ANALYZING THE COSTS OF EXCHANGE COMPETITION

A Look at the Experiences of the United States, European Union, Canada and Australia

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Introduction and Executive Summary

On June 13, Brazil's securities regulator, the Comissão de Valores Mobiliários (CVM), issued a request for comments from market participants regarding the potential introduction of competition with BM&F Bovespa SA, which is currently the only venue on which exchange-listed stocks may change hands in Brazil. In this document, the CVM specifically asked for advice about how to handle three aspects of exchange competition: best execution policies, market-data consolidation and potential changes to the self-regulatory and rulemaking structure. The CVM request for comment specifically cites the experiences of several developed markets that have in recent years made the transformation from single or dominant exchanges to competing trading venues, and asks for relevant details from these jurisdictions that may inform its own decisions.

Following the release of the CVM request for comment, BM&F Bovespa (BVMF) engaged Rosenblatt Securities to analyze the experiences of Australia, Canada, the European Union and the United States, focusing solely on the best-execution and market-data-consolidation regimes adopted in these jurisdictions, with the goal of informing its responses to the CVM request. In the pages that follow, we provide detailed accounts of how each of these markets has handled the issues in question, and how the specific rules and structures they adopted have affected market participants.

The frameworks governing best execution and market data become particularly important when markets evolve from a single or dominant exchange to multiple venues that display and execute orders. Both the concept of best execution and the management of market data also become more complex and difficult to manage as alternative venues compete with the national, incumbent or listing exchange. The two issues are closely linked: the need for consolidated market data flows from best-execution obligations. Once new venues are allowed to compete with a previously dominant or sole market, brokers and investors must consider whether shares can be bought and sold at superior prices — or with a better overall experience, including execution price, accruing to the end client — on venues other than the main exchange.

Additionally, managing best execution and data as trading fragments across multiple markets often introduces substantial costs for some market participants, particularly

brokers, dealers and other intermediaries charged with handling and executing end-investor orders. This report attempts to quantify and estimate, to the extent possible, the costs borne by such intermediaries in markets that experienced a change from dominant exchanges to multiple venues.

Notes on Methodology and Scope

In conducting our research, we relied on a variety of sources. These include public documents and records, such as legislation, regulation and guidance adopted and provided by government entities in the relevant jurisdictions, as well as academic and other studies. We also relied upon the public disclosures of exchanges and alternative venues regarding the various fees they charge to members and subscribers. Additionally, we corresponded with a wide array of market participants and regulatory personnel in Australia, Canada, the EU and the US. These telephone conversations and e-mail exchanges, which included discussions with brokers, trading-venue executives, market-data professionals, proprietary traders and regulators, served two primary purposes. First they allowed us to accurately interpret both the intent and practical application of the often difficult-to-understand language used in legislative and regulatory texts. Second, this correspondence gave us a richer appreciation of what effects the various best-execution and market-data policies have had on market participants, as well as the nuances that often come with applying complex fee schedules for various exchange services. Finally, we relied on our own knowledge of market 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.

In preparing this report, we have been charged specifically with analyzing best-execution and market-data policies, and the costs intermediaries incur to comply with them. Transitions from dominant, incumbent exchanges to multiple venues also affect the experiences of end investors, including specifically the costs associated with implementing their ideas and strategies. In some instances, such transitions have coincided with significant reductions in these implementation costs for both retail and institutional investors. The United States during the past 16 years stands out as one example of this. However, it is not clear whether or to what extent the introduction of exchange competition

and related market-structure and behavioral changes directly caused this reduction in costs for end investors, given other major structural changes during the same time period, including new order-handling rules and the decimalization of price quotes. Additionally, the evolution of market structure away from centralized national or listing exchanges in such jurisdictions also presents a burden for end investors, in terms of having to understand and monitor their outcomes in a vastly more complex environment. And any benefits accruing to end investors as a result of these transformations must also be weighed against the increased costs to intermediaries of navigating a more-complex structure, which can sometimes result in these middlemen passing through some of their costs, indirectly, to clients. Moreover, there are often substantially higher costs and complications associated with regulating a market in which transactions are scattered among multiple venues.

Our study of the Australian, Canadian, EU and US experiences explicitly *does not* consider the effects of transformations in these places on end investors, or on regulatory costs. Rather, we focus, in keeping with our mandate, on how best-execution and market-data policies have affected the operating costs of intermediaries.

Summary of Our Findings

The experiences of Australia, Canada, the European Union and the United States suggest a number of potential approaches for the CVM in Brazil, as well as for other regulators globally that may be contemplating the advent of competition with national exchanges. As we will demonstrate, each has taken a slightly different course with respect to best-execution regimes and the consolidation of market data. In all cases, there are significant costs for the brokerage community, but these can vary greatly with particular paths taken by regulators.

It is reasonably clear that highly prescriptive best-execution regimes, focused on mandating executions at the best displayed prices market-wide, tend to support venue proliferation, as well as higher (or at least less flexible) connectivity and data costs. Markets with such a regulatory structure — examples in the group of jurisdictions we studied are Canada and the United States — can also expect knock-on effects like greater structural complexity, including proliferation of exchange order types and off-exchange venues. Conversely, regimes that offer intermediaries significant latitude to take into account factors other than

best price, such as execution size, speed or fees, can result in lower costs for some market participants than they would bear in a strict order-protection environment. These effects can be seen, to varying degrees, in the experiences of Australia and the European Union.

We believe that of the two topics considered in this report, the regulatory approach to best execution is paramount. As stated earlier, the need for market data stems from market participants' best-execution obligations. Decisions about how best execution is to be defined and pursued, then, directly affect what decisions should be taken regarding market data. For example, regulations that require — either explicitly or implicitly — market participants to regularly access liquidity on venues other than the dominant or listing exchange, by definition, make consolidated market data vitally important to fulfilling best-execution requirements. When setting up such regimes, regulators would do well to consider mechanisms that help to control the costs of both connectivity and market data, such as allocation schemes that divide data revenues among exchanges according to their respective contributions to price discovery and liquidity. Even with such controls or mechanisms in place, such as the tape-revenue sharing scheme in the United States, strict inter-exchange price-protection regimes can create artificial subsidies for venues with *de minimis* market shares. But without them, as is the case in Canada, exchanges can extract higher rents from market participants.

However, in some cases poorly thought-out market-data policies can also make best execution very difficult to enforce. Europe stands out as a prime example here, with the lack of a consolidated tape contributing to confusion and high market-data costs for some market participants – particularly the big banks that elect to equate best execution with best price and route customer orders accordingly.

When analyzing the experiences of other jurisdictions, it is also very important to consider market size. Generally speaking, larger markets can support a greater array of execution venues. Taking just a few percentage points of market share in a very big market can be a sustainable business proposition for an upstart trading venue, whereas similar market-share levels in jurisdictions with less total trading activity may not be sufficiently profitable without relying on outsized connectivity and data fees. Additionally, regulators in smaller markets may anticipate a limited number of viable alternatives to the primary exchange and

act accordingly when establishing best-execution and market-data policies. As we will explain in detail shortly, the choices that regulators make regarding best execution can also have a profound effect on the number of venues that appear in a given jurisdiction. Generally speaking, highly prescriptive, rules-based best-execution regimes tend to encourage greater fragmentation, by requiring market participants to access the best prices regardless of where they are displayed. Imposing such a strict regime in a small market may result in outsized costs falling on the broker and dealer communities. This is best illustrated by the example of Canada, which we examine in greater detail in the following section.

Average Daily Value Traded on Major Fragmented Equity Markets (in BRL)

	2011	2012	2013	# of Lit/Protected Venues
USA	421,969,352,016	413,809,193,474	461,512,148,221	13
EU	175,063,950,324	157,414,722,338	186,548,571,232	21
Japan	32,710,326,809	35,168,660,835	78,328,536,838	3
Canada	16,051,815,539	15,239,760,048	16,117,027,754	9
Australia	7,859,746,980	7,587,486,616	8,848,856,396	2
Brazil	6,096,258,910	6,861,333,188	7,187,606,464	1

Sources: Arcavision, BM&F Bovespa, Investment Industry Regulatory Organization of Canada, Thomson Reuters
2013 data through June, except Brazil (May)

Various Approaches to Constructing Best Execution Frameworks

Regulators face an array of challenges in adapting best-execution regulations to allow for competition with a previously dominant listing or national exchange. Competing venues may regularly make securities available at prices that are superior to those displayed on the primary market. However, some market participants may view best price as just one component of best execution, which has long been a somewhat amorphous, hard-to-define concept in the securities industry. For example, the quantity of shares available at a given price can be of great importance, particularly for those seeking to buy or sell very large quantities while minimizing the impact of their outsized orders on market prices. Additionally, the rules, structures and systems of individual trading venues may affect execution quality. A market may advertise the best available price for a security at a given point in time, for instance, but take so long to process and execute an incoming order that its quote becomes inferior to rivals during that time interval. Such delays may result from

the inherent structure of the market, such as depending on a manual trading floor or auction process,[1] or from systems issues or outages.

Consequently, regulators have found it necessary to establish rules and principles to govern best execution in multiple-venue markets. The fundamental challenge of doing so is to strike a balance between, on the one hand, providing sufficient protection for end investors from mispriced or otherwise poor executions and, on the other hand, giving intermediaries enough latitude within the regulatory framework to meet individual client needs and respond to specific market circumstances.

Regulators in the four jurisdictions we examine here — Australia, Canada, the EU and the US —each have taken slightly different approaches to multiple-market best execution frameworks. We believe it is best to think about these varying stances in terms of a continuum, from highly prescriptive, rules-based regimes focused on best price to highly flexible, principles-based regimes that allow brokers to weigh an array of factors other than best price. If we consider each of the four markets we analyze here in this context, and organize them from most prescriptive to most flexible, they fall in the following order:

- **Canada** comes down strongly on the side of best execution equaling best price, with minimal exemptions, and offers full depth-of-book price protection for displayed bids and offers.
- **The US** also operates under a best-price regime, with minimal exemptions, but only offers price protection for quotes at the top level of each venue's order book.
- **Australia**, coming latest to the game, has put forward a hybrid approach that adheres to best price for retail orders but provides brokers with greater flexibility when executing for wholesale clients.
- **The EU** has a principles-based system, in which market participants must establish, and share with both regulators and clients, written policies for achieving best execution, but are essentially free, within reason, to define it in their own terms.

[1] This was an issue in the United States during the early-to-mid-2000s, when the comparatively slow execution-turnaround time at the New York Stock Exchange helped prompt rules offering "trade-through" protection only to quotes that could be accessed in automated fashion.

In the remainder of this section, we will provide further details about each of these jurisdictions, running in order from the most highly prescriptive to the most flexible. In each case we will cite:

- The appropriate best-execution regulations or principles, as well as written guidance provided by regulatory authorities, where available.
- Any differentiation in these regulations or principles based on customer or transaction type.
- The effect these regulations or principles have, as a practical matter, on market participants who must comply with them — including specific costs where obtainable or possible to estimate. Note that we have attempted to quantify the recurring fees charged by exchanges for order-entry ports and and co-location services. But the true costs of connectivity would in practice be substantially higher when including one-time membership fees, as well as personnel costs related to building and maintaining order routing technology, mandatory periodic upgrades to the software for each venue and changes to order types and fee schedules, all of which can require systems changes and testing for brokers.

Best Execution in Canada

Canada's best-execution rules are the most highly prescriptive of the four developed markets we examined. On July 1, 2012, Canadian regulators made effective a series of amendments to National Instrument 23-101. These, among other things, clarified the definition of best execution, establishing depth-of-book protection for all displayed bids and offers from being "traded through," or bypassed for inferior price quotes. They also imposed requirements on both trading venues and brokers to prevent the entry and execution of orders that would result in trade-throughs.

Previously, Canadian dealers were required to "make reasonable efforts to ensure that the client receives the best execution price on a purchase or sale of securities by the client." In so doing, dealers were expected to "not execute a transaction on a marketplace that could be filled at a better price on another marketplace or with another dealer." But following the migration of market share away from the previously dominant Toronto Stock Exchange,

beginning in 2008, to a host of newly launched, alternative trading systems, regulators moved to clarify the best execution rules.

The amended NI 23-101 broadly defines best execution as "the most advantageous execution terms reasonably available under the circumstances." More specific definitions and rules, clearly providing for depth-of-book order protection, are laid out in Parts 1 and 6 of NI 23-101.

Part 1 defines protected orders as bids and offers displayed on auto-ex marketplaces and visible to the wider market by means of a consolidated data processor or vendor. It further defines as a "trade-through" any execution of a buy order at a price that is higher than *any* protected offer, or any execution of a sell order at a price that is lower than *any* protected bid.

Part 6 requires marketplaces to establish policies and procedures designed to prevent trade throughs. It also mandates that brokers take steps to avoid violations. But the rule specifically identifies situations in which trade-throughs are permissible, such as:

> Situations in which where one marketplace judges that better a price on an away market is inaccessible or difficult to efficiently access because of that market having technical or systems issues.[2,3]
>
> Execution of a Directed-Action Order (DAO). A firm can use a DAO to simultaneously access liquidity at the best-displayed prices in the market at a given moment, as well as at inferior price levels. Without the DAO, orders executed against the quotes at inferior price levels might otherwise be deemed impermissible trade-throughs. The Canadian DAO is similar to the Intermarket Sweep Order (ISO) established in the US under Regulation NMS.

As we have alluded to earlier, the provision of strict, market-wide limit-order protection tends to support a higher number of competing limit-order books. In Canada, depth-of-book order protection means, practically speaking, that market participants must have a way of

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[2] In any such case the marketplace experiencing issues is required to notify both regulators and any relevant securities information processor

[3] Brokers also may route around marketplaces having systems issues, but must notify the markets in question as well as all regulatory authorities

accessing protected orders on every displayed market, no matter how infrequently any one of these markets may actually be the only one displaying the best price in a given situation. For the biggest dealers, as well as many mid-tier firms, this means maintaining direct connections to all lit marketplaces. As we will discuss in more detail in the next section, it also means having to see real-time, depth-of-book (or Level II) market data from each of these venues. Without this data, it would be impossible for dealers to determine where protected orders reside among the many lit markets in Canada and, therefore, to comply with best-execution policy.

Indeed, the proliferation of venues in Canada has been greater than one might expect for a market of its size. One useful way to measure this is to compare Australia, Canada and the US, with respect to market size and number of lit venues.[4] Canada's average daily turnover is roughly twice that of Australia's, but it has more than four times as many lit marketplaces. Conversely, the United States dwarfs Canada in turnover terms by a ratio of nearly 29:1, but in terms of protected, quoting markets by a measure of just 1.4:1.

Average Daily Turnover and # of Lit Venues in Major Fragmented Equity Markets (in BRL)

	2011	2012	2013	# of Lit Venues
USA	421,969,352,016	413,809,193,474	461,512,148,221	13
Canada	16,051,815,539	15,239,760,048	16,117,027,754	9
Australia	7,859,746,980	7,587,486,616	8,848,856,396	2

Sources: Arcavision, Investment Industry Regulatory Organization of Canada, Thomson Reuters
2013 data through June

And the ranks of market centers continue to grow. As recently as June 2011, there were seven lit venues in Canada. TMX Group, the parent of the Toronto Stock Exchange, launched a second market, TMX Select, in July 2011. Chi-X Canada did the same, with CX2, in May 2013. And a consortium of market participants is launching yet another venue that will offer a lit component, Aequitas, that will bring the number of displayed markets to 10.

The costs associated with fulfilling best-execution obligations in Canada are thus among the most onerous in the world. In this section we address the costs of connectivity to multiple venues (market data will be covered in the next section). These include the fees charged by

[4] We exclude the EU from this analysis because, unlike Australia, Canada and the US, it is a collection of several national markets, each with their own exchanges, knitted together by common regulation, as well as a handful of newer, pan-European venues launched following the MiFID directive in 2007.

marketplaces for brokers to establish connectivity (often referred to as administrative or maintenance fees, and charged on a monthly basis per connection), as well as co-location services, which are also a consideration for many dealers. This stems in large part from the fact that trade-through protection is offered only to automated markets, making speed of order entry, acknowledgement, confirmation and cancellation critical for all market participants. Reducing the time lag, or latency, of such messaging is particularly important for liquidity providers, who need to carefully manage the risk that the quotes they display will be executed at the wrong times — such as when prices are about to move against them, making it harder to profitably flatten their exposures on either side of the market — or become stale. Consequently, many automated market-making firms avail themselves of co-location services provided by exchanges and other vendors. These services permit members of trading venues to place their order-entry servers in the same data centers as the venues' matching engines, thereby minimizing messaging latency. Once co-located liquidity provision becomes widespread, other market participants find it necessary to take similar services. For example, major brokers providing algorithmic agency brokerage services often choose to co-locate their own routing technology, so that they may optimally interact with the most sophisticated market participants.

Taken together, these costs can be substantial. Consider just the connectivity fees charged by exchanges (see "Connectivity Fees for Canadian Marketplaces" table on next page). The cost for maintaining one "line," or order-entry session, with each of Canada's nine displayed markets, is C$5,400 per month, or C$67,800 per year. For major market participants, such as the five dominant dealers in the Canadian equity market, multiple order-entry sessions — in some cases 100 or more, spread across the nine displayed venues — are necessary to satisfy client order flow. Assuming a base level of 10 sets of connections to each market for each of the biggest Canadian dealers, then, costs for order-entry ports alone can easily run up to C$54,000 per month — or about C$650,000 per year — for the biggest Canadian dealers.

Tacking on co-location fees brings connectivity costs significantly higher. The two major co-location centers for the Canadian equity market are TMX Group's data center in Markham, Ontario and Equinix's TR1 data center, about 16 miles to the south at 121 Front Street in Toronto's financial district. The Markham site offers co-location with the TSX, TSX Venture

Exchange and TMX Select matching engines (and, soon, Alpha, which was acquired by TMX Group as a result of the Maple Group transaction involving TMX last year). Chi-X Canada's matching engine is run out of Equinix TR1. Space in the Markham facility costs C$8,000 per month per cabinet. Equinix TR1 cabinets are C$1,300 per month. A major dealer running an agency algorithmic execution business for institutional investors typically takes two to three co-lo cabinets to handle this flow. At Markham, that means a monthly co-location bill of as much as C$24,000 – or C$288,000 annually. This, combined with the estimated order-entry port charges of about C$650,000 annually, brings connectivity costs into the neighborhood of C$1 million per year for the biggest dealers. Firms offering sponsored market access for short-term-oriented, quantitative asset managers and proprietary trading firms can require far more co-location cabinets – as many as 15 to 30, bringing their co-location bills into the C$4 million+ range annually.

Connectivity Fees for Canadian Marketplaces

Venue	Market Share	Admin (Connection) Fee (C$)
TSX	50.15%	1,500/month
TSX Venture	18.08%	750/month
Chi-X Canada	12.59%	500/month
Alpha	11.57%	1,250/month
Pure Trading	2.05%	500/month
TMX Select	1.75%	350/month
CX2	1.49%	350/month
Omega ATS	1.15%	200/month C$125/mo for each order-entry session above 10
CNSX	0.50%	none

Sources: Company Reports, Investment Industry Regulatory Organization of Canada
Market Share is % of volume traded during Q213

The biggest market participants can more easily absorb some of the fixed costs of market fragmentation, such as exchange connectivity and co-location, than can mid-tier and smaller firms. Additionally, as the nature of liquidity provision has changed in Canada, traditional dealers have been unable to compete with newer, independent, automated proprietary trading firms that are adept at making markets electronically. These dealers find themselves abandoning principal trading, in which revenues come from providing liquidity and capturing the bid-ask spread, and increasingly accessing liquidity, as agent, on behalf of

clients. This means crossing the spread more often than capturing it, and paying the associated "taker" fees to remove liquidity from the various trading-venue order books. As their profit margins decline, these dealers and brokers are incentivized to get bigger, thus spreading across a larger revenue base the costs of connectivity, data, transaction fees and other charges levied by an array of trading venues. The combination of increased fixed costs and higher variable trade-execution fees, then, puts a premium on scale in the brokerage industry. This, in turn, may encourage concentration and consolidation over time and endanger the existence of specialized, boutique brokers.

Strict trade-through protection, combined with high fees for removing liquidity from trading-venue order books[5], also gives dealers a powerful incentive to divert customer order flow to the venues charging the lowest fees for removing liquidity on behalf of customers, all other things (namely, best price) being equal. This, at least in the short term, can result in further fragmentation, as brokers starting their own trading venues — in many cases so-called dark pools that do not post bids or offers and therefore contribute less to price discovery than do displayed markets — primarily to avoid exchange fees and thereby fatten their profit margins. This occurred in Canada, with several major dealers banding together in November 2008 to start the Alpha ATS. Alpha originally served as a "printing" venue for block trades but later became the country's second-biggest dark pool, through its Intraspread facility, which began trading in June 2011 and specifically allowed dealers to internalize retail order flow. The growth of dark trading, which reached a record 5.87% of total volume in August, prompted Canadian regulators to introduce new rules, on October 15, requiring either block size or significant price improvement for dark trades. Since then, dark market share has retreated to about 2% (most recently, 2.25% in June).

Best Execution in the United States

Best execution in the US is only slightly less prescriptive than the Canadian approach. Rather than full depth-of-book price protection, US regulators require only top-of-book order protection, as called for under Regulation National Market System, commonly known as Reg NMS, which was adopted in 2005 and fully implemented in 2007.

[5] Unlike in the United States, the other of the four markets examined here that provides strict trade-through protection to displayed quotes, there is no cap on lit-market access fees in Canada

Just as Canada's amendments to NI 23-101 came in response to the evolution of equity market structure — and, particularly, the fragmentation of liquidity away from the Toronto Stock Exchange toward alternative markets like Chi-X Canada and Alpha — Reg NMS represented an attempt by the US Securities and Exchange Commission to modernize its rules to better accommodate changing competitive and practical realities. And the US had long permitted competition among several exchanges and the National Association of Securities Dealers (which launched the Nasdaq automated quoting platform for its member dealers in 1971), with certain conditions. In 1975, for example, following an SEC study on the growth of institutional investment in the country, the US Congress passed a series of amendments to the Securities Exchange Act of 1934 "to remove barriers to competition" and "foster the development of a national securities market system," among other goals.[6] The US experience with encouraging competition among exchanges, then, is best considered with a longer time horizon, including some analysis of the regime created by the so-called '75 amendments as well as the more-recent introduction of Reg NMS.

The '75 amendments established what has since been known in the US as the National Market System. The goal was to better knit together the various market centers that had developed for executing investor orders, particularly in the wake of a volume explosion, driven by the ascendance of pension funds and other institutional asset managers, during the "go-go years" of the 1960s. These big investors were increasingly availing themselves of options other than the NYSE, which historically had served the needs of individual investors and their relatively smaller orders. Non-NYSE alternatives at that time included the growing ranks of off-exchange market makers (often referred to as the "third market," after the two main listing markets of that time, the NYSE and the American Stock Exchange) who committed large amounts of their own capital to fill block orders in NYSE-listed issues as principal. Some brokers also were establishing specialist operations on the regional exchanges that had long existed in the US, including the Midwest Stock Exchange (now the Chicago Stock Exchange), Pacific Stock Exchange (now NYSE Arca), Boston Stock Exchange

[6] Notably, the '75 amendments also established a national clearing and settlement utility, which has ensured the fungibility of positions between rival exchanges and off-exchange venues. This is a critical strength of the US system compared with that of the EU, which addressed competition among trading venues in the 2007 Markets in Financial Instruments Directive, but failed to establish a unified, market-wide post-trade system for these competing venues to plug into.

(Now Nasdaq BX) and Philadelphia Stock Exchange (now Nasdaq PSX)[7], which offered execution of NYSE-listed shares. Market participants and regulators soon grew concerned about investors' ability to receive the best possible executions among these disparate trading venues, even as the NYSE continued to hold a dominant market share of the trading in NYSE-listed stocks.

To address this problem, the '75 amendments created a mechanism called the Intermarket Trading System (ITS), which became fully implemented in 1983. The ITS was a system of exchange rules that directed market participants to avoid trade-throughs in exchange-listed stocks, but did not explicitly prohibit them. Rather, ITS required exchanges to respond to orders from away markets seeking the best available price within a two-minute interval, and created a process through which aggrieved parties could complain to, and seek redress from, markets that traded through their quotes.

This worked reasonably well when all exchanges were manual, floor-based markets. But technological advancements — as well as separate regulatory actions such as the 1997 limit order display rules, the 1998 passage of Regulation ATS and the 2001 decimalization of US stock pricing — encouraged the growth of electronic trading and purely automated execution venues. In the years leading up to the adoption of Reg NMS, a collection of alternative marketplaces known as ECNs took approximately half of the market share in Nasdaq-listed stocks from the NASD dealers that traditionally had an oligopoly on trading in these issues. However, certain regulatory impediments, as well as the difference in order-turnaround time between these new markets and the NYSE, prevented the ECNs from competing effectively for trades in NYSE-listed securities. Specifically, ECNs frequently would be required to route liquidity-seeking orders to the NYSE when it was quoting the best prices. But it often took so long for the NYSE to respond that prices on the electronic venues would move, rendering the NYSE quotes inferior. The latency differences between the manual and automated markets, in both NYSE and Nasdaq-listed stocks (the latter were not covered by ITS), often resulted in trade-throughs, or transactions executed at prices that were worse than the best displayed quotes across all markets nationwide. Studies by SEC staff during the deliberations preceding Reg NMS concluded that "an estimated 1 out of

[7] Founded in 1790, the Philadelphia Stock Exchange was the first in the US. The NYSE's founding came two years later, with the famous Buttonwood Agreement of 1792.

every 40 trades for both NYSE and Nasdaq stocks are executed at prices inferior to the best displayed quotations, or approximately 98,000 trades per day in Nasdaq stocks alone."[8]

Frustration with this state of affairs among many market participants led the SEC, beginning in 2000, to conduct what it calls in the Reg NMS adopting release "a broad and systematic review to determine how best to keep the NMS up-to-date." The review, the release continues, "required the Commission to grapple with many difficult and contentious issues that have lingered unresolved for many years." Most pertinent to our subject matter here, Reg NMS both reaffirmed longstanding principles of best execution in the US — notably the link to best price — and made significant practical changes to the US best execution regime. Section II.B(4) of Reg NMS broadly states that "the duty of best execution requires broker-dealers to execute customers' trades at the most favorable terms reasonably available under the circumstances, i.e., at the best reasonably available price." More specifically, Rule 611 of NMS (known as the Order Protection Rule) prohibits trades occurring at prices lower than a "protected bid" or higher than a "protected offer." To be considered protected, a quote must be automated, displayed by an automated venue and represent "the best bid or offer of an exchange, the NASDAQ Stock Market or an association other than the NASDAQ Stock Market…."[9]

Practically speaking, in today's market, this means that only electronically accessible quotes displayed at the tops of the limit order books of automated exchanges are protected from trade-throughs. Quotes displayed by non-exchange limit order books — namely ATSs such as Lava FLOW and Credit Suisse's Light Pool — do not enjoy trade-through protection unless they are delivered to and displayed at the top of the book of a licensed exchange.[10] Any bids or offers displayed by exchanges that are not the *best* bid or offer on a particular exchange also do not enjoy trade-through protection. This makes the US order protection rule less prescriptive than Canada's full-depth-of-book regime, and means that US market participants require less data than do their counterparts in Canada to comply with best execution (more on this in the next section).

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[8] Reg NMS adopting release, pp 10-11

[9] Nasdaq had not yet become an officially licensed exchange at the time Reg NMS was adopted. The reference to associations other than Nasdaq at that time referred to the NASD's Automated Display Facility, which brokers and ATSs sometimes used to display quotes.

[10] This was also true of the BATS BZX and Direct Edge EDGA and EDGX markets while they operated as ATSs, prior to becoming registered exchanges in 2008 and 2010, respectively.

Even though US order protection is less stringent than its northern neighbor's, it still represents a strict, inter-market best-price obligation that has similar, if less intense, effects on fragmentation and the related costs borne by intermediaries. As in Canada, market-wide order protection supports a higher number of competing exchanges than would exist without such rules. To comply with the US order protection rule, brokers must be able to access every US exchange — either directly or indirectly, through routing arrangements with other exchanges or brokers — no matter how infrequently any one of these markets may actually be the only one displaying the best price in a given situation.

This is illustrated it in part by the growing number of exchanges since the adoption of Reg NMS. When the rules became effective there were nine stock exchanges in the US — NYSE, NYSE Arca[11], Nasdaq, and the American, Boston, Chicago, Cincinnati, ISE and Philadelphia Stock Exchanges.[12] Today, with the additions of BATS BZX, BATS BYX, the CBOE Stock Exchange, EDGA and EDGX, there are 13.[13] Another sign of the tendency toward venue proliferation in a strict-order-protection regime is the operation of multiple exchanges by single companies. Six companies operate the 13 US exchanges. The two biggest, NYSE Euronext and Nasdaq OMX, each operate three exchanges. Three other companies (BATS Global Markets, Direct Edge and CBOE Holdings[14]) each run two exchanges. Just one, the Chicago Stock Exchange, is a single-market operator.

But perhaps the most convincing evidence of the power of strict, market-wide order protection to support exchange proliferation is the stated plan of Nasdaq OMX when it attempted to in early 2011 to acquire NYSE Euronext's US securities businesses.[15] During a conference call to explain the deal to Wall Street analysts in April 2011, Nasdaq OMX CEO Robert Greifeld said that Nasdaq planned to continue to operate all six NYSE and Nasdaq US stock exchanges separately if his merger plan succeeded. Exchange consolidation, in other

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11 The Archipelago ECN, one of many ATSs that took significant market share in Nasdaq-listed stocks from NASD dealers in the late 1990s and early 2000s, acquired PCX Holdings, parent of the Pacific Stock Exchange, in 2005. NYSE Group acquired Archipelago later that year. Today, NYSE Euronext operates the old Pacific Stock Exchange as NYSE Arca.

12 Several mergers and acquisitions have changed the names and structures of some of the old regional and secondary exchanges. The Amex is now owned by NYSE Euronext and known as NYSE MKT. The Boston and Philadelphia exchanges were acquired by Nasdaq OMX and are today known as Nasdaq BX and Nasdaq PSX, respectively. The Cincinnati exchange has changed its name to the National Stock Exchange.

13 The ISE Stock Exchange was acquired by Direct Edge and folded into EDGX

14 CBOE Holdings owns 51% of the CBOE Stock Exchange, which last year acquired the National Stock Exchange.

15 The plan was part of a joint bid by Nasdaq OMX and Intercontinental Exchange to break up a separate merger agreement between NYSE Euronext and Deutsche Börse Group

words, would continue to occur at the parent company level, where it could eliminate duplicative costs, but not on the individual-exchange level. In a market that protects the top of book at each exchange, operating six exchanges from the same technological infrastructure is a better business proposition than operating five, four, three, two or one. To be sure, other factors play a role in exchange proliferation and the operation of multiple books by single parent companies. The requirement that exchanges provide fair access to their execution services, also codified in Reg NMS (and part of Canada's NI 23-101), means that, unlike a broker or ATS, a single exchange has limited flexibility to offer individual members customized services. Access to the order book, order types and other exchange services must be offered on the same terms to all market participants. For example, exchanges cannot negotiate separate fees with two different customers. Consequently, to offer different fee schedules or market structures that might appeal to different market segments, companies often operate separate exchanges, each with their own clearly defined rules and fees that apply equally to all customers. Indeed, multiple markets operated by one company also exist in Europe, but to a lesser extent, and with pricing and structural experimentation, not the lure of multiple protected tops-of-books, the primary driver.

The costs of complying with the US order protection rule are substantial. Again, looking solely at venue connectivity (with market-data costs to be examined in the next section), it currently costs $4,200 per month ($50,400 per year) to connect to all 13 US stock exchanges. At many exchanges, the monthly connection fee covers multiple order-entry ports, with each additional port carrying a larger fee. As in Canada, major market participants — such as bulge-bracket brokers offering algorithmic trading services to institutional investors — may need about 10 order-entry ports per exchange to effectively execute client order flow. As a result, and considering the differences in fees for multiple ports outlined in the "Connectivity Fees for US Exchanges" table on the next page, connection costs alone can run major US brokers at least $35,700 monthly, or $428,400 annually.

The need for co-location is even greater in the speed-dominated US market, and the associated costs make total connectivity charges even higher. There are four major co-location centers for the US equities market: the data center for NYSE Euronext's markets, in Mahwah, NJ; the Nasdaq OMX markets' data center in Carteret, NJ; Savvis' Weehawken data

center, which houses the BATS exchange matching engines; and Equinix's NY4 facility in Secaucus, NJ, where Direct Edge runs its exchanges. Only the most active high-frequency trading firms co-locate at all four facilities. Typically, a big broker executing institutional client flow through its algorithms and smart router might choose to co-locate at one or two of the facilities housing the highest-market-share exchanges, and use so-called cross-connects to access other data centers. For the purposes of estimating the co-location costs of a major algo broker, we add together the fees charged by Nasdaq OMX and NYSE Euronext. The monthly cost for one high-density (maximum 10 kW) cabinet at Nasdaq's Carteret facility is $7,000[16]. A similar level of service at NYSE's Mahwah data center runs $10,500. A major algo broker might require two to three cabinets to process client flow. At that level, such a firm's monthly co-location services bill would come to about $52,500, or $630,000 annually. Taken together, connectivity and co-lo costs for a major US market participant would then run approximately $1.06 million annually, similar to that of a typical big dealer in Canada.

Connectivity Fees for US Exchanges

Venue	Market Share	Order-Entry Port Fees	Cost of 10 Ports
Nasdaq	15.79%	$400 each; Add'l ports $200 each	$1,200/month
NYSE	12.28%	$200 for first 5; $500 each thereafter	$2,700/month
NYSE Arca	10.59%	$200 for first 5; $500 each thereafter	$2,700/month
BATS BZX	8.54%	$400 each	$4,000/month
EDGX	8.12%	$500 each	$5,000/month
EDGA	3.28%	$500 each	$5,000/month
Nasdaq BX	2.37%	$400/pair; Add'l ports $200/pr	$1,200/month
BATS BYX	1.85%	$400 each	$4,000/month
Nasdaq PSX	0.88%	$400/pair; Add'l ports $200/pr	$1,200/month
Chicago Stk Exch	0.73%	$400 each	$4,000/month
CBOE Stk Exch	0.39%	$100 each	$1,000/month
NYSE MKT	0.36%	$200 for first 5; $500 each thereafter	$2,700/month
National Stk Exch	0.34%	$100 each	$1,000/month

Sources: Company Reports, Arcavision
Market Share is % of volume traded in June 2013
Order-Entry Port Fees are assessed monthly

[16] Nasdaq OMX has run a temporary discount program for new co-location cabinets in 2013. Under the program, which ran in January/February and is scheduled again for July/August, the cost of a new high-density cabinet would be $4,500 per month for two years.

Additionally, US brokers and dealers have faced the same challenges as their Canadian neighbors with respect to making the transition from being the market's primary liquidity providers to serving as automated agency brokers who are forced to pay fees to access protected quotes. However, in the US the damage from this effect is comparatively less onerous because Reg NMS caps the fees exchanges can charge to access quotes at 30 cents per 100 shares. Like the allocation of market-data revenues according to a formula that takes into account market share and time quoting at the National Best Bid and Offer, the access-fee cap militates against individual protected markets extracting excessive rents from market participants. As institutional commission rates have come down since the passage of Reg NMS, however, some brokers have begun complaining that access fees should be reduced, to better balance broker costs with revenues.

One way that brokers have tried to better manage costs without a reduction in the access-fee cap, however, is by diverting a greater portion of their trading activity off-exchange. Indeed, access-fee avoidance by brokers has contributed to a significant increase in trading on non-displayed, non-exchange markets in recent years. According to our analysis of volume on exchanges and various off-exchange venues, the portion of total US equity volume executed in such a fashion has more than doubled, from approximately 16% in the first quarter of 2008 to 35% in the second quarter of 2013. A large part of this growth has come from so-called dark pools, many of which are run by major brokers as internal crossing engines for their institutional clients' algorithmic orders. These dark pools — there are approximately 24 that handle significant volume — have increased their share of total US equity trading from just 5% in January 2008 to 14% in June 2013.

Best Execution in Australia

Australian regulators had the benefit of studying market-structure transformations in the US, EU and Canada when establishing the rules under which the country would introduce competition with ASX Ltd, operator of the Australian Stock Exchange, in equity trade execution. The Australian Securities and Investments Commission, which took over regulation of securities from ASX as part of the transition, struck a middle ground between the highly prescriptive, best-price-focused regimes in Canada and the United States and the

highly flexible, principles-based system adopted by the EU through its Markets in Financial Instruments Directive in 2007.

Australia's new best-execution policy is set out in Chapter 3 of ASIC's 2011 Market Integrity Rules, which broadly states that "when handling and executing an Order for a client a Participant must take reasonable steps to obtain the best outcome for that client." The rules go on to define "best outcome" more specifically, and establish different definitions for retail and wholesale orders. For retail orders, best execution is defined as "best total consideration." For wholesale orders, brokers are permitted to take into account a wider array of factors, including "price, costs, Total Consideration, speed, likelihood of execution or any other relevant outcome, or any combination of those outcomes."

ASIC provides exceptions to both standards for instances in which clients have provided "clear and unambiguous" instructions for handling a specific order in a way that would contradict the best-execution mandate. The rules state that such instructions should be written or, if provided verbally, recorded and retained by the broker for seven years. In these cases, brokers "must take reasonable steps to handle and execute the order in a way which satisfies the [client's] instructions." And, importantly, ASIC does not require brokers to connect to alternative venues, specifically because regulators did not want to repeat the experiences of Canada and the US in mandating costly connections to marginal market centers. Specifically, ASIC set out a transitional period for enforcement of best execution, through March 1, 2013, during which brokers specifically were not required to connect to alternative venues. And ASIC guidance specifically states that even after the sunset of that transitional period, brokers are only required to connect to competing venues when they have judged that the benefits outweigh the costs.

Still, for retail clients in Australia, practically speaking, best execution means best price. Technically, the use of the phrase "total consideration" in the rules allows retail brokers to weigh brokerage commissions, venue and post-trade fees along with the prices bid or offered for shares. But as a practical matter, Australian retail brokers typically charge a fixed commission that bundles all of these costs together, so best execution essentially means best price. However, the wiggle room afforded under "total consideration" does allow Australia's best-execution policy to flex with potential market-structure changes, such

as competitive clearing. Currently, ASX is the sole provider of clearing and settlement services for Australian equity trading. Chi-X Australia signed a long-term post-trade contract with ASX before launching, but has been exploring alternatives for when this arrangement ends, including partnering with other organizations to launch a competing post-trade provider in Australia. Should the fees charged by such an organization differ substantially from those levied by ASX, retail brokers would be able to weigh whether a lower clearing cost, borne by the client, would justify paying a slightly higher price when buying shares on the client's behalf — and vice-versa.

The substantial wiggle room offered to brokers executing institutional orders, however, means brokers can routinely ignore better prices posted on Chi-X Australia, the sole competitor to incumbent exchange ASX. And the specific rules and guidance that free brokers from connecting to competing venues, combined with best-execution rules that do not require a strict adherence to best price, means that some brokers handling only institutional order flow in Australia continue to connect and send all client orders only to ASX. This does not necessarily mean that these orders are being disadvantaged, as the presence of Chi-X Australia as a significant competitor, with automated market makers aggressively quoting tight markets, has pressed ASX participants to improve their quotes. It also has prompted ASX to reduce fees and improve its matching-engine technology, all of which benefits the broader Australian investment community.

Additionally, ASIC maintains a program through which it encourages brokers to actively monitor Chi-X Australia trading activity and consider whether the impact on best execution would outweigh connection costs. ASIC arranged for multiple market-data vendors to give brokers indications of instances in which they could have achieved better prices on Chi-X, and mounted an educational campaign in the brokerage community about these real-time alerts, as well as ways to conduct post-trade analyses of Chi-X data to inform their best-execution practices. ASIC combined this approach with phone calls to every broker in the country to check whether they had conducted such best-execution analyses, what they revealed and whether the brokers were considering connecting to Chi-X. This process is ongoing in Australia today.

We believe that Australia's careful, measured approach to introducing competition may be particularly instructive for CVM. ASIC took several steps to consider both the positive and negative aspects of how the US, EU and Canada had managed transitions from dominant to fragmented markets. Among these were commissioning detailed studies from outside consultants and inviting representatives of the Canadian regulatory community and equity trading industry to spend time in Australia, during the summer of 2010, as ASIC contemplated changes to the Market Integrity Rules. The Canadian representatives not only helped ASIC understand the pros and cons of various regulatory approaches, but also prepared Australian market participants about what to expect during the transition to competitive trading venues. ASIC's rules concerning best execution and, to a lesser extent, market data reflect this thorough study. They also represent an attempt to avoid some of the worst outcomes seen in jurisdictions, particularly Canada, in which highly prescriptive best-execution policies have contributed to venue proliferation and the associated complexity and costs for intermediaries.

But Australia's hybrid approach also does not appear to have unduly restricted competition with the incumbent market, ASX. Since its launch in October 2011, Chi-X Australia has taken substantial market share from ASX, and today executes approximately 10% of the country's equity volume. In addition to automated market-making firms, some of whom jointly own Chi-X Australia, the venue sees substantial liquidity-seeking flow from retail brokers that are mandated to achieve best price for their clients.

Australian Venue Connectivity Fees

Venue	Market Share	Monthly Fees	Annual Fees
ASX	88.5%	A$675	A$2,500, plus A$5,000 access to ASX Trade platform, A$4,000 for "trade feed"
Chi-X Australia	11.5%	A$1,300	

Sources: ASX, Chi-X Australia, Rosenblatt Securities

Australia's measured approach to best execution — requiring brokers to access the best market-wide prices for retail clients, while allowing far more leeway for institutional orders, yet stopping short of an absolute mandate that brokers connect to all trading venues —has led to far less exchange proliferation than in Canada and the US. To be sure, Australia is also

the smallest of the four jurisdictions we studied, at just 55% of the average daily turnover of the next biggest, Canada. But its two lit markets are just 22% of the total number in Canada, nine. Connectivity costs are also far lower. To be a member of ASX, a broker pays A$2,500 annually. Access to the ASX Trade platform is A$5,000 annually, and a "trade feed" that permits orders to be entered into the system runs A$4,000 annually. There are also monthly fees charged at a rate of A$675, bringing total annual connectivity costs for ASX to A$19,600. At Chi-X Australia, a similar level of service carries a monthly fee of A$1,300 (see "Australian Venue Connectivity Fees" table on previous page). Assuming a similar number of required connections as in Canada and the US, this puts the total annual cost for a major broker to connect to both markets at approximately A$209,000.

Co-location is also a less complicated and less costly undertaking in the Australian equities market. Because they can take other factors besides best price into account when executing institutional orders, many brokers do not regard co-location as essential. Those who do tend to co-locate at ASX, owing to its still-dominant market share. Chi-X Australia's matching engine is located at Equinix's SY3 data center in Sydney. The automated market-making firms that are the primary liquidity providers on Chi-X choose to co-locate there, but few others join them at this point. ASX offers co-location with its matching engine at its Australian Liquidity Centre, about three miles northwest of central Sydney. A high-density cabinet at the ALC costs A$5,500 monthly. A major broker taking two to three co-lo cabinets, then, would pay as much as A$16,500 per month, or A$198,000 annually. Together, estimated connectivity and co-lo costs of A$407,000 per year for a major market participant in Australia are far less than the approximately C$1 million (A$1.05 million) paid by similar firms in Canada and the $1.06 million (A$1.15 million) that big US firms lay out.

Best Execution in the European Union

The European Union's is by far the most liberal and flexible of the four best-execution regimes we examined. The Markets in Financial Instruments Directive (MiFID), which took effect in November 2007, ended the so-called concentration rules that previously required trades to be executed on national exchanges, for the first time enabling true competition in execution services. Article 21 of MiFID states that brokers must "take all reasonable steps to obtain, when executing orders, the best possible result for their clients taking into account

price, costs, speed, likelihood of execution and settlement, size, nature or any other consideration relevant to the execution of the order." Like in Australia, there is an exemption for instances in which clients provide specific instructions, which requires firms to execute the order in question according to those instructions. Article 21 also requires firms to implement an order-execution policy that lists the destinations to which they send orders and the factors that drive routing decisions. Clients must be notified of, and consent to, such policies. Additionally, the directive requires brokers to continuously monitor the effectiveness of their best-execution policies, "to identify and, where appropriate, correct any deficiencies," including whether the current lineup of execution venues is sufficient to achieve best execution for clients.

The so-called Level 2 text of MiFID clarifies these principles somewhat. Specifically, Article 44 mandates that firms review annually the execution policies required under Article 21. Article 44 also defines "the best possible result" for retail orders as "the total consideration, representing the price of the financial instrument and the costs related to execution." This is very similar to the language in Australia's policy, except for one critical passage (emphasis added):

> For the purposes of delivering best execution where there is more than one competing venue to execute an order for a financial instrument, in order to assess and compare the results for the client that would be achieved by executing the order on each of the execution venues listed in the firm's order execution policy that is capable of executing that order, *the firm's own commissions and costs for executing the order on each of the eligible execution venues shall be taken into account in that assessment.*

The combination of this principles-based approach, which does not specifically provide trade-through protection to the best bids and offers throughout the EU, with brokers' express ability to consider their own costs when choosing among execution venues, means the EU provides brokers with the greatest amount of flexibility in obtaining best execution of any of the jurisdictions we analyze in this report.

Practically speaking, firms' compliance approaches fall into two main categories. First, very large, global banks and brokerages that operate not only in the EU but also in the US and

other major markets, tend to adopt routing practices that are very similar to what exists in the US, even in the absence of strict trade-through protection for the best EU-wide quotes. These firms often serve clients throughout the EU, as well as beyond its borders, who want to trade a wide variety of stocks listed in the various EU member states. Many of them already had invested in advanced order-routing technology, which they deploy in the US. These firms' clients tend to be more sophisticated than others investing in the EU and expect them to connect to multiple pan-EU venues. Such firms also can enjoy significant cost savings, scaled across the entirety of their client order flow, by executing trades away from incumbent exchanges. This was particularly true when MiFID first became effective, as the differential in execution fees charged by incumbent exchanges and the Mulitlateral Trading Facilities that sprung up to challenge them were far wider than they are today, following a series of substantial fee reductions by the likes of the London Stock Exchange, NYSE Euronext and Deutsche Börse. Consequently, these big, global organizations that execute client orders in multiple EU countries tend to connect to a wide variety of competing execution venues, obtain market data from them to gain a view of the best prices available on a pan-EU basis (though the lack of a true consolidated tape makes this very difficult, as we will illustrate in the next section), and route client orders to be executed at the best possible price — even though the letter of the law does not expressly require them to do this.

Then there are smaller brokers, many of which have clients primarily in a single EU country that invest primarily in stocks listed in that member state. These firms may not have technology that allows them to route orders for the same security to multiple execution venues. Their clients tend to be less sophisticated, and either unaware of or less concerned about the various options brokers face for executing their orders on venues other than the national exchange. Additionally, the scale of their client order flow may not be big enough to deliver enough savings from routing orders to MTFs, which typically charge cheaper execution fees than do the incumbent markets, to justify the costs of maintaining connections to the alternative markets and the order-routing technology (as well as market data) necessary to choose among them. Because MiFID permits them to take into account a broad range of factors when defining best execution — including "costs, speed, likelihood of execution and settlement, size, nature or any other consideration relevant to the execution

of the order," they often bypass alternative markets completely and connect only to one or a small group of national exchanges. Certainty of execution is a particularly important factor for these brokers, who are able to argue that the market shares of incumbent exchanges — still well above 50% in each of the major European national markets — mean more available liquidity and a better chance of filling client orders.

The fragmentation of EU clearing and settlement among multiple providers, organized roughly along the same lines that trade matching at national exchanges once was, represents a huge complication and impediment to best execution (at least as defined by best price) in the region. Consider again the two main groups of EU brokers we discussed above when relaying common order-routing practices. Members of the first group — the big, pan-European banks — typically are members of multiple clearing and settlement organizations throughout Europe. Firms in the second group — smaller, individual-country-focused brokers — may be members of a single post-trade provider, or clear trades through a larger organization that would pass through additional charges for executing across borders. The complications and costs related to clearing and settlement that come with routing an order to a destination other than the long-established, incumbent market, thus prevent many European brokers from doing so.[17] Only those with significant incentives to support the growth and success of MTFs such as Chi-X Europe (now BATS Chi-X CXE) and Turquoise (an MTF started as a bank consortium, that is now owned by London Stock Exchange Group) would become members of the upstart central counterparties supporting those venues — the European Multilateral Clearing Facility (EMCF) and Euro CCP (a division of US clearing and settlement utility DTCC), respectively.[18] These supporters have tended to be the big liquidity providers and banks that trade in very large volumes, often own stakes in these platforms and stand to gain the most from their success.

Europe's liberal best-execution principles have produced far less venue proliferation than the more-prescriptive regimes present in Canada and the US. To be sure, the total number of lit venues in the EU, at 21, is seven more than the US and more than double the total in Canada. But the EU is unique among the four jurisdictions we studied, in that it is not a

[17] Indeed, we are reminded here of a frequent refrain we heard from a senior incumbent-exchange executive in Europe during the early days of MiFID: "You can trade wherever you like, but then you have to clear and settle."

[18] EMCF and Euro CCP recently announced a merger that is expected to make trading away from incumbent exchanges a bit easier for European market participants.

single market but rather a collection of disparate national markets knitted together by common legislation. Of the 21 quoting venues in the region, 15 are national exchanges — such as the London Stock Exchange, Deutsche Börse, the four Euronext markets (Paris, Amsterdam, Lisbon and Brussels), Borsa Italiana, Bolsas y Mercados Españolas, SIX Swiss Exchange, the Irish Stock Exchange and the various Nasdaq OMX Nordic markets (Stockholm, Helsinki, Copenhagen, etc.) that had monopolies on trading their listed securities before MiFID. So some level of fragmentation was built in to Europe before MiFID brought about competition, owing to the legacy of national bourses in each country, each trading only their own listed stocks. Just seven of Europe's 21 lit venues — BATS Chi-X BXE, BATS Chi-X CXE, Equiduct, Turquoise, Burgundy, Quote MTF and TOM MTF — are MTFs or new exchanges that offer trading across the EU or in more than one of its member states. And only three of these — The two BATS markets and Turquoise — are major, truly pan-European markets, as Quote MTF and TOM MTF have *de minimis* market shares and Burgundy is focused on the Nordic markets. In most of the biggest member-state equity markets, there are just three to five lit-market competitors with the national exchange. In other words, trades in most European stocks can be routed to a maximum of four to six competing execution venues, compared with 13 exchanges for each US stock and nine for those listed in Canada.

The relatively small number of competing lit venues for any listed stock, combined with wide regulatory latitude for brokers to connect to only national exchanges in their countries if they so choose, gives European brokers considerable flexibility in managing their connectivity (and data) costs. Firms that choose to connect and route to multiple venues, seeking best price for customer orders, will have bigger connectivity bills as a result of exchange competition than those that don't, and the already fragmented nature of European equity markets means these costs — connecting to all the major national markets as well as alternative platforms — can add up quickly. Indeed, for a major market participant executing substantial pan-European client flow, connecting to all major national and alternative lit venues costs approximately €601,500 annually, assuming the same 10 connections per market needed for a major broker to process its client flow (see table, next page). But the brokers who choose to continue to connect only to their home-country listing market have seen little in the way of additional costs from fragmentation.

Connectivity Costs for EU Venues

Venue	Market Share	Annual Fee	Other Fees	Cost/10 Connections
LSE	15.0%	€16,210		€162,100
BATS Chi-X CXE	9.5%	€2,320		€23,200
Euronext	9.4%	€12,000	€10/message/second order-entry capacity fee	€120,000
Deutsche Börse	7.5%	€4,500	€6,000/yr per session after first two	€93,000
BME (Spain)	4.4%	€3,600/desk beyond first two		€28,800
Turquoise	4.1%	€2,320	€175 per 250 trades/sec (£3,475 max/participant)	€23,200
Nasdaq OMX Nordic	3.3%	€10,800		€108,000
Borsa Italiana	3.2%	£2,320		€23,200
BATS Chi-X BXE	2.5%	Included w/CXE		
Burgundy	0.02%	£2,000		€20,000

Sources: Thomson Reuters, BATS Global Markets, LSE Group, NYSE Euronext, Nasdaq OMX Group, Deutsche Börse Group, BME
Market Share is % of pan-European value traded for June 2013
BATS Chi-X offers access to both its CXE and BXE order books for a single price

The cost of co-location also can be significant for the big firms that choose to buy it. For this reason, many firms tend to operate their equity brokerage operations out of London and co-locate with the many European exchange data centers located in and around the city. Like in the US, co-locating in a single location often allows access to multiple markets. In the UK, for example, both the LSE and Turquoise, operated by the same parent company, house their matching engines in the same London data center, along with LSE's Borsa Italiana unit and the Oslo Börs matching engine, which runs on LSE's Millennium IT technology. Likewise, following the November 2011 acquisition of Chi-X Europe, the region's biggest lit MTF, by

BATS Global Markets, both the old Chi-X venue (now called BATS Chi-X CXE) and the old BATS Europe market (today BATS Chi-X BXE) can be accessed in the same data center, Equiniex's LD4 facility in Slough, outside London. The matching engines of all four Euronext markets are housed in NYSE Euronext's giant data center in Basildon, also a London suburb. Co-location costs are not readily accessible for EU markets, but thought to be roughly comparable with the cost of similar services in the US and Canada, and thus add substantial outlays for major market participants. However, smaller firms focused on one or a small number of individual countries likely will choose to not co-locate their trading applications and therefore will not bear this cost.

Anecdotal evidence from European market participants suggests that the costs of connectivity for the biggest brokers, however, goes far beyond the fee schedules of execution venues for access to matching engines. Mandatory upgrades of trading-venue software, new fee schedules and order types can all require systems changes and testing by brokers. Connections to new venues also require one-time membership fees, as well as compliance reviews of their rule books, policies and practices. These internal projects alone can run bulge-bracket brokers €500,000 or more annually, according to conversations with European market participants. And firms' ability to deal with these tasks has been negatively affected by soft volumes and difficult macroeconomic conditions in recent years, which have prompted massive operational staff cuts. In some cases, big banks have seen their personnel assigned to exchange connectivity shrink from more than 60 when MiFID was first implemented to less than five today, making new connections, as well as maintenance of existing connections, far more taxing on these organizations.

Various Approaches to Market-Data Consolidation

As we have stated earlier in this report, the degree to which market participants rely on consolidated data from multiple trading venues depends in large part on the best-execution regimes present in the jurisdictions where they do business. For this reason, decisions regarding best-execution policies are the very core of market-structure regulation and should be taken with the utmost care and consideration of the potential effects, both intended and unintended, on market participants.

Because of the strong link between best-execution policies and the need for — and costs of — market data, we consider in the same order in this section the four jurisdictions whose best-execution regimes we studied in depth in the previous section, beginning with the most highly prescriptive regime, Canada, and ending with the most flexible, the EU.

Canada

Canada did not explicitly set forth a framework regarding the distribution of consolidated market data in the July 2012 amendments to NI 21-103, or in the text of these rules prior to the amendments. Previously, in July 2009, the Canadian Securities Administrators, an umbrella group for Canada's various provincial regulators, awarded TMX Group a 5-year contract to act as a consolidated Information Processor. Consolidated equity-trading data are available directly through TMX's Datalink unit, as well as from vendors who package this data along with other information for Canadian banks and dealers operating in a variety of financial markets. These vendors include Thomson Reuters, the dominant player in Canada (with a market share in excess of 90%, according to market participants), and Bloomberg. In each case, the distributors tack on a fee to the individual data-subscription charges levied by each protected marketplace.

Practically speaking, Canada's full-depth-of-book best-price protection for displayed orders means that market participants involved in executing client trades must buy real-time, depth-of-book (or Level II) market data to comply with the country's best-execution policy. Additionally, the high level of venue proliferation that is supported by Canada's best-execution regime means that even personnel who are not directly involved in executing client transactions — such as representatives dealing with retail customers, investment bankers and securities analysts — typically are accessing top-of-book (or Level I) data from nine displayed venues to get a true picture of market prices. The associated costs can be very high. Our discussions with market participants and data professionals in Canada reveal that the cost of a data subscription delivered through the dominant vendor, Thomson Reuters, ranges from a low of C$55-65 per user for the country's biggest dealers to a high of C$150-170 per user for the smallest firms. This is just the fee charged by the vendor, and does not include fees for each marketplace's data, which the vendor passes through to customers. Considering both vendor fees and the appropriate mix of Level I and Level II

data needed by market participants, the total cost of consolidated equity market data in Canada can run as much as C$6.4 million annually for the biggest dealers. We attempt to estimate these costs for a range of market participants, according to their size, in the table below.

Canadian Market-Data Fee Estimates

	Big Dealer	Mid-Tier Firm	Small Firm
# of Users	3,000	500	120
Vendor Fees	C$2,160,000	C$495,000	C$230,400
Venue Fees	C$4,257,060	C$759,228	C$172,741
Total Annual Cost	C$6,417,060	C$1,254,228	C$403,141

Sources: Rosenblatt Securities, Trading Venue Fee Schedules (where available), Investment Industry Association of Canada
# of Users estimated based on discussions with market participants, representing midpoint of range for firm type
Exchange Fees based on fee schedule data, estimated numbers of Level I and Level II users for each firm type

It is important to note that the figures in the above table are rough estimates, based on conversations with Canadian market participants, who helped us to apply fees disclosed by the various venues to real-life situations and relayed lesser-known information about numbers of data users at firms of various types, as well as the split between which of these users receives Level II, as opposed to just Level I, data. Some firms choose to give only TSX Level I data to certain users that are not involved in executing client orders in the equity market. However, the TSX's dominant market share means that its data is a "must have" for anyone who needs a real-time price for a TSX-listed security. This inelastic demand for TSX data may give TMX Group considerable pricing power. Additionally, this bottom-up approach to building data costs estimates may not reflect discounts that very large enterprises may negotiate with the various displayed trading venues.

Still, the high costs of market data in Canada have led to widespread complaints from the dealer community — which, as we stated earlier, is also feeling squeezed by connectivity and transaction-matching costs at the various marketplaces. The Investment Industry Association of Canada, a membership organization representing dealers of all sizes, has been pushing aggressively for measures that would curb data costs. These include implementing a data-revenue allocation formula for splitting costs among the various displayed markets according to their contributions to price discovery and liquidity, similar

to the Reg NMS tape-revenue sharing plan, as well as a broader re-evaluation of Canada's best-execution rules.[19]

In November 2012, the CSA responded to this dissatisfaction by issuing a consultation paper seeking comment from market participants on real-time market-data fees. In this paper, the CSA acknowledged that the high cost of Canadian market data was cause for concern, stating that:

> "…the costs of acquiring real-time market data have been escalating in recent years due to an increasing number of marketplaces entering the market and charging for their market data. In addition, there is a concern that the current market structure and regulatory environment may be contributing to these increasing costs. Too high or excessive costs are a form of friction in the market. We would be concerned that such an outcome would be inconsistent with our mandate to foster fair and efficient capital markets. By not addressing these issues, we risk negatively impacting confidence in the Canadian capital markets."

Elsewhere in the paper, the CSA suggests that TSX and TSXV data costs are "reasonable" given their market shares, but that "marketplaces with a smaller market share are charging fees that are high in relation to their share of trading activity," and questions whether this is justified by the cost of producing that data. The paper also acknowledges that "the cost of consolidated data in Canada is higher than it is in the United States relative to trading activity," but suggests that differences in regulation, industry structure and the scale and size of the two markets may mean that some gap in this measure always will exist. The CSA is still evaluating comments on the paper, but appears to be at least considering the kinds of measures that the IIAC and others have been advocating to better control data costs.

United States

Although the US has a similar market structure and best-execution obligations to that of Canada, two factors ensure that market-data costs are not as onerous for US market participants. The first is that US order protection extends only to the best prices displayed

[19] The IIAC commissioned a study on Canadian market-data costs, which was released in 2011 and contains a wealth of information on both costs in Canada and how they compare with similar charges in the US and Europe. It would be very much worth the CVM's time and effort to review this document and speak with IIAC staff and members for more information.

at the top of each venue's order book, not to all displayed bids and offers across every marketplace. The second is the so-called tape-revenue sharing plan that the SEC implemented alongside the order protection rule when it crafted Reg NMS.

There are three consolidated "tapes" in the US: Tape A aggregates last-sale and quote data for NYSE-listed stocks; Tape C does the same for Nasdaq-listed issues and Tape B handles securities (mostly exchange-traded funds and notes) that are listed by NYSE Arca, BATS BZX and other exchanges). These securities information processors, or SIPs, however, allocate the revenue they receive from data consumers among the 13 US exchanges according to two main criteria: market share (known as the Trading Share) and time quoting at the best market-wide prices (known as the Quoting Share). Each of these two components is weighted the same when determining how much of the total revenue pool a given exchange receives. The total revenue available for sharing is largely determined by the number of subscribers — which, in turn stems from securities-industry employment, a primary driver of demand for data.

The tape-revenue-sharing system helps to partially curb the natural tendency of strict order-protection best-execution regimes to lead to venue proliferation. Exchanges only share in the fees paid for market data to the extent that they are contributing to price discovery and liquidity – by executing trades and displaying quotes that contribute to market-wide depth at the best bid or offer. Unlike in Canada, exchanges with *de minimis* market shares are unable to collect outsized data fees simply by dint of their protected-quote status.

However, this does not mean that market participants are happy with the costs of market data in a fragmented market governed by strict best-price order protection. In a recent presentation to the SEC on market-structure issues, for example, Morgan Stanley argued that the collective tape revenue shared by exchanges "grossly exceeds (the) costs" of producing that data. The firm also weighed in on the costs associated with connecting to small exchanges, asserting that "protected quote status should be **earned** — not an entitlement (emphasis theirs)."

And the revenue-sharing scheme also contributes somewhat to market-structure complexity, by incentivizing exchanges to develop order types that maximize the chances of

orders being displayed at the inside market. Such "price-adjustment" mechanisms have been a topic of controversy in the US, and make order routing and execution more difficult for some market participants to understand.

We have not conducted a bottom-up estimate of individual firms' data costs in the US, largely because the Reg NMS allocation system makes such an exercise prohibitively complex, particularly in the short time period we have had to conduct our analysis. However, there have been public disclosures about the total size of the US equity market-data revenue sharing pool. In 2004, according to a Traders Magazine article, the total tape-revenue pool was $434 million. By 2008, according to the SEC's January 2010 Concept Release on Equity Market Structure, that figure had risen to $464 million. Based on our discussions with US market participants who have knowledge of the revenue-sharing system, we believe that the total revenue pool for 2013 will be just $360 million, down from the earlier measures largely because securities-industry employment has fallen in the wake of the financial crisis.

Australia

Australian regulators did not mandate the creation of a consolidated tape when they amended their Market Integrity Rules in 2011 to allow for the introduction of competing execution venues. ASIC specifically recognized the importance of consolidated market data for firms charged with best-execution obligations. However, Australia is a bit of a special case in this regard because of local-market dynamics. Historically, the overwhelming majority of Australian market participants have accessed ASX through an order-management system provided by private vendor IRESS, which enjoys a market share in the neighborhood of 90-95% in the country, according to our conversations with industry professionals there. IRESS already acted as a distributor of ASX market data prior to the new market integrity rules and the launch of Chi-X Australia. Regulators were highly confident that IRESS would aggregate and deliver consolidated market data to market participants once competition commenced, and did not want to inadvertently anoint IRESS as a government-sanctioned consolidated tape provider by mandating that market participants use consolidated data. Based on our conversations with Australian market participants, we believe that IRESS is in fact acting as a data consolidator for the vast

majority of intermediaries who have connected to — or are at least monitoring prices on — Chi-X to fulfill their best-execution obligations.

Currently, the cost of consolidated data in Australia is far lower than in Canada or the US, primarily because there is just one venue — ASX — that charges fees for its data. Another reason for Australia's comparatively lower data costs may be that not all market participants are bound to execute at the best quoted prices. Wholesale orders can routinely trade on ASX at prices that are inferior to those posted on Chi-X, under Australia's hybrid best-execution regime. Retail orders effectively must be executed at the best displayed price, but there is no strict order-protection rule as in Canada and the US, and certainly not the depth-of-book protection we see in Canada, which seems to have played an important role in venue proliferation and high market-data costs there.

ASX currently charges A$55 per month per user for its ASX Total data feed. The rate increased earlier this year from A$45 per month, and does not include what IRESS or other vendors may charge users for broader data or other services. IRESS does not disclose this information publicly, and we were unable to obtain this information during the course of our research. Chi-X does not currently charge for its data, but it could possibly begin doing so in the near-to-medium-term, consistent with the approach of Chi-X Global in Canada, where its Chi-X Canada market began charging for data after building a significant market share. We believe that Chi-X Australia will charge substantially less for its data feed than does ASX. Because it is owned and supported by some of the world's biggest automated market-making firms, Chi-X's bid-ask spreads often are as good or better than those on ASX, and we believe that it accounts for a significant enough portion of quotes at the inside market to appeal, at a projected rate of A$10-20 per month per user, to some cost-conscious data consumers as a viable alternative to ASX data.

Assuming Chi-X does start charging for market data in the reasonably near future, and that the fee is as high as A$20 per user per month, the total portion of consolidated data costs attributable to venue fees in Australia will be A$75 per user per month, or A$900 per user per year, considerably less than the approximately C$1,400-1,500 (A$1,500-1,600) blended venue data fees we estimate per user per year in Canada. Furthermore, because connections to multiple marketplaces and strict best-price routing is not technically required under the

Australian best-execution regime, it's possible that Chi-X's introduction of a far lower fee for its data may lead to the aforementioned substitution effect and cause ASX to reduce its monthly fee to prevent market-share losses to Chi-X.

European Union

MiFID does not mandate the aggregation, distribution or use of consolidated market data. A wide swath of European market participants regards this as one of the most glaring oversights in the directive. Several industry professionals with whom we spoke noted that repealing so-called concentration rules, which required trades of shares listed on a national exchange to be executed exclusively on that exchange, was such a monumental change for the EU that legislators and regulators may not have wanted to take on even more controversy by mandating a consolidated tape. Indeed, recent efforts to tackle data consolidation as part of the ongoing review-and-amendment process commonly known as MiFID II, as well a private initiative called the COBA Project to create an industry-sponsored tape, reveal the powerful interests involved — particularly the national exchanges that have suffered substantial market-share losses in trade-matching as a result of MiFID and are loath to cede control over billions of Euros in market-data revenues.

In the absence of either a government-mandated or vendor-provided pan-European tape, some individual market participants collect and consolidate data from multiple venues on their own. The entities that do this typically are big banks and brokers serving clients who trade stocks across multiple EU member states, as well as some trading venues that compete with the national exchanges and offer best-price routing services to customers for a fee. Additionally, some MTFs that operate as "dark pools" — or markets that do not display price quotes — are required under MiFID to use a "reference price" when executing transactions. Practically speaking, using this "reference price waiver" to MiFID's pre-trade transparency requirements means that executions must be struck at the midpoint of the best bid and offer displayed by the reference market. For stocks that trade regularly not just on their listing market but also on lit MTF rivals like the BATS markets and Turquoise, this means that the dark MTFs in question must effectively calculate their own European best bid/offer for the purposes of determining the midpoint. And because of the unique nature of the EU equity market — as a collection of national markets knitted together by common

legislation and regulation, rather than a single national market, like the US, Canada and Australia, that saw rival venues step in to compete with one or two incumbents — the costs of obtaining direct data from the full array of displayed venues can be quite taxing. For instance, one veteran trading-venue executive with whom we spoke put the cost for consolidating data from five major venues, for the purpose of determining the best bid and offer across all of them, at €1 million annually.

Market Data Fees for Major EU Displayed Markets

	Per user/month	in £
LSE (UK Level I)	£28.00	£28.00
LSE (Int'l Level I)	£14.00	£14.00
LSE (European Level I)	€ 6.60	£5.69
Borsa Italiana (Level I)	€ 12.00	£10.35
BATS Chi-X Europe (Level I)	£20.00	£20.00
Euronext (Level I)	€ 59.00	£50.90
Deutsche Börse (Level I)	€ 56.00	£48.31
Total		£177.25
Total per year		£2,127.00

Sources: Trading Venue Fee Schedules

Some vendors offer data from each of the venues separately, but not as a "pan-European consolidated tape." The costs of the non-consolidated data obtained through these means also can be significant. For just the five biggest markets in the region, the venue portion of the cost alone (not including vendor fees) for obtaining Level I data comes to £177.25 (€205) per user per month, or £2,127 (€2,462) per user per year. This is more than three times the approximately A$900 (£541) per user per year that we estimate consolidated data would cost in Australia should Chi-X begin charging for data in the near future. It is also more than double the C$1,400-1,500 (£885-950) range we estimated for Canada. And it does not include many of the national exchanges operating in the EU, including Spain's BME and the Nasdaq OMX Nordic markets.

However, as with venue-connectivity costs, the flexibility in the EU best-execution regime allows individual market participants to minimize costs by choosing not to take data from multiple venues. The subset of firms that elects to connect only to the national exchange in its home country, or a small group of national exchanges, does not need data from the other

venues to fulfill its best-execution policy, and therefore can keep its costs far lower than those paid by the bigger market participants who observe best-price routing even in the absence of a strict, best-price-based order protection rule.

Ironically, the ability of some firms to limit their data intake to only their home-country national exchange may be feeding the problem of high costs for others who choose to create their own internal "tapes" by taking data from multiple venues throughout the EU. The significant base of local firms taking only their data give national exchanges a substantial cushion against price competition. In other words, a firm buying only one exchange's data is less likely to press for price cuts than one that is buying data from 10 or more exchanges and competing lit markets. This can result in prices for national-exchange data being higher than they otherwise would be, inflating the costs of those who construct their own internal tapes.

Additionally, some degree of high costs already was baked into the EU's market structure before MiFID, owing to the practice of individual stocks being tradable only on their national, listing markets. Even though new venues have sprouted to compete for this order flow, the incumbents still retain majority market share, making their data essentially irreplaceable for those large firms that choose to connect to all venues and route customer orders to the best displayed quotes across all of them. And as we've seen in Canada and Australia, European exchanges have been raising their data fees to help offset lost revenue in the increasingly competitive trade-matching business. Without a government-sanctioned utility, competing tapes run by data vendors or a revenue-sharing scheme like that which prevails in the US, market data will continue to represent a major cost for the biggest market participants in the EU.

Conclusions and Recommendations

Because venue-connectivity costs, as well as the need for market data and its associated costs, are determined in large part by a particular jurisdiction's best-execution rules, choosing a best-execution framework is probably the most critical decision for any regulator contemplating how to handle the introduction of competition with a long-dominant national exchange.

Highly prescriptive best-execution regimes that require brokers to route orders to the best displayed price quotes tend to result in greater lit-venue proliferation, and higher costs for connectivity and market data, than frameworks that offer brokers flexibility to consider factors other than best price, including size, speed and certainty of execution, as well as issues related to clearing and settlement. Such regimes also tend to support market-structure complexity beyond the number of lit venues, including disparities in how different market participants perceive the best displayed market-wide prices at a given moment, and more complex order types that are designed to prevent trade-throughs of protected quotes. Another layer of complexity comes from order-routing and compliance contingencies related to venue outages or systems issues, during which market participants may be permitted to execute trades on other markets displaying prices that are inferior to the exchange having technological problems or acting to slow down trading to avoid executing transactions at absurd prices because of other market participants' systems issues. The "flash crash" that occurred on May 6, 2010, in the US is an example of how such decisions by brokers can lead to outcomes that regulators may not have fully contemplated when establishing the best-execution rules under Reg NMS.

Additionally, choosing strict best-price order protection as the foundation for best execution can bestow tremendous market-data pricing power upon the displayed markets to which brokers are required to route customer orders. Without some mechanism for limiting market-data fees, lit venues may be able to extract outsized rents from such market participants. Methods for balancing this pricing power include the establishment of a market-wide data-processing-and-distribution utility, capping the fees venues can charge for data and establishing formulas that allocate data revenues according to industry demand and the contributions of individual venues to liquidity and price discovery (such as the Reg NMS tape-revenue sharing plan in the US).

The size of a market, in terms of value traded, is also very important when considering the appropriate best-execution framework and the effect it will have on market participants. Strict price protection may be more appropriate for bigger markets, where market participants can spread connectivity and data costs across larger-scale operations. The effect of full-depth-of-book order protection in Canada, for example, appears to be especially pronounced because of the small size of the market relative to others, such as the

US and the EU. Given that Brazil's equity market is slightly smaller than that of Australia — which, in turn, is the smallest of the four markets we examined in this report — we believe that the CVM should carefully consider the potential negative consequences for market participants of adopting strict best-price order protection for the Brazilian equities market.

As we did in the introductory section, we would like to stress that we specifically have not considered for the purposes of this report any effects on the outcomes of end investors that result from exchange monopolies giving way to competition. There is substantial evidence, particularly in the US, that end investors enjoy far better outcomes in today's more-complex, fragmented market structure than they did when the NYSE and Nasdaq enjoyed virtual monopolies over trading in their own listed securities, though this may have been caused by multiple factors and not just competition with incumbent exchanges. Our mandate was to explore the costs to the broker and dealer communities, and we believe it is clear that the advent of exchange competition brings considerable additional costs to bear on such entities.

We believe the CVM would do well to consider in great detail the experiences of other jurisdictions that have gone from centralized to competitive trading venues. Judging from the questions asked in its request for comment, the CVM is keenly aware of the need for such study. We believe that having regulators and key market participants from these jurisdictions visit Brazil would be valuable for the CVM as it considers the correct path forward.