markets*, 39 J. FIN. & QUANTITATIVE ANALYSIS 365, 381–82 (2004) (evidence from equity index futures trading on the Chicago Mercantile Exchange); Benediktsdottir, *supra* note 19, at 3–4 (evidence from equity trading on the NYSE); Michel van der Wel et al., *Are Market Makers Uninformed and Passive? Signing Trades in the Absence of Quotes* 20–21 (Fed. Reserve Bank of N.Y., Staff Report No. 395, 2009), available at [http://www.newyorkfed.org/research/staff\\_reports/sr395.html](http://www.newyorkfed.org/research/staff_reports/sr395.html) (evidence from government securities futures trading on the Chicago Board of Trade).

<sup>34</sup> In the recent past, the issue of potential abuses of informational advantages effectively conferred by the NYSE's trading architecture on its market makers—then called “specialists”—was quite controversial. See, e.g., *Market Structure III: The Role of the Specialist in the Evolving Modern Marketplace: Field Hearing Before the Subcom. on Capital Mkts., Ins. & Gov't Sponsored Enters. of the H. Comm. on Fin. Servs.*, 108th Cong. 56 (2004) (prepared statement of Robert Greenfield, President and Chief Executive Officer, NASDAQ Stock Market, Inc.) (arguing that the practice of “‘stepping ahead’ of customer orders and a host of other occurrences with equally disturbing names like ‘penny-jumping,’ ‘holding up cancel requests,’ and ‘matching the public’ .... [were caused by the specialists’ exclusive access to] non-public material information about the trading characteristics of their assigned stock”). Ultimately, the NYSE eliminated the “advance ‘look’ at incoming orders,” which was previously available to specialists, for their successors, “designated market makers.” Order Approving a Proposed Rule Change To Create a New NYSE Market Model, Exchange Act Release No. 58,845, 73 Fed. Reg. 64,379, 64,389 (Oct. 24, 2008).

<sup>35</sup> See Joel Hasbrouck & George Sofianos, *The Trades of Market Makers: An Empirical Analysis of NYSE Specialists*, 48 J. FIN. 1565, 1588 (1993) (evidence from equity trading on the NYSE); Oliver Hansch et al., *Preferencing, Internalization, Best Execution, and Dealer Profits*, 54 J. FIN. 1799, 1801–02 (1999) (evidence from equity trading on the LSE); Michaël Dewally et al., *Determinants of Trading Profits of Individual Traders: Risk Premia or Information* 31 (Mar. 4, 2010) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1535543> (evidence from energy futures trading on NYMEX).

<sup>36</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 118.

transactions by insiders on the NYSE, the AMEX, and NASDAQ from 1988 to 2002, when such transactions were reported with a significant delay, and suggested that equity market makers were able to identify information-based orders and execute them at adjusted prices.<sup>37</sup> Furthermore, the study asserted that “[m]arket makers do not front-run informed trades before the trade. However, with the large initial stock price adjustment, the market maker shares into the insider profits.”<sup>38</sup> A companion study of insiders’ registered transactions from the same time period and trading venues found that market makers’ quote revisions are greater for insiders’ purchases compared to other purchases, and it also pointed to “[t]he piggy-backing of market makers on insider trades.”<sup>39</sup> Another related study concluded that equity market makers on the NYSE and the AMEX increase price sensitivity before both *scheduled* and *unscheduled* corporate announcements, “suggest[ing] that market makers are able to extract and react to information related to timing.”<sup>40</sup> In any instance, the analysis of the overall impact of insider trading on market makers must take into account both potential costs and benefits of this practice.

## II. THE DISTINCTION BETWEEN INSIDER TRADING AND OTHER FORMS OF INFORMED TRADING

In the context of the link between insider trading and market liquidity, it is critical to make the distinction between true insider trading and other forms of informed trading, despite the blurry economic and legal boundaries of these types of transactions. The gamut of informational advantages in securities markets is rather broad, with different types of company-specific, including security-specific, and non-company-specific information that may be inherently concentrated or dispersed among different

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<sup>37</sup> A. Can Inci & H. Nejat Seyhun, *How Do Quotes and Prices Evolve Around Isolated Informed Trades?*, J. ECON. & FIN. (forthcoming) (manuscript at 4, 6, 20) (on file with author).

<sup>38</sup> *Id.* (manuscript at 3).

<sup>39</sup> A. Can Inci et al., *Intraday Behavior of Stock Prices and Trades Around Insider Trading*, FIN. MGMT., Spring 2010, at 323, 341.

<sup>40</sup> Joon Chae, *Trading Volume, Information Asymmetry, and Timing Information*, 60 J. FIN. 413, 415 (2005). Another contribution concluded that bid-ask spreads for stocks on the NYSE do not change before unanticipated announcements, as opposed to anticipated announcements, and argued that, “[b]efore unanticipated events, if there is informed trading, the market maker either does not recognize it or does not react to it.” John R. Graham et al., *Information Flow and Liquidity Around Anticipated and Unanticipated Dividend Announcements*, 79 J. BUS. 2301, 2302–03 (2006). However, an alternative interpretation is that informed trading provides market makers with valuable information about future price moves—not just signals about increased volatility.

market participants. Such advantages may stem from the possession of pieces of information that originate *inside* the company whose securities are being traded—or even another company, such as a potential acquirer—or may be based on macroeconomic, industry-wide, and other similar *outside* factors.<sup>41</sup> Informed trading may also be based on the quickness of reaction to *public* information.<sup>42</sup> In addition, market participants’ “knowledge of their own inventory and customer order flow may convey information about fundamentals, short-term price fluctuations, or customer demand.”<sup>43</sup>

Overall, market makers are likely to be seriously disadvantaged “by trading on short-lived information stemming from non-instantaneous dissemination of public announcements, advance knowledge of certain trading trends or incoming orders, or certain advantages in acquiring, processing, and aggregating public information.”<sup>44</sup> One example of a market par-

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<sup>41</sup> For empirical studies discussing informed trading and price discovery in markets for basket- and index-based securities, see Rafiqul Bhuyan et al., *LEAPS of Faith: A Trading Indicator Based on CBOE S&P 500 LEAPS Option Open Interest Information*, J. INVESTING, Summer 2010, at 85; Kam C. Chan et al., *Do Options Contribute to Price Discovery in Emerging Markets?*, 1 INT’L REV. ACCT. BANKING & FIN. 92 (2009); Jeff Fleming et al., *Trading Costs and Relative Rates of Price Discovery in Stock, Futures, and Option Markets*, 16 J. FUTURES MKTS. 353 (1996).

<sup>42</sup> See, e.g., Hee-Joon Ahn et al., *Informed Trading in the Index Option Market: The Case of KOSPI 200 Options*, 28 J. FUTURES MKTS. 1118, 1121 (2008) (arguing that “sophisticated investors [can] capitalize on their superior information-processing skills and/or their superior trading skills ... [resulting in] information-motivated trading based on public information”); Pierluigi Balduzzi et al., *Economic News and Bond Prices: Evidence from the U.S. Treasury Market*, 36 J. FIN. & QUANTITATIVE ANALYSIS 523, 539 (2001) (arguing that “asymmetry arises not because different information is received by traders, but because traders may have differing ability to process the information”); T. Clifton Green, *Economic News and the Impact of Trading on Bond Prices*, 59 J. FIN. 1201, 1202 (2004) (arguing that “the release of public information raises the level of information asymmetry ... [because] some market participants have an advantage at determining [the impact of] macro news”); see also Ryan Riordan et al., *Public Information Arrival: Price Discovery and Liquidity in Electronic Limit Order Markets 2* (Apr. 4, 2011) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1620425> (“Most news is still read by humans but news providers have started to offer newswire products with machine-learning systems that specifically cater to algorithmic traders.”).

<sup>43</sup> Roger D. Huang et al., *Information-Based Trading in the Treasury Note Interdealer Broker Market*, 11 J. FIN. INTERMEDIATION 269, 270 (2002).

<sup>44</sup> Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, at 397; see also Lawrence R. Glosten & Lawrence E. Harris, *Estimating the Components of the Bid/Ask Spread*, 21 J. FIN. ECON. 123, 140 (1988) (“Perhaps information from which market-makers must protect themselves is related to superior analytical ability among some investors rather than information obtained by legally defined insiders.”); Oliver

ticipant in today's high-speed securities markets, whose presence may harm a market maker, is "a quantitative trader ... who performs bleeding-edge statistical analysis on screaming-fast computing hardware .... [to] make reasonably confident predictions based on very strong alpha signals, thereby seeing something in the markets that others do not, or at least before they do."<sup>45</sup> Market makers may even be disadvantaged by short-term trading activities of their counterparts in a related market, with the latter getting ahead of the former's transactions.<sup>46</sup> Furthermore, the feasibility of various short-trading activities has been aided by decreased bid-ask spreads in many markets: "[W]hen spreads narrow to a penny or less, it's that much easier for a small informational advantage by the well-informed trader to become a costly disadvantage to the less-informed market maker."<sup>47</sup>

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Kim & Robert E. Verrecchia, *Market Liquidity and Volume Around Earnings Announcements*, 17 J. ACCT. & ECON. 41, 44 (1994) ("The ability of information processors to produce superior assessments of a firm's performance on the basis of an earnings announcement provides them with a comparative information advantage over market makers.").

<sup>45</sup> DURBIN, *supra* note 17, at 93–94. The existence of such market participants, which are exemplified by high-frequency traders, explains both why traditional market makers have to catch on in terms of technology and why high-frequency traders themselves are becoming a part of the market making industry. *See id.* at vi, 92–94; *see also* Letter from Paul O'Donnell, Chief Operating Officer & Anna Westbury, Head of Compliance and Regulatory Affairs, BATS Trading Ltd., to the Comm. of Eur. Sec. Regulators 2 (Apr. 30, 2010), available at [http://www.batstrading.co.uk/resources/publications/BATSEurope\\_CESRMicrostructuresubmission\\_20100430.pdf](http://www.batstrading.co.uk/resources/publications/BATSEurope_CESRMicrostructuresubmission_20100430.pdf) ("The democratisation of market making is now such that any appropriately constituted firm can become a liquidity provider. However, such liquidity providers have automated their trading in order that they are able to remain efficient and competitive."); Thomas Peterffy, Chairman & Chief Exec. Officer, Interactive Brokers Grp., Comments Before the Joint CFTC-SEC Advisory Committee on Emerging Regulatory Issues 1 (June 22, 2010), <http://www.sec.gov/comments/265-26/265-26-23.pdf> ("[High-frequency traders] have elbowed out Market Makers by copying or even bettering Market Makers' quotes but for very small sizes."). On the other hand, the set of techniques for providing liquidity employed by high-frequency traders tends to differ from those employed by traditional market makers: "[T]he high-frequency trader must resort to more innovative, aggressive, and (some would say) predatory strategies than those of traditional market-makers.... The high-frequency trader is also more selective than the pure market-maker when it comes to choosing which securities to trade ...." DURBIN, *supra* note 17, at 40. For a further analysis of these distinctions, see SEC's Concept Release on Equity Market Structure, *supra* note 2, at 3607–08.

<sup>46</sup> DURBIN, *supra* note 17, at 69–70.

<sup>47</sup> *Id.* at 94.

Similarly, market makers are likely to be harmed by stale quotes caused by various institutional, regulatory, and other frictions.<sup>48</sup> This problem is compounded in options markets “because of the increased difficulty of updating quotations in multiple series of options on the same underlying security, increasing the risk that a trader may trade against a still-displayed stale price.”<sup>49</sup> One historical illustration points to courtroom struggles between market makers and “SOES bandits” and “RAES bandits,” short-term traders exploiting stale quotes for stocks on NASDAQ and for options on the Chicago Board Options Exchange (CBOE), respectively, via small-sized transactions.<sup>50</sup> The existence of “flash orders”/“step-up mechanisms” in options markets is also rationalized as a response by market makers to the intertwined concerns about stale quotes

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<sup>48</sup> Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, at 397 & n.33; see also INT’L SEC. EXCH., POSITION PAPER ON FLASH ORDERS IN THE U.S. OPTIONS MARKET 3 n.1 (2009), available at [http://www.ise.com/assets/files/about\\_ise/ISE\\_Position\\_Paper\\_on\\_Flash\\_Website.pdf](http://www.ise.com/assets/files/about_ise/ISE_Position_Paper_on_Flash_Website.pdf) (“[T]he market could move so quickly that a liquidity provider may not be able to update his quote quickly enough to avoid an opportunistic professional trader from trading against the still-displayed stale price.”); Jon “Doctor J” Najarian, *A New Options Game: The Market Taker*, in MASTER TRADERS: STRATEGIES FOR SUPERIOR RETURNS FROM TODAY’S TOP TRADERS 205, 208 (Fari Hamzei ed., 2006) (“The market makers ... [may] find themselves on the other side of thousands of options contracts at a price that was stale by a second—and more times than not, the advantage will be to the computerized trading program and not to the market maker ....”); Thomas Peterffy, Chairman & Chief Exec. Officer, Interactive Brokers Grp., Comments Before the 2010 General Assembly of the World Federation of Exchanges 6 (Oct. 11, 2010), <http://interactivebrokers.com/download/worldFederationOfExchanges.pdf> (“It obviously takes much longer for the market maker to move thousands of quotes than for the [high-frequency trader] to hit a handful.”).

<sup>49</sup> Letter from Thomas F. Price, Managing Dir., Equity Options Trading Comm., Sec. Indus. & Fin. Mkts. Ass’n, to Elizabeth M. Murphy, Sec’y, U.S. Sec. & Exch. Comm’n 3 (Dec. 1, 2009), available at <http://www.sec.gov/comments/s7-21-09/s72109-95.pdf>; see also Letter from Michael J. Simon, Sec’y, Int’l Sec. Exch., to Elizabeth Murphy, Sec’y, U.S. Sec. & Exch. Comm’n 9 (Nov. 23, 2009), available at <http://www.sec.gov/comments/s7-21-09/s72109-83.pdf> (“By providing liquidity to multiple series of options on the same underlying instrument options market makers expose themselves to much greater risk than their equity counterparts. Persons ‘sweeping’ liquidity in the options market can hit multiple quotations virtually simultaneously, requiring market makers to buy (or sell) a much higher dollar amount of securities than in the cash market.”).

<sup>50</sup> See *Cathedral Trading, LLC v. Chi. Bd. Options Exch.*, 199 F. Supp. 2d 851, 855–56 (N.D. Ill. 2002); *Datek Sec. Corp v. Nat’l Ass’n of Sec. Dealers, Inc.*, 875 F. Supp. 230, 232 (S.D.N.Y. 1995). For background information on “SOES bandits” and “RAES bandits,” see Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 109 n.119; Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, at 397 n.33. Options market makers on the Pacific Stock Exchange also experienced a similar problem. See Laura Johnson, *P-Coast Intros Measures to Protect Market Makers from Hi-Tech Arbitrage*, WALL ST. LETTER, Mar. 27, 2000, at 1.

and short-term informed trading.<sup>51</sup> A much earlier example similarly points to the harm to options market makers on the CBOE from “tape racing,” the practice of taking “advantage of time disparities between the actual trades [in underlying securities] and the transaction being disseminated via the price reporting system .... result[ing] in smaller, less liquid [options] markets.”<sup>52</sup> Furthermore, recent proposals to impose a mandatory minimum duration for quotes were criticized, because “the likelihood that your quotes become stale [would] increase significantly.... [allowing others] to trade on your outdated quotes and thus pocket an easy profit. Effectively as a market maker you would be short a strangle every time you post a two sided market.”<sup>53</sup> Turning to empirical evidence, one study found a positive correlation between the speed of quote adjustment and realized spreads as a measure of market makers’ revenues for stocks on

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<sup>51</sup> See INT’L SEC. EXCH., *supra* note 48, at 3 (“[L]iquidity providers may rationally determine not to publicly display the full size they are willing to trade at specific price points in today’s rapidly moving electronic markets due to ‘pick off’ concerns. However, these market participants may be willing to provide liquidity when shown a flash order.”) (footnote omitted); Letter from Thomas F. Price, Managing Dir., Equity Options Trading Comm., Sec. Indus. & Fin. Mkts. Ass’n, to Elizabeth M. Murphy, Sec’y, U.S. Sec. & Exch. Comm’n 2 (Aug. 10, 2010), *available at* <http://www.sec.gov/comments/s7-21-09/s72109-145.pdf> (“Quoting in size ... increases the risk to the market-maker of losses resulting from having quotes opportunistically accessed by sophisticated traders who may have superior information or take advantage of the momentary lags in a market-maker’s ability to update quotes to reflect new information that the market-maker receives.... [A] ban on flash orders would reduce the incentive of market makers on traditional exchanges to quote in size ....”); Larry Harris, *The Economics of Flash Orders* 4 (Dec. 4, 2009) (unpublished manuscript) (on file with author), *available at* <http://www.sec.gov/comments/s7-21-09/s72109-97.pdf> (“[F]lash facilities ... allow [market makers] to avoid offering liquidity to high speed traders who have learned about material information moments before [them] .... This information may include electronically transmitted headlines or information about the prices of correlated securities. In either event, liquidity suppliers who offer firm quotes risk losing to faster well-informed traders.”). However, one point of view is that “flash orders increase the probability that a displayed quotation will trade with an informed order, which decreases the incentive to display aggressive quotations,” with corresponding implications for liquidity. Letter from John A. McCarthy, Gen. Counsel, Global Elec. Trading Co., to Elizabeth Murphy, Sec’y, U.S. Sec. & Exch. Comm’n 3 (Aug. 10, 2010), *available at* <http://www.sec.gov/comments/s7-21-09/s72109-142.pdf>.

<sup>52</sup> C.B.O.E. MARKET MAKER ASS’N, MARKET MAKER REPORT ON THE ISSUE OF TAPE RACING 3 (1976), [http://c0403731.cdn.cloudfiles.rackspacecloud.com/collection/papers/1970/1976\\_0429\\_TapeRacingT.pdf](http://c0403731.cdn.cloudfiles.rackspacecloud.com/collection/papers/1970/1976_0429_TapeRacingT.pdf).

<sup>53</sup> Thierry Rijper et al., *Optiver Holding B.V., High Frequency Trading* 15 (Dec. 2010) (unpublished manuscript) (on file with author), *available at* <http://optiver.com/corporate/hft.pdf>.

the NYSE,<sup>54</sup> while another study of the same trading venue even suggested that “designated market makers’ attention constraints on earnings-announcement days affect the liquidity of the non-announcement stocks they handle.”<sup>55</sup>

Overall, the existence of short-term informed trading based on some combination of uneven distribution of information, as well as different capabilities with respect to its acquisition, processing, and aggregation, stale quotes, and transaction cost and speed advantages is a permanent fixture of securities markets that is fueled by technological developments. Furthermore, this type of trading, whether justly or unjustly called “parasitic” or “predatory,” has little to do with true insider trading and its regulation.<sup>56</sup> Such trading activities, given the short-lived nature of the underlying information and corresponding difficulties with inventory management, are likely to be more harmful to market makers than insider trading, translating into a more significant adverse impact on market liquidity. Perhaps this type of trading, rather than insider trading, is primarily captured in empirical research that links better market liquidity or smaller adverse selection costs with non-anonymity of transactions and reputation of intermediaries or proposes an information-based explanation for the practice of price improvements offered by market makers to se-

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<sup>54</sup> Alex Boulatov et al., *Dealer Attention, the Speed of Quote Adjustment to Information, and Net Dealer Revenue*, 33 J. BANKING & FIN. 1531, 1531 (2009).

<sup>55</sup> Bidisha Chakrabarty & Pamela C. Moulton, *Earnings Announcements and Attention Constraints: The Role of Market Design*, J. ACCT. & ECON. (forthcoming) (manuscript at 1) (on file with author), available at <http://ssrn.com/abstract=1357338>.

<sup>56</sup> As an illustration of the uncertain split between insider trading and informed trading in empirical research, several studies have indicated that, in certain situations, institutional investors possess information-based trading advantages, but this phenomenon is at least partially attributable to factors other than leakages of inside information to these market participants. See Benjamin C. Ayers & Robert N. Freeman, *Evidence That Analyst Following and Institutional Ownership Accelerate the Pricing of Future Earnings*, 8 REV. ACCT. STUD. 47, 63–64 (2003); Ekkehart Boehmer & Eric K. Kelley, *Institutional Investors and the Informational Efficiency of Prices*, 22 REV. FIN. STUD. 3563, 3592 (2009); Brian J. Bushee & Theodore H. Goodman, *Which Institutional Investors Trade Based on Private Information About Earnings and Returns?*, 45 J. ACCT. RES. 289, 317–18 (2007); James Jiambalvo et al., *Institutional Ownership and the Extent to Which Stock Prices Reflect Future Earnings*, 19 CONTEMP. ACCT. RES. 117, 141 (2002); Bin Ke & Kathy Petroni, *How Informed Are Actively Trading Institutional Investors? Evidence from Their Trading Behavior Before a Break in a String of Consecutive Earnings Increases*, 42 J. ACCT. RES. 895, 924–25 (2004); Xuemin (Sterling) Yan & Zhe Zhang, *Institutional Investors and Equity Returns: Are Short-Term Institutions Better Informed?*, 22 REV. FIN. STUD. 892, 920–21 (2009).

lected traders.<sup>57</sup> The distinction between insider trading and other forms of informed trading was also recognized—explicitly or implicitly—in the context of recent debates on various market structure issues.<sup>58</sup> Recent

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<sup>57</sup> See Michael J. Barclay et al., *Competition Among Trading Venues: Information and Trading on Electronic Communications Networks*, 58 J. FIN. 2637, 2638, 2660 (2003) (analyzing anonymity in the context of equity trading on NASDAQ and electronic communications networks); Robert Battalio et al., *Reputation Effects in Trading on the New York Stock Exchange*, 62 J. FIN. 1243, 1269–70 (2007) (analyzing reputation in the context of equity trading on the NYSE); Khoury et al., *supra* note 30, at 226 (analyzing price improvement in the context of options trading on the Boston Options Exchange); Kaun Y. Lee & Kee H. Chung, *Information-Based Trading and Price Improvement*, 36 J. BUS. FIN. & ACCT. 754, 771 (2009) (analyzing price improvement in the context of equity trading on the NYSE and NASDAQ); Erik Theissen, *Trader Anonymity, Price Formation and Liquidity*, 7 EUR. FIN. REV. 1, 13, 23–24 (2003) (analyzing anonymity and price improvement in the context of equity trading on the Frankfurt Stock Exchange); Louis R. Mercorelli et al., *Modeling Adverse Selection on Electronic Order-Driven Markets* 35 (Mar. 16, 2008) (unpublished manuscript) (on file with author), *available at* <http://ssrn.com/abstract=1107049> (analyzing anonymity in the context of equity trading on the Australian Stock Exchange). The link between greater anonymity and higher bid-ask spreads was also found in commodity futures markets, in which the problem of asymmetric information is less important. See Henry L. Bryant & Michael S. Haigh, *Bid-Ask Spreads in Commodity Futures Markets*, 14 APPLIED. FIN. ECON. 923, 933–35 (2004) (data from the London International Financial Futures Exchange). However, several empirical studies in the context of equity trading came to a different conclusion. See Carole Comerton-Forde & Kar Mei Tang, *Anonymity, Liquidity and Fragmentation*, 12 J. FIN. MKTS. 337, 338 (2009) (arguing that the introduction of anonymity on the Australian Stock Exchange resulted in “the reduction in trading costs ... driven mainly by a reduction in the adverse selection component of the spread in large stocks”); Thierry Foucault et al., *Does Anonymity Matter in Electronic Limit Order Markets?*, 20 REV. FIN. STUD. 1707, 1740 (2007) (finding that the introduction of anonymity on the Paris Bourse decreased bid-ask spreads, and attributing this phenomenon to the use of *volatility* information by certain traders); Yusif Simaan et al., *Market Maker Quotation Behavior and Pretrade Transparency*, 58 J. FIN. 1247, 1264, 1266 (2003) (suggesting that the introduction of anonymity on NASDAQ decreased bid-ask spreads by making dealer collusion more problematic). For an additional survey of empirical literature on the link between anonymity and market liquidity, which distinguishes between pre-trade and post-trade anonymity, see Alexandra Hachmeister & Dirk Schiereck, *Dancing in the Dark: Post-Trade Anonymity, Liquidity and Informed Trading*, 34 REV. QUANTITATIVE FIN. & ACCT. 145, 147–48 (2010).

<sup>58</sup> See *Dark Pools, Flash Orders, High-Frequency Trading, and Other Market Structure Issues: Hearing Before the Subcomm. on Sec., Ins., & Inv. of the S. Comm. on Banking, Hous., & Urban Affairs*, 111th Cong. 15 (2009) [hereinafter *Market Structure Hearings*] (statement of Daniel Mathisson, Managing Director and Head of Advanced Execution Services, Credit Suisse) (“Who would benefit from additional quantitative information [from ‘dark pools’] hitting the tape in real time, fundamental long-term investors or short-term information-based traders?”); SEC’s Concept Release on Equity Market Structure, *supra* note 2, at 3612 (“Liquidity providers generally consider the

courtroom struggles also reflect tensions between market makers and certain types of short-term traders.<sup>59</sup> Additionally, it is possible that the continuing existence of the practice of payment of order flow by market makers to brokers for diverted—typically retail—orders, which was earlier attributed to informational *disadvantages* of retail customers vis-à-vis market makers,<sup>60</sup> at least partially reflects certain *advantages* of short-term traders in today's securities markets.<sup>61</sup>

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orders of individual investors very attractive to trade with because such investors are presumed on average to not be as informed about short-term price movements as are professional traders.”); Letter from Robert A. Bright, Chief Exec. Officer, Bright Trading LLC, et al. to the U.S. Sec. & Exch. Comm’n 1 (n.d.), *available at* <http://www.sec.gov/comments/s7-02-10/s70210-246.pdf> (“When we discuss informed order flow, we are not referring to market participants with inside information, we are referring to market participant’s orders that are on the right side of the market in the short-term.”).

<sup>59</sup> For instance, one case addressed the conflict between options market makers and sophisticated direct access customers and pointed to the alleged discrimination of orders placed by direct access customers by options market makers, including interference with execution and mishandling of such orders. *Last Atlantis Capital LLC v. AGS Specialist Partners*, No. 04 C 397, 2010 U.S. Dist. LEXIS 29175, at \*4–5 (N.D. Ill. Mar. 26, 2010). The plaintiffs themselves stated that their trading strategies were based on “information and/or technological capabilities that are superior to that of Specialist Defendants and other traders in the market.” *Consol. Complaint and Demand for Jury Trial* at 43, *Last Atlantis Capital LLC v. Chi. Bd. Options Exch., Inc.*, 455 F. Supp. 2d 788 (N.D. Ill. 2006) (No. 04 C 397), 2005 U.S. Dist. Ct. Pleadings LEXIS 10704, at \*43.

<sup>60</sup> *See, e.g.*, JON NAJARIAN, *HOW I TRADE OPTIONS* 185–86 (2001) (“[R]etail customers are looking at delayed quotes, which is a snapshot of where the market was 20 minutes ago.... Trading against someone who has a different timeframe from you can be profitable and is how payment for order flow came into being.”). For a further discussion of the practice of payment for order flow in the context of informational asymmetry, see Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, at 421 n.136. However, this practice is likely to owe its existence to a number of factors. *See, e.g.*, *Gilman v. BHC Sec., Inc.*, 104 F.3d 1418, 1420, 1423 (2d Cir. 1997) (describing payment for order flow as a “volume discount” and a “means by which the market makers compete with one another”).

<sup>61</sup> *See* Jonathan Spicer, *For Wall Street, Dumb Money Pays*, REUTERS, Dec. 17, 2010, *available at* <http://www.reuters.com/article/2010/12/17/us-markets-dumb-money-idUSTRE6BG2H320101217> (discussing the practice of payment for order flow and stating that “in contrast to high-frequency traders, retailers don’t have reams of algorithmic code and rapid-fire trading software that often shows where stocks are headed in the next few milliseconds”); *see also* Letter from Suhas Daftuar, Managing Dir., Hudson River Trading LLC, to Elizabeth M. Murphy, Sec’y, U.S. Sec. & Exch. Comm’n 8 (Apr. 30, 2010), *available at* <http://www.sec.gov/comments/s7-02-10/s70210-171.pdf> (arguing that “[t]he existence of payment for order flow and price improvement are generally driven by OTC market maker’s ability to discriminate among potential customers, taking the other side of individual investor orders which, unlike orders from proprietary trading firms or institutional investors, are unlikely to have a short-term adverse impact on the liquidity provider”).

Several empirical studies examined the impact of insider trading on liquidity of equity markets, but the results are ambiguous and contradictory.<sup>62</sup> More generally, it is hard to isolate, identify, and measure insider trading and its impact on market liquidity. Furthermore, analyzing *specific* concealed or registered transactions by insiders has its limitations. Concealed insider trading is not necessarily detected or even suspected *ex ante*, and, theoretically, there may be a long-term increase in bid-ask spreads rather than frequent temporary increases to compensate for such losses. Similarly, the information content of registered transactions may be hard to separate from the noise generated by idiosyncratic liquidity needs and individual judgments of insiders. Furthermore, this content is more likely to convey “soft” information with a relatively long time horizon

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<sup>62</sup> See J.C. Bettis et al., *Corporate Policies Restricting Trading by Insiders*, 57 J. FIN. ECON. 191, 218 (2000) (arguing that corporate policies regulating insiders’ registered transactions decrease bid-ask spreads on the NYSE); Sugato Chakravarty & John J. McConnell, *An Analysis of Prices, Bid/Ask Spreads, and Bid and Ask Depths Surrounding Ivan Boesky’s Illegal Trading in Carnation’s Stock*, FIN. MGMT., Summer 1997, at 18, 32–33 (examining illegal insider trading before a corporate acquisition and finding unchanged bid-ask spreads and greater market depths on the NYSE); Louis Cheng et al., *The Effects of Insider Trading on Liquidity*, 14 PAC.-BASIN FIN. J. 467, 481 (2006) (examining directors’ registered transactions and arguing that they increase bid-ask spreads and decrease market depths on the HKSE on the days when such transactions are executed); Bradford Cornell & Erik R. Sirri, *The Reaction of Investors and Stock Prices to Insider Trading*, 47 J. FIN. 1031, 1054–55 (1992) (examining illegal insider trading before a corporate acquisition and finding that bid-ask spreads on the NYSE in fact decreased); Richard Frankel & Xu Li, *Characteristics of a Firm’s Information Environment and the Information Asymmetry Between Insiders and Outsiders*, 37 J. ACCT. & ECON. 229, 253 (2004) (finding that a higher profitability of insiders’ registered transactions is associated with increased bid-ask spreads on various trading venues); Katherine Gleason, *Does Market Maker Competition Affect the Response to Insider Trading?*, 17 APPLIED FIN. ECON. 691, 699 (2007) (examining insiders’ registered transactions and finding that they increase bid-ask spreads but do not alter market depths on NASDAQ); Walayet A. Khan et al., *The Impact of Insider Trading on Market Liquidity in the NASDAQ Market*, 21 J. APPLIED BUS. RES. 11, 19 (2005) (examining insiders’ registered transactions and finding that they *decrease* bid-ask spreads on NASDAQ on the days when they are executed but suggesting that market makers still recoup their losses to insiders through *increased* bid-ask spreads in the long run); Suchi Mishra et al., *Spread Behavior Around Board Meetings for Firms with Concentrated Insider Ownership*, 12 J. FIN. MKTS. 592, 594 (2009) (examining insiders’ registered transactions around board meetings for firms with concentrated ownership and arguing that they increase bid-ask spreads on the NYSE); Diane Del Guercio et al., *An Analysis of the Price and Liquidity Effects of Illegal Insider Trading 2* (July 19, 2011) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1784528> (examining illegal insider trading on various trading venues and finding “no measurable effects [on market liquidity] as captured by standard metrics such as quoted and effective spreads, quoted depths, and information-based price impacts.”).

instead of more specific bits of data relating to immediate developments.<sup>63</sup> Thus, transactions based on this “soft” information are less likely to inflict harm on a market maker.

### III. THE IMPORTANCE OF DISENTANGLING INFORMED TRADING, INFORMATIONAL ASYMMETRY, AND UNCERTAINTY

Another key issue is the necessity of disentangling informed trading, informational asymmetry, and uncertainty. Bid-ask spreads are partly determined by factors related to, but not requiring the existence of, informed trading. These interrelated factors include the quality and flow of disclosure, price volatility of the security in question, and uncertainty more generally, all of which have a direct impact on market makers’ inventory holding costs.<sup>64</sup> Linkages among these factors and market liquidity have been suggested by several recent empirical studies,<sup>65</sup> although

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<sup>63</sup> Recent empirical studies lead to a number of conclusions about registered transactions by insiders. See Partha Gangopadhyay et al., *Profitability of Insider Trades in Extremely Volatile Markets: Evidence from the Stock Market Crash and Recovery in 2000–2003*, 48 Q.J. FIN. & ACCT. 45, 60 (2009) (documenting abnormal gains for insiders’ registered transactions and suggesting that a significant portion of such gains is attributable to the use of private information); Adam Kolasinski & Xu Li, *Are Corporate Managers Savvy About Their Stock Price? Evidence from Insider Trading After Earnings Announcements*, 29 J. ACCT. & PUB. POL’Y 27, 27 (2010) (examining insiders’ registered transactions after earnings announcements and suggesting that insiders’ abnormal gains are due to their ability to exploit market under-reaction); Lauren Cohen et al., *Decoding Insider Information* 27–29 (Nat’l Bureau of Econ. Research, Working Paper No. 16454, 2010), available at <http://www.nber.org/papers/w16454.pdf> (arguing that an identifiable subset of insiders’ registered transactions is information-based and predicts future news and events for individual firms); Itzhak Ben-David & Darren Roulstone, *Do Insiders Act as Arbitrageurs?* 30–32 (July 2009) (unpublished manuscript) (on file with author), available at [http://fisher.osu.edu/~roulstone\\_1/20090212\\_writeup\\_IRISK1.pdf](http://fisher.osu.edu/~roulstone_1/20090212_writeup_IRISK1.pdf) (concluding that insiders’ abnormal gains from registered transactions are largely due to their ability to exploit market mispricing of public information rather than the use of private information).

<sup>64</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 133, 163–64.

<sup>65</sup> See Wei-Peng Chen et al., *Corporate Governance and Equity Liquidity: Analysis of S&P Transparency and Disclosure Rankings*, 16 CORP. GOVERNANCE 644, 657–58 (2007) (linking lower bid-ask spreads for stocks on the NYSE and better information transparency and disclosure policies); Alex Frino & Stewart Jones, *The Impact of Mandated Cash Flow Disclosure on Bid-Ask Spreads*, 32 J. BUS. FIN. & ACCT. 1373, 1373 (2005) (linking lower bid-ask spreads for stocks on the Australian Stock Exchange and mandatory disclosure of cash flows); Frank L. Heflin et al., *Disclosure Policy and Market Liquidity: Impact of Depth Quotes and Order Sizes*, 22 CONTEMP. ACCT. RES. 829, 829 (2005) (linking higher market liquidity for stocks on various trading venues, as measured

there is a tendency to attribute these linkages to informed trading rather than inventory holding costs. For instance, one study treated “a measure of the disagreement in analysts’ earnings forecasts .... as a proxy for the informational disadvantage of market makers with respect to informed traders” instead of a proxy for volatility or uncertainty.<sup>66</sup> Empirical research that points to the correlation between greater informational advantages enjoyed by certain equity market makers and greater market liquidity<sup>67</sup> may also reflect other factors, such as better pricing accuracy due to decreased uncertainty, rather than the informed trading effect.<sup>68</sup>

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by bid-ask spreads and market depths, and better disclosure policies); Kiridaran Kanagaretnam et al., *Relationship Between Analyst Forecast Properties and Equity Bid-Ask Spreads and Depths Around Quarterly Earnings Announcements*, 32 J. BUS. FIN. & ACCT. 1773, 1797 (2005) (linking lower bid-ask spreads for stocks on the NYSE and the AMEX and lower information asymmetry, as measured by analysts’ forecast dispersion, forecast reversion volatility, and coverage); Mark Lang et al., *Transparency, Liquidity, and Valuation: International Evidence on When Transparency Matters Most*, J. ACCT. RES. (forthcoming) (manuscript at 37–38) (on file with author), available at <http://ssrn.com/abstract=1323514> (linking lower bid-ask spreads for stocks on various trading venues and greater transparency, as measured by the occurrence of earnings management, quality of accounting standards, quality of auditors, analyst following, and accuracy of analysts’ forecasts); Regina Wittenberg-Moerman, *The Role of Information Asymmetry and Financial Reporting Quality in Debt Trading: Evidence from the Secondary Loan Market*, 46 J. ACCT. & ECON. 240, 240–42 (2008) (linking lower bid-ask spreads for syndicated loans in over-the-counter markets and conservative financial reporting and the availability of firm-specific and loan-specific credit ratings); Haiyan Zhou, *Auditing Standards, Increased Accounting Disclosure, and Information Asymmetry: Evidence from an Emerging Market*, 26 J. ACCT. & PUB. POL’Y 584, 584 (2007) (linking lower bid-ask spreads for stocks on the Shanghai Stock Exchange and the Shenzhen Stock Exchange and additional disclosures required by new auditing standards); Siddharth Shankar et al., *Spread Behavior and Multiple Restatement Announcements 2* (Aug. 26, 2009) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1462238> (documenting higher bid-ask spreads for stocks on the NYSE around restatement announcements).

<sup>66</sup> Andros Gregoriou et al., *Information Asymmetry and the Bid-Ask Spread: Evidence from the UK*, 32 J. BUS. FIN. & ACCT. 1801, 1801 (2005).

<sup>67</sup> See Shantaram P. Hegde & Robert E. Miller, *Market-Making in Initial Public Offerings of Common Stocks: An Empirical Analysis*, 24 J. FIN. & QUANTITATIVE ANALYSIS 75, 87 (1989) (data from NASDAQ in the context of underwriting activities); Simi Kedia & Xing Zhou, *Local Market Makers, Liquidity and Market Quality*, 14 J. FIN. MKTS. 540, 540 (2011) (data from NASDAQ in the context of geographic proximity); Leonardo Madureira & Shane Underwood, *Information, Sell-Side Research, and Market Making*, 90 J. FIN. ECON. 105, 126 (2008) (data from NASDAQ in the context of securities research); H. Nejat Seyhun, *Insider Trading and the Effectiveness of Chinese Walls in Securities Firms*, 4 J.L. ECON. & POL’Y 369, 369 (2008) (data from the NYSE, the AMEX, and NASDAQ in the context of board representation).

<sup>68</sup> Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 128 n.220.

Several empirical studies attempted to link information asymmetry and liquidity of equity markets for spinoffs and tracking stock issuances, given a possible impact on the feasibility of different types of informed trading, but such studies were also inconclusive and did not separate informed trading from other similar factors.<sup>69</sup> For instance, such structural changes may “reduce[] uninformed investors’ uncertainty about the [firm] value,”<sup>70</sup> which, in turn, would have an effect on the information environment.<sup>71</sup> Thus, this group of studies also demonstrates the relevance of disentanglement.

#### IV. BID-ASK SPREAD DECOMPOSITION STUDIES

For estimating the impact of informed trading on different measures of bid-ask spreads,<sup>72</sup> the pivotal position is occupied by bid-ask spread decomposition studies.<sup>73</sup> From the methodological perspective, a comparison

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<sup>69</sup> See John Elder et al., *Do Tracking Stocks Reduce Informational Asymmetries? An Analysis of Liquidity and Adverse Selection*, 28 J. FIN. RES. 197, 211–13 (2005) (finding that the introduction of tracking stocks is associated with a relative increase in bid-ask spreads and a larger adverse selection component in relative and absolute terms on various trading venues); Mark R. Huson & Gregory MacKinnon, *Corporate Spinoffs and Information Asymmetry Between Investors*, 9 J. CORP. FIN. 481, 501–02 (2003) (finding higher bid-ask spreads on various trading venues after spinoffs and attributing this phenomenon to more frequent informed trading); Thomas Bates et al., *Spinoffs, Spreads, and Information Asymmetry* 16–17 (Aug. 1999) (unpublished manuscript) (on file with author), available at <ftp://ns1.ystp.ac.ir/YSTP/1/1/ROOT/DATA/PDF/unclassified/BCSFMA99.PDF> (finding lower bid-ask spreads on the NYSE after spinoffs and attributing this phenomenon to less frequent informed trading, although the impact on the adverse selection component was ambiguous).

<sup>70</sup> Michel A. Habib et al., *Spinoffs and Information*, 6 J. FIN. INTERMEDIATION 153, 153 (1997).

<sup>71</sup> See *id.* at 154.

<sup>72</sup> For the definitions of the “quoted spread,” “effective spread,” and “realized spread,” see Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 88 n.26. Another frequently used metric, the “traded spread,” “reflects trades inside the spread but outside the midpoint.” Roger D. Huang & Hans R. Stoll, *The Components of the Bid-Ask Spread: A General Approach*, 10 REV. FIN. STUD. 995, 1000 (1997). A less common—and substantively different—definition of the “traded spread” is “the difference between the average price of trades at the ask side less the average price of trades at the bid side” during a specified time period. Hans R. Stoll, *Friction*, 55 J. FIN. 1479, 1487 (2000). Yet another metric, the “implied spread,” captures the difference between the pre-trade ask and bid prices at the same moment. Ananth Madhavan et al., *Why Do Security Prices Change? A Transaction-Level Analysis of NYSE Stocks*, 10 REV. FIN. STUD. 1035, 1040, 1047 (1997).

<sup>73</sup> For a sample of empirical studies comparing various bid-ask spread decomposition methodologies, see Bonnie F. Van Ness et al., *How Well Do Adverse Selection Compo-*

of absolute or relative bid-ask spreads requires isolating different components in order to make conclusions about the impact of informed trading. For instance, it has been argued that “[t]he substantially lesser vulnerability of stock index futures to insider information is another reason why market spreads for futures are substantially smaller than on separate stocks that make up the index.”<sup>74</sup> However, while comparing different markets, one must take into account factors that affect other components of bid-ask spreads, such as the differences in liquidity and volatility, in addition to the impact of other types of informed trading.

In terms of taxonomy, the three major components identified in the literature are attributed to order processing, inventory holding, and adverse selection costs, although the inventory holding component is often omitted and thus implicitly lumped together with the other two.<sup>75</sup> Several studies also presumed the existence of additional components that capture such factors as non-competitive pricing,<sup>76</sup> profit markup,<sup>77</sup> market-wide buying/selling pressure, and firm-wide inventory holding costs.<sup>78</sup> As pointed out earlier, bid-ask spread decomposition studies have employed different methodologies and produced a wide range of estimates for the magnitude of the adverse selection component—even for similar methodologies and data sets<sup>79</sup>—although one study found that such estimates under different methodologies are highly correlated.<sup>80</sup> This dispersion of results is also demonstrated by the below summary of recent bid-ask spread decomposi-

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*nents Measure Adverse Selection?*, FIN. MGMT., Autumn 2001, at 77; Jonathan Clarke & Kuldeep Shastri, On Information Asymmetry Metrics (Oct. 3, 2001) (unpublished manuscript) (on file with author); Thomas Henker et al., The Short-Term Dynamics of Information Risk (May 5, 2008) (unpublished manuscript) (on file with author), available at <http://69.175.2.130/~finman/Reno/Papers/dynamicsFMA09.pdf>.

<sup>74</sup> Merton H. Miller, *International Competitiveness of U.S. Futures Exchanges*, 4 J. FIN. SERVICES RES. 387, 407 n.7 (1990).

<sup>75</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 149, 173 n.502.

<sup>76</sup> See, e.g., Patrick de Fontnouvelle et al., *How New Entry in Options Markets Affected Market Making and Trading Costs*, J. INVESTMENT MGMT., 2d Q. 2005, at 24; Mark Klock & D. Timothy McCormick, *The Impact of Market Maker Competition on Nasdaq Spreads*, 34 FIN. REV. 55 (1999).

<sup>77</sup> See, e.g., Eric J. Levin & Robert E. Wright, *Estimating the Profit Markup Component of the Bid-Ask Spread: Evidence from the London Stock Exchange*, 44 Q. REV. ECON. & FIN. 1 (2004).

<sup>78</sup> See, e.g., Thomas Henker & Martin Martens, *Spread Decomposition with Common Spread Components*, 6 INT’L J. MANAGERIAL FIN. 88 (2010).

<sup>79</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 150–62; Dolgoplov, *Risks and Hedges of Providing Liquidity*, *supra* note 1, at 413–17 & nn.94–114.

<sup>80</sup> Clarke & Shastri, *supra* note 73, at 17.

tion studies for the *same* trading venue, the NYSE, which are only a small part of recent studies of this type analyzing equity securities on various trading venues.<sup>81</sup>

Chung et al. 2004<sup>82</sup>

- The study uses a sample consisting of thirty-six NYSE stocks traded from 1990 to 1991, and transactions of NYSE specialists were separated from limit orders,<sup>83</sup> assuming that “the limit order spread is not likely to be determined by market-making costs.”<sup>84</sup>

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<sup>81</sup> See, e.g., Timotheos Angelidis & Alexandros Benos, *Liquidity Adjusted Value-at-Risk Based on the Components of the Bid-Ask Spread*, 16 APPLIED FIN. ECON. 835 (2006) (data from the Athens Stock Exchange); Najah Attig et al., *Effects of Large Shareholding on Information Asymmetry and Stock Liquidity*, 30 J. BANKING & FIN. 2875 (2006) (data from the Toronto Stock Exchange); Ekkehart Boehmer et al., *Managerial Bonding and Stock Liquidity: An Analysis of Dual-Class Firms*, 28 J. ECON. & FIN. 117 (2004) (data from the NYSE and the AMEX); Nicolas P.B. Bollen et al., *Modeling the Bid/Ask Spread: Measuring the Inventory-Holding Premium*, 72 J. FIN. ECON. 97 (2004) (data from NASDAQ); Charlie X. Cai et al., *Trading Frictions and Market Structure: An Empirical Analysis*, 35 J. BUS. FIN. & ACCT. 563 (2008) (data from the LSE); Huimin Chung, *Investor Protection and the Liquidity of Cross-Listed Securities: Evidence from the ADR Market*, 20 J. BANKING & FIN. 1485 (2006) (data from the NYSE and NASDAQ); Jonathan E. Clarke et al., *Corporate Diversification and Asymmetric Information: Evidence from Stock Market Trading Characteristics*, 10 J. CORP. FIN. 105 (2004) (data from the NYSE and the AMEX); Alex Frino et al., *Liquidity in Auction and Specialist Market Structures: Evidence from the Italian Bourse*, 32 J. BANKING & FIN. 2581 (2008) (data from the Italian Bourse); Maria Kasch-Haroutounian & Erik Theissen, *Competition Between Exchanges: Euronext Versus Xetra*, 15 EUR. FIN. MGMT. 181 (2009) (data from Euronext Paris and Xetra); Hung-Neng Lai, *The Market Quality of Dealer Versus Hybrid Markets: The Case of Moderately Liquid Securities*, 34 J. BUS. FIN. & ACCT. 349 (2007) (data from the LSE); Mingsheng Li et al., *Asymmetric Information in the IPO Aftermarket*, 40 FIN. REV. 131 (2005) (data from NASDAQ); David Michayluk et al., *What Do Options Have To Do with It?: Inclusion of Options Market Indicators in Bid-Ask Spread Decomposition*, 38 ASIA-PAC. J. FIN. STUD. 455 (2009) (data from the Australian Stock Exchange); T. Shawn Strother et al., *Electronic Communication Networks, Market Makers, and the Components of the Bid-Ask Spread*, 5 INT’L J. MANAGERIAL FIN. 81 (2009) (data from NASDAQ); Bonnie F. Van Ness et al., *The Impact of Market Maker Concentration on Adverse-Selection Costs for Nasdaq Stocks*, 28 J. FIN. RES. 461 (2005) (data from NASDAQ); Robert E. Verrecchia & Joseph Weber, *Redacted Disclosure*, 44 J. ACCT. RES. 791 (2006) (data from the NYSE, the AMEX, and NASDAQ).

<sup>82</sup> Kee H. Chung et al., *Specialists, Limit-Order Traders, and the Components of the Bid-Ask Spread*, 39 FIN. REV. 255 (2004).

<sup>83</sup> *Id.* at 256–58.

<sup>84</sup> *Id.* at 257.

- The study employs two different decomposition methodologies: (1) the approach applying to quoted spreads and assuming the existence of the adverse selection and order processing components and (2) the approach applying to effective spreads and assuming the existence of the adverse selection and “transitory” components.<sup>85</sup>
- The estimates of the adverse selection component are as follows: for specialist transactions, 9% of the effective spread and 15% of the quoted spread; for specialist and limit order transactions combined, 10% of the effective spread and 20% of the quoted spread; and for limit order transactions, 11% of the effective spread and 20% of the quoted spread.<sup>86</sup>
- The following explanation for the difference between specialist and limit order transactions was given: “To the extent that specialists can discriminate between informed and uninformed orders, specialists are likely to execute low-information-content orders proportionately more frequently (at better prices) than limit-order traders.... [or] let limit orders execute against high-information-content orders by not posting their proprietary interests at times of high information asymmetry.”<sup>87</sup>

Chakravarty et al. 2005<sup>88</sup>

- The study uses a sample consisting of 304 decimalized NYSE stocks and a matching sample of non-decimalized NASDAQ stocks, with stocks in both samples traded in 2001.<sup>89</sup>

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<sup>85</sup> *Id.* at 260–62.

<sup>86</sup> *Id.* at 266 tbl.5.

<sup>87</sup> *Id.* at 265–67.

<sup>88</sup> Sugato Chakravarty et al., *The Effect of Decimalization on Trade Size and Adverse Selection Costs*, 32 J. BUS. FIN. & ACCT. 1063 (2005).

<sup>89</sup> *Id.* at 1065.

- The study employs two different decomposition methodologies: (1) the approach applying to quoted spreads and assuming the existence of the adverse selection and order processing components and (2) the approach applying to effective spreads and assuming the existence of the adverse selection and order processing components.<sup>90</sup>
- The estimates of the adverse selection component are as follows: for the NYSE stocks before decimalization, 46% of the quoted spread and 43% of the effective spread; for the NYSE stocks after decimalization, 52% of the quoted spread and 48% of the effective spread; and for the NASDAQ stocks, from 20 to 21% of the quoted spread and from 18 to 19% of the effective spread.<sup>91</sup>
- Both decomposition methodologies indicate a large decrease of the adverse selection component in absolute terms for the NYSE stocks and no change in absolute terms for the NASDAQ stocks.<sup>92</sup>

Prucyk 2005<sup>93</sup>

- The study uses a sample consisting of thirty NYSE stocks traded from 1993 to 1994.<sup>94</sup>
- The study employs a decomposition methodology applying to traded spreads and assuming the existence of the adverse selection, order processing, and inventory holding components.<sup>95</sup>
- The study hypothesized that “[b]oth increases and decreases in volatility should cause an increase in the adverse selection component of the spread.”<sup>96</sup>
- Depending on the magnitude of volatility changes, the adverse selection component varies from 21 to 24% of the traded spread.<sup>97</sup>

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<sup>90</sup> *Id.* at 1068–71.

<sup>91</sup> *Id.* at 1072 tbl.2.

<sup>92</sup> *Id.* at 1073–74.

<sup>93</sup> Brian Prucyk, *Specialist Risk Attitudes and the Bid-Ask Spread*, 40 FIN. REV. 223 (2005).

<sup>94</sup> *Id.* at 228, 230–31.

<sup>95</sup> *Id.* at 226–27.

<sup>96</sup> *Id.* at 225.

<sup>97</sup> *Id.* at 251 tbl.9.

- The conclusion is that “the widening in spreads and the decrease in depth [associated with changes in volatility] arises not in response to worries about trading with better-informed investors, but because of increased inventory risks for the specialist.”<sup>98</sup>

Serednyakov 2005<sup>99</sup>

- The study uses a sample consisting of 118 NYSE stocks and a matching sample of NASDAQ stocks, with stocks in both samples traded in 1996, 1999, and 2002.<sup>100</sup>
- The study employs a decomposition methodology applying to traded spreads and assuming the existence of the adverse selection, order processing, and inventory holding components.<sup>101</sup>
- Depending on the trade classification method, the estimates of the adverse selection component of the traded spread are 53% and 77% for the NYSE stocks and 41% and 46% for the NASDAQ stocks.<sup>102</sup>

Chen et al. 2007<sup>103</sup>

- The study uses a sample consisting of every S&P 500 stock traded in 2002 on the NYSE—424 stocks altogether.<sup>104</sup>
- The study employs a decomposition methodology applying to effective spreads and assuming the existence of the adverse selection and order processing components.<sup>105</sup>
- The adverse selection component constitutes 41% of the effective spread.<sup>106</sup>

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<sup>98</sup> *Id.* at 253–54.

<sup>99</sup> Alexey Serednyakov, A Model of the Components of the Bid-Ask Spread (Nov. 2005) (unpublished manuscript) (on file with author), *available at* <http://ssrn.com/abstract=754346>.

<sup>100</sup> *Id.* at 17, 45 tbl.IX.

<sup>101</sup> *Id.* at 2–3.

<sup>102</sup> *Id.* at 45 tbl.IX.

<sup>103</sup> Chen et al., *supra* note 65.

<sup>104</sup> *Id.* at 648–49. However, only 341 stocks were deemed to have sufficient data for the purposes of the study. *Id.* at 649.

<sup>105</sup> *Id.*

<sup>106</sup> *Id.* at 652 tbl.1.

Jiang et al. 2009<sup>107</sup>

- The study uses samples of 809, 791, and 426 pairs of matched NYSE and NASDAQ stocks, with stocks in each sample traded in 2001 after decimalization.<sup>108</sup>
- The study employs two different decomposition methodologies: (1) the approach applying to effective spreads and assuming the existence of the adverse selection and order processing components and (2) the approach applying to effective spreads and assuming the existence of the adverse selection and “transitory” components.<sup>109</sup>
- Depending on the sample and methodology, the estimates of the adverse selection component of the effective spread vary from 40 to 60% for the NYSE stocks and from 6 to 10% for the NASDAQ stocks.<sup>110</sup>

Hegde et al. 2010<sup>111</sup>

- The study uses a sample of eight NYSE stocks in the NASDAQ’s dual listing program traded from 2004 to 2007.<sup>112</sup>
- The study employs two different decomposition methodologies: (1) the approach applying to effective spreads and assuming the existence of the adverse selection and order processing components and (2) the approach applying to effective spreads and assuming the existence of the adverse selection and “transitory” components.<sup>113</sup>
- Depending on the methodology, the estimates of the adverse selection component of the effective spread vary from 62 to 65% for the NYSE data and from 50 to 60% for the NASDAQ data.<sup>114</sup>

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<sup>107</sup> Christine X. Jiang et al., *Adverse Selection Costs for NASDAQ and NYSE After Decimalization*, 18 INT’L REV. FIN. ANALYSIS 205 (2009).

<sup>108</sup> *Id.* at 205–06.

<sup>109</sup> *Id.* at 207, app. A, at 210–11.

<sup>110</sup> *Id.* at 208 tbl.3.

<sup>111</sup> Shantaram Hegde et al., *Competitive Stock Markets: Evidence from Companies’ Dual Listings on the NYSE and NASDAQ*, FIN. ANALYSTS J., Jan.–Feb. 2010, at 77.

<sup>112</sup> *Id.* at 78.

<sup>113</sup> *Id.* at 84.

<sup>114</sup> *Id.* at 84 tbl.5.

Hendershott et al. 2011<sup>115</sup>

- The study uses a sample of 1082 NYSE stocks traded from 2002 to 2003 around the introduction of the “autoquote” mechanism, considered to be a likely cause of an increase in algorithmic trading.<sup>116</sup>
- The study employs a decomposition methodology applying to effective spreads and assuming the existence of the adverse selection and realized spread components.<sup>117</sup>
- Depending on market capitalization, the estimate of the adverse selection component of the effective spread varies from 67 to 77%.<sup>118</sup>
- The study concluded that the introduction of the “autoquote” mechanism resulted in narrowed effective and quoted spreads and attributed this change to “a sharp decline in adverse selection, or equivalently a decrease in the amount of price discovery associated with trades.”<sup>119</sup>

Overall, estimates of the adverse selection component for the NYSE data vary from 9 to 77%, and there is a substantial divergence, from 6 to 60%, for the NASDAQ data as well. This dispersion raises doubts about the accuracy of bid-ask spread decomposition methodologies. Indeed, one common proxy for the adverse selection component is a measure of the price impact of transactions,<sup>120</sup> but this approach ignores the blurry line between informed trading and price discovery and makes it problematic to isolate the contribution of inventory management-related price adjustments by market makers. Another potential complication is that “spread decompositions fail to capture the full extent of adverse-selection risk

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<sup>115</sup> Terrence Hendershott et al., *Does Algorithmic Trading Improve Liquidity?*, 66 J. FIN. 1 (2011).

<sup>116</sup> *Id.* at 13–14, 16.

<sup>117</sup> *Id.* at 10–11.

<sup>118</sup> *Id.* at 17 tbl.I.

<sup>119</sup> *Id.* at 3.

<sup>120</sup> See, e.g., Hendrik Bessembinder & Herbert M. Kaufman, *A Cross-Exchange Comparison of Execution Costs and Information Flow for NYSE-Listed Stocks*, 46 J. FIN. ECON. 293, 303 (1997); Glosten & Harris, *supra* note 44, at 124–25; Hendershott et al., *supra* note 115, at 11.

when [market makers] choose depth.”<sup>121</sup> Furthermore, one study concluded that

standard techniques applied in order to decompose bid-ask spreads into adverse selection and other components produce spurious positive and economically and statistically significant adverse selection component [*sic*] in the world where no adverse selection exists. This finding implies that standard asymmetric information models may not actually be testing asymmetric information.... [A]n increase in serial correlation that is attributable to tick size reduction *only* but not due to a change in adverse selection (in fact, in the absence of adverse selection) may be mistakenly identified by a spread decomposition algorithm as being indicative of a genuine shift in adverse selection.<sup>122</sup>

Even if a given bid-ask spread decomposition methodology is reliable, it is unclear to what extent the adverse selection component captures the impact of insider trading, as opposed to other forms of informed trading.<sup>123</sup> For instance, several empirical studies argued that the introduction of derivatives, such as equity options or single stock futures, decreases bid-ask spreads and the adverse selection component in relative and absolute terms for the underlying market because informed traders “migrate” to derivatives markets,<sup>124</sup> but this relationship is consistent with both insider trading and other types of informed trading sensitive to leverage and transaction costs. Furthermore, several empirical studies examining such issues as execution speed<sup>125</sup> and margin requirements<sup>126</sup> are *more* consis-

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<sup>121</sup> Cecilia Caglio & Kenneth A. Kavajecz, *A Specialist's Quoted Depth as a Strategic Choice Variable: An Application to Spread Decomposition Models*, 29 J. FIN. RES. 367, 367 (2006).

<sup>122</sup> Lynn Doran et al., *Tick Size and Adverse Selection: Spurious Effects Arising from Serial Correlation* 25–26 (Mar. 15, 2009) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1360323>.

<sup>123</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 162–63.

<sup>124</sup> See Raman Kumar et al., *The Impact of Options Trading on the Market Quality of the Underlying Security: An Empirical Analysis*, 53 J. FIN. 717, 717–19, 726 (1998) (discussing the impact of the introduction of equity options on stocks on various trading venues); Shastri et al., *supra* note 9, at 341, 348–50 (analyzing the impact of the introduction of single stock futures on stocks on the NYSE and NASDAQ). *But see* Petri Sahlström, *Impact of Stock Option Listings on Return and Risk Characteristics in Finland*, 10 INT'L REV. FIN. ANALYSIS 19, 29–32 (2001) (finding that the introduction of equity options decreased bid-ask spreads for stocks on the Helsinki Stock Exchange but did not change the relative size of the adverse selection component vis-à-vis the order processing/inventory holding component).

<sup>125</sup> See Terrence Hendershott & Pamela C. Moulton, *Automation, Speed, and Stock Market Quality: The NYSE's Hybrid*, 14 J. FIN. MKTS. 568, 601 (2011) (documenting an increase in bid-ask spreads and the adverse selection component in relative and absolute

tent with reflecting informed trading other than insider trading. On the other hand, given the observation that a smaller tick size leads to greater amounts of short-term informed trading that is harmful to market makers,<sup>127</sup> and the conjecture that “[d]ecimalization makes [it] easier and cheaper for informed traders to break-up their large trades and jump in front of other orders,”<sup>128</sup> empirical evidence on the impact of decimalization on the adverse selection component is ambiguous.<sup>129</sup>

Another key issue concerns bid-ask spread decomposition studies for data sets from markets in foreign currency, government debt, and basket- and index-based securities. In these markets, the problem of asymmetric information is less important, and the very definitions of “insider trading” and, to some degree, “informed trading” become ambiguous.<sup>130</sup> On the

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terms for stocks on the NYSE after the introduction of a trading mechanism that substantially lowered the execution time for market orders). *But see* Andreas Storkenmaier & Ryan Riordan, *The Effect of Automated Trading on Market Quality: Evidence from the New York Stock Exchange*, 23 LECTURE NOTES IN BUS. INFO. PROCESSING 11, 23–24 (2009) (documenting a *decrease* in bid-ask spreads and the adverse selection component in relative and absolute terms after the introduction of this trading mechanism); John Ritter, *The Effect of the NYSE’s Hybrid Conversion on the Bid-Ask Spread* 3 (Nov. 2009) (unpublished manuscript) (on file with author) (documenting *smaller* quoted and *larger* effective spreads after the introduction of this trading mechanism and showing that the conclusion of whether the adverse selection component has increased or decreased depends on the methodology); *see also* Ryan Riordan & Andreas Storkenmaier, *Latency, Liquidity and Price Discovery* 24–25 (Mar. 29, 2011) (unpublished manuscript) (on file with author), *available at* <http://ssrn.com/abstract=1247482> (documenting *smaller* bid-ask spreads and the adverse selection component in relative and absolute terms for stocks on Xetra after the introduction of a new trading mechanism that decreased latency).

<sup>126</sup> *See* Gordon J. Alexander et al., *Margin Regulation and Market Quality: A Microstructure Analysis*, 10 J. CORP. FIN. 549, 571 (2004) (documenting no change in bid-ask spreads and an increase in the adverse selection component in relative and absolute terms for stocks on NASDAQ when they become margin-eligible).

<sup>127</sup> DURBIN, *supra* note 17, at 94.

<sup>128</sup> Jiang et al., *supra* note 107, at 205.

<sup>129</sup> *See* Chakravarty et al., *supra* note 88, at 1079 (documenting a significant *increase* of the adverse selection component and an overall *decrease* of adverse selection costs in absolute terms for stocks on the NYSE after decimalization); Scott Gibson et al., *The Effect of Decimalization on the Components of the Bid-Ask Spread*, 12 J. FIN. INTERMEDIATION 121, 121, 145–46 (2003) (documenting *smaller* bid-ask spreads for stocks on the NYSE after decimalization, which was attributed almost entirely to a decrease of the order processing component, and hypothesizing that this result could be attributed to the existence of non-competitive pricing).

<sup>130</sup> *See, e.g.,* Campbell R. Harvey & Roger D. Huang, *Volatility in the Foreign Currency Futures Market*, 4 REV. FIN. STUD. 543, 545 (1991) (“[T]he definition of private information and informed traders is not clear in the FX market.”); In Joon Kim et al., *Time-Varying Bid-Ask Components of Nikkei 225 Index Futures on SIMEX*, 10 PAC.-BASIN FIN. J. 183, 186 (2002) (“[T]he price of stock index futures does not depend on the

other hand, transactions on information about macroeconomic, industry-wide, and other similar factors not absorbed by the market and “inside-like” information, such as the advance knowledge of an upcoming macroeconomic policy announcement, exchange-rate intervention, or issuance of government bonds, as well as order flow and inventory-related information, certainly can and do occur. Bid-ask spread decomposition studies for these markets have also yielded a wide range of results—even for similar assets—and, in several instances, estimates of the adverse selection component seem too high, sometimes exceeding 100%. This variation is visible in over-the-counter foreign currency markets,<sup>131</sup> with several studies questioning whether asymmetric information has any influence on liquidity in these markets.<sup>132</sup> Markets for government securities and their futures display an even wider range of estimates,<sup>133</sup> although one study

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idiosyncratic information of individual stocks, but it is more dependent on the economic conditions and general stock market information .... [T]he number of well-informed traders is far less in stock index futures markets than in stock markets.”); Toni Gravelle, *The Market Microstructure of Dealership Equity and Government Securities Markets: How They Differ 2* (n.d.) (unpublished manuscript) (on file with author), available at [http://www.bis.org/publ/cgfs11gra\\_b.pdf](http://www.bis.org/publ/cgfs11gra_b.pdf) (“It is unclear to what extent there exists private information about the value of government securities.”).

<sup>131</sup> See Geir Høidal Bjonnes & Dagfinn Rime, *Dealer Behavior and Trading Systems in Foreign Exchange Markets*, 75 J. FIN. ECON. 571, 589, 590 tbl.6 (2005) (estimating the adverse selection component of the effective spread, depending on the currency, from 50 to 80%); Richard Payne, *Informed Trade in Spot Foreign Exchange Markets: An Empirical Investigation*, 61 J. INT’L ECON. 307, 321 (2003) (estimating the adverse selection component of the effective spread at 63%); Jian Yao, *Spread Components and Dealer Profits in the Interbank Foreign Exchange Market* 28 (Nov. 2, 1997) (unpublished manuscript) (on file with author), available at <http://faculty.haas.berkeley.edu/lyons/Yao%20FX%20dealer%20profits.pdf> (estimating the adverse selection component of the effective spread for an average-sized transaction at 17%).

<sup>132</sup> See, e.g., Frank McGroarty et al., *The Role of Private Information in Return Volatility, Bid-Ask Spreads and Price Levels in the Foreign Exchange Market*, 19 J. INT’L FIN. MKTS. INSTITUTIONS & MONEY 387, 400 (2009) (concluding that “private information has no discernable effect on the bid-ask spread”); Carol Osler et al., *Price Discovery in Currency Markets* 12 (Sch. Econ. & Mgmt., Leibniz Universität Hannover, Discussion Paper No. 351, 2006), available at <http://www.wiwi.uni-hannover.de/Forschung/Diskussionspapiere/dp-351.pdf> (suggesting that “adverse selection has little influence over customer spreads”).

<sup>133</sup> See Green, *supra* note 42, at 1213 tbl.III (analyzing over-the-counter transactions in U.S. government securities around economic announcements and estimating the adverse selection component of the effective spread from 160 to 177%); Huang et al., *supra* note 43, at 288 tbl.III (analyzing over-the-counter transactions in U.S. government securities around macroeconomic announcements and estimating the adverse selection component of the effective spread from 40 to 260%); Jianxin Wang, *Asymmetric Information and the Bid-Ask Spread: An Empirical Comparison Between Automated Order Execution*

questioned the magnitude of the adverse selection component.<sup>134</sup> Finally, estimates for markets in basket- and index-based securities also range widely,<sup>135</sup> and some of these studies questioned the applicable bid-ask

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*and Open Outcry Auction*, 9 J. INT'L FIN. MKTS. INSTITUTIONS & MONEY 115, 125 tbl.3 (1999) (analyzing transactions in Australian government securities futures on the Sydney Futures Exchange and estimating the adverse selection component of the quoted spread, depending on the methodology and the trading platform, from 4 to 56%).

<sup>134</sup> See Mark D. Griffiths et al., *Market-Making Costs in Treasury Bills: A Benchmark for the Cost of Liquidity*, 34 J. BANKING & FIN. 2146, 2148 (2010) (analyzing over-the-counter transactions in U.S. government securities and concluding that “dealers do not appear to price any asymmetric information risk at a time when the true value may be the most uncertain”).

<sup>135</sup> See Ahn et al., *supra* note 42, at 1118, 1131 (analyzing transactions in KOSPI 200 equity index options on the Korea Exchange and estimating the adverse selection component of the implied spread at 35% for call options and 39% for put options); Henk Berkman et al., *A Note on Execution Costs for Stock Index Futures: Information Versus Liquidity Effects*, 29 J. BANKING & FIN. 565, 571 tbl.1, 573 tbl.2, 574 tbl.3 (2005) (analyzing transactions in FTSE100 equity index futures on the London International Financial Futures and Options Exchange and estimating the adverse selection component of the effective spread at 18%); Patricia Chelley-Steeley & Keebong Park, *The Adverse Selection Component of Exchange Traded Funds*, 19 INT'L REV. FIN. ANALYSIS 65, 71 (2010) (analyzing transactions in index and industry-based exchange-traded funds on various trading venues and estimating the adverse selection component, depending on the methodology, at 0%, with many estimates being negative, of the effective spread and 18% and 24% for index and industry-based funds, respectively, of the implied spread); Shantaram P. Hegde & John B. McDermott, *The Market Liquidity of DIAMONDS, Q's, and Their Underlying Stocks*, 28 J. BANKING & FIN. 1043, 1060 tbl.4, 1061 tbl.5 (2004) (analyzing transactions in exchange-traded funds comprised of the Dow Jones Industrial Average stocks on the NYSE and estimating the adverse selection component, depending on the methodology, at 23% of the effective spread and 26% of the quoted spread); Yu Chuan Huang, *The Components of Bid-Ask Spread and Their Determinants: TAIFEX Versus SGX-DT*, 24 J. FUTURES MKTS. 835, 846 tbl.I, 855 tbl.VI (2004) (analyzing transactions in Taiwan equity index futures on the Taiwan Futures Exchange and the Singapore Exchange and estimating the adverse selection component, depending on the methodology and the spread metric used, from 42 to 61% for a floor-based trading platform and from 11 to 26% for an automated trading platform); Kim et al., *supra* note 130, at 194 (analyzing transactions in Nikkei 225 equity index futures on the Singapore International Monetary Exchange and estimating the adverse selection component of the traded spread at 4%); Wang, *supra* note 133, at 125 tbl.3 (1999) (analyzing transactions in SPI equity index futures on the Sydney Futures Exchange and estimating the adverse selection component of the quoted spread, depending on the methodology and the trading platform, from 9 to 35%); Jonathan Clarke & Kuldeep Shastri, *Adverse Selection Costs and Closed-End Funds* 31 tbl.2 (Jan. 2001) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=256728> (analyzing transactions in various closed-end funds, including equity, bond, and municipal debt-focused funds, on the NYSE and estimating the adverse selection component, depending on the methodology, at 19% of the implied spread and 10% of the quoted spread).

spread decomposition methodology.<sup>136</sup> While there are plausible explanations for the magnitude of the adverse selection component, including reasons other than informational asymmetry,<sup>137</sup> this dispersion of results is more difficult to explain.

Overall, bid-ask spread decomposition studies appear unreliable at quantifying the impact of informed trading and, of course, insider trading more specifically. This observation may indicate either a host of methodological problems, leading to the question of whether estimates of the adverse selection component are really “noise,”<sup>138</sup> or difficulties with defining and isolating “informed trading.”<sup>139</sup>

#### V. THE CONNECTION AMONG ESTIMATES OF THE PROBABILITY OF INFORMED TRADING AND BID-ASK SPREADS AND THEIR COMPONENTS

Another key area of research analyzes estimates of the probability of informed trading (PIN).<sup>140</sup> Several of these studies appear to lend support

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<sup>136</sup> See Robert Neal & Simon M. Wheatley, *Adverse Selection and Bid-Ask Spreads: Evidence from Closed-End Funds*, 1 J. FIN. MKTS. 121, 128 tbl.1, 138, 139 tbl.5 (1998) (analyzing transactions in shares of closed-end equity-focused funds on the NYSE and the AMEX, estimating the adverse selection component, depending on the methodology, at 19% of the implied spread and 52% of the quoted spread, and questioning these estimates because they are comparable to matched common stocks).

<sup>137</sup> See Ahn et al., *supra* note 42, at 1143 (arguing that the magnitude of the adverse selection component for equity index options markets “can be interpreted as evidence for informed trading based on public information”); Bjønnes & Rime, *supra* note 131, at 589 (suggesting that the magnitude of the adverse selection component for foreign currency markets is explained by their higher liquidity and lower inventory and order processing costs); Green, *supra* note 42, at 1212–14 (arguing that the estimate of the adverse selection component for U.S. government securities markets exceeding 100% might be explained by dealers’ consumption of liquidity, informed trading based on public information, unobserved customer trading, and the existence of the interdealer market and showing that the adverse selection component increases immediately *after* disclosure); Huang et al., *supra* note 43, at 273 (arguing that the magnitude of the adverse selection component for U.S. government securities markets “suggests trading based on superior inventory or order flow information”); see also Clarke & Shastri, *supra* note 135, at 25–26 (pointing out that the adverse selection component for closed-end funds is still lower than for matched securities and portfolio components).

<sup>138</sup> For several critical studies leading to this conclusion, see sources in Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 162 n.436, 172 n.500.

<sup>139</sup> See *id.* at 179.

<sup>140</sup> This methodology for computing PIN estimates was pioneered in David Easley et al., *Liquidity, Information, and Infrequently Traded Stocks*, 51 J. FIN. 1405 (1996). Several other studies used modified methodologies to obtain such estimates. See, e.g., Ekkehart Boehmer et al., *Estimating the Probability of Informed Trading—Does Trade Misclassification Matter?*, 10 J. FIN. MKTS. 26 (2007); David Jackson, *Inferring Trader*

to bid-ask spread decomposition studies by pointing to the positive correlation between PIN estimates and the adverse selection component in equity markets,<sup>141</sup> although one study found a “surprising negative correlation” between PIN estimates and several measures of the adverse selection component for stocks on the NYSE.<sup>142</sup> Other studies similarly pointed to the positive correlation between PIN estimates and bid-ask spreads in equity markets.<sup>143</sup> Of course, the first approach is somewhat problematic because it links two econometric *estimates* rather than *observed* variables, while the second approach is more objective because bid-ask spreads are readily observable.

There is some empirical evidence in favor of PIN that passes the “it makes sense” test,<sup>144</sup> but several empirical studies are more difficult to

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*Behavior from Transaction Data: A Trade Count Model*, 31 J. ECON. & FIN. 283 (2007); Qin Lei & Guojun Wu, *Time-Varying Informed and Uninformed Trading Activities*, 8 J. FIN. MKTS. 153 (2005); Ken Nyholm, *Estimating the Probability of Informed Trading*, 25 J. FIN. RES. 485 (2002); Syed Walid Reza & Craig A. Wilson, *Does Corporate Ownership Impact the Probability of Informed Trading?*, 7 INT’L J. BUS. RES. 188 (2007); Anthony Tay et al., *Using High-Frequency Transaction Data to Estimate the Probability of Informed Trading*, 7 J. FIN. ECONOMETRICS 288 (2009); David Easley et al., *Flow Toxicity and Volatility in a High Frequency World* (Cornell Univ., Johnson Sch. Research Paper No. 09-2011, 2011), available at <http://ssrn.com/abstract=1695596>; Yuxing Yan, *A New Method to Estimate PIN (Probability of Informed Trading)* (Mar. 17, 2009) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1361921>.

<sup>141</sup> See, e.g., Kee H. Chung & Mingsheng Li, *Adverse-Selection Costs and the Probability of Information-Based Trading*, 38 FIN. REV. 257, 262, 270 (2003) (data from the NYSE); Joachim Grammig et al., *Knowing Me, Knowing You: Trader Anonymity and Informed Trading in Parallel Markets*, 4 J. FIN. MKTS. 385, 385, 408 (2001) (data from the Frankfurt Stock Exchange); Jackson, *supra* note 140, at 294–95 (data from the NYSE); Elizabeth R. Odders-White & Mark J. Ready, *Credit Ratings and Stock Liquidity*, 19 REV. FIN. STUD. 119, 131, 138 tbl.5 (2006) (data from the NYSE).

<sup>142</sup> Clarke & Shastri, *supra* note 73, at 17–18.

<sup>143</sup> See, e.g., Paul Brockman & Dennis Y. Chung, *Informed and Uninformed Trading in an Electronic, Order-Driven Environment*, 35 FIN. REV. 125, 125, 145 (2000) (data from the HKSE); David Easley et al., *Time-Varying Arrival Rates of Informed and Uninformed Trades*, 6 J. FIN. ECONOMETRICS 171, 173, 179 (2008) (data from the NYSE); Hans G. Heidle & Robert D. Huang, *Information-Based Trading in Dealer and Auction Markets: An Analysis of Exchange Listings*, 37 J. FIN. & QUANTITATIVE ANALYSIS 391, 416–17 (2002) (data from the NYSE, the AMEX, and NASDAQ); Jackson, *supra* note 140, at 294 (data from the NYSE); Lei & Wu, *supra* note 140, at 177 (data from the NYSE); Odders-White & Ready, *supra* note 141, at 138 tbl.5 (data from the NYSE); Clara Vega, *Stock Price Reaction to Public and Private Information*, 82 J. FIN. ECON. 103, 128 (2006) (data from various trading venues).

<sup>144</sup> See, e.g., Stephen Brown & Stephen A. Hillegeist, *How Disclosure Quality Affects the Level of Information Asymmetry*, 12 REV. ACCT. STUD. 443, 444 (2007) (finding a negative correlation between the quality of disclosure and PIN estimates for stocks on

interpret.<sup>145</sup> Another perspective is whether PIN is a meaningful concept that is priced in equity markets.<sup>146</sup> Furthermore, there are doubts whether

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various trading venues); Jinghan Cai et al., *How Better Informed Are the Institutional Investors?*, 106 *ECON. LETTERS* 234, 237 (2010) (finding that PIN estimates are significantly higher for institutional trades compared to retail trades for stocks on the Shenzhen Stock Exchange); Juan J. Cruces & Enrique Kawamura, *Insider Trading and Corporate Governance in Latin America*, in *INVESTOR PROTECTION AND CORPORATE GOVERNANCE: FIRM-LEVEL EVIDENCE ACROSS LATIN AMERICA* 85, 129 (Alberto Chong & Florencio López-de-Silanes eds., 2007) (finding increased PIN estimates before certain types of announcements for stocks on various trading venues); Vanthuan Nguyen et al., *Inter-Market Competition for Exchange Traded Funds*, 31 *J. ECON. & FIN.* 251, 258 (2007) (finding that PIN estimates for exchange-traded funds on various trading venues are significantly lower compared to component securities); Hadiye Aslan et al., *Firm Characteristics and Informed Trading: Implications for Asset Pricing* 14–15 (Sept. 1, 2008) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1334465> (finding reasonable correlations between PIN estimates and such variables as insider holdings, accounting accruals, volatility, and firm size for stocks on the NYSE and the AMEX).

<sup>145</sup> See, e.g., Nihat Aktas et al., *The PIN Anomaly Around M&A Announcements*, 10 *J. FIN. MKTS.* 169, 170–71, 189 (2007) (finding that PIN estimates decrease before M&A announcements and increase after such announcements for stocks on Euronext Paris); Evangelos Benos & Marek Jochec, *Testing the PIN Variable 1* (Mar. 12, 2007) (unpublished manuscript) (on file with author), available at <http://www.business.uiuc.edu/finance/phd/pdf/5299.pdf> (finding that PIN estimates before earnings announcements are slightly lower than estimates after such announcements for stocks on the NYSE); Clarke & Shastri, *supra* note 135, at 16 (finding that non-municipal bond funds on the NYSE have PIN estimates comparable to individual stocks).

<sup>146</sup> See Laurence Copeland et al., *Information-Based Trade in the Shanghai Stock Market*, 20 *GLOBAL FIN. J.* 180, 180 (2009) (concluding that PIN is priced on the Shanghai Stock Exchange but finding that some of its effect is indistinguishable from the turnover effect); Malay K. Dey, *Is Information Risk Really a Determinant of Security Returns? Evidence from TORQ*, *J. TRADING*, Summer 2010, at 51, 51 (concluding that PIN is not priced on the NYSE); Jefferson Duarte & Lance Young, *Why Is PIN Priced?*, 91 *J. FIN. ECON.* 119, 119 (2009) (concluding that PIN is priced on the NYSE and the AMEX to the extent it reflects illiquidity rather than informational asymmetry); David Easley et al., *Factoring Information into Returns*, 45 *J. FIN. & QUANTITATIVE ANALYSIS* 293, 308 (2010) (finding evidence consistent with the view that PIN is priced on the NYSE and the AMEX but also considering the possibility that PIN is a proxy for another underlying factor); David Easley et al., *Is Information Risk a Determinant of Asset Returns?*, 57 *J. FIN.* 2185, 2218–19 (2002) (concluding that PIN is priced on the NYSE); Kathleen P. Fuller et al., *Is Information Risk Priced for NASDAQ-Listed Stocks?*, 34 *REV. QUANTITATIVE FIN. & ACCT.* 301, 310–11 (2010) (concluding that PIN is only weakly priced on NASDAQ and likely to be a proxy for other variables); Partha Mohanram & Shiva Rajgopal, *Is PIN Priced Risk?*, 47 *J. ACCT. & ECON.* 226, 241 (2009) (concluding that PIN is not priced on the NYSE and the AMEX); Y.C. Lu & Woon K. Wong, *Probability of Information-Based Trading as a Pricing Factor in Taiwan Stock Market* 16 (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1115419> (concluding that PIN is priced on the Taiwan Stock Exchange).

PIN captures—or is highly sensitive to changes in—insider trading rather than informed trading that reflects inherent differences in acquiring, processing, and aggregating information, as well as other similar factors:

PIN is likely to be most highly correlated with information asymmetries that exist between groups of outside investors rather than asymmetries that exist between insiders and outside investors. As a result, it is possible that PIN is computed mainly from observations of one kind of information asymmetry while insider trading is purely due to a second kind.<sup>147</sup>

Another study linked a decrease in the tick size with higher PIN estimates for stocks on the NYSE,<sup>148</sup> which is also consistent with an increase in short-term informed trading.<sup>149</sup> The skepticism that insider trading constitutes the bulk of informed trading captured by PIN estimates is reinforced by the fact that such estimates for individual stocks often seem to be quite high, although several methodological approaches yield lower estimates.<sup>150</sup> An additional consideration is the detection of relatively large PIN estimates in a variety of markets in assets other than equities or equity options.<sup>151</sup> Furthermore, one study analyzed the “flash crash” of May 6,

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<sup>147</sup> Steven J. Huddart & Bin Ke, *Information Asymmetry and Cross-Sectional Variation in Insider Trading*, 24 CONTEMP. ACCT. RES. 195, 219 (2007).

<sup>148</sup> Xin Zhao & Kee H. Chung, *Decimal Pricing and Information-Based Trading: Tick Size and Informational Efficiency of Asset Price*, 33 J. BUS. FIN. & ACCT. 753, 764 (2006).

<sup>149</sup> See DURBIN, *supra* note 17, at 93–94.

<sup>150</sup> See, e.g., Brockman & Chung, *supra* note 143, at 132, 137 (a mean value of 33% for a sample of 532 stocks on the HKSE); Kee H. Chung et al., *Order Preferencing, Adverse-Selection Costs, and the Probability of Information-Based Trading*, 27 REV. QUANTITATIVE FIN. & ACCT. 343, 346, 353 tbl.3 (2006) (mean values of 27% and 30% for two different samples of 3032 and 2983 stocks on NASDAQ); Chung & Li, *supra* note 141, at 263 tbl.1 (a mean value of 14% for a sample of 538 stocks on the NYSE); Dey, *supra* note 146, at 53, 55 (a mean value of 21% for a sample of 65 stocks on the NYSE); Easley et al., *supra* note 143, at 179, 190 tbl.4 (a mean value of 14% for a sample of 16 stocks on the NYSE); Jackson, *supra* note 140, at 292 tbl.2 (mean values of 19% and 23%, depending on the methodology, for a sample of 90 stocks on the NYSE); Lei & Wu, *supra* note 140, at 162, 165 tbl.2 (a mean value of 23% for a sample of 40 stocks on the NYSE); Reza & Wilson, *supra* note 140, at 194, 208 tbl.12 (a mean value ranging from 9 to 11%, depending on the subsample, for a sample of 73 stocks on the NYSE and the AMEX); Yan, *supra* note 140, at 50 tbl.9 (mean values of 7% and 20%, depending on the methodology, for a sample of 90 stocks on the NYSE).

<sup>151</sup> See, e.g., Julien Idier & Stefano Nardelli, *Probability of Informed Trading on the Euro Overnight Market Rate*, 16 INT’L J. FIN. & ECON. 131, 139 (2011) (a mean value of 45% for over-the-counter interest rate markets); Haitao Li et al., *Are Liquidity and Information Risks Priced in the Treasury Bond Market?*, 64 J. FIN. 467, 484 tbl.III (2009) (a

2010, which was a system-wide phenomenon, and found that one of the PIN metrics for E-mini S&P 500 futures “was abnormally high at least one week before the flash crash [and] reached its highest level in the history of the E-mini S&P 500 [shortly before the crash].”<sup>152</sup>

Another direction in empirical research specifically links PIN estimates in equity markets and insider trading, although one of these studies explicitly recognized that PIN “provides estimates of *privately* informed trading, which is more general and not necessarily restricted to illegal insider trading.”<sup>153</sup> Several studies examined correlations among PIN estimates and various corporate governance characteristics, such as CEO compensation, director ownership, the existence of an outside board chairperson, and ownership concentration,<sup>154</sup> with some of them having a plausible connection to insider trading. One study even tied higher scores for an *index* measuring the quality of corporate governance to lower PIN estimates on the NYSE, the AMEX, and NASDAQ.<sup>155</sup> It is, however, problematic to make any definite conclusions based on such imprecise proxies. This limitation is also relevant for a study that linked PIN esti-

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mean value of 26% for over-the-counter government securities markets); Clarke & Shastri, *supra* note 135, at 31 tbl.2 (a mean value ranging from 15 to 19% for various equity- and debt-focused closed-end funds on the NYSE); Ramazan Gençay et al., When Do Informed Traders Arrive in Foreign Exchange Markets? 13 (Apr. 2008) (unpublished manuscript) (on file with author), *available at* <http://economics.ca/2008/papers/0027.pdf> (a mean value of 12% for over-the-counter foreign currency markets); Ian W. Marsh & Ceire O'Rourke, Customer Order Flow and Exchange Rate Movements: Is There Really Information Content? 18 (Apr. 2005) (unpublished manuscript) (on file with author), *available at* <http://ssrn.com/abstract=704944> (a mean value of 31% for over-the-counter foreign currency markets); Clara Vega & Jin (Ginger) Wu, Stock Market Microstructure Measures of Information Asymmetry Are Related to Marketwide Information 26 tbl.1A (Dec. 13, 2006) (unpublished manuscript) (on file with author), *available at* <http://ssrn.com/abstract=951491> (a mean value ranging from 12 to 14%, depending on maturity, for over-the-counter government securities markets).

<sup>152</sup> David Easley et al., *The Microstructure of the “Flash Crash”*: Flow Toxicity, Liquidity Crashes, and the Probability of Informed Trading, *J. PORTFOLIO MGMT.*, Winter 2011, at 118, 122. One researcher criticized this methodology and asserted that, “the flash crash reveals a key weakness of the PIN measure in that it overlooks the possibility of order imbalances induced by firm-specific or market-wide liquidity shocks.” Qin Lei, *Unveiling the Identity of PIN from the Flash Crash: Illiquidity or Information Asymmetry?* 1, 14 (Aug. 1, 2011) (unpublished manuscript) (on file with author), *available at* <http://ssrn.com/abstract=1697879>.

<sup>153</sup> Cruces & Kawamura, *supra* note 144, at 128.

<sup>154</sup> *See id.* at 108–13 (data from various trading venues); David Jackson et al., *Corporate Governance and Informed Trading*, 4 *INT'L J. MANAGERIAL FIN.* 295, 308 tbl.II (2008) (data from the Toronto Stock Exchange).

<sup>155</sup> Kee H. Chung et al., *Corporate Governance and Liquidity*, 45 *J. FIN. & QUANTITATIVE ANALYSIS* 265, 265 (2010).

mates on the NYSE and the AMEX and various firm-specific financial indicators and ratios, and concluded that such estimates are most influenced by asset turnover and dividend yields.<sup>156</sup> One contribution found no correlation between PIN estimates on the NYSE and insiders' registered transactions and argued that this result "casts some doubt on the validity of [the PIN] measure."<sup>157</sup> By contrast, another study pointed to a positive correlation between PIN estimates on the NYSE, the AMEX, and NASDAQ, and the percentage of insider ownership.<sup>158</sup>

A different approach to linking insider trading and PIN estimates in equity markets focuses on regulation. One cross-country study examined key features of insider trading regulation and found negative correlations among PIN estimates and the maximum incarceration sentence allowed by law and the potential strength of pecuniary sanctions.<sup>159</sup> However, it failed to identify any significant correlations with respect to the existence of potential criminal sanctions, the actual existence of civil and criminal enforcement, the strength of the public regulator, and the availability of private right of action.<sup>160</sup> Another contribution evaluated the impact of a piece of legislation in New Zealand that had implemented a continuous disclosure regime, established a powerful regulatory agency to oversee securities markets and enforce insider trading restrictions, and required insiders to disclose their transactions within five trading days, but this extensive regulatory framework was found to have no significant effect on PIN estimates.<sup>161</sup> A related study examined PIN estimates on the weakly regulated Prague Stock Exchange and concluded that their mean values ranged from 0 to 2%, depending on the subsample, and thus were much lower compared to more regulated markets, although this counterintuitive result could be justified by the specifics of the trading mechanism and the existence of off-exchange informed transactions.<sup>162</sup> By contrast, a later

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<sup>156</sup> Chuan Liao et al., *Firm Characteristics and Information Risk*, JASSA, no. 2, 2010, at 41, 43, 46–47.

<sup>157</sup> Clarke & Shastri, *supra* note 73, at 23.

<sup>158</sup> Patrick J. Dennis & James P. Weston, *Who's Informed?: An Analysis of Stock Ownership and Informed Trading* 2–3 (Sept. 25, 2001) (unpublished manuscript) (on file with author).

<sup>159</sup> Bart Frijns et al., *Elements of Effective Insider Trading Laws* 8, 35 tbl.6 (n.d.) (unpublished manuscript) (on file with author), available at <http://www.fma.org/Texas/Papers/ElementsInsiderTrading.pdf>.

<sup>160</sup> *Id.* at 8–9, 35 tbl.6, 37 tbl.7.

<sup>161</sup> Russell Poskitt & Peihong Yang, *The Impact of Disclosure Reform on Information Risk in NZX-Listed Stocks*, 18 PAC. ACCT. REV. 47, 50–51 (2006).

<sup>162</sup> Libor Němeček, *Liquidity and Information-Based Trading on the Order Driven Capital Market: The Case of the Prague Stock Exchange* 16–17 (Aug. 25, 1997) (unpub-

study of the same trading venue found that the mean value of PIN estimates is 32%, which is at least as large as in more regulated markets.<sup>163</sup> An additional study analyzed PIN estimates for companies in Latin America, a region in which “illegal insider trading goes unpunished,”<sup>164</sup> but the median estimates of 11% for the most liquid stocks and 20% for the least liquid stocks are comparable to more regulated markets.<sup>165</sup> A similar investigation focused on PIN estimates in Chinese securities markets, in which insider trading is also common and weakly controlled,<sup>166</sup> but the obtained mean value of 21% is similarly comparable to more regulated markets.<sup>167</sup> Yet another China-focused study calculated mean PIN estimates for institutional and individual trades at 24% and 17%, respectively.<sup>168</sup> One potential explanation for the seeming irrelevance of regulation is that insider trading is only a small part of informed trading captured by PIN estimates.

Overall, the totality of the existing empirical research suggests that the PIN-related studies do not offer clear and consistent evidence to link informed trading and market liquidity because of a variety of conceptual, methodological, and measurement problems. The link between PIN estimates and insider trading is also suspect.

## VI. VARIOUS MECHANISMS FOR PROVIDING LIQUIDITY

A separate area of research on the link between informed trading and market liquidity pertains to the impact of various mechanisms for providing liquidity. One common approach is to compare bid-ask spreads and their components for similar equity securities on dealer and auction markets, typically the NYSE and NASDAQ.<sup>169</sup> Although several theoretical approaches predict why market makers on a certain trading venue might be more vulnerable to informed trading, actual results of empirical re-

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lished manuscript) (on file with author), available at <http://www.cerge.cuni.cz/pdf/wp/Wp117.pdf>.

<sup>163</sup> Jan Hanousek & Richard Podpiera, *Information-Driven Trading at the Prague Stock Exchange: Evidence from Intra-Day Data*, 10 ECON. TRANSITION 747, 758 (2002).

<sup>164</sup> Cruces & Kawamura, *supra* note 144, at 128.

<sup>165</sup> *See id.* at 128–29.

<sup>166</sup> Weihua Zhu, *Corporate Governance and Insider Trading Regulation Efficiency*, 4 FRONTIERS BUS. RES. CHINA 306, 307 (2010).

<sup>167</sup> *See id.* at 313 tbl.1.

<sup>168</sup> Cai, *supra* note 144, at 237.

<sup>169</sup> *See* Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 122–25 & nn.193–206.

search have not yielded a consistent answer.<sup>170</sup> Recent comparative studies indicate that the adverse selection component is higher for the NYSE than for NASDAQ, although the magnitude of the inter-market difference varies across these studies.<sup>171</sup> Furthermore, one must take into account the rapid evolution of both types of markets and their convergence, as well as possible systemic differences in other components of bid-ask spreads.

Another direction in empirical research examines the introduction of designated market makers in equity markets, which often have exchange-granted incentives to provide liquidity. Several studies concluded that the introduction of such market participants had decreased bid-ask spreads without an impact on the adverse selection component in absolute terms on Euronext Amsterdam<sup>172</sup> and Xetra.<sup>173</sup> If the existence of designated market makers aids the detection of informed trading,<sup>174</sup> these results look puzzling, although technological and other market structure changes must be taken into account. A different study analyzed the introduction of designated market makers on the Italian Stock Exchange and found lower bid-ask spreads and adverse selection costs, as well as lower volatility.<sup>175</sup> However, such market makers had undertaken the obligation to function as de facto securities analysts,<sup>176</sup> and the study ultimately concluded that “the decrease in information asymmetries observed ... is due to an improvement in the degree of information disclosure.”<sup>177</sup>

Yet another angle is the examination of trading venues without formal market makers, such as markets that function as open limit order books or

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<sup>170</sup> *Id.*

<sup>171</sup> See Charkavarty et al., *supra* note 88, at 1071–73 tbl.2; Jiang et al., *supra* note 107, at 208 tbl.3; Srednyakov, *supra* note 99, at 45 tbl.IX.

<sup>172</sup> Albert J. Menkveld & Ting Wang, How Do Designated Market Makers Create Value for Small-Caps? 31–33 (Jan. 28, 2009) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=890526>.

<sup>173</sup> Inga van den Bongard & Jördis Klar, Determinants of the Bid-Ask Spread and the Role of Designated Sponsors: Evidence for Xetra 22–23 (Oct. 5, 2006) (unpublished manuscript) (on file with author), available at <http://www.socialpolitik.de/tagungshps/2007/paper/Klar.pdf>; Jördis Hengelbrock, Designated Sponsors and Bid-Ask Spreads on Xetra 23–24 (Oct. 2008) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1046961>.

<sup>174</sup> For a discussion of this proposition in the context of the specialist system in auction markets, see Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 122–23 & nn.193–95 & 198–200.

<sup>175</sup> Pietro Perotti & Barbara Rindi, *Market Makers as Information Providers: The Natural Experiment of STAR*, 17 J. EMPIRICAL FIN. 895, 914–15 (2010).

<sup>176</sup> *Id.* at 897, 915.

<sup>177</sup> *Id.* at 915.

aggregate market and limit orders.<sup>178</sup> This model, which has a long history,<sup>179</sup> is acquiring importance even outside of equity markets.<sup>180</sup> Although the existence of de facto market makers without specific exchange-granted advantages is not necessarily precluded for such trading venues,<sup>181</sup> there might be industry norms or regulatory restrictions to that effect.<sup>182</sup> Even putting aside the existence of de facto market makers, one formal model concluded that bid-ask spreads in an open limit order book market should reflect the cost of informed trading.<sup>183</sup> However, it is debatable whether the risk of trading with a better-informed counterparty is of real significance to a random trader compared to a trader regularly transacting in both directions.<sup>184</sup> Several empirical studies analyzed the magnitude of the

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<sup>178</sup> The vision of trading venues without the pivotal importance of traditional market makers was clearly articulated in Fischer Black, *Toward a Fully Automated Stock Exchange* (pts. 1 & 2), FIN. ANALYSTS J., July–Aug. 1971, at 28, FIN. ANALYSTS J., Nov.–Dec. 1971, at 24. For a later analysis of this issue by the same author, see Fischer Black, *Equilibrium Exchanges*, FIN. ANALYSTS J., May–June 1995, at 23.

<sup>179</sup> For instance, a commission formed to study the LSE recommended back in 1878 that “a book or register should be kept ... in which brokers should be invited to enter from time to time the names and quantities of [certain illiquid] securities ... which they may have instructions to buy or sell, with or without a price at which they are willing to deal... [thus achieving] the exclusion of the middleman.” LONDON STOCK EXCHANGE COMMISSION, REPORT OF THE COMMISSIONERS, 1878, [C. (2d series)] 2157, at 10.

<sup>180</sup> See, e.g., ANDY NYBO, TABB GRP., TRYING TO MAKE CHANGE: MARKET MAKERS AND THE EVOLVING OPTIONS MARKET 1 (2008) (“Slowly but surely, options trading is transitioning from a quote-driven market where liquidity is provided by market makers, to an order-driven market with liquidity being provided by natural market participants.”).

<sup>181</sup> See, e.g., Brockman & Chung, *supra* note 143, at 128 (“Although there are no market makers with an affirmative obligation to trade in an order-driven environment, de facto market makers on the [HKSE, an open limit order book market] are likely to provide liquidity in much the same fashion as ‘scalpers’ on floor-based futures exchanges.”).

<sup>182</sup> See, e.g., G.-F. Gu et al., *Quantifying Bid-Ask Spreads in the Chinese Stock Market Using Limit-Order Book Data*, 57 EUR. PHYSICS J. B 81, 82 (2007) (“In order to reduce the market risks and speculation actions, the Chinese stock market adopts *t+1* trading system, which does not allow traders to sell the stocks bought on the same day ...”); Yasushi Hamao & Joel Hasbrouck, *Securities Trading in the Absence of Dealers: Trades and Quotes on the Tokyo Stock Exchange*, 8 REV. FIN. STUD. 849, 850 (1995) (“[B]y custom and convention, members [of the Tokyo Stock Exchange] refrain from placing proprietary limit orders on both sides of the market... [which] effectively prevents a group of traders that would naturally gravitate toward functioning as de facto dealers from doing so.”).

<sup>183</sup> Lawrence G. Glosten, *Is the Electronic Open Limit Order Book Inevitable?*, 49 J. FIN. 1127, 1140 (1994).

<sup>184</sup> Some evidence on this issue is presented by empirical research finding a negative correlation between bid-ask spreads in equity markets and disclosure quality for trading venues without formal market makers. See Andrea Maria Accioly Fonseca Minardi et al., *Bid-Ask Spreads in a Stock Exchange Without Market Specialists*, 7 LATIN AM. BUS.

adverse selection component for stocks on trading venues without formal market makers and found this component to be relatively large.<sup>185</sup> Another study argued that “the price impact measure and the adverse selection component of the bid-ask spread” for stocks in the open limit order book markets in China “explain[] 44% and 46% of the variation in [foreign-held equity] discounts.”<sup>186</sup> These results may seem surprising, but the ambiguities of the definition of “informed trading” and other limitations of bid-ask spread decomposition methodologies must be taken into account.

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REV. 19, 33–34 (2006) (data from the São Paulo Stock Exchange); Frino & Jones, *supra* note 65, at 1393 (data from the Australian Stock Exchange); Zhou, *supra* note 65, at 615–16 (data from the Shanghai Stock Exchange and the Shenzhen Stock Exchange). It is debatable whether this phenomenon can be attributed—at least partially—to inventory holding costs rather than adverse selection costs for trading venues in which even de facto market makers do not exist. Compare Chengying He et al., *Adverse Selection Costs: A Study on the Chinese Stock Market*, 4 FRONTIERS BUS. RES. CHINA 209, 222 (2010) (“[A]n investor who submitted limit orders acts as an implied market maker ... [T]he theory of inventory holding costs can be used in order-driven market, based on the view that limited orders absorb the inventory passively according to the instructions (orders) from the market in exchange for price reverse.”) (citation omitted), with Zhou, *supra* note 65, at 591 n.12 (“[T]here is no requirement for dealers to hold a certain level of inventory to meet demand immediately, and hence, no inventory holding cost in an order-driven market.”).

<sup>185</sup> Hee-Joon Ahn et al., *The Components of the Bid-Ask Spread in a Limit-Order Market: Evidence from the Tokyo Stock Exchange*, 9 J. EMPIRICAL FIN. 399, 411, 412 tbl.4 (2002) (estimating the adverse selection component of the implied spread on the Tokyo Stock Exchange, a trading venue that aggregates market and limit orders, from 45 to 57%, depending on the share price); Paul Brockman & Dennis Y. Chung, *Bid-Ask Spread Components in an Order-Driven Environment*, 22 J. FIN. RES. 227, 237–40 (1999) (estimating the adverse selection component of the effective spread on the HKSE, a limit order book, at 33%); Frank de Jong et al., *Price Effects of Trading and Components of the Bid-Ask Spread on the Paris Bourse*, 3 J. EMPIRICAL FIN. 193, 200–01 (1996) (estimating the adverse selection component of the effective spread on the Paris Bourse, a trading venue that aggregates market and limit orders, from 30 to 45%, depending on the trade size); He et al., *supra* note 184, at 219–20 tbl.3 (estimating the adverse selection component of the effective spread on the Shanghai Stock Exchange, an open limit order book, from 2 to 43% of the effective spread, depending on the bid-ask spread decomposition methodology, firm size, and order size); Zhou, *supra* note 65, at 600 tbl.3 (estimating the adverse selection component of the effective spread on the Shanghai Stock Exchange and the Shenzhen Stock Exchange, open limit order books, at 37%). None of these studies isolated the inventory holding component, and one of them explicitly recognized this methodological limitation. He et al., *supra* note 184, at 228–29. From the measurement perspective, it is argued that, “there is no essential difference between effective spread and quoted spread in order-driven markets.” Zhou, *supra* note 65, at 593 n.14.

<sup>186</sup> Kalok Chan et al., *Information Asymmetry and Asset Prices: Evidence from the China Foreign Share Discount*, 63 J. FIN. 159, 159 (2008).

VII. THE EXAMINATION OF UNREGULATED SECURITIES MARKETS  
AND THE IMPACT OF INSIDER TRADING REGULATION ON MARKET  
LIQUIDITY

Another avenue for examining the link between informed trading and bid-ask spreads includes historical experiences of unregulated securities markets and the impact of insider trading regulation, including various cross-country studies. However, one methodological complication is that many studies are not easily comparable.

A separate category of research brings together studies of historical experiences of unregulated securities markets—although there is little direct evidence that insider trading was of concern to equity market makers and thus had an adverse impact on market liquidity. One study analyzed stocks on the Berlin Stock Exchange in the late nineteenth and early twentieth centuries and concluded that, in this active securities market, “trading costs were low ... in the decades before World War I, even by modern US standards and certainly by recent German standards.”<sup>187</sup> Puzzled by this result, the study hypothesized that “the Berlin banks may have intervened in price determination as informed market makers and thereby reduced adverse selection costs.”<sup>188</sup> A related study of the NYSE argued that the adverse selection component of bid-ask spreads for a representative sample of common stocks increased from 49% in 1900 to 69% in 1910 in relative terms, corresponding to a 114% increase in absolute terms.<sup>189</sup> However, there were improvements in other measures of market liquidity during the same time period,<sup>190</sup> and the estimates of the adverse selection component displayed several inconsistencies when broken down by subgroups.<sup>191</sup> The study also concluded that “trading costs and measures of illiquidity for the most heavily traded securities compare quite

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<sup>187</sup> Thomas Gehrig & Caroline Fohlin, *Trading Costs in Early Securities Markets: The Case of the Berlin Stock Exchange 1880–1910*, 10 REV. FIN. 587, 589–90 (2006). Another study also came to a similar conclusion, but it still argued that “[l]iquidity was negatively correlated with active informed trading.” Carsten Burhop & Sergey Gelman, *Liquidity Measures, Liquidity Drivers and Expected Returns on an Early Call Auction Market 1* (Max Planck Inst. for Research on Collective Goods, Preprint No. 19, 2011), available at [http://www.coll.mpg.de/pdf\\_dat/2011\\_19online.pdf](http://www.coll.mpg.de/pdf_dat/2011_19online.pdf).

<sup>188</sup> Gehrig & Fohlin, *supra* note 187, at 610.

<sup>189</sup> Caroline Fohlin et al., *Liquidity and Competition in Unregulated Markets: The New York Stock Exchange Before the SEC 1*, 45 tbl.4 (Mar. 2010) (unpublished manuscript) (on file with author), available at <http://www.iga.ucdavis.edu/Research/All-UC/conferences/spring-2010/Fohlin%20paper.PDF>.

<sup>190</sup> *Id.* at 19–20.

<sup>191</sup> *See id.* at 23–24, 45 tbl.4.

closely with modern-day rates in well-developed markets”<sup>192</sup>—despite the lack of insider trading regulation.<sup>193</sup>

A different category of empirical research consists of studies of modern securities markets that lack regulatory norms or stringent enforcement. One study focused on the Prague Stock Exchange, a market in which insider trading is common.<sup>194</sup> This study concluded that the adverse selection component of the effective spread for stocks averages at 17%, which is quite low compared to more regulated markets.<sup>195</sup> A study of the Ukrainian stock market during the time period when this trading venue had no formal market makers estimated the adverse selection component of the traded spread at 10%<sup>196</sup>—despite the industry opinion that “insider trading is unfortunately a permanent feature of the Ukrainian stock market.”<sup>197</sup> Furthermore, the magnitude of the adverse selection component was statistically insignificant for 50% of stocks in the sample, although this result might have been caused by the data’s insufficiency.<sup>198</sup> One justification for the results produced by these two studies could be that more regulated markets possess more developed financial infrastructure, which may mean greater amounts of other types of informed trading.

Another direction in empirical research studies the impact of insider trading regulation on liquidity of equity markets. One contribution focused on the two key laws aimed at insider trading in the United States and documented that they were associated with a decrease in bid-ask spreads on NASDAQ, but their impact on the adverse selection component was ambiguous.<sup>199</sup> One more U.S.-centered study found a decrease in bid-ask spreads and the adverse selection component in relative and absolute terms on various trading venues after the passage of the Sarbanes-Oxley Act and

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<sup>192</sup> *Id.* at 32.

<sup>193</sup> *See id.* at 4 (noting “the absence of regulation regarding insider trading” during the applicable time period).

<sup>194</sup> Jan Hanousek & Richard Podpiera, *Informed Trading and the Bid-Ask Spread: Evidence from an Emerging Market*, 31 J. COMP. ECON. 275 (2003).

<sup>195</sup> *Id.* at 295.

<sup>196</sup> Yuriy Ryzhkov, *Bid-Ask Spread Components: Evidence from PFTS (First Ukrainian Trading System)* 29 (2007) (unpublished M.A. thesis, National University of “Kyiv-Mohyla Academy”) (on file with author), *available at* [http://www.kse.org.ua/uploads/file/library/2007/ryzhkov\\_2007.pdf](http://www.kse.org.ua/uploads/file/library/2007/ryzhkov_2007.pdf). This study also found “almost no econometric evidence of inventory holding costs.” *Id.* at 26.

<sup>197</sup> *Id.* at 11.

<sup>198</sup> *Id.* at 27.

<sup>199</sup> Vaughn S. Armstrong, *The Microstructure of Informed Trading: A Theoretical and Empirical Analysis of Insider Trading Sanctions* iii, 135–36, 159 (May 1995) (unpublished Ph.D. dissertation, Arizona State University) (on file with author).

related regulation.<sup>200</sup> Another study analyzed the impact of an omnibus securities law passed in New Zealand that had several insider trading-related provisions and concluded that this law had no impact on the adverse selection component in either relative or absolute terms.<sup>201</sup> By contrast, a study examining the impact of the same piece of legislation found smaller bid-ask spreads,<sup>202</sup> although the implementation of a continuous disclosure regime<sup>203</sup> might be responsible for this result. A different analysis of this piece of legislation found a decrease in bid-ask spreads and the adverse selection component in relative and absolute terms.<sup>204</sup>

An additional case study considers the impact of Regulation Fair Disclosure (Reg FD) that banned selective disclosure of certain types of information to favored investors and securities analysts.<sup>205</sup> Empirical studies present evidence—often from different data sets—consistent with a range of views about the effectiveness and the overall effect of Reg FD, which could have impacted bid-ask spreads and their components in a variety of ways. For example, there is a debate whether this regulation has achieved its ultimate objectives,<sup>206</sup> and some recent anecdotal evidence suggests

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<sup>200</sup> Pankaj K. Jain et al., Trends and Determinants of Market Liquidity in the Pre- and Post-Sarbanes-Oxley Act Periods 26–27, 34 tbl.2 (Sept. 2006) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=488142>; see also Francois Brochet, *Information Content of Insider Trades Before and After the Sarbanes-Oxley Act*, 85 ACCT. REV. 419, 419 (2010) (presenting empirical evidence from various trading venues, which is based on market reaction to certain filings, consistent with the view that “SOX and regulatory actions [have] reduc[ed] the incentives to sell ahead of privately known negative news”).

<sup>201</sup> Poskitt & Yang, *supra* note 161, at 47, 63.

<sup>202</sup> Gilbert et al., *supra* note 5, at 748.

<sup>203</sup> See Poskitt & Yang, *supra* note 161, at 50.

<sup>204</sup> Bart Frijns et al., *Insider Trading, Regulation, and the Components of the Bid-Ask Spread*, 31 J. FIN. RES. 225, 225, 232, 233 tbl.1 (2008).

<sup>205</sup> Selective Disclosure and Insider Trading, Securities Act Release No. 7881, Exchange Act Release No. 43,154, Investment Company Act Release No. 24,599, 65 Fed. Reg. 51,716 (Aug. 15, 2000) (to be codified at 17 C.F.R. pt. 243).

<sup>206</sup> See Anwer S. Ahmed & Richard A. Schneible Jr., *The Impact of Regulation Fair Disclosure on Investors' Prior Information Quality—Evidence from an Analysis of Changes in Trading Volume and Stock Price Reactions to Earnings Announcements*, 13 J. CORP. FIN. 282, 297 (2007) (“[Reg] FD succeeded in eliminating selective disclosure [for firms on various trading venues.]”); Chiraphol N. Chiyachantana et al., *The Impact of Regulation Fair Disclosure on Information Asymmetry and Trading: An Intraday Analysis*, 39 FIN. REV. 549, 552 (2004) (“[T]he [post-Reg FD] decline in information asymmetry in the pre-announcement period [for firms on the NYSE] is closely associated with lower institutional trading.”); Charles D. Collver, *Is There Less Informed Trading After Regulation Fair Disclosure?*, 13 J. CORP. FIN. 270, 279 (2007) (“[I]nformed trading declined after implementation of Reg FD [on the NYSE], but ... this decline is not due to Reg FD.”); Andreas Gintschel & Stanimir Markov, *The Effectiveness of Regulation FD*,

that Reg FD has merely shifted, rather than eliminated, at least some part of insider trading activities.<sup>207</sup> Other aspects of empirical research focus on the impact of this regulation—often with different conclusions—on the informational environment,<sup>208</sup> volatility,<sup>209</sup> and cost of capital<sup>210</sup> as a

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37 J. ACCT. & ECON. 293, 312–13 (2004) (“Reg FD achiev[ed] its immediate goal of curtailing the flow of private information from managers to financial analysts.... [as measured by] the price impact of analyst announcements in the post-Reg FD period [for firms on various trading venues] ....”); Bin Ke et al., *The Effect of Regulation FD on Transient Institutional Investors’ Trading Behavior*, 46 J. ACCT. RES. 853, 853 (2008) (“Reg FD has had an impact on management’s selective disclosure behavior and significantly changed the trading behavior of transient institutions [on various trading venues].”); Robert B. Mendelson et al., *Regulation Fair Disclosure and Volatility: An Intraday Analysis*, J. INVESTMENT MGMT., 3d Q. 2005, at 31, 32 (“Reg FD has been successful in its goal of reducing information asymmetry in the market [as measured by various variables, such as volatility, share volume, number of transactions, bid-ask spreads, and average trade size on the NYSE].”).

<sup>207</sup> See Gregory Zuckerman & Susan Pulliam, *The Insider-Trading Case: How an SEC Crackdown Led to Rise of ‘Expert Networks,’* WALL ST. J., Dec. 17, 2010, at C1.

<sup>208</sup> See Ahmed & Schneible, *supra* note 206, at 297 (“[Reg FD resulted in] a decrease in the average quality of information [about small and high-tech firms on various trading venues] ....”); Brian J. Bushee et al., *Managerial and Investor Responses to Disclosure Regulation: The Case of Reg FD and Conference Calls*, 79 ACCT. REV. 617, 617 (2004) (“[There seems to be no] evidence that Reg FD decreased the amount of information disclosed during the call period [for firms on various trading venues] ....”); Afshad J. Irani & Irene Karamanou, *Regulation Fair Disclosure, Analyst Following, and Analyst Forecast Dispersion*, 17 ACCT. HORIZONS 15, 15 (2003) (“[Reg FD is associated with] a decrease in analyst following and an increase in forecast dispersion [for firms on various trading venues] ....”); Seung-Woog (Austin) Kwag & Kenneth Small, *The Impact of Regulation Fair Disclosure on Earnings Management and Analyst Forecast Bias*, 31 J. ECON. & FIN. 87, 97 (2007) (“[A]nalyst forecast accuracy has deteriorated in the post-FD period.... [and] analysts tend, on average, to overestimate earnings more in the post-FD period [for firms on various trading venues].”); Yan Sun, *How Does Regulation Fair Disclosure Affect Pre-Fair Disclosure Selective Disclosers?*, 24 J. ACCT. AUDITING & FIN. 59, 61 (2009) (“Reg FD is associated with a deterioration in the information environment for firms [on the NYSE, the AMEX, and NASDAQ] that relied on selective disclosures before the passage of the regulation [as measured by various variables, such as analyst following, analysts’ forecast error and dispersion, and informational efficiency of stock prices].”); Carla Carnaghan & Ranjini Sivakumar, *The Effects of Regulation Fair Disclosure on Management Forecasts*, at i (n.d.) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=492662> (“[I]nformation disclosed by managers has improved in terms of frequency, specificity and verifiable information provided [for firms on the NYSE, the AMEX, and NASDAQ].”).

<sup>209</sup> See Warren Bailey et al., *Regulation Fair Disclosure and Earnings Information: Market, Analyst, and Corporate Responses*, 58 J. FIN. 2487, 2511 (2003) (finding no change in volatility for firms on various trading venues); Bushee et al., *supra* note 208, at 617 (finding increased volatility for firms on various trading venues); Alberto Dell’Acqua et al., *Conference Calls and Stock Price Volatility in the Post-Reg FD Era*,

proxy for risk, and these factors also influence market makers' inventory holding costs.<sup>211</sup> To turn to the link between regulation and liquidity of equity markets, several studies documented a decrease in bid-ask spreads for a number of trading venues after the passage of Reg FD,<sup>212</sup> although another contribution found increased bid-ask spreads on the NYSE, the AMEX, and NASDAQ.<sup>213</sup> A group of studies concluded that the adverse selection component decreased in both relative and absolute terms for stocks on the NYSE after the regulatory change,<sup>214</sup> which is consistent with its effectiveness *if* the applicable bid-ask spread decomposition methodology is accurate. By contrast, another contribution found that the adverse selection component substantially *increased* in both relative and absolute terms for stocks on NASDAQ post-Reg FD, while bid-ask

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16 EUR. FIN. MGMT. 256, 268–69 (2010) (finding lower volatility for high-tech firms on the NYSE and NASDAQ); Jennifer Francis et al., *Re-Examining the Effects of Regulation Fair Disclosure Using Foreign Listed Firms to Control for Concurrent Shocks*, 41 J. ACCT. & ECON. 271, 281–82 (2006) (finding lower volatility for firms on various trading venues, but not relative to foreign firms *exempt* from Reg FD); Chun I. Lee et al., *Effect of Regulation FD on Asymmetric Information*, FIN. ANALYSTS J., May–June 2004, at 79, 79 (finding “no significant increase in volatility” for firms on the NYSE, the AMEX, and NASDAQ); Mendelson et al., *supra* note 206, at 31 (finding lower volatility for firms on the NYSE); Carnaghan & Sivakumar, *supra* note 208, at 22 (finding no increase in volatility for firms on the NYSE, the AMEX, and NASDAQ); *see also* Dana Hobson, *Effects of Regulation and Technology on U.S. Stocks: Evidence from Earnings Announcements*, J. TRADING, Spring 2007, at 89, 93 (“The changes brought about by Reg FD and Sarbanes-Oxley led to a doubling of volatility in response to EPS [earnings per share] announcements [for firms on different trading venues].”).

<sup>210</sup> *See* Zhihong Chen et al., *Regulation Fair Disclosure and the Cost of Equity Capital*, 15 REV. ACCT. STUD. 106, 139 (2010) (“[T]he cost of capital decreases significantly for a broad cross-section of US firms [on various trading venues] in the post-Reg FD period relative to the pre-Reg FD period.... [compared to foreign firms] which are exempt from Reg FD.”); Armando Gomes et al., *SEC Regulation Fair Disclosure, Information, and the Cost of Capital*, 13 J. CORP. FIN. 300, 330 (2007) (“[S]mall firms [on the NYSE and NASDAQ] were adversely affected by Reg FD; their cost of capital rose.”).

<sup>211</sup> *See* Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 133 & n.246, 172–73 & nn.501–03 (discussing the impact of volatility and risk on market makers' inventory holding costs).

<sup>212</sup> Chiyachantana et al., *supra* note 206, at 552 (data from the NYSE); Venkat R. Eleswarapu et al., *The Impact of Regulation Fair Disclosure: Trading Costs and Information Asymmetry*, 39 J. FIN. & QUANT. ANALYSIS 209, 223 (2004) (data from the NYSE); Mendelson et al., *supra* note 206, at 31 (data from the NYSE); Carnaghan & Sivakumar, *supra* note 208, at 22 (data from the NYSE, the AMEX, and NASDAQ).

<sup>213</sup> Lee et al., *supra* note 209, at 87.

<sup>214</sup> Chiyachantana et al., *supra* note 206, at 552; Eleswarapu et al., *supra* note 212, at 210.

spreads *decreased*,<sup>215</sup> which raises doubts about the effectiveness of this regulatory measure or the accuracy of the bid-ask spread decomposition methodology. Yet another study found that the adverse selection component stayed the same in absolute terms and decreased in relative terms for stocks on the NYSE, the AMEX, and NASDAQ post-Reg FD.<sup>216</sup>

Several cross-country studies analyzed the impact of insider trading regulation on bid-ask spreads and their components and market depths in equity markets, while another approach linked such regulation and other measures of market liquidity.<sup>217</sup> One study examined the world's leading stock exchanges and concluded that the enforcement of insider trading regulation is associated with lower bid-ask spreads.<sup>218</sup> A study of American Depositary Receipts (ADRs) traded on the NYSE indicated that the link between the enforcement of insider trading laws and bid-ask spreads is statistically insignificant,<sup>219</sup> while a later study of a similar sample of ADRs traded on the NYSE and NASDAQ concluded that such enforcement is associated with narrower bid-ask spreads, greater market depths, and smaller adverse selection costs.<sup>220</sup> Another contribution examined the impact of key features of insider trading regulation on bid-ask spreads and different estimates of the adverse selection component.<sup>221</sup> This analysis has yielded a number of correlations with different levels of significance, with some of them supporting the link between regulation and greater market liquidity, but no significant correlations were detected among *any*

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<sup>215</sup> Baljit Sidhu et al., *Regulation Fair Disclosure and the Cost of Adverse Selection*, 46 J. ACCT. RES. 697, 697, 707, 715–16 (2008).

<sup>216</sup> Lee et al., *supra* note 209, at 86.

<sup>217</sup> See, e.g., Beny, *supra* note 5, at 264, 280 (stock market turnover, defined as “the ratio of the total value traded to total stock market capitalization”); Hazem Daouk et al., *Capital Market Governance: How Do Security Laws Affect Market Performance?*, 12 J. CORP. FIN. 560, 560, 562 (2006) (trading volume, defined as “[t]he ratio of dollar traded per month to the dollar market capitalization at the end of the month,” and market depth, defined as “[t]he ratio of trading volume to the standard deviation of daily returns (or the absolute value of monthly return) computed each month”); Thomas Lagoarde-Segot, *Financial Reforms and Time-Varying Microstructures in Emerging Equity Markets*, 33 J. BANKING & FIN. 1755, 1761, 1769 (2009) (illiquidity, defined as “the variation in asset prices per unit of trading volume”).

<sup>218</sup> Pankaj Jain, *Improving Liquidity Through Efficient Stock Market Structure and Operational Design*, J. FIN. TRANSFORMATION, Nov. 2006, at 151, 159.

<sup>219</sup> Venkat R. Eleswarapu & Kumar Venkataraman, *The Impact of Legal and Political Institutions on Equity Trading Costs: A Cross-Country Analysis*, 19 REV. FIN. STUD. 1081, 1084 (2006).

<sup>220</sup> Kee H. Chung & Hao Zhang, *Insider Trading Regulation and Market Quality: Evidence from American Depositary Receipts*, 39 ASIA-PAC. J. FIN. STUD. 340, 342 (2010).

<sup>221</sup> Frijns et al., *supra* note 159.

of these measures of liquidity and such important features as the actual existence of criminal enforcement and the strength of the public regulator.<sup>222</sup> A different study considered the impact of insider trading regulation in France and the United Kingdom and found a decrease in bid-ask spreads only in the former nation, attributing this result to the consistency of enforcement.<sup>223</sup> Yet another study found that the existence of certain “insider trading” exchange-mandated rules lowers bid-ask spreads, but such rules relate to the conduct of securities market professionals, such as front-running, trading ahead of research reports, affiliation, and intimidation/coordination, rather than the conduct of true insiders.<sup>224</sup>

#### VIII. THE SIGNIFICANCE OF FIRM CHARACTERISTICS

A further key area of research considers various firm characteristics that relate to information asymmetry and informed trading in order to test their impact on liquidity of equity markets and adverse selection costs. One study analyzed various characteristics, such as volatility, volume, leverage, institutional ownership, security analyst activities, book-to-market ratios, the importance of intangible assets, and R&D expenses, and concluded that

most of the variables that measure information asymmetries [on the NYSE] are not related to adverse selection. The informed trader proxies have some impact on adverse selection, but the impact is not uniform across the [bid-ask spread decomposition] models. No single model appears to perform significantly better than the others.<sup>225</sup>

Another study of the NYSE focused on similar variables, such as R&D expenses, the importance of physical assets, firm age, and insiders’ transactions, and asserted that “estimates of adverse selection costs ... are related to firm characteristics that ex ante should be associated with information asymmetry,”<sup>226</sup> although the overall results appear to be ambiguous.<sup>227</sup> The same study also looked at other variables, such as book-to-market ratios, P/E ratios, and security analyst forecasts, and found

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<sup>222</sup> *Id.* at 8–9, 36–37 tbl.7.

<sup>223</sup> Olivier Maisondieu-Laforge, *Informed Trading and the Consistent Enforcement Hypothesis: Evidence from Bid-Ask Spreads in France and Britain*, 17 GLOBAL FIN. J. 439, 439 (2007).

<sup>224</sup> Douglas Cumming et al., *Exchange Trading Rules and Stock Market Liquidity*, 99 J. FIN. ECON. 651, 656 tbl.1, 668 & tbl.6 (2011).

<sup>225</sup> Van Ness et al., *supra* note 73, at 95.

<sup>226</sup> Clarke & Shastri, *supra* note 73, at 23.

<sup>227</sup> *See id.* at 20–23, 43–44 tbl.3.

“only weak evidence to suggest that the [adverse selection] measures are related to [these] proxies for a firm’s investment opportunity set.”<sup>228</sup>

One contribution analyzed the impact of corporate governance—by using an index and its components, such as management discipline, transparency, independence, accountability, responsibility, fairness, and social awareness—on the adverse selection component for stocks on the Singapore Exchange and concluded that “higher quality corporate governance lowers the adverse selection component.”<sup>229</sup> Another study analyzed stocks on the NYSE and the AMEX and found “that changes in bid-ask spreads at the time of earnings announcements are significantly negatively related to board independence, board activity, and the percentage stock holdings of directors and officers [and] that depth changes are significantly positively related to board structure, board activity, and directors’ and officers’ percentage stock holdings.”<sup>230</sup> But the same study stated that “[a] sizable body of prior research indicates that boards that do a more effective job of monitoring management enhance the quality and the frequency of information released by management,”<sup>231</sup> which suggests that this effect on market liquidity may be at least partially attributed to a channel other than informed trading. By contrast, another contribution found no evidence that insider holdings have an impact on adverse selection costs for stocks on various trading venues and argued that different dimensions of liquidity are affected by the institutional ownership level and its concentration,<sup>232</sup> which may be attributed to informed trading other than insider trading. Yet another study found a correlation between the greater percentage of equity held by the largest institutional investor, as opposed to the second largest institutional investor or all other institutional investors combined, and bid-ask spreads for stocks on NASDAQ.<sup>233</sup>

Another study maintained that the magnitude of retail shareholdings is associated with smaller bid-ask spreads for stocks on the Australian Stock Exchange and hypothesized that “retail participation, in conjunction with measures to increase shareholder numbers, may assist to reduce the proba-

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<sup>228</sup> *Id.* at 25.

<sup>229</sup> Charlie Charoenwong et al., *Adverse Selection and Corporate Governance*, 20 INT’L REV. ECON. & FIN. 406, 412, 418 (2011).

<sup>230</sup> Kiridaran Kanagaretnam et al., *Does Good Corporate Governance Reduce Information Asymmetry Around Quarterly Earnings Announcements?*, 26 J. ACCT. & PUB. POL’Y 497, 498 (2007).

<sup>231</sup> *Id.* (citation omitted).

<sup>232</sup> Amir Rubin, *Ownership Level, Ownership Concentration and Liquidity*, 10 J. FIN. MKTS. 219, 245 (2007).

<sup>233</sup> Karen Schnatterly et al., *Informational Advantages of Large Institutional Owners*, 29 STRATEGIC MGMT. J. 219, 225–26 (2008).

bility of trading with an informed trader, reducing adverse selection costs and spreads.”<sup>234</sup> A related study of the Toronto Stock Exchange argued that “stocks with greater deviations between ultimate control and ownership have a larger information asymmetry component of their bid-ask spread and wider bid-ask spread.”<sup>235</sup> A different study analyzed stocks on Euronext Paris and concluded that “the adverse selection component of the spread is increasing with the ultimate and direct percentage of capital held by the main and the second shareholders, confirming that controlling shareholders are informed traders”<sup>236</sup> and that “[t]he deviation between ultimate control and ownership increases the spread [and its adverse selection component].”<sup>237</sup>

Providing a different perspective, one contribution analyzed the impact of the expiration of lockup provisions and found a decrease in bid-ask spreads for stocks on the NYSE and NASDAQ, which was primarily attributed to a decline in the adverse selection component,<sup>238</sup> thus “not find[ing] any support for the hypothesized adverse information effects of insider selling in the post-lockup expiration period.”<sup>239</sup> A study of the HKSE also analyzed the expiration of lockup provisions, but it found wider bid-ask spreads for stocks and argued that this result “is likely to be caused by the potential sales by insiders and the risk for market makers to end up trading with better informed insiders.”<sup>240</sup> An additional contribution suggested that announcements of losses or negative earnings changes are associated with a smaller decline in bid-ask spreads and larger adverse selection costs for stocks of firms on the NYSE, the AMEX, and NASDAQ, as opposed to firms with positive earnings announcements.<sup>241</sup>

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<sup>234</sup> Carole Comerton-Forde & James Rydge, *Director Holdings, Shareholder Concentration and Illiquidity* 30–31 (Jan. 2006) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=713181>.

<sup>235</sup> Attig et al., *supra* note 81, at 2875.

<sup>236</sup> Edith Ginglinger & Jacques Hamon, *Ownership, Control and Market Liquidity* 23 (May 2010) (unpublished manuscript) (on file with author), available at <http://www.fma.org/NY/Papers/ownershipliquidityFMANY.pdf>.

<sup>237</sup> *Id.* at 16.

<sup>238</sup> Chandrasekhar Krishnamurti & Tiong Yang Thong, *Lockup Expiration, Insider Selling and Bid-Ask Spreads*, 17 INT’L REV. ECON. & FIN. 230, 230, 234 (2008).

<sup>239</sup> *Id.* at 231.

<sup>240</sup> Marc Goergen et al., *Price, Volume and Spread Effects Associated with the Expiry of Lock-In Agreements: Evidence from the Hong Kong IPO Market*, 18 PAC.-BASIN FIN. J. 442, 458 (2010).

<sup>241</sup> Jeffrey Ng et al., *Firm Performance Measures and Adverse Selection* 25, 29–30 (Sept. 2009) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1324874>.

Another study found that better scores for an index capturing various factors for individual firms, such as disclosure, corporate governance, and investor rights, are associated with smaller bid-ask spreads and the adverse selection component for stocks on the NYSE,<sup>242</sup> but the impact of informed trading—and, even more so, insider trading—was not isolated.<sup>243</sup> A different contribution, which focused on country-wide factors, analyzed ADRs traded on the NYSE, the AMEX, and NASDAQ and argued that bid-ask spreads and the adverse selection component are “positively correlated with information opaqueness and poor protection of investor rights in the capital market environment of the home countries.”<sup>244</sup> A similar study analyzed ADRs traded on the NYSE and NASDAQ and concluded that “ADRs of firms operating in good investor protection environments tend to have both lower information asymmetry costs and higher liquidity levels [as measured by bid-ask spreads and market depths].”<sup>245</sup>

Overall, studies addressing various firm characteristics that relate to information asymmetry and informed trading do not amount to a consistent pattern, and conclusions of such studies often depend on the validity of the applicable bid-ask spread decomposition methodology. Furthermore, several studies that analyzed the connection between informed trading and market liquidity have causal factors that appear to be relatively remote,<sup>246</sup> which also casts doubts on similar research.

#### CONCLUSION

A balanced analysis of empirical studies and other evidence shows that the link between the impact of insider trading on market makers and market liquidity is quite weak in the context of many regulated and unregulated securities markets. Market makers do not necessarily absorb the bulk of losses even if insider trading is viewed as a “zero-sum game” for

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<sup>242</sup> Chen et al., *supra* note 65, at 647, 657–58 & tbl.8.

<sup>243</sup> *See id.* at 649.

<sup>244</sup> Qiaoqiao Zhu, *The Home Stigma: Adverse Selection in ADRs and the Home Capital Market Environment* 26 (Mar. 2010) (unpublished manuscript) (on file with author), available at <http://ssrn.com/abstract=1537502>.

<sup>245</sup> Chung, *supra* note 81, at 1503.

<sup>246</sup> *See, e.g.*, Boehmer et al. *supra* note 81 (the dual-class structure and the management’s willingness to tie its personal wealth to firm performance); Maneeporn Gorkittisunthorn et al., *Insider Ownership, Bid-Ask Spread, and Stock Splits: Evidence from the Stock Exchange of Thailand*, 15 INT’L REV. FIN. ANALYSIS 450 (2006) (insider ownership in the context of stock splits); Gilles Hilary, *Organized Labor and Informational Asymmetry in the Financial Markets*, 11 REV. ACCT. STUD. 525 (2006) (the strength of organized labor).

insiders and outsiders in a static framework.<sup>247</sup> In fact, market makers are more concerned with certain types of short-term informed trading that has a direct impact on their losses and, hence, market liquidity. In many instances, the adverse impact of insider trading on market makers may all but drown in the impact of overall order flow imbalances, inventory management, and short-term informed trading—without creating liquidity externalities in securities markets.

One group clearly harmed by insider trading—with implications for liquidity of the applicable markets—consists of options market makers. While transactions on inside information in options may make the market for the underlying security more “efficient” via additional price-related signals, depending on the effectiveness of price discovery and its transmission, and, consequently, more liquid, the decrease in liquidity of options markets may have adverse consequences for equity markets as well. Thus, these countervailing forces make social welfare calculations quite difficult.

Overall, the current level of insider trading appears to have no significant adverse effect on equity market makers, and any further tightening of insider trading regulation and additional enforcement is unlikely to increase liquidity of equity markets. However, *completely* freeing the modern financial marketplace from regulatory restrictions on insider trading *may* present substantial problems for all types of market makers, but it is not a foregone conclusion. Although observing order flow that includes transactions based on inside information may still generate tangible benefits for these market participants, the erosion of their institutional advantages must be taken into account.

Quite frequently, the existing empirical research on the link between informed trading and liquidity is used selectively to justify the necessity of insider trading regulation,<sup>248</sup> and relevant conceptual, methodological, and measurement flaws and contradictions are largely ignored. Bid-ask spread decomposition studies are the Achilles’ heel of the efforts to use empirical research in support of insider trading regulation because of the uncertainty

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<sup>247</sup> For the “zero-sum game” paradigm in the context of insider trading formulated as the “Law of the Conservation of Securities,” see WILLIAM K.S. WANG & MARK I. STEINBERG, *INSIDER TRADING* § 3.3.5, at 55–58 (3d ed. 2010). For a more general “zero-sum game” paradigm in the context of securities markets, see LARRY HARRIS, *TRADING AND EXCHANGES: MARKET MICROSTRUCTURE FOR PRACTITIONERS* (2003).

<sup>248</sup> See, e.g., Mark Klock, *Mainstream Economics and the Case for Prohibiting Insider Trading*, 10 GA. ST. U. L. REV. 297, 330 & n.214 (1994); Robert A. Prentice & Dale C. Donelson, *Insider Trading as a Signaling Device*, 47 AM. BUS. L.J. 1, 66–67 & nn.302–05 (2010); A.C. Pritchard, *United States v. O’Hagan: Agency Law and Justice Powell’s Legacy for the Law of Insider Trading*, 78 B.U. L. REV. 13, 50 & n.234 (1998).

regarding how “noisy” such results are and what exactly they measure. Even similar data sets and methodologies produce a wide range of estimates of the cost of informed trading—frequently, without isolating the impact of insider trading as such—and, perhaps, in many cases, there is no unique “superior” methodology. Of course, these observations are not a general mistrust of advanced econometric techniques, but a call for an understanding of their limitations in public policy debates in order to avoid far-reaching conclusions based on very imprecise proxies. In fact, there is a need for *further* empirical research that would separate insider trading from other forms of informed trading and answer questions relating to such issues as the detection of insider trading activity by market makers and the use of inferred information, the impact of insider trading on inventory management by market makers, actual responses of market makers to perceived insider trading, the impact of insider trading in derivatives on equity markets, and the effect of insider trading as such on volatility.<sup>249</sup> In that respect, one necessary and difficult task consists of designing econometric proxies for the extent and impact of insider trading that are more reliable than the adverse selection component of bid-ask spreads or PIN estimates.

Given the ambiguity of the existing evidence on the link between insider trading and market liquidity—without an undue focus on outlier studies—it follows that the search for real economic costs of insider trading is not over. Perhaps the impact of insider trading on corporate governance, such as agency, incentives, and disclosure issues, is a more fruitful area for debating the desirability and the appropriate reach of regulation.<sup>250</sup> Another important question concerns the identity of “losers” in the

<sup>249</sup> See Dolgoplov, *Insider Trading and the Bid-Ask Spread*, *supra* note 1, at 178–79.

<sup>250</sup> For a sample of empirical studies in this area, see Daniel Bergstresser & Thomas Philippon, *CEO Incentives and Earnings Management*, 80 J. FIN. ECON. 511 (2006); Qiang Cheng & Kin Lo, *Insider Trading and Voluntary Disclosures*, 44 J. ACCT. RES. 815 (2006); Qiang Cheng & Terry D. Warfield, *Equity Incentives and Earnings Management*, 80 ACCT. REV. 441 (2005); Bikki Jaggi & Judy Tsui, *Insider Trading, Earnings Management and Corporate Governance: Empirical Evidence Based on Hong Kong Firms*, 18 J. INT’L FIN. MGMT. & ACCT. 192 (2007); Sarah McVay et al., *Trading Incentives To Meet the Analyst Forecast*, 11 REV. ACCT. STUD. 575 (2006); Scott Richardson et al., *The Walk-Down to Beatable Analyst Forecasts: The Role of Equity Issuance and Insider Trading Incentives*, 21 CONTEMP. ACCT. RES. 885 (2004); Jonathan L. Rogers, *Disclosure Quality and Management Trading Incentives*, 46 J. ACCT. RES. 1265 (2008); Julia Sawicki & Keshab Shrestha, *Insider Trading and Earnings Management*, 35 J. BUS. FIN. & ACCT. 331 (2008); Anup Agrawal & Tommy Cooper, *Insider Trading Before Accounting Scandals* (Nov. 2008) (unpublished manuscript) (on file with author), *available at* <http://bama.ua.edu/~aagrwal/IT.pdf>; Steven Huddart & Henock Louis, *Insider Selling, Earnings Management, and the 1990s Stock Market Bubble* (Apr. 2011) (unpub-

“zero-sum game” between insiders and outsiders. It is entirely possible that an increasing portion of trading losses from insider trading of outsiders as a group is borne by high-frequency traders, given their growing importance,<sup>251</sup> whether de facto market makers or not, because of the largely marginal nature of their transactions.<sup>252</sup> Furthermore, the social utility of certain strategies employed by such traders has been repeatedly questioned—although this issue is controversial on both conceptual and empirical levels—by legislators, regulators, industry professionals, and researchers.<sup>253</sup>

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lished manuscript) (on file with author), *available at* <http://ssrn.com/abstract=912214>. For a recent restatement of the argument that insider trading may serve as a desirable form of entrepreneurial compensation, see Henry G. Manne, *Entrepreneurship, Compensation, and the Corporation*, Q.J. AUSTRIAN ECON., Spring 2011, at 3.

<sup>251</sup> See SEC’s Concept Release on Equity Market Structure, *supra* note 2, at 3606 (“Estimates of [high-frequency trading] volume in the equity markets vary widely, though they typically are 50% of total volume or higher.”); Rob Iati, *The Real Story of Trading Software Espionage*, ADVANCED TRADING (July 10, 2010), <http://www.advancedtrading.com/algorithms/showArticle.jhtml?articleID=218401501> (“[H]igh-frequency trading firms, which represent approximately 2% of the 20,000 or so trading firms operating in the U.S. markets today, account for 73% of all U.S. equity trading volume.”).

<sup>252</sup> The idea that insider trading induces unfavorable transactions by short-term traders—not necessarily those who trade directly with insiders—was articulated long before the emergence of high-frequency trading in Henry G. Manne, *In Defense of Insider Trading*, HARV. BUS. REV., Nov.–Dec. 1966, at 113, 114–15. Furthermore, some industry participants have stated that, in the world of high-frequency trading, the lines between market making and other trading strategies, such as statistical arbitrage, are becoming increasingly blurry. See Letter from Manoj Narang, Chief Exec. Officer, Tradeworx, Inc., to Elizabeth M. Murphy, Sec’y, U.S. Sec. & Exch. Comm’n app. at 9 (Apr. 21, 2010), *available at* <http://www.sec.gov/comments/s7-02-10/s70210-129.pdf>.

<sup>253</sup> See, e.g., *Market Structure Hearings*, *supra* note 58, *passim* (2009); Bernard S. Donefer, *Algos Gone Wild: Risk in the World of Automated Trading Strategies*, J. TRADING, Spring 2010, at 31; Sal L. Arnuk & Joseph Saluzzi, Themis Trading LLC, *What Ails Us About High Frequency Trading?* (n.d.) (unpublished manuscript) (on file with author), *available at* [http://www.themistrading.com/article\\_files/0000/0508/What\\_Ails\\_Us\\_About\\_High\\_Frequency\\_Trading\\_--\\_Final\\_2\\_10-5-09.pdf](http://www.themistrading.com/article_files/0000/0508/What_Ails_Us_About_High_Frequency_Trading_--_Final_2_10-5-09.pdf); X. Frank Zhang, *The Effect of High-Frequency Trading on Stock Volatility and Price Discovery* (Dec. 2010) (unpublished manuscript) (on file with author), *available at* <http://ssrn.com/abstract=1691679>.