ROSENBLATT SECURITIES INC.

Benefits of Exchange Competition

Prepared for

Bolsa Institucional de Valores (BIVA)

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20 Broad Street, New York, NY 10005
+1.212.607.3100
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Introduction and Background

Central de Corretajes, SA de CV (CENCOR), a company providing brokerage, valuation and technology services in Latin American capital markets, in October 2015 asked the Mexican Ministry of Finance for permission to launch a new stock exchange in Mexico, called Bolsa Institucional de Valores. BIVA would be the first domestic challenger to Bolsa Mexicana de Valores (BMV), currently the country's only stock exchange.

Pending regulatory approval, BIVA plans to launch in Q4 2016. It will use Nasdaq's X-stream trading platform and SMARTS surveillance system. It also plans to offer trade settlement through Grupo BMV's Contraparte Central de Valores clearinghouse. Initially, BIVA will cross-list all BMV-listed company shares but also plains to provide new-listing services, aiming particularly to serve mid-cap companies.

Mexico, of course, would not be the first major world economy to allow competition with its primary listing exchange. Several other major national and regional markets — most notably the United States, the European Union, Japan, Canada and Australia — have allowed other exchanges and alternative trading systems to compete with their incumbent listing markets for many years. The rival markets in these jurisdictions range from exchanges that display price quotations and derive the vast majority of their volume from other customers accessing those bids and offers to a variety of off-exchange venues, many of which do not display price quotations and therefore are often called "dark" markets. The experience of these jurisdictions is instructive to Mexican policymakers and market participants as they consider the entry of a rival to BMV for the trading and listing of Mexican ordinary shares.

BIVA has engaged Rosenblatt Securities to analyze and report on the benefits that exchange competition has brought to other markets around the world. Rosenblatt is an agency broker for institutional investors in the US, where it is the top broker by volume on the New York Stock Exchange floor. The firm also is a leading authority on financial-market structure and regulation worldwide. Rosenblatt's market-structure group produces periodic and special reports on a wide variety of topics pertaining to the US, EU and Canadian equity markets, as well as derivatives and other markets globally. It also has completed consulting engagements for numerous exchanges, regulatory agencies, banks, asset managers and proprietary trading firms around the globe.

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Notes on Methodology and Scope

To complete this report, we relied on a variety of data and other sources of information. These include public documents and records, such as legislation and related final and draft guidance adopted and provided by national and regional government entities. We also incorporated public disclosures from stock exchanges, alternative trading venues and third-party data vendors regarding fees, technology, turnover, share volume and other information. And we reviewed academic literature for evidence of the effects of exchange competition on market participants.

To supplement this information, we spoke with a range of market participants, including brokers, investment management firms and trading venues, regarding their experiences in competitive markets. We also relied on our own knowledge of market history and practices, gleaned from operating as a broker and member of multiple exchanges and ATSs in the United States, and from longstanding contacts with market participants globally.

Our mandate for this project, as defined by BIVA, was to provide evidence of how competition has benefited market participants in other countries around the world. Accordingly, we have focused on identifying and explaining instances in which the introduction of competition with incumbent markets has been followed by or coincided with cost reductions for brokers and investors, improvements in market quality and increases in trading activity and liquidity, as well as other benefits for market participants. It should be noted that the existence of competition is often one of many factors affecting these outcomes. Rosenblatt believes, based on its many years studying market structure globally, that exchange competition generally makes for healthier markets and, in particular, better outcomes for end investors and issuers. However, this paper is not designed to be an exhaustive study of all available evidence or render a definitive, empirical judgment on the subject.

Although some market participants view the number of listed companies in a given jurisdiction as an expression of whether competition has brought benefits to the wider market, we have chosen not to focus on this specific metric. Although listing companies certainly want to be assured that their markets function well and are appropriately regulated, we believe that listing decisions for operating companies are driven in large part by an exchange's brand and marketing compared with its competitors, both within and across borders. Market-structure details tend to play little to no role in these listings decisions. As a general principle, however,

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market-quality improvements like narrower bid-ask spreads and greater liquidity, which have occurred following the introduction of competition with national exchanges in several countries throughout the world, result in better price discovery and more-efficient capital formation. Additionally, the presence of multiple listing markets within a country does give issuers options regarding the brand with which they choose to associate and protection against unreasonably high listings fees. In the US, for example, many fast-growing companies in industries such as technology and telecommunications elected to list on Nasdaq, which developed a reputation for listing such companies following the growth of such concerns as Microsoft and Intel from small startups to blue chips in the 1980s and early 1990s, even though they met the listings requirements for the more-established New York Stock Exchange. Nasdaq also generally charges lower listings fees than NYSE, though the big companies that qualify for either market typically don't make a listings choice based on the difference in fees. And some non-operating companies — particularly exchange-traded funds, which have been growing in number and assets under management globally in recent years — pay more attention to market-quality and market-structure statistics when making listings decisions, as evidenced by the early success of Bats Global Markets' BZX exchange as an ETF listing market in the US, which it has achieved despite not having a premier corporate-listings franchise.

Executive Summary

We find a wealth of evidence that subjecting incumbent, national exchanges to competition brings substantial benefits to a wide array of market participants, including investors, issuers and intermediaries.

This evidence comes in a variety of forms. For example, numerous academic studies comparing competitive markets with those in which one exchange enjoys protected or monopoly status have concluded that competition reduces broker and investor costs while improving liquidity. We cite several of these works and explain their findings in the section of this paper titled "Review of Academic Literature," which begins on page 6.

Additionally, the experiences of major jurisdictions that began to allow competition with incumbent national exchanges show that as rival markets launched and grew, they offered cheaper and often superior products and services to the marketplace. This, in turn, allowed them to take market share from the incumbents, prompting the former monopolies to reduce their own fees and enhance their product and service offerings, in ways that contributed to the

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market-quality and cost improvements cited above. This pattern has been observed in the United States, Canada, European Union, Japan and Australia. Its effects tend to be most pronounced when regulators provide an appropriate regulatory and enforcement framework regarding best execution, so that brokers are required to seriously consider the trading opportunities available on rival market centers when seeking the best possible outcome for client orders. In some cases, the mere threat of competition has prompted significant, proactive fee reductions and technology advancements by monopoly bourses seeking to blunt the advantage of rivals that appeared poised to enter their markets with lower fees and faster, more-robust systems. We examine this evidence in greater depth in the section of this paper titled "Impact of Exchange Competition on Exchange Fees, Products & Services," which begins on page 10.

The benefits of multiple-marketplace environments also can be seen in instances of volume growth that have followed the introduction of competition with incumbent exchanges. The most notable and powerful example of this is the expansion of trading activity in NYSE-listed securities in the United States following the implementation of Regulation NMS in 2007, upon which we elaborate in the section of this report titled "Impact of Competition on Trading Activity," beginning on page 21. Others include the increases in volume and turnover seen in Canada following the launch of major Alternative Trading Systems and in with the advent of exchange competition in Australia.

Still more evidence for the benefits of exchange competition can be found in data on investor transaction costs. Again, the most notable and powerful example of this phenomenon comes from the US, where all-in transaction costs for institutional investors have plummeted during the two-decade market-structure transformation that replaced the old NYSE-Nasdaq duopoly with true competition among multiple trading venues for every US-listed equity security. Meaningful cost reductions also occurred alongside the introduction of rival markets in Europe and Japan. We explore these statistics in greater depth in the section of this report titled "Impact of Competition on Investor Outcomes," which begins on page 23.

Review of Academic Literature

Much of the academic research into market structure and market quality in recent years either states or suggests that market participants, broadly speaking, benefit substantially from competition between multiple exchanges. Indeed, several studies detailed below examined the

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introduction of new exchanges or alternative trading platforms in markets where a single, national listing market previously enjoyed monopoly status. This research finds that competition coincided with reductions in costs for both investors and intermediaries, in the form of narrower bid-ask spreads and lower execution fees for brokers and proprietary traders. It also concludes that competing venues contribute to increased liquidity (both narrower spreads and greater depth) and can help attract new market participants and strategies that may not have been possible under monopoly regimes due to outdated technology and market structures, which in turn can boost liquidity and volume while reducing spreads. Additionally, some academic work finds that off-exchange venues that do not display price quotations but compete for order flow with established exchanges can contribute to market-quality improvements and better price discovery in the market as a whole.

For example, in a 2014 study titled *The Determinants of Alternative Trading Venue Market Share: Global Evidence from the Introduction of Chi-X*, Peng William He, Elvis Jarnecic and Yubo Liu examined the impact of Chi-X Global and Chi-X Europe launching alternative order books for equity trading in several European countries, Japan and Australia between 2007 and 2011. The authors found that Chi-X's early market-share gains from incumbent exchanges in these jurisdictions were associated with a range of beneficial outcomes, including lower execution fees charged to brokers, faster execution times and greater liquidity (including narrower bid-ask spreads and improved depth). The authors observed market-quality improvements following Chi-X launches in all the markets they studied. This included reductions in proportional bid-ask spreads and improvements in market depth. "Overall, the introduction of Chi-X is associated with a positive change in market quality," they wrote.

Another example comes from Thierry Foucault and Albert Menkveld's 2008 study, *Competition for Order Flow and Smart Order Routing Systems*. Foucault and Menkvend examine the effect in 2004-05 of London Stock Exchange Group's 2004 launch of EuroSETS, a competing limit-order book for Dutch stocks, which theretofore had been traded only on Euronext's NSC limit-order book in Amsterdam.

The authors make several conclusions pertinent to a discussion of exchange competition's benefits. First, the amount and depth of liquidity in Dutch stocks increased substantially when EuroSETS entered the market. "For the most actively traded stocks, we find that consolidated depth through the fourth tick behind the best quote increased by a significant 46.3% and 100.8% in our two sample periods following EuroSETS entry," they write. Additionally, bid-ask

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spreads narrowed significantly. Quoted spread, taking both venues into consideration, fell by 1.16 bps (14.7%) and 1.05 bps (13.3%) during the two sample periods after competition began. These results are controlled for price levels, volume and volatility, to isolate the effect of a new order book entering the market. Moreover, the authors attribute the increased market-wide depth in part to the effect that competition had on trading fees. Euronext reduced fees for the NSC order book after EuroSETS launched, leading to increased depth on NSC itself. Additionally, the study finds that brokers helped contribute to the market-quality improvements by using smart-routing technology that allowed them to source liquidity on both order books, depending on where the best price resided at a given point in time. This encouraged liquidity provision on EuroSETS. Finally, this study underscores the importance of best-execution regulations that protect limit orders against "trade-throughs," or executions occurring at worse prices than those displayed on one of multiple, competing markets:

> *These findings have intriguing policy implications. They provide support to the claim that protecting limit orders against trade-throughs is important because trade-throughs discourage liquidity provision. They also imply that smart routers create a positive externality for other smart routers (smart routers make EuroSETS more liquid and thereby increase the benefit of using smart routers).*

A subsequent study of Dutch stocks by Menkveld, 2013's *High-Frequency Trading and the New Market Makers*, looks at more-recent competition between Euronext and Chi-X Europe in 2007 and 2008. Taking a slightly different approach from his work with Foucault, Menkveld studies the onset of competition through the lens of a high-frequency trading firm that entered the Dutch equity market by connecting to and trading on both platforms simultaneously.

When Chi-X Europe launched, three big reasons why it proved more appealing to many customers than Euronext and other national listing markets that previously enjoyed monopoly status (the LSE's EuroSETS order book shut down before Chi-X debuted) were better technology, lower fees and fewer restrictions on order cancellations. For example, when Chi-X began trading Dutch stocks in 2007, Euronext charged €1.20 per trade, with volume discounts that could bring this fixed charge down to €0.60 per trade, plus a variable fee of 0.05 bps on the value of transaction, as well as a €0.10 fee for any order cancellations that would bring a firm's cancel-to-trade ratio above 5. Based on an average trade size of approximately €25,000 at the time, the authors estimated that each party to a trade paid about 0.48 bps at the standard rate and 0.28 bps with the full volume discount. Chi-X, on the other hand, charged a single flat fee of

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0.3 bps to remove liquidity from its book and rebated liquidity providers 0.2 bps when their resting bids and offers were filled. That meant a net charge of just 0.1 bps on each Chi-X trade, about 1/10 the standard Euronext rate and 1/5 what the highest-volume trader would pay on Euronext.

Menkveld's paper illustrates how this fee schedule — particularly the rebate paid to liquidity providers — helped attract the HFT market-making firm, whose quoting activity contributed to a significant improvement in market quality for the 14 Dutch stocks (accounting for 80% of the country's market capitalization). This firm's entry into the market "coincided with a 50% drop in the bid-ask spread," writes Menkveld. Similar benefits did not accrue to the group of Belgian-listed stocks that Menkveld used as a control group. Euronext used the same order-book technology, pricing and rules for these stocks as it did for Dutch stocks at the time, but Chi-X had not yet begun to trade Belgian stocks. Interestingly, the market-quality benefits Menkveld observed in the Dutch market persisted even on days when the HFT firm was not active, suggesting that other market participants adapted their behavior to remain competitive. For example, Menkveld writes, "on December 24 and 31, the HFT was virtually absent in the market, Chi-X share dropped to almost zero, yet spread levels did not bounce back to pre-event levels."

Yet another academic study of competition in Europe following MiFID, Michael Chlistalla and Marco Lutat's *Competition in Securities Markets: The Impact on Liquidity* (2011), shows market-quality improvements in French CAC-40 index constituents coinciding with the launch of Chi-X in France. The authors looked at trading during the 60 days before and 30 days after Chi-X began trading French stocks in late September 2007. "Our findings suggest that [as a] consequence of the new competitor's market entry, liquidity in the most-actively traded stocks has enhanced on the home market during the observation period. This improvement exceeds the general European liquidity trend measured by a matching firm approach," suggesting that market quality improved in spite of trading interest and order flow being fragmented, the authors write. Interestingly, both papers by Menkveld cited above also provide evidence of home-market-quality improvement, on Euronext, when both EuroSETS and Chi-X competed with the incumbent market in Dutch stocks. The paper also finds evidence of "more-aggressive quoting behavior in the incumbent market [Euronext] induced by its new competitor's market entry" and "reduced trading costs for investors investing in [the Chi-X-traded] stocks."

Two other studies examine the first wave of alternative markets that challenged the long-established NYSE/Nasdaq duopoly in the United States during the late 1990s and early 2000s.

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Jennifer Conrad, Sunil Wahal and Kevin Johnson's *Institutional Trading Costs and Alternative Trading Systems* (2002), looks at trading in crossing systems, which initially were designed to facilitate institutions trading with one another, as well as in Electronic Communications Networks, which were displayed limit-order books and precursors to such modern-day exchanges as NYSE Arca and Bats' BZX and EDGX. The authors examined about $1.6 trillion in transactions between 1996 and 1998, and found that "realized execution costs are generally lower on crossing systems and ECNs." These results controlled for differences in order characteristics and difficulty, as well as other endogenous factors. The other study looking at early US competition, Jason Fink, Kristin Fink and James Weston's *Competition on the Nasdaq and the Growth of Electronic Communication Networks* (2006) focuses more-specifically on ECNs and Nasdaq-listed securities. The authors document that as ECNs took market share from Nasdaq dealers between 1996 and 2002, market quality for Nasdaq-listed issues improved significantly, including "tighter quoted, effective, and relative bid–ask spreads, greater depths, and less concentrated markets."

Another US-focused paper, Christine Jiang, Thomas McInish and James Upson's *Why Fragmented Markets Have Better Market Quality: The Flight of Liquidity Order Flows to Off-Exchange Venues* (2011), illustrates that competition among multiple on-exchange and off-exchange venues can facilitate segmentation of uninformed order flow from informed order flow, with uninformed orders being sent off-exchange and filled at narrower spreads (32% inside the NBBO vs. 7% on-exchange and 15% at midpoint vs. 3% on-exchange). "Overall, our results indicate that the price discovery on exchanges improves in fragmented markets because uninformed traders are able to self-segment their order flow to off-exchange trading venues, leaving a larger proportion of informed traders at the exchange," the authors write. "Normally, highly informative orders contribute to better price discovery, but also tend to worsen adverse selection, resulting in wider spreads and higher price impact."

Impact of Exchange Competition on Exchange Fees, Products & Services

As major countries each moved from single-equity-market or (in the case of the US) duopolistic structures toward true competition, exchanges and alternative trading platforms generally improved the quality of their products and services while also reducing their cost. These quality improvements and cost reductions brought widespread benefits to a wide range of market participants. Faster, higher-capacity matching engines allowed professional market makers to better manage risk and routinely quote better prices, for example. Technology enhancements,

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combined with lower fees for a range of products and services like trading and market data, also enabled trading strategies that had not been possible on slower, more-expensive legacy markets. This attracted to these countries new kinds of participants — specifically, automated proprietary trading firms — that often had not previously traded there, in many cases boosting liquidity and market volumes. Additionally, upstart exchanges and alternative platforms typically charged members a tiny fraction of what incumbent listing markets did. This resulted in direct savings for intermediaries using those platforms and influenced legacy markets to cut their fees to remain competitive, resulting in further cost savings for the market as a whole. In this section of our paper, we provide further details about how the advent of competition in several major jurisdictions resulted in better products and services being provided to market participants at lower cost.

Perhaps the most instructive example comes from the US, where two waves of competition during the past 20 years have revolutionized market structure for the better. The first wave came during the mid-to-late 1990s, following a price-fixing scandal in which the US Department of Justice found that Nasdaq Stock Market dealers illegally colluded to keep bid-ask spreads artificially wide.[1] At that point in time, the US had a duopolistic market structure. In one segment, the NYSE dominated trading of exchange-listed securities. In the other, a small group of Nasdaq dealers dominated activity in unlisted, or "over-the-counter" issues. By the 1980s and 1990s, as the personal-computing and telecommunications industries grew by leaps and bounds, many of these OTC-traded companies had grown from tiny startups into blue-chip behemoths, including Microsoft Corp., Intel Corp. and Cisco Systems. Even though such stocks became very actively traded during this period, Nasdaq dealers typically were involved in every investor trade as principal. With the minimum trading increment set at 1/8 of a dollar ($0.125) and dealers systematically and purposely not quoting odd-eighth prices, investors paid at least an extra $0.25 per share to dealers whenever buying or selling these and other OTC stocks traded in the Nasdaq market. This was more than triple the typical per-share commission institutional investors paid brokers when transacting in exchange-listed securities. Worse, dealers were found to be systematically disregarding customer limit orders at prices better than their own quotes.

[1] Complaint, *United States of America v. Alex. Brown & Sons, et al*, July 17, 1996
[2] Transcript, SEC Equity Market Structure Advisory Committee meeting, October 27, 2015; comments of

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The US government sought to remedy this rigged market with so-called order-handling rules that were implemented in 1997. A key provision required dealers to display to the entire market any customer limit orders at prices better than the dealers' own quotes. Dealers chose to comply with this rule in an unexpected way, however. Rather than reflecting the customer orders in their own quotes, and narrowing the Nasdaq spread in the process, they instead sent the orders to tiny, little-known firms known as Electronic Communications Networks. These ECNs used cutting-edge technology to quickly match trades at dramatically lower cost. The first such system, operated by a firm called Instinet, charged just $0.25 per 100 shares at the time, for example. Perhaps the most-successful of the ECNs, Island, in 1997 developed a system known as "maker-taker," in which the party removing liquidity from the order book paid a fee and the party who provided that liquidity earned a rebate. At that time Island charged the "taker" $0.25 per 100 shares while rebating the "maker" $0.10 per 100 shares, for a net charge of $0.15 per 100 shares. This compared with a net charge of $0.50 at Instinet ($0.25 per side) and $1.00 at another popular ECN, Archipelago.[2]

These faster, cheaper markets quickly grew in number and market share. By the turn of the century, according to an article in *Institutional Investor*[3], ECNs were executing nearly one-third of the volume in OTC stocks. At the same time, additional government reforms establishing a new regulatory status for such platforms — that of the Alternative Trading System, which allowed them to function as quasi-exchanges but with lighter regulatory requirements — and reducing the minimum tick in US equities to $0.01 further boosted ECNs while making it impossible for traditional dealers to continue to survive making principal markets. By 2003 many of the biggest dealers — including Goldman Sachs, Morgan Stanley and Credit Suisse (at that time known as CS First Boston) — were abandoning manual, principal dealing for an electronic, agency business model. This involved them developing, or acquiring from smaller startups, automated tools that would divide big institutional orders into many small pieces and intelligently route them among the several competing market centers on which trading interest had become fragmented. At the same time, a new generation of automated market-making firms was rising to thrive in the narrower-spread environment and relying upon low-latency ECN matching engines to routinely quote narrower spreads than the traditional OTC dealers had. In

[2] Transcript, SEC Equity Market Structure Advisory Committee meeting, October 27, 2015; comments of former Island CEO Matt Andresen on Island, competitors' fee schedules
[3] Carroll, Michael; Lux, Hal; Schack, Justin: "Trading Meets the Millennium," *Institutional Investor*, January 2000

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short, a combination of regulatory change that encourage competition with the Nasdaq dealers, market participants' reaction to those reforms and advancing technology changed the nature of both liquidity provision and removal for Nasdaq-traded stocks, in ways that dramatically reduced investor costs while preserving a role for intermediaries who adapted by shifting to an electronic-agency business model.[4]

In the early 2000s, the first wave of ECN competitors in the US began to merge with one another to achieve economies of scale. And in 2004-2005, NYSE and Nasdaq, both in the process of demutualizing and becoming publicly traded companies (Nasdaq also would become registered as an exchange, ending its status as the OTC market), announced deals to acquire the only ECNs remaining. This effectively re-created the old NYSE/Nasdaq duopoly and set the stage for the next wave of competition in US equity trading.

Market participants that had grown accustomed to competitive markets for Nasdaq-listed stocks and the promise of competition in NYSE-listed shares (various regulatory and technological barriers prevented ECNs from meaningfully competing in the NYSE-listed market until after the 2007 implementation of Regulation NMS, which had been adopted by the SEC in 2005) disliked those companies' re-creation of their duopoly and backed a new wave of ATS competitors. This second phase of competition involved both ECNs — operated by BATS Trading and Direct Edge, which are now part of Bats Global Markets — and so-called dark pools, which were run by an array of bulge-bracket and agency brokers.

In 2005, former Kansas City Board of Trade floor trader Dave Cummings, then CEO of new-generation automated proprietary trading firm Tradebot Systems, founded BATS (an acronym for Better Alternative Trading System), which began as a single ECN. BATS used a combination of cutting-edge technology, deep-discount fees and a semi-mutual ownership structure to swiftly take significant market share from Nasdaq and, later, NYSE.

The BATS matching engine, created using the best-available technology about a decade after the first wave of ECNs were founded, then boasted average roundtrip latency of approximately 930 microseconds. That was about half the time it took a trade to occur on the next-fastest system, the Inet platform that Nasdaq it acquired in its 2005 deal for Instinet's ECN business. By mid-2008 it had cut that figure by more than half, to less than 450 microseconds. During periods of high volatility BATS' technology performed even better, with latency of roughly 28 milliseconds

[4] Schack, Justin, "The Battle of the Black Boxes," *Institutional Investor,* June 2004

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during peak message-traffic periods, compared with 890 milliseconds on Nasdaq and 1.5 seconds at NYSE's Arca exchange, which ran on the technology acquired from the former Archipelago ECN in 2005.[5] This was extremely important to firms like Tradebot, which had become the market's primary liquidity providers as traditional dealers converted to electronic agency models over the previous decade, as it allowed them to better manage risk in fast-moving markets and reduce the likelihood of having stale quotes picked off. Other new-generation proprietary trading firms like GETCO, as well as several of the bulge-bracket brokers that had adapted to the new market structure, acquired equity stakes in BATS and aggressively backed it as a lower-cost, more-efficient competitor to Nasdaq and NYSE.

Upon launching in 2006 BATS charged liquidity removers $0.26 per 100 shares and rebated liquidity providers $0.24 per 100 shares, for a net revenue capture of $0.02 per round lot traded. This compared with net capture rates of approximately $0.10 per 100 shares on Nasdaq and NYSE Arca. In early 2007 BATS made a splash with what it called its "January Effect" fee promotion. The ECN charged liquidity removers $0.20 per 100 shares while rebating liquidity providers $0.30 per 100 shares, for a net revenue capture of $-0.10 on every round lot traded.[6] On just the third trading day of that month, BATS had a record day, executing 9% of Nasdaq-listed volume.[7] By January 26 that figure reached 14%.[8] Even after the promotion ended, BATS maintained its significantly lower fees than the two incumbent US exchanges. So did Direct Edge, another second-wave ECN operator. Direct Edge pioneered the practice of operating separate order books with different fees and features designed to appeal to distinct sets of market participants. Its EDGX ECN competed head-to-head with BATS, charging a slightly higher "take" fee than its "make" rebate. But its EDGA order book debuted as free to both sides of the transaction.[9] The BATS and Edge markets also did not charge users for connection ports, or for changing or cancelling orders, unlike the incumbents.

The implementation of Regulation NMS, beginning in July 2007, helped cement and further the growth of these new-generation ECNs. Reg NMS was an attempt to deal with the unintended consequences of the 1997 order-handling rules, the passage of Regulation ATS in 1999 and the

[5] Based on figures provided by BATS in 2008
[6] BATS Fee Schedule, effective January 1, 2007.
[7] Press Release, "BATS ECN Passes 200M-Share Mark, About 9% of Nasdaq-Listed Volume," January 4, 2007
[8] Press Release, "BATS ECN Surpasses 300M-Share Milestone, 13.9% Of Nasdaq-Listed Volume," January 26, 2007
[9] In the cases of both EDGA's early fee structure and BATS' January Effect, revenue from US consolidated-tape plans helped offset the flat or negative net-capture rates.

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decimalization of stock pricing in 2000-2001. Under the first wave of competition described above, early ECNs such as Island and Archipelago frequently displayed better prices than those advertised by Nasdaq and the NYSE, only to see trades go off at worse prices on those exchanges. These "trade-throughs" frustrated both market participants and the SEC, which proposed under Reg NMS an Order Protection Rule to prohibit them. Importantly, only price quotations deemed "immediately accessible" would be afforded such protection. This meant that the manual quotes on the NYSE and the remnants of the Nasdaq upstairs dealer market could be traded through with impunity once Reg NMS became effective. That is why Nasdaq and NYSE acquired the major surviving ECNs in 2005, when Reg NMS was first proposed. By 2007 Nasdaq had moved trading to a single electronic order book. NYSE operated Arca as a separate market, but its legacy NYSE exchange still relied overwhelmingly on its storied, two-century-old trading floor. And NYSE still dominated trading in NYSE-listed stocks. The implementation of Reg NMS, then, helped bring to the market for NYSE-listed stocks a similar level of competition that had already occurred in Nasdaq stocks over the previous decade. By October 2008, when BATS BZX became an officially licensed exchange, the three BATS and Direct Edge ECNs accounted for 16.5% of consolidated US equity volume.

Reg NMS also helped to spawn an array of ATSs that don't display price quotations, which quickly became known as dark pools. A few dark ATSs did exist prior to Reg NMS being proposed, but these were mostly focused on crossing large institutional orders. Once Reg NMS was proposed and implemented, major brokers reacted by launching their own dark pools, where they could internalize customer orders as long as the execution prices didn't "trade through" the best exchange quotes. Within a few years the ranks of dark pools with significant liquidity mushroomed to about two dozen. Institutional investors found these venues desirable for a number of reasons, including the opportunity to better hide their intentions by not posting price quotations when trading passively. Dark pools also offered asset managers and their brokers minimum-quantity settings and conditional order types, which could be used to filter out undesirable counterparties and more-efficiently source block liquidity. They also routinely offered better prices than could be had on exchanges, including midpoint executions. By 2008, 7.51% of consolidated US equity volume occurred in dark pools.

Incumbent exchanges responded to the second major wave of competition by continuously cutting fees and improving their products and services. Take latency, for example. Today Bats Global Markets boasts roundtrip latency of just 57 microseconds on its four US equity

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exchanges. But Nasdaq has continuously improved its Inet technology, bringing latency below 100 microseconds in 2010 and currently to less than 40 microseconds. And NYSE parent IntercontinentalExchange in 2014 bought startup Algo Technologies, which developed a platform with roundtrip latency of a mere 16 microseconds, and is using the technology as the basis for its new Pillar matching-engine platform. These improvements allow market makers greater ability to manage the risk associated with fast-moving markets, enabling them to quote the tightest possible bid-ask spreads. Net revenue capture associated with trading fees, which was at least $0.10 per 100 shares on incumbent exchanges before competition, is currently just $0.021 at Bats. Even Nasdaq and NYSE are roughly half the levels seen before the second wave of competition, at $0.051 and $0.050, respectively.

Moreover, competition between 11 exchanges, none of which has a market share exceeding 14%, and some two dozen significant dark pools has brought an array of fee schedules, order types and other services designed to appeal to different customer segments. Brokers that primarily remove liquidity from order books, for example, can choose from several exchanges that pay rebates to liquidity "takers," inverting the longstanding maker-taker system invented by Island in 1997, as well as an array of dark pools that charge lower fees for removing liquidity than the major exchanges. Participants that systematically provide liquidity can choose among exchanges that pay high "maker" rebates, as well as the inverted (taker-maker) exchanges that often are among the first to receive liquidity-seeking orders, depending upon which factor matters most to them on a given transaction.

A similar pattern to the second wave of US competition described above occurred in the European Union around the 2007 implementation of the Markets in Financial Instruments Directive, or MiFID. This package of reforms, among other things, repealed the so-called concentration rules that had previously required most trades in a listed security to occur on the listing market. As a result, upstart platforms much like the ECNs and dark pools that took market share from Nasdaq and the NYSE in the US for the first time could compete for trading market share in countries across the EU. So-called Multilateral Trading Facilities including Chi-X Europe and Turquoise launched in several EU markets with superior technology and far cheaper tariffs than Europe's national exchanges (A typical disparity was the difference between Chi-X and Euronext in Dutch stocks, detailed on page 9 above, in which the upstart market charged a net fee of just 0.1 bps on each trade, about 1/10 the standard Euronext rate and 1/5 what the highest-volume trader would pay on Euronext). Like BATS and Direct Edge in

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the US, Chi-X and Turquoise employed semi-mutual ownership structures that gave them the backing of significant order-flow providers in addition to technology and fee advantages. Chi-X awarded equity stakes based on participation,[10] while Turquoise was started by major banks[11] hoping to push down incumbent-exchange fees.

These MTFs swiftly captured significant market share throughout Europe, prompting incumbent exchanges to slash fees and enhance their technology. By September 2008, for example, Chi-X Europe and Turquoise had taken 23% of the trading in FTSE 100 issues from the London Stock Exchange, which responded by reducing its net trading fees.[12] One year later the LSE adopted a volume-discount model that favored its biggest customers. Other incumbent exchanges, including Euronext[13] and Deutsche Börse[14] also lowered trading fees in the wake of MiFID, as they lost market share to the likes of Chi-X Europe and Turquoise. National exchanges also responded to the advent of competition by taking steps to improve their trading technology. The London Stock Exchange Group, for instance, in 2009 acquired Millennium IT, a provider of low-latency matching-engine technology. Euronext, under the ownership of NYSE Euronext, rolled out a new system called the Universal Trading Platform that reduced latency and increased capacity.

Dark pools also grew in Europe during the years following the implementation of MiFID, as they did in the US after Reg NMS. Dark MTFs and broker crossing facilities executed approximately 4% of consolidated, pan-EU turnover in 2010, and grew to control about 12% of the market last year. As in the US, these markets offer a range of choices to institutional investors and other market participants that aren't necessarily available on national exchanges or MTFs that display quotes, including greater ability to disguise intentions, source block liquidity and achieve midpoint price improvement.

Another market that has seen new entrants lead the charge toward better products and services at cheaper rates is Canada. TMX Group's Toronto Stock Exchange enjoyed a virtual monopoly on Canadian equity trading until several Alternative Trading Systems arrived on the scene in the late 2000s. The first, Pure Trading, launched in September 2007. Chi-X Canada followed in

[10] Press Release, "Chi-X Europe Announces 2009 'Jump Ball' Equity Plan for Members," June 1, 2009
[11] The original Turquoise consortium consisted of Citigroup, Credit Suisse, Deutsche Bank, Goldman Sachs, Merrill Lynch, Morgan Stanley and UBS.
[12] Press Release, "London Stock Exchange Introduces New Order-Book Pricing," September 7, 2009
[13] Schmerken, Ivy, "NYSE Euronext Reduces Fees for Trading Pan-European Cash Markets," *Wall Street & Technology,* March 24, 2009
[14] Wilson, James, "Deutsche Börse to Cut Fees for Frequent Traders," *Financial Times,* August 26, 2008

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February 2008, along with the Alpha ATS in November 2008. Chi-X and Alpha became the biggest threats to TSX. As in the US and EU, both major rivals were backed by big order-flow providers, with Chi-X employing a similar "jump ball" equity-award system for members as its European cousin and Alpha backed by the biggest Canadian equity dealers.[15] They also deployed cutting-edge trade-matching technology and lower fees than the incumbent to win away market share. TSX responded early, slashing fees and making technology improvements in early November 2008, just before Alpha launched.[16]

Despite TSX's effort to battle back, by June 2009 these and other alternative platforms, including Omega ATS, had captured nearly 15% of all equity trading volume in the country. And at the start of 2011, TMX Group's market share had fallen further, to just 60%, helping drive it into the arms of would-be acquirer London Stock Exchange Group.[17] But just a few months after that February 2011 deal was announced, major Canadian dealers and pension funds organized a rival bid for TMX, which ultimately succeeded and resulted in TMX also taking over the biggest ATS at the time, Alpha. Today, TMX operates three markets — its legacy Toronto Stock Exchange and TSX Venture markets, as well as newly rebranded TMX Alpha — in competition with six other displayed marketplaces and three dark pools. This competition between several displayed and dark venues provides a similar level of choice, fee competition and innovation as seen in the US and described above.

Japan also has seen the benefits of competition with the incumbent national exchange. So-called Private Trading Systems have competed with the Tokyo Stock Exchange since SBI Japannext launched in October 2008. Chi-X Japan, part of the Chi-X Global parent company that also operated alternative markets in Canada[18] and Australia, joined the battle for order flow in July 2010. The TSE acted to head off the threat from Chi-X's launch by rolling out a vastly improved technology platform, dubbed Arrowhead, in January 2010. The new system featured roundtrip

[15] The Alpha consortium consisted of BMO Capital Markets, CIBC World Markets, RBC Capital Markets, Scotia Capital, TD Securities and four other Canadian market participants.
[16] Alexander, Doug, "Toronto Exchange Cuts Prices as Alpha Trading Platform Starts," *Bloomberg News,* November 7, 2008
[17] Press Release, "London Stock Exchange Group PLC and TMX Group Inc. Join Forces in Merger of Equals," February 9, 2011.
[18] Private-equity firm JC Flowers in January announced it would acquire Chi-X Global; As part of this deal Nasdaq acquired Chi-X Canada and now operates its two Canadian ATSs under the Nasdaq Canada name.

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latency of 5 milliseconds, compared with an average of two to three seconds on the TSE's older technology.[19]

Chi-X Japan came out of the gate with aggressively low pricing, adopting a maker-taker system that charged no fee to liquidity providers and just 0.2bps to liquidity removers.[20] This represented a significant discount to the TSE. Japanese PTSs have been less successful at taking market share than have their counterparts elsewhere in the world, in part because of certain rules that favor the incumbent. Still, as early as November 2011, Chi-X and SBI Japannext had reached 7% market share between them. In January 2011 Chi-X introduced a 0.1bps rebate for liquidity providers,[21] and by mid-January the TSE's market share fell further, to 92%. But TSE's share rebounded after the Chi-X promotion ended.

More recently, In July 2014, the TSE reduced minimum tick sizes for blue-chip stocks,[22] partly in a bid to fend off competition from the PTSs, which had long supported narrower quoting increments. This allowed automated proprietary trading firms and other market participants to quote better prices in actively traded stocks, with any savings going to investors in Japanese stocks. Following the initial phases of the tick-size-reduction program Japan Exchange Group, TSE's parent company, analyzed its impact on trading costs. Its study determined that both quoted and effective spreads declined for the stocks with lower tick sizes, compared with test groups for which the minimum increment was unchanged. Estimated annual savings from the reduction in spreads was JPY99.2 billion. The study also showed lower intraday volatility and greater quoted depth in the pilot stocks.[23]

Finally, Australia and Brazil are two examples of the mere threat of competition prompting the incumbent national exchange to make technology improvements and cut fees. In Australia, the government authorized competition with incumbent operator ASX in March 2010. The Australian Securities and Investments Commission spent the following 13 months developing rules under which such competition would occur, including transferring the market regulatory function from ASX to ASIC. During this time, ASX also proactively launched a midpoint dark pool called CentrePoint, and announced improvements to its trade-matching technology and fee

[19] "Tokyo Stock Exchange to Launch New Trading System on January 4," *Reuters,* January 2, 2010
[20] Chi-X Japan Client Notice, "Did You Know? Chi-X Japan Doesn't Charge Trading Fees for Liquidity Providers," June 16, 2011
[21] Chi-X Japan Client Notice, "Chi-X Japan Introduces Liquidity Provider Credit," November 13, 2011
[22] "TSE to Reduce Tick Sizes for Certain Stocks," *Japan Times,* July 15, 2014
[23] JPX Working Paper, "Impact of Tick Size Pilot Program on Trading Costs at Tokyo Stock Exchange," January 2015

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reductions designed to blunt the impact of Chi-X Australia's planned launch. In June 2010 it slashed trading fees by approximately 40%. Six months later, in December 2010, ASX licensed Nasdaq's low-latency Inet matching-engine platform,[24] which shared the same technological heritage as Chi-X's.[25]

In a recent review of how competition has progressed in the country, ASIC wrote that it "expected to observe: increased innovation; maintained or improved market quality (including market depth, liquidity and price formation); more choice in trading venues; and lower costs (including lower exchange trading fees and reductions in bid-ask spreads)." Upon examining the effect that Chi-X Australia, which began competing with ASX on October 31, 2011, has had on markets, ASIC cited an array of benefits that have accompanied Chi-X's growing market-share (which exceeded 10% during 2012 and more recently has hovered in the 14-17% range). Among these, "headline trading costs have decreased. Price is a significant factor in how ASX and Chi-X compete with one another, as are other market innovations (for example, new order types)." ASIC also cited a 3 bps decline in spreads from the onset of competition to the six months ended January 2013, which it said amounted to AUS$300 million in annualized savings for those trading Australian stocks.[26]

In Brazil, regulators have yet to officially authorize competition with national exchange BM&F Bovespa. But BM&F has spent the past several years taking steps designed to prepare for what it views as the inevitability of competition, following expressions of interest in launching competing exchanges from the likes of Direct Edge.[27] In late 2011 BM&F revamped its pricing structure, slashing trading fees by 75% and making up the difference with higher post-trade charges. Although this was a shrewd move to head off potential competition from rivals that likely would have had to use its post-trade infrastructure (as Chi-X Australia did with ASX) while preserving revenues, it also had the effect of helping to bring new participants to the country's markets. Specifically, automated market-making and other proprietary trading firms typically seek to quickly enter and exit positions, resulting in little or no net directional exposure and therefore smaller clearing and settlement charges. In another proactive step to

[24] Smith, Peter and Jeremy Grant, "ASX on the Offensive to Fend Off Chi-X," *Financial Times*, August 15, 2011
[25] Instinet, Chi-X's former parent company, retained the international rights to use the system when Nasdaq bought its US ECN business in 2005
[26] Australian Securities and Investments Commission, "Market Supervision Cost Recovery Impact Statement (Consultation Draft)," 1 July 2013 to 30 June 2015, pp 31-32
[27] Parra-Bernal, Guillermo and Jonathan Spicer, "Direct Edge to Take On Brazil's BM&F Bovespa," *Reuters*, November 21, 2011.

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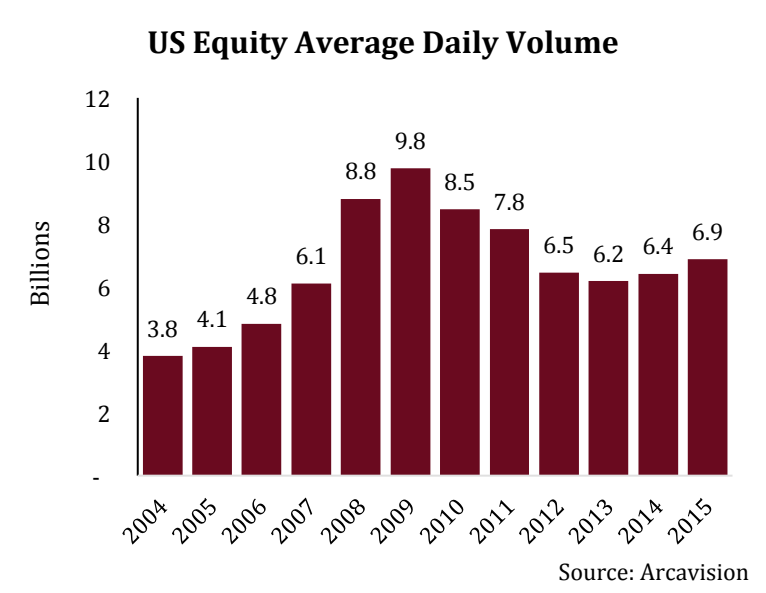
fend off potential competition and provide more-attractive conditions for new market participants, BM&F in 2010 entered into a partnership with Chicago's CME Group under which the two companies jointly developed a next-generation trade-matching technology, called PUMA, which BM&F recently rolled out for its equities and derivatives markets.

Impact of Competition on Trading Activity

The technology improvements, reduced costs and innovation that come with exchange competition can often stimulate trading activity. As we've discussed earlier in this paper, faster matching engines can attract new types of participants and trading strategies that were not possible using older, slower, less robust technology. Lower trading fees also can stimulate volume, as the use of a product or service generally rises as its price falls. All these factors can support increased trading activity in newly competitive markets. Volume and turnover, however, are influenced by an array of other variables, including volatility and macroeconomic conditions. This makes judging the impact of competition on volumes tricky, particularly because so many of the instances of previously monopolistic markets opening up have occurred during the period in which global markets were profoundly influenced by the 2008-2009 financial crisis, the effects of which continued to be felt in certain parts of the world for quite some time after the worst danger subsided.

Still, there are some examples of trading-venue competition appearing to positively influence trading activity. One such instance is the growth of volume in the US market during the second major wave of competition we described in the "Impact of Exchange Competition on Exchange Fees, Products & Services" section above. After the 2005 acquisitions of the Instinet and Archipelago ECNs by Nasdaq and NYSE, respectively, new competitors such as BATS and Direct Edge sprung up to challenge the re-formed duopoly. During the next several years, volumes grew significantly in US equities, peaking at a record 9.8



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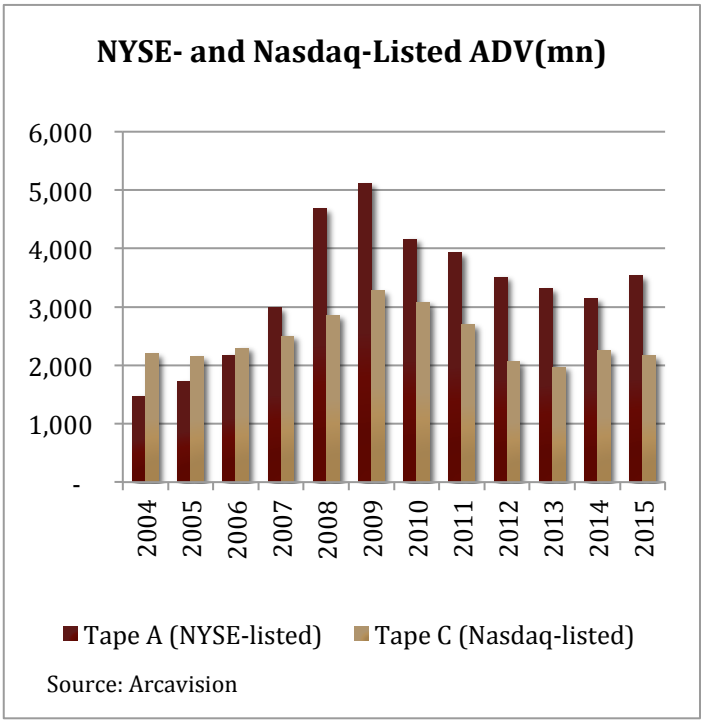
billion shares per day in 2009 *(see chart, "US Equity Average Daily Volume," previous page)*. Clearly, volume between 2008-2011 was inflated somewhat by very high volatility and low share prices associated with the financial crisis. Still, post-crisis ADV bottomed out at 6.2 billion shares in 2013 and rebounded last year to 6.9 billion, 82% higher than in 2004. Through the first four months of 2016, US equity ADV was an even-more-robust 8.2 billion, or 116% higher than full-year 2004.

Interestingly, a deeper look at the data allows us to observe the impact of true competition coming to NYSE-listed securities following the implementation of Regulation NMS in 2007. As we stated earlier, ATSs had already been competing vigorously with Nasdaq's fledgling electronic order book and its upstairs dealer community for several years following the passage Regulation ATS in 1999. Several of these alternative platforms, such as the Island and Archipelago ECNs, charged lower fees and routinely quoted narrower spreads than the Nasdaq order book and dealers, creating arbitrage opportunities and cost savings that, combined with the reduction of the US market's minimum tick from 12.5 cents to one cent in 2001, helped boost trading volume. In 2004 and 2005, the earliest years for which we were able to source full data, Tape C (Nasdaq-listed) securities, traded more actively than did their Tape A (NYSE-listed) counterparts. But following the implementation in 2007 of Reg NMS, which mandated the same multi-marketplace competition for NYSE-listed stocks, Tape A trading activity grew to eclipse that of the Nasdaq-listed universe and has remained a far more-actively traded segment of the market ever since *(see chart, "NYSE- and Nadsaq-Listed ADV," above).*



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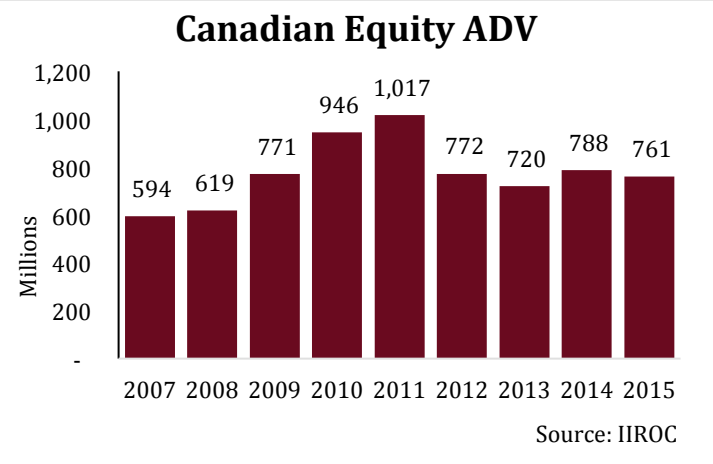
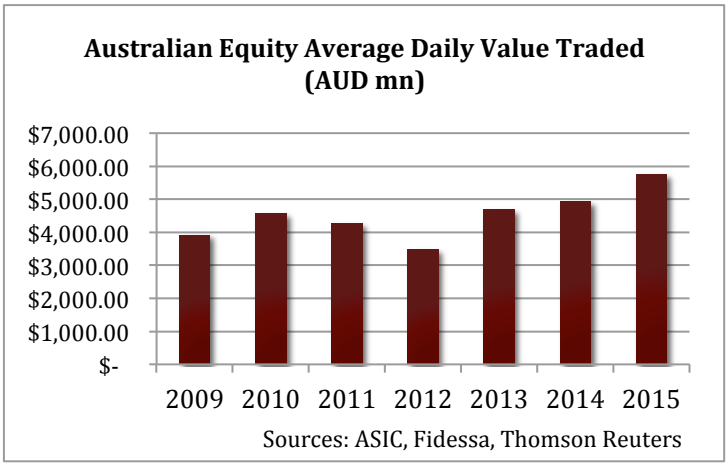
A similar pattern occurred in Canada, where meaningful ATS competition with the Toronto Stock Exchange began in 2008. Trading volume surged during the next three years, reaching a record 1.02 billion shares per day in 2011, up 71% from 2007's ADV of 594 million *(see chart, "Canadian Equity ADV," right)*. To be sure, crisis-era volatility also played a role in this increase, but 2015 ADV of 761 million represented a 28% increase over 2004's level. And ADV through the first four months of 2016 was 956 million, 61% higher than 2004.



In Australia, average daily turnover stood at AUD3.9 billion in 2009, the year before the government authorized competition with ASX and the incumbent exchange proactively moved to slash its fees and improve its trading technology. The following year turnover increased 17%, to AUD4.6 billion. Trading activity declined the following two years, though in 2011 it remained 9% higher than in 2009. And since 2012 turnover has increased every year, reaching AUD5.8 billion in 2015, 47% higher than in 2009 *(See chart, "Australian Equity Average Daily Value Traded," above)*.



Impact of Competition on Investor Outcomes

The previous sections of this report provide substantial evidence that the introduction of competition with previously unchallenged exchanges can result in significant benefits for end investors, including narrower bid-ask spreads as well as more and deeper liquidity. These effects have been documented in a wide array of markets that went competitive, including the US, Europe, Canada, Japan and Australia. To recap some of the most salient points regarding lower investor costs, recall that the Australian Securities and Investments Commission found

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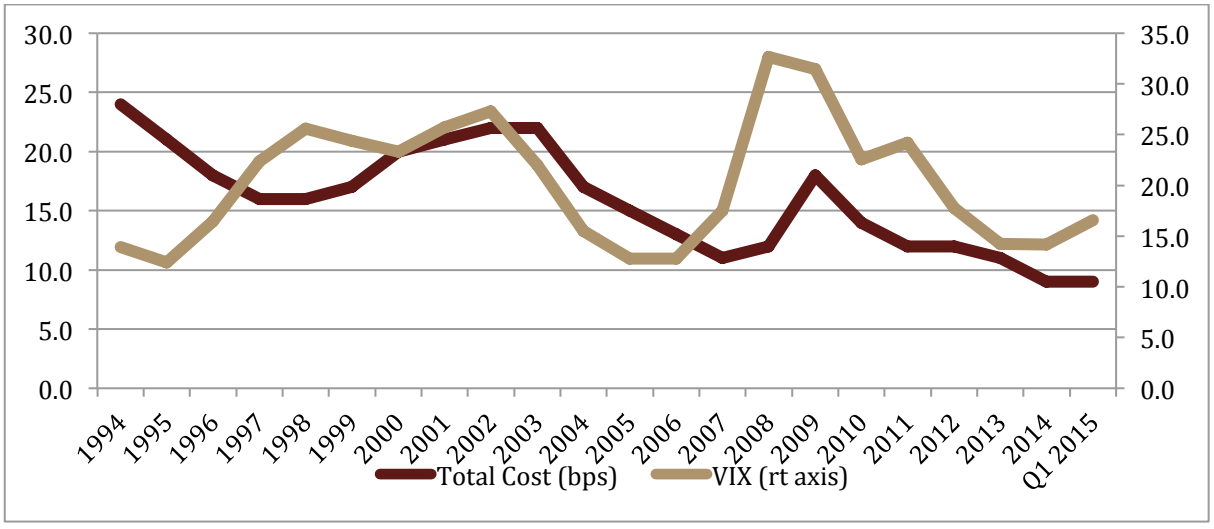
that lower spreads following the launch of Chi-X Australia amounted to AUS$300 million in annualized savings for investors in Australian stocks. Japan Exchange Group studied the impact of the lower tick-size program it instituted in 2014, in part to fend off competition from PTSs that had long traded in finer ticks, and found spread compression that saved investors in Japanese stocks JPY99.2 billion annually.

Another way to measure the impact of competition on investor outcomes is to look at the all-in trading costs of institutional investors. Measures such as these include explicit costs like spreads, commissions and fees, as well as implicit costs resulting from market impact and price slippage. There is substantial evidence that these all-in costs have declined significantly in markets that have introduced competition with incumbent exchanges. Consider the US, for example. All-in transaction costs for institutional investors in US equities are far lower today than before market structure transformed in ways that encouraged competition with the NYSE floor and Nasdaq dealers. Many market-structure experts attribute this to a reduction of explicit costs, including exchange fees and spreads, as well as greater efficiency that may reduce implicit costs like market impact. And the far lower implementation costs seen in the current environment have been achieved even at similar or higher volatility levels (as measured by the average daily closing value of the CBOE's VIX index) than observed before the market-structure transformation *(see chart below).* Additionally, other data obtained from Investment Technology Group show declining all-in costs during the onset of competition in other major markets, including the United Kingdom, Continental Europe and Japan *(see chart, next page)*.

All-In Transaction Costs for Institutional Investors in US Equities, vs. Volatility



Sources: Abel Noser Corp., CBOE

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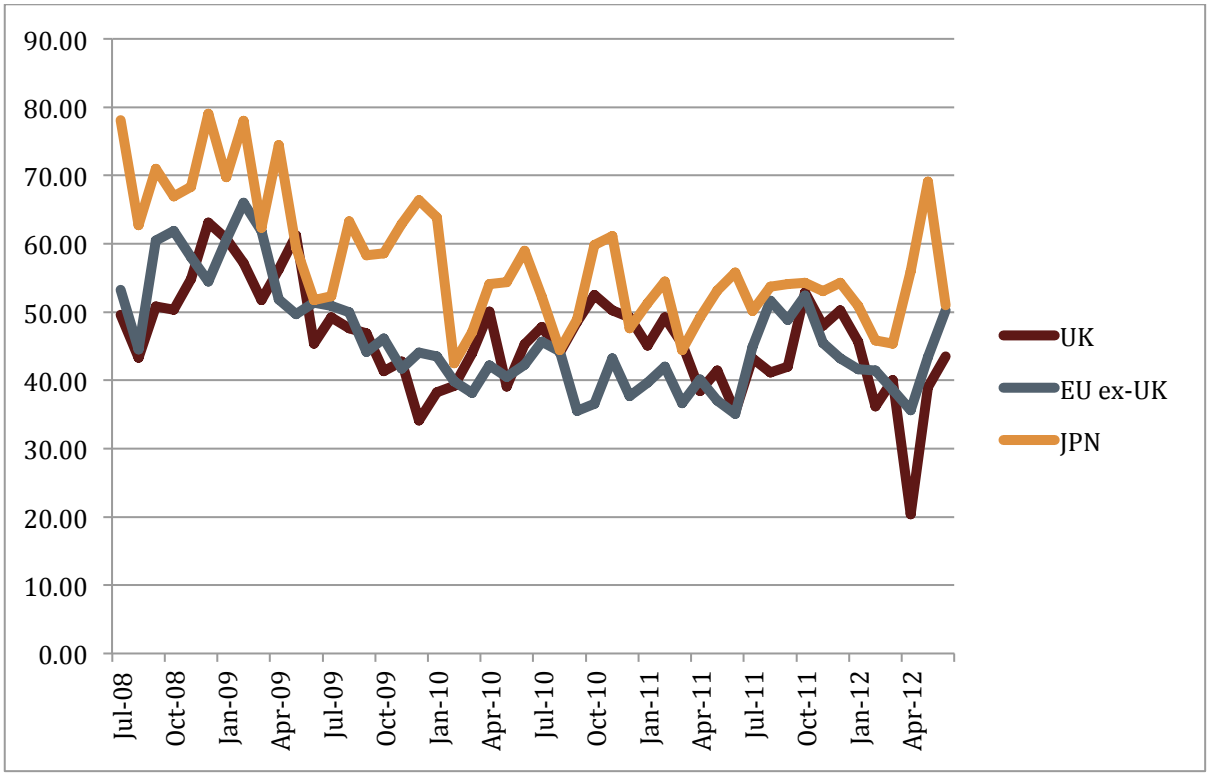
All-In Transaction Costs for Institutional Investors in UK, Continental Europe, Japan (bps)



Source: ITG

Conclusion

Competition clearly has brought substantial benefits to a wide range of market participants in the US, EU, Canada, Japan and Australia. A long list of academic studies, detailed in the first section of this report, provide examples of market-quality improvements and cost reductions that have boosted liquidity and saved both brokers and investors significant amounts of money. The experiences of these countries as they have allowed rivals to challenge incumbent listing exchanges, explored in our second section, also reveal numerous instances of important products and services being delivered with improved quality and lower cost as a result of competition. Trading volume in several of these jurisdictions has increased, in some cases dramatically, following the arrival of new entrants in the market. And all-in transaction costs for end investors have declined along with the advent of competition in markets around the world, helping citizens more quickly reach their goals for education and retirement savings, among other investment objectives.

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