

Program on International Financial Systems

International Review of Equity Market Structure Regulation

Phase III: Best Practices for Regulating Equity Market Structure

May 2021

- © Program on International Financial Systems 2021. All rights reserved.
Limited extracts may be reproduced or translated provided the source
is stated.



The Program on International Financial Systems (PIFS) is a 501(c)(3) organization that conducts research on issues impacting the global financial system. PIFS also hosts international symposia, executive education programs and special events that foster dialogue and promote education on these issues. PIFS was founded in 1986, by Hal S. Scott, now Professor Emeritus of Harvard Law School. Over thirty years later, Hal Scott continues to lead PIFS.

This report was prepared by PIFS staff, including John Gulliver, Executive Director, and Brian Johnson, Fellow, as well as Jon Ondrejko, Senior Research Fellow at the Committee on Capital Markets Regulation.

The Program on International Financial Systems would like to thank Citadel Securities for supporting this research. We also thank Virtu Financial and AbelNoser for providing invaluable access to the transaction cost analysis data used in this series of reports.

International Review of Equity Market Structure Regulation

Phase III: Best Practices for Regulating Equity Market Structure

Contents

International Review of Equity Market Structure Regulation	1
Executive Summary	1
Part I: Consistent Regulations across Five Major Trading Markets	4
A. Common Regulations Across the Five Major Trading Markets.....	4
(1) Broker-dealer Best Execution Obligations	4
(2) Regulation of Stock Exchanges	5
(3) Trade Reporting Requirements.....	7
(4) Volatility Controls	9
B. Performance of the Five Major Equity Trading Markets.....	11
C. Discussion and Recommendations	13
Part II: Regulatory Distinctions among the Five Major Trading Markets.....	15
A. Transaction Cost Differences	15
B. Trading Venue Competition, “Dark” Trading and High-Frequency Trading	16
(1) Trading Venue Competition	16
(2) Dark Trading	21
(3) High Frequency Trading	27
C. Discussion and Recommendations	30

International Review of Equity Market Structure Regulation

Phase III: Best Practices for Regulating Equity Market Structure

Executive Summary

The research staff of the Program on International Financial Systems (“PIFS”) has conducted a three-phase comparative analysis of international equity market structure regulation in the five major global equity trading markets. The five markets include the People’s Republic of China (including both the Mainland market and the Hong Kong Special Administrative Region),¹ the European Union, Japan and the United States, which collectively represent 90% of global equity trading market volume. This report represents the third phase of our international equity market structure review.

In Phase I, we reviewed the regulation of equity market structure in each of the five major jurisdictions.² The purpose of this phase was to inform the public and policymakers as to key similarities and differences among the regulatory regimes. In Phase II, we set forth a quantitative analysis of equity trading in the five markets, including a summary of market characteristics, as well as an overview of the performance of each market for investors, measured primarily by institutional trading costs.³ The purpose of this phase was to assess the performance in each of the five major markets. We found that each of these markets performs well for institutional investors and demonstrates a positive five-year trend. We also noted certain cost differences among the markets.

In Phase III, we will assess key similarities and differences between the regulatory structures outlined in Phase I and their impact on performance measures quantified in Phase II. Our goal is to provide policymakers with guidance as to best practices for regulating equity market structure. We list our policy recommendations at the end of the Executive Summary.

The first part of Phase III describes the equity market regulations common across all five major markets, each of which contribute to their jurisdiction’s strong performance for investors. These regulations include (i) broker-dealer best execution obligations, (ii) regulation of trading venues, including exchange fees, (iii) public reporting requirements for executed trades, and (iv) volatility controls. We then review the performance of each of the five major markets, illustrating the relatively low transaction costs prevalent in each of the markets. In addition, we note the positive trend in each of the markets with respect

¹ For ease of reference, this report refers to (i) the People’s Republic of China as “China”; (ii) the Hong Kong Special Administrative Region of the People’s Republic of China as “Hong Kong”; and (iii) the rest of China as “Mainland China.”

² PROGRAM ON INTERNATIONAL FINANCIAL SYSTEMS, *International Review of Equity Market Structure Regulation: Phase I: Regulations* (Oct. 2019), https://www.pifsinternational.org/wp-content/uploads/2021/01/PIFS-International-Review-of-Equity-Market-Structure-Reg_Oct2019.pdf [“PIFS Report: Phase I”].

³ PROGRAM ON INTERNATIONAL FINANCIAL SYSTEMS, *International Review of Equity Market Structure Regulation Phase II: Quantitative Analysis* (Oct. 2020), <https://www.pifsinternational.org/wp-content/uploads/2020/10/PIFS-EMS-Quantitative-Report-10-08-2020.pdf> [“PIFS Report: Phase II”].

to these performance measures. This part concludes by recommending that policymakers in other jurisdictions that lack these regulations implement the four core features of equity market regulation that are common across the five major trading markets.

The second part of Phase III notes the differences in average transactions costs among the five major jurisdictions and then discusses key regulatory differences between the E.U. and U.S. markets and their counterparts in Mainland China, Hong Kong, and Japan, including: (i) market decentralization and competition among trading venues, (ii) dark trading as a complement to lit trading, and (iii) electronic, algorithmic and high frequency trading activity. Each of these discussions includes a literature review of empirical research on the link between the specific market characteristic and overall market performance.

The E.U. and U.S. markets demonstrate that competition among trading venues, an appropriate balance of dark and lit trading and a framework that facilitates electronic, algorithmic and high frequency trading are key components of transparent, resilient and efficient equity markets. We therefore believe that policymakers should consider creating a regulatory framework to foster evolution of such trading activity. As demonstrated throughout PIFS' series of reports on international equity market structure, regulations in place in the E.U. and U.S. can provide guidance as to the appropriate regulatory structure. Although certain emerging markets have low levels of liquidity and thus may not yet be sufficiently developed to fully benefit from an immediate transition to trading venue competition, dark trading (as a complement to lit trading) or electronic, algorithmic and high frequency trading, we believe that it is incumbent on policymakers in all jurisdictions to evaluate how their markets could benefit from a modernized regulatory framework that can enhance liquidity and investor outcomes.

Policy Recommendations

Part I

- (1) Broker-dealers should be regulated and subject to a best-execution mandate, which helps ensure that customers receive the most favorable trade execution under prevailing market conditions. The best execution mandate should provide guidance as to the meaning of best execution, including priorities such as price, time of execution and size of an order.
- (2) Stock exchanges should be regulated and supervised in furtherance of investor protection. In particular, exchange fees should be subject to regulatory approval and/or limits due to the dominant role of exchanges for stock execution.
- (3) Trade execution information, including price, time of execution and share volume, should be publicly disseminated immediately. This post-trade transparency mandate should apply to trades executed in both lit and dark markets.

- (4) Volatility controls should be implemented by all stock exchanges, specifically circuit breakers for individual stocks that trigger under pre-specified conditions.

Part II

- (1) Regulations should support a decentralized market structure and encourage competition by permitting multiple stock exchanges, multilateral trading venues, and broker-dealer internalization. Enhanced transparency requirements for broker-dealer routing and trading venue execution performance can facilitate competition and lower transaction costs.
- (2) Trading without pre-trade transparency can act as a complement to lit trading and should be permitted on all trading venues, including stock exchanges and off-exchange trading platforms, including multilateral trading venues and through broker-dealer internalization.
- (3) Electronic trading, algorithmic trading and high frequency trading should be recognized as important aspects of efficient markets. Regulations such as registration requirements, risk controls, disclosure obligations, and prohibitions on manipulative trading practices (e.g., spoofing) should be applied to such trading activity as they are applied to manual trading.

Part I: Consistent Regulations across Five Major Trading Markets

Each of the five major trading markets that we analyze have implemented comprehensive regulations in furtherance of the three fundamental goals of equity market structure regulation: (1) transparency, (2) resilience, and (3) low transaction costs for investors. Overall, four distinct regulatory practices help achieve these goals. Those practices include (i) broker-dealer best execution obligations, (ii) regulation of trading venues, (iii) public reporting requirements for orders and trades, and (iv) volatility controls. The positive effects of these regulatory structures are evident by the strong performance in each of these markets, as illustrated by objective performance measures. In this part, we will review the regulatory regimes with respect to the four regulatory practices listed above and describe how these regulations have led to strong performance for investors. We will conclude with a set of recommendations for policymakers in other jurisdictions that lack these four core aspects of equity market structure regulation.

A. Common Regulations Across the Five Major Trading Markets

(1) Broker-dealer Best Execution Obligations

Broker-dealers stand at the heart of the equity market structure in each of the five jurisdictions, as they are responsible for routing investor orders to trading venues for execution. Each jurisdiction requires that broker-dealers register with a regulatory agency, and each jurisdiction imposes the duty of best execution on broker-dealers with respect to client orders.⁴ The best execution obligations are critical for an efficient equity market structure, as they both increase the likelihood that investors receive the best execution terms (such as price, size and time), while also ensuring that executed trades, whose prices are subsequently displayed publicly, accurately reflect current market sentiment for a given stock.

Mainland China: broker-dealers must treat their clients fairly and route client orders to the relevant exchange according to the instruction of the clients.⁵

European Union: broker-dealers must take “all sufficient steps” to obtain the best possible results 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.⁶

⁴ PIFS Report: Phase I, *supra* note 2, at 5-7.

⁵ PIFS Report: Phase I, *supra* note 2, at 5; CHINA SECURITIES LAW, Articles 39 and 145, http://www.csrc.gov.cn/pub/newsite/f1b/f1fg/flxzsf/201312/t20131205_239325.html. See also CHINA SECURITIES LAW, Articles 111-112, http://www.csrc.gov.cn/pub/newsite/f1b/f1fg/flxzsf/201312/t20131205_239325.html. See English version here: <https://www.accaglobal.com/content/dam/accaglobal/pdf/ChinaSecuritiesLaw2006.pdf> (p. 28).

⁶ PIFS Report: Phase I, *supra* note 2, at 6; MiFID 2 Directive, Article 27.

Hong Kong: broker-dealers must execute client orders on the best available terms, which include (i) price, (ii) cost, (iii) speed of execution, (iv) likelihood of execution, (v) speed of settlement, (vi) likelihood of settlement, and (vii) the size and nature of an order.⁷

Japan: broker-dealers must adopt a policy and method for executing orders from customers under the best terms and conditions.⁸

United States: broker-dealers must “use reasonable diligence to ascertain the best market for the subject security and buy or sell in such market so that the resultant price to the customer is as favorable as possible under prevailing market conditions.”⁹ The U.S. is unique in that it prioritizes price above other considerations.

(2) Regulation of Stock Exchanges

Equity trading occurs in one of three different types of venues. “**Stock exchanges**” match buyers and sellers of stock, while also serving as self-regulatory organizations that are the primary listing venue for public companies.¹⁰ “**Multilateral trading venues**” also match buyers and sellers but are *not* self-regulatory organizations and cannot be the primary listing venue for public companies.¹¹ Finally, “**broker-dealer internalizers**” do *not* match buyers and sellers but rather act as principals, executing customer orders against the broker-dealer’s own inventory.¹²

In each of the five jurisdictions that we reviewed, the majority of stock trades are executed on stock exchanges, particularly in Mainland China, Hong Kong and Japan, where more than 90% of stock trades are executed on exchanges.¹³ As a result, regulation of stock exchanges, and particularly the regulation of the fees that exchanges may charge broker-dealers are of paramount importance, including fees for exchange auctions (opening or closing), accessing an exchange, executing client orders or for market data that can only be accessed from an exchange (collectively, “**exchange fees**”). In each of the five jurisdictions, the relevant regulatory authority provides oversight of exchange fees and must approve them.¹⁴

Mainland China: The China Securities Regulatory Commission (“**CSRC**”) regulates and supervises stock exchanges with the goal of ensuring market fairness and integrity, as

⁷ PIFS Report: Phase I, *supra* note 2, at 6; HONG KONG SECURITIES & FUTURES COMMISSION, *Circular to Licensed Corporations on Best Execution* (Jan. 30, 2018) <https://www.sfc.hk/edistributionWeb/gateway/EN/circular/doc?refNo=18EC7>.

⁸ PIFS Report: Phase I, *supra* note 2, at 5-6; FINANCIAL INSTRUMENTS EXCHANGE ACT, Article 40-2.

⁹ PIFS Report: Phase I, *supra* note 2, at 6; FINRA Rule 5310.

¹⁰ PIFS Report: Phase I, *supra* note 2, at 1.

¹¹ PIFS Report: Phase I, *supra* note 2, at 1.

¹² PIFS Report: Phase I, *supra* note 2, at 1.

¹³ PIFS Report: Phase I, *supra* note 2, at 7. See, e.g., SECURITIES AND FUTURES COMMISSION, *Report on the Thematic Review of Alternative Liquidity Pools in Hong Kong*, 4 (Apr. 9, 2018) [https://www.sfc.hk/web/EN/files/IS/publications/ALP%20Report%20\(EN\).pdf](https://www.sfc.hk/web/EN/files/IS/publications/ALP%20Report%20(EN).pdf); FINANCIAL MARKETS DIVISION, FINANCIAL SERVICES AGENCY (JAPAN), *Agenda for competition among trading venues and alternative trading platforms*, (June 15, 2016), available at <https://www.fsa.go.jp/en/news/2016/20160513-1/03.pdf>.

¹⁴ PIFS Report: Phase I, *supra* note 2, at 7-9.

well as transparent trading and investor protection.¹⁵ The CSRC together with the National Development and Reform Commission have the express authority to set fees at stock exchanges.¹⁶ The CSRC has stated that “market size and environment” are among the factors used to determine appropriate fee levels.¹⁷

European Union: Exchange fees must be transparent, fair and non-discriminatory as determined by the competent authority in the E.U. Member State.¹⁸ Generally, exchanges must charge broker-dealers similar fees for similar services.¹⁹ For example, with respect to market data fees, exchanges must provide market data on a “reasonable commercial basis.”²⁰ As a result, market data prices must be: (i) based on costs of producing and disseminating such data, including a reasonable margin; (ii) offered on a non-discriminatory basis to all clients; (iii) charged according to the individual end-user’s use; and (iv) available without being bundled with other services.²¹

Hong Kong: Exchange fees must be specified in rules approved by the Securities and Futures Commission of Hong Kong (“SFC”).²² In making its decision on fee rules, the SFC considers the level of competition, if any, in Hong Kong for the matter for which the fee is to be imposed and the fees, if any, imposed by another recognized exchange controller or recognized exchange company or any similar entity outside Hong Kong for equivalent matters.²³

Japan: Exchanges are required to obtain approval from the Financial Service Authority (“FSA”) for the fees that they charge.²⁴ Exchanges are also required to perform benchmarking analysis and/or impact analysis, and the FSA must determine whether the structure of the model or the fee charge is fair or unduly discriminatory.²⁵ The FSA evaluates the reasonableness of exchange fees by considering service provided vs. fees

¹⁵ PIFS Report: Phase I, *supra* note 2, at 15.

¹⁶ PIFS Report: Phase I, *supra* note 2, at 7; IOSCO, *Trading Fee Models and their Impact on Trading Behaviour*, 12 (Dec. 2013)

http://www.csrc.gov.cn/pub/csrc_en/affairs/AffairsIOSCO/201402/P020140213529122654245.pdf.

¹⁷ PIFS Report: Phase I, *supra* note 2, at 7-8; CHINA SECURITIES AND REGULATORY COMMISSION, *Substantial Decrease on A-share Transaction-related Fees* (April 30, 2012)

http://www.csrc.gov.cn/pub/csrc_en/newsfacts/release/201205/t20120508_209698.html

¹⁸ PIFS Report: Phase I, *supra* note 2, at 8; MiFID 2 Directive, Article 48(9).

¹⁹ PIFS Report: Phase I, *supra* note 2, at 8; RTS 10, 330.

²⁰ PIFS Report: Phase I, *supra* note 2, at 8; EUROPEAN SECURITIES AND MARKETS AUTHORITY, *Consultation Paper: MiFID II/MiFIR Review Report on the Development in Prices for Pre- and Post-Trade Data and on the Consolidated Tape for Equity Instruments*, 15 (July 12, 2019).

²¹ PIFS Report: Phase I, *supra* note 2, at 8; EUROPEAN SECURITIES AND MARKETS AUTHORITY, *Consultation Paper: MiFID II/MiFIR Review Report on the Development in Prices for Pre- and Post-Trade Data and on the Consolidated Tape for Equity Instruments*, 15 (July 12, 2019).

²² PIFS Report: Phase I, *supra* note 2, at 8; Hong Kong Securities and Futures Ordinance, Section 76.

²³ PIFS Report: Phase I, *supra* note 2, at 8; Hong Kong Securities and Futures Ordinance, Section 76.

²⁴ PIFS Report: Phase I, *supra* note 2, at 8; 2 IOSCO, *Trading Fee Models and their Impact on Trading Behaviour: Final Report*, FR12/13 (December 2013).

²⁵ PIFS Report: Phase I, *supra* note 2, at 8; 2 IOSCO, *Trading Fee Models and their Impact on Trading Behaviour: Final Report*, FR12/13 (December 2013).

charged, operational cost, value added, comparable fees of other trading venues and competition factors.²⁶

United States: Exchange rules must provide for the equitable allocation of reasonable fees and other charges among its broker-dealer members, not permit unfair discrimination and not impose any unnecessary burden on competition.²⁷ Until November 2020, exchange fees did not require pre-approval and were effective upon filing with the Securities and Exchange Commission (“SEC”).²⁸ As of November 2020, exchange fee changes must be approved by the SEC after an opportunity for public comment.²⁹ Consolidated market data fees charged by exchanges must be fair and reasonable.³⁰ Further, there is an explicit cap on “access” fees (30 cents/100 shares) that exchanges can charge for publicly displayed orders.³¹

(3) Trade Reporting Requirements

“Lit” trades are those executed on venues with pre-trade transparency, meaning that orders to buy and sell a stock (including size and price information) are publicly displayed before execution of the trade.³² Trades that take place in the “dark” are simply trades that are executed on venues without pre-trade transparency.³³ But in reality there is no truly “dark” trading in the jurisdictions that we review, because all five jurisdictions mandate *post-trade* transparency, meaning that the size and price information of *all* executed trades must be publicly reported.³⁴ Post-trade transparency is critical for market efficiency, as it not only provides investors with relevant information for assessing the

²⁶ PIFS Report: Phase I, *supra* note 2, at 8; 2 IOSCO, *Trading Fee Models and their Impact on Trading Behaviour: Final Report*, FR12/13 (December 2013).

²⁷ PIFS Report: Phase I, *supra* note 2, at 8; Section 6 of the Securities Exchange Act of 1934.

²⁸ PIFS Report: Phase I, *supra* note 2, at 8; U.S. SEC. & EXCH. COMM’N, *Rescission of Effective-Upon-Filing Procedure for NMS Plan Fee Amendments and Modified Procedures for Proposed NMS Plans and Plan Amendments*, 85 FED. REG. 65470 (Oct. 5, 2020), <https://www.federalregister.gov/documents/2020/10/15/2020-18572/rescission-of-effective-upon-filing-procedure-for-nms-plan-fee-amendments-and-modified-procedures>.

²⁹ U.S. SEC. & EXCH. COMM’N, *Rescission of Effective-Upon-Filing Procedure for NMS Plan Fee Amendments and Modified Procedures for Proposed NMS Plans and Plan Amendments*, 85 FED. REG. 65470 (Oct. 5, 2020), <https://www.federalregister.gov/documents/2020/10/15/2020-18572/rescission-of-effective-upon-filing-procedure-for-nms-plan-fee-amendments-and-modified-procedures>.

³⁰ PIFS Report: Phase I, *supra* note 2, at 9. See generally 15 U.S.C. § 78k-1 (2012). See also Regulation NMS, Exchange Act Release No. 51808, 70 FED. REG. 37496, 37560, 37567 (Jun. 29, 2005) <https://www.sec.gov/rules/final/34-51808fr.pdf>.

³¹ PIFS Report: Phase I, *supra* note 2, at 9; Access to Quotations, 17 C.F.R. § 242.610.

³² PIFS Report: Phase I, *supra* note 2, at 4.

³³ PIFS Report: Phase I, *supra* note 2, at 4.

³⁴ PIFS Report: Phase I, *supra* note 2, at 4; U.S. SEC. & EXCH. COMM’N, *Concept Release on Equity Market Structure*, Exchange Act Release No. 61358, File No. S7- 02-10, 75 FED. REG. 3594, 3600 (Jan. 21, 2010); INTERNATIONAL MONETARY FUND, MONETARY AND CAPITAL MARKETS DEPARTMENT, *People’s Republic of China–Hong Kong Special Administrative Region: Financial Sector Assessment Program - IOSCO Objectives and Principles of Securities Regulation-Detailed Assessment of Observance*, Country Report No. 14/205, 212 (July 16, 2014); JAPAN CABINET OFFICE, *Ordinance on Financial Instruments Business*, Table 1, Articles 74-75. In China, as noted earlier, all trading takes places on exchanges. For the EU, see MiFIR, Articles 6 and 20; RTS 1.

quality of their broker-dealers' execution of trades, but it also provides overall insight into current market sentiment for a stock, thus supporting efficient price formation.³⁵

Mainland China: All stock trading for public equities in Mainland China occurs on lit exchanges with pre-trade transparency, as well as post-trade transparency.³⁶

European Union: Trading venues and investment firms must make public the price, volume, and time of executed transactions as close to real time as is technically possible.³⁷

Hong Kong: Post-trade transparency is mandated by the trading rules of the Stock Exchange of Hong Kong Limited ("SEHK").³⁸ Post-trade information includes last traded price, day high, day low, closing price and trading volume.³⁹ The SEHK post-trade transparency obligations apply not only to on-exchange transactions, but also to off-exchange transactions that are executed by exchange participants.⁴⁰

Japan: Stock exchanges must display post-trade information immediately after a trade occurs.⁴¹ Exchanges must also publicly disclose the total volume of daily transactions, highest price, lowest price, and closing price for each listed security.⁴² However, we note that the venue of execution is not provided for trades that are executed off-exchange without pre-trade transparency.

United States: The SEC mandates post-trade transparency, requiring timely reports of executed trades.⁴³ Both lit trades and trades without pre-trade transparency are subject to the post-trade transparency requirements.⁴⁴

³⁵ PIFS Report: Phase I, *supra* note 2, at 93; Concept Release on Equity Market Structure, Exchange Act Release No. 61358, File No. S7-02-10, 75 FED. REG. 3594, 3600 (Jan. 21, 2010).

³⁶ PIFS Report: Phase I, *supra* note 2, at 4; Securities Law of the People's Republic of China, Article 39 (2005), <https://www.accaglobal.com/content/dam/acca/global/pdf/ChinaSecuritiesLaw2006.pdf>.

³⁷ PIFS Report: Phase I, *supra* note 2, at 52; MiFIR, Articles 6 and 20; RTS 1, Articles 12, 13, and 14.

³⁸ PIFS Report: Phase I, *supra* note 2, at 32.

³⁹ PIFS Report: Phase I, *supra* note 2, at 32-33; INTERNATIONAL MONETARY FUND, MONETARY AND CAPITAL MARKETS DEPARTMENT, *People's Republic of China-Hong Kong Special Administrative Region: Financial Sector Assessment Program-IOSCO Objectives and Principles of Securities Regulation-Detailed Assessment of Observance*, Country Report No. 14/205, 212-213 (July 16, 2014), <https://www.imf.org/en/Publications/CR/Issues/2016/12/31/Peoples-Republic-of-ChinaHong-Kong-Special-Administrative-Region-Financial-Sector-Assessment-41750>.

⁴⁰ PIFS Report: Phase I, *supra* note 2, at 33; INTERNATIONAL MONETARY FUND, MONETARY AND CAPITAL MARKETS DEPARTMENT, *People's Republic of China-Hong Kong Special Administrative Region: Financial Sector Assessment Program-IOSCO Objectives and Principles of Securities Regulation-Detailed Assessment of Observance*, Country Report No. 14/205, 212-213 (July 16, 2014), <https://www.imf.org/en/Publications/CR/Issues/2016/12/31/Peoples-Republic-of-ChinaHong-Kong-Special-Administrative-Region-Financial-Sector-Assessment-41750>.

⁴¹ PIFS Report: Phase I, *supra* note 2, at 78; Financial Instruments Exchange Act Article 130.

⁴² PIFS Report: Phase I, *supra* note 2, at 78; Financial Instruments Exchange Act Article 131.

⁴³ PIFS Report: Phase I, *supra* note 2, at 92; Concept Release on Equity Market Structure, Exchange Act Release No. 61358, File No. S7-02-10, 75 FED. REG. 3594, 3600 (proposed Jan. 21, 2010).

⁴⁴ PIFS Report: Phase I, *supra* note 2, at 92; Concept Release on Equity Market Structure, Exchange Act Release No. 61358, File No. S7-02-10, 75 FED. REG. 3594, 3600 (proposed Jan. 21, 2010).

(4) Volatility Controls

Volatility controls are intended to minimize extreme price volatility in stocks, which can be disruptive to an orderly trading environment.⁴⁵ To this end, each of the five jurisdictions require circuit breakers for individual stocks that trigger when there is significant price volatility for that stock during a specified period of time.⁴⁶ Of note, the U.S. is the only jurisdiction that also imposes market-wide circuit breakers in addition to individual stock circuit breakers.⁴⁷

Mainland China: Exchanges have adopted individual stock circuit breakers that trigger when a stock's price fluctuates by 10% over a specified period of time.⁴⁸

European Union: Exchanges and multilateral trading venues are required to adopt circuit breakers for individual stocks when there is significant price movement during a short period, using a pre-defined statistically supported methodology.⁴⁹

Hong Kong: The Hong Kong Exchanges and Clearing Limited ("HKEx") imposes individual stock circuit breakers that trigger when a stock's price fluctuates by 10% over a pre-specified period of time.⁵⁰

⁴⁵ PIFS Report: Phase I, *supra* note 2, at 12.

⁴⁶ PIFS Report: Phase I, *supra* note 2, at 12-13.

⁴⁷ PIFS Report: Phase II, *supra* note 3, at 13-14, 101; Self-Regulatory Organizations; Notice of Filing of Amendments No. 1 and Order Granting Accelerated Approval of Proposed Rule Changes as Modified by Amendments No. 1, Relating to Trading Halts Due to Extraordinary Market Volatility, Exchange Act Release No. 67090 (May 31, 2012), <http://www.sec.gov/rules/sro/bats/2012/34-67090.pdf>.

⁴⁸ PIFS Report: Phase I, *supra* note 2, at 12; Trading Rules, Chapter III, 3.4.13-14 (Shanghai) / 3.3.15-16 (Shenzhen). Although the Shanghai and Shenzhen stock exchanges adopted market-wide circuit breakers on January 1, 2016, they were promptly suspended effective January 8, 2016, and they have not been reinstated since. See SHANGHAI STOCK EXCHANGE, *Notice on the suspension of the implementation of the index circuit breaker mechanism* (January 7, 2016), http://www.sse.com.cn/lawandrules/sselawsrules/trade/universal/c/c_20210128_5312089.shtml;

https://www.szse.cn/lawrules/rule/allrules/business/t20160606_565187.html; CAIXIN, *Xiao Gang rethinks the fuse: the retail market is difficult to play a role* (July 7, 2020), <https://finance.caixin.com/2020-07-07/101576788.html>; Trading Rules of Shenzhen Stock Exchange, Section 6, available at <http://www.szse.cn/English/rules/siteRule/P020181124401737559498.pdf>; Trading Rules of Shanghai Stock Exchange, Section 5, available at <http://english.sse.com.cn/start/rules/sse/trading/c/4962524.pdf>.

⁴⁹ PIFS Report: Phase I, *supra* note 2, at 13; MiFID 2 Directive, Recital 64 and Article 48(5); ESMA Guidelines 'Calibration of circuit breakers and publication of trading halts under MiFID II' (06/04/2017). See also Cyrille Guillaumie, Giuseppe Loiacono, Christian Winkler, Steffen Kern, *ESMA Working Paper 2020-1: Market impacts of circuit breakers – Evidence from EU trading venues*, EUROPEAN SECURITIES AND MARKETS AUTHORITY, 12 (Jan. 2020), https://www.esma.europa.eu/sites/default/files/library/esmawp-2020-1_market_impacts_of_circuit_breakers.pdf.

⁵⁰ PIFS Report: Phase I, *supra* note 2, at 12; MARKETS MEDIA, *HKEX to Roll Out Volatility Control Mechanism for its Securities Market* (Aug. 19, 2016) <https://www.marketsmedia.com/hkex-roll-volatility-control-mechanism-securities-market/>; HKEx, *Trading Mechanism of Volatility Control (VCM) in the Securities Market* (Aug. 12, 2016) https://www.hkex.com.hk/eng/market/sec_tradinfra/vcm_cas/Documents/Trading%20Mechanism%20for%20VCM%20Eng.pdf. See also Wei Yiyang and Denise Jia, *Hong Kong Stock Market Mulls Marketwide Circuit Breaker*, CAIXIN (June 21, 2019), <https://www.caixinglobal.com/2019-06-21/hong-kong-bourse-mulls-marketwide-circuit-breaker-101429560.html>.

Japan: The Tokyo Stock Exchange (“**TSE**”) imposes individual stock circuit breakers that vary based on the absolute price of a stock.⁵¹

United States: Exchanges and the Financial Industry Regulatory Authority (“**FINRA**”) impose individual stock circuit breakers that apply when a stock’s price fluctuates from 5-20% depending on the price and liquidity of the stock.⁵² The SEC has also approved market-wide circuit breakers that trigger trading halts based on different levels of market-wide price declines. For example, a 7% price decline in the S&P 500 index triggers a 15-minute trading halt for all exchange-listed stocks, while a 20% price decline halts trading for the remainder of the day.⁵³

⁵¹ PIFS Report: Phase I, *supra* note 2, at 12-13; INTERNATIONAL MONETARY FUND, MONETARY AND CAPITAL MARKETS DEPARTMENT, *Japan: IOSCO Objectives and Principles of Securities Regulation— Detailed Assessment of Implementation*, IMF Country Report No. 12/230 (August 2012).

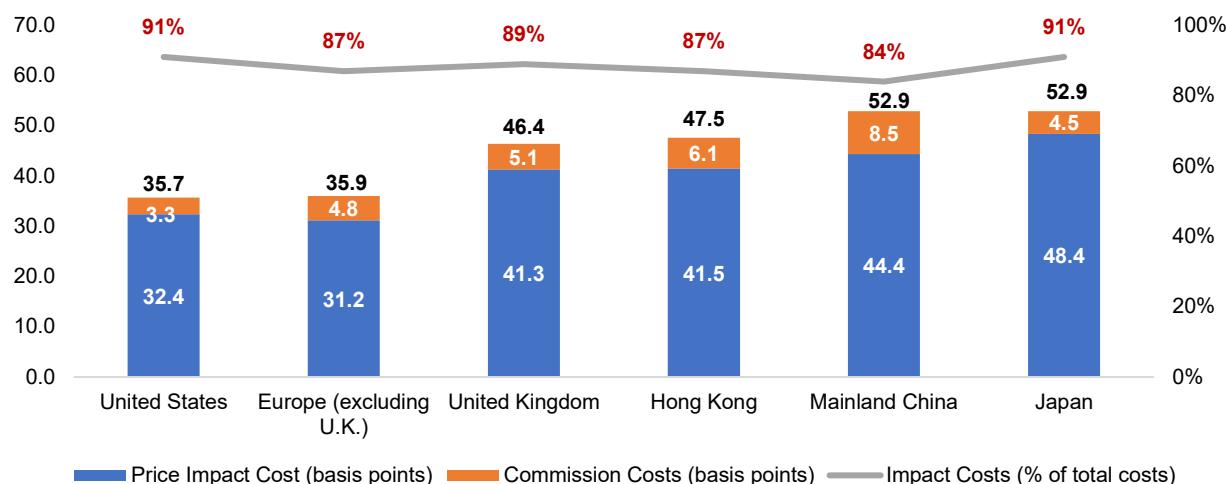
⁵² PIFS Report: Phase I, *supra* note 2, at 13; Joint Industry Plan; Order Approving the Tenth Amendment to the National Market System Plan to Address Extraordinary Market Volatility, Exchange Act Release No. 77679, File No. 4-631 (Apr. 21, 2016) <https://www.sec.gov/rules/sro/nms/2016/34- 77679.pdf>.

⁵³ PIFS Report: Phase II, *supra* note 3, at 13-14, 101; Self-Regulatory Organizations; Notice of Filing of Amendments No. 1 and Order Granting Accelerated Approval of Proposed Rule Changes as Modified by Amendments No. 1, Relating to Trading Halts Due to Extraordinary Market Volatility, Exchange Act Release No. 67090 (May 31, 2012), <http://www.sec.gov/rules/sro/bats/2012/34-67090.pdf>.

B. Performance of the Five Major Equity Trading Markets

The benefits of the regulations described in **Section A** are readily apparent in a quantitative review of each jurisdiction's equity trading transaction costs. In general, institutional trading costs, which include two components (price impact costs and brokerage commissions), are low in each of the five markets and have been trending downward over the past five years.⁵⁴ **Figure 1** illustrates the average trading costs in each of the jurisdictions in 2019, as estimated by Virtu Financial.⁵⁵ Note that trading cost data for the United Kingdom is presented separately from that of the E.U.

Figure 1: Trading Costs by Market (2019 Average)



As illustrated in **Figure 1**, trading costs are generally low across all markets, with the highest average trading cost estimated at approximately 53 basis points (0.53%) in Mainland China and Japan. It is noteworthy that trading costs are highest in Mainland China despite the fact that trading volume in Mainland China exceeds trading volumes in the U.K. and Europe. Typically, higher trading volumes are associated with lower trading costs. As described in more detail in the next section, such higher trading costs may be due to a lack of trading venue competition, dark trading (as a complement to lit trading) and/or high frequency trading in Mainland China.

Between the two components of total costs – price impact and commissions – price impact constitutes the largest component of total costs in each of the markets as there is typically insufficient liquidity at the best bid or offer to execute large institutional orders. Price impact costs as a percentage of total costs (denoted in red in **Figure 1**) range from 84% to 91%.

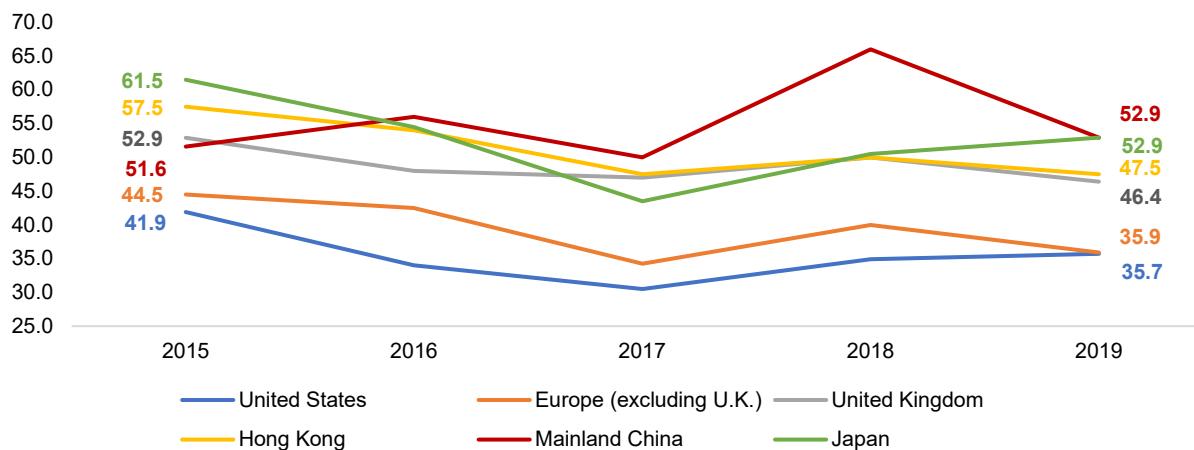
As demonstrated by **Figure 2**, the low average trading costs across all jurisdictions has been relatively consistent over a five-year period from 2015 to 2019. While average

⁵⁴ PIFS Report: Phase II, *supra* note 3, at 17, 22.

⁵⁵ PIFS Report: Phase II, *supra* note 3, at 13.

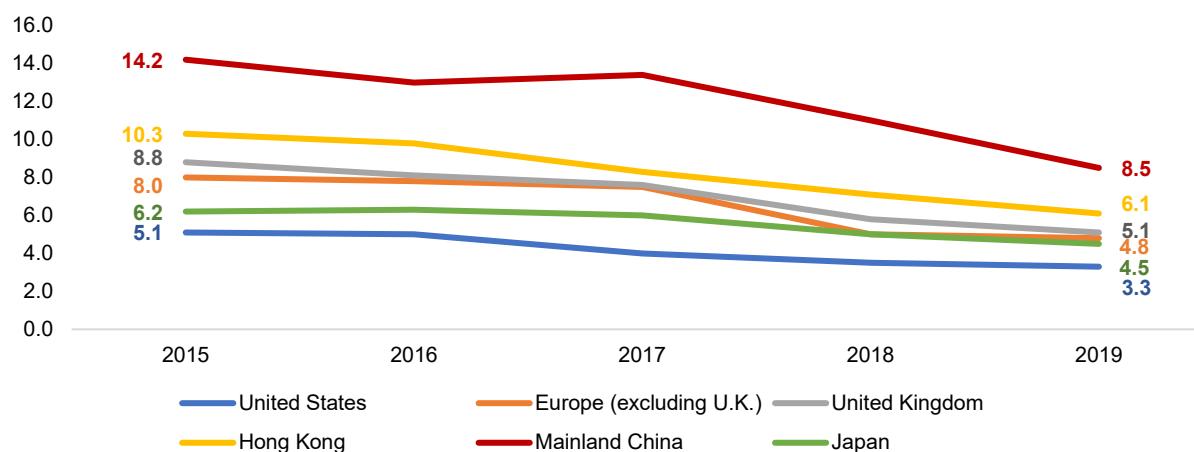
trading costs have increased moderately since a low in 2017, average costs in 2019 were lower than in 2015 for all jurisdictions except Mainland China. The Mainland China increase is likely related to a decrease in trading volumes in the jurisdiction. On-exchange trading volume in Mainland China surged from 2011 to 2015, coinciding with a bull market in Chinese equities that peaked in June 2015.⁵⁶ Subsequently, trading volumes declined significantly from 2015 to 2019, effectively reverting to historical (pre-2011) averages.⁵⁷ The increase in average trading costs accompanied the decrease in trading volumes from 2015 to 2019.

Figure 2: Annual Average Institutional Total Trade Costs by Market (basis points)



Average institutional commission costs have also trended substantially downward in each jurisdiction over the last five years. **Figure 3** shows the downward trend in each jurisdiction.⁵⁸

Figure 3: Annual Average Institutional Commission Costs by Market (basis points)



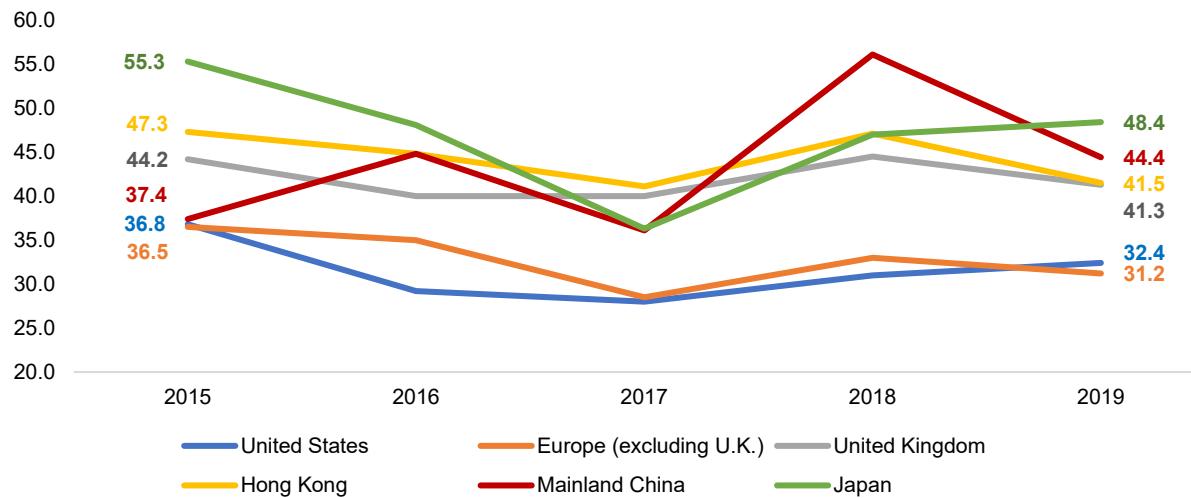
⁵⁶ See PIFS Phase II

⁵⁷ Id.

⁵⁸ PIFS Report: Phase II, *supra* note 3, at 15.

As illustrated in **Figure 3**, average institutional commission costs from 2015 to 2019 dropped more than 40% in four jurisdictions: down 42.0% in U.K., 40.8% in Hong Kong, 40.1% in Mainland China, and 40.0% in Europe (ex. U.K.). The U.S. and Japan have also fared well, down 35.3% and 27.4%, respectively. Finally, **Figure 4** shows that average institutional price impact costs have also trended downward in all markets except for Mainland China.⁵⁹

Figure 4: Annual Average Institutional Price Impact Cost by Market (basis points)



As demonstrated by **Figure 4**, average institutional price impact costs have remained consistently low over a five-year time period from 2015 to 2019. While average price impact costs have increased moderately since a low in 2017, average costs in 2019 were lower than in 2015 for all jurisdictions except Mainland China. As previously noted, the increase in Mainland China is likely related to the decrease in overall trading volumes in the jurisdiction.

C. Discussion and Recommendations

Each of the four regulatory principles described above contribute to the strong market performance in each jurisdiction. First, broker-dealer regulation fosters competition among brokers that reduces costs, as broker-dealers attract more customers with lower fees and better performance. The downward trend in commission costs, illustrated above in **Figure 3**, shows that competition among broker-dealers has significantly reduced commission costs in each jurisdiction. In addition, best-execution obligations have also contributed to the consistently low price impact costs, as illustrated in **Figure 4**.

⁵⁹ PIFS Report: Phase II, *supra* note 3, at 16.

Second, regulation of exchange fees can directly limit the trading costs imposed on broker-dealers and passed through to clients, particularly when such fees are due to a lack of trading venue competition (including for example with respect to exchange closing auctions). Regulating such fees has helped each jurisdiction maintain relatively low overall trading costs. Third, post-trade transparency provides investors with relevant information for assessing their broker-dealers' performance, which helps foster competition among broker-dealers, further reducing costs as discussed above. Moreover, post-trade transparency also provides insight into current market sentiment for a stock, thus supporting efficient price formation.

Third, large and abrupt price moves can destabilize markets.⁶⁰ Volatility controls enhance the stability of markets by protecting market participants from executing trades at extreme and unintended prices and providing time for market participants to respond to new information and adjust their orders during periods of extreme price volatility.⁶¹ Volatility controls can thereby reduce the market impact of abrupt price movements, facilitate more orderly trading and enhance market confidence.

Given the commonality, importance of these regulations and positive impact on market performance across all five jurisdictions, we recommend that policymakers in markets that lack such regulations consider implementing similar core regulations for their equity market structure.

Policy Recommendations

- (1) Broker-dealers should be regulated and subject to a best-execution mandate, which helps ensure that customers receive the most favorable trade execution under prevailing market conditions. The best execution mandate should provide guidance as to the meaning of best execution, including priorities such as price, time of execution and size of an order.
- (2) Stock exchanges should be regulated and supervised in furtherance of investor protection. In particular, exchange fees should be subject to regulatory approval and/or limits due to the dominant role of exchanges for stock execution.
- (3) Trade execution information, including price, time of execution and share volume, should be publicly disseminated immediately. This post-trade transparency mandate should apply to trades executed in both lit and dark markets.
- (4) Volatility controls should be implemented by all stock exchanges, specifically circuit breakers for individual stocks that trigger under pre-specified conditions.

⁶⁰ U.S. SEC. & EXCH. COMM'N, *Staff Report on Algorithmic Trading in U.S. Capital Markets*, 60 (Aug. 5, 2020), https://www.sec.gov/files/Algo_Trading_Report_2020.pdf.

⁶¹ Findings Regarding the Market Events of May 6, 2020, Report of the Staffs of the CFTC and SEC to the Joint Advisory Committee on Emerging Regulatory Issues 7 (Sept. 30, 2010), available at <https://www.sec.gov/news/studies/2010/marketevents-report.pdf>

Part II: Regulatory Distinctions among the Five Major Trading Markets

Across all five major trading jurisdictions reviewed, effective regulatory regimes have contributed to strong equity market structure performance, as evidenced by low transactions costs that continue to trend downward. However, among the five jurisdictions, differences in regulatory regimes also exist, which may have contributed to even stronger performance in certain markets – in particular, Europe (ex U.K.) and U.S. In this part, we describe the differences in trading costs among the five jurisdictions, followed by a review and discussion of the key regulatory differences among the five jurisdictions and how those differences likely contribute to the particularly strong performance of equity market structure in certain jurisdictions. This part concludes with policy recommendations to help guide other jurisdictions.

A. Transaction Cost Differences

Despite the relatively low trading costs across the five jurisdictions reviewed, certain differences are apparent among the various jurisdictions. In general, average trading costs in the E.U. and U.S. are lower than those in Mainland China, Hong Kong and Japan. As illustrated in **Figure 1** on page 11, in 2019 the average institutional trading costs for Europe (ex. U.K.) and the U.S. were 35.9 and 35.7 basis points, respectively, lower than Hong Kong (47.5 basis points), Mainland China (52.9 basis points), and Japan (52.9 basis points).⁶² Most of the difference is explained by the lower price impact costs in Europe (ex U.K.) and the U.S., but lower commission costs are also a factor in the cases of Mainland China and Hong Kong.⁶³ **Table 1** illustrates the relative differences in trading costs among the markets.

Table 1
Comparisons of Average Trading Costs

	Mainland China	Hong Kong	Japan
U.S.	32.5% lower in U.S.	24.8% lower in U.S.	32.5% lower in U.S.
Europe (ex. U.K.)	32.1% lower in Europe	24.4% lower in Europe	32.1% lower in Europe

The relatively lower trading costs in Europe (ex U.K.) and the U.S. are not merely a 2019 phenomenon. From 2015-2019, average institutional trading costs in Europe (ex. U.K.) and the U.S. have been lower than their counterparts in Mainland China, Hong Kong and Japan in each year.⁶⁴ As we now explain, regulatory differences that impact the equity market structure in each jurisdiction likely play a role in contributing to the trading cost variations.

⁶² See Figure 1; PIFS Report: Phase II, *supra* note 3, at 13.

⁶³ See Figure 1; PIFS Report: Phase II, *supra* note 3, at 13.

⁶⁴ See Figure 2; PIFS Report: Phase II, *supra* note 3, at 17.

B. Trading Venue Competition, “Dark” Trading and High-Frequency Trading

Despite the strong performance of the markets that we have reviewed, three key differences among the five jurisdictions have emerged. First, equity markets in Mainland China, Hong Kong and Japan are highly centralized with no competition between exchanges (stocks are not traded off their listed exchange) and very limited off-exchange trading, largely due to regulatory restrictions.⁶⁵ On the other hand, E.U. and U.S. markets are more decentralized with competition between exchanges and off-exchange trading.⁶⁶ Second, there is a higher incidence of dark trading (as a complement to lit trading) in the E.U. and U.S. markets than in other jurisdictions.⁶⁷ And third, high-frequency trading plays an important role in the E.U., Hong Kong, Japan, and the U.S., but is nonexistent in Mainland China.⁶⁸

(1) Trading Venue Competition

As noted in Part I, there are three types of trading venues: stock exchanges, multilateral trading venues and broker-dealer internalizers.⁶⁹ Each type of trading venue is subject to its own regulations. Trading venue competition can arise both across different types of trading venues – e.g., stock exchanges competing with multilateral trading venues – and among the same type of trading venue – e.g. stock exchanges competing with each other.

a. Regulatory overview

Mainland China: stock exchanges are the only type of trading venue for publicly-listed stocks, as off-exchange trading (including both multilateral trading venues and broker-dealer internalization) is prohibited.⁷⁰ Therefore, there is no competition among trading venues for publicly-listed stocks.⁷¹ Moreover, publicly-listed stocks can only trade on one stock exchange - their primary listing exchange - so there is no competition among stock exchanges for trading volume.⁷² The CSRC has approved two national stock exchanges,

⁶⁵ See, e.g., PIFS Report: Phase II, *supra* note 3, at 7-9.

⁶⁶ See, e.g., PIFS Report: Phase II, *supra* note 3, at 7-9.

⁶⁷ PIFS Report: Phase I, *supra* note 2, at 4-5; PIFS Report: Phase II, *supra* note 3, at 9.

⁶⁸ PIFS Report: Phase I, *supra* note 2, at 11.

⁶⁹ PIFS Report: Phase I, *supra* note 2, at 1.

⁷⁰ PIFS Report: Phase I, *supra* note 2, at 1; Securities Law of the People's Republic of China, Article 39 (2005) <https://www.accaglobal.com/content/dam/accaglobal/pdf/ChinaSecuritiesLaw2006.pdf>.

⁷¹ PIFS Report: Phase I, *supra* note 2, at 1; WORLD BANK, *People's Republic of China: Financial Sector Assessment Program* 279 (October 2017)

<http://documents.worldbank.org/curated/en/363291512541399092/pdf/121861-WP-P157065-PUBLIC-ADD-FSAP-SERIES-Financial-Sector-Assessment-Program-FSAP-China-FSAP-2017-DAR-IOSCO.pdf>.

⁷² PIFS Report: Phase I, *supra* note 2, at 22; WORLD BANK, *People's Republic of China: Financial Assessment Program: Detailed Assessment of Observance*, 279 (Oct. 2017), <http://documents.worldbank.org/curated/en/363291512541399092/pdf/121861-WP-P157065-PUBLICADD-FSAP-SERIES-Financial-Sector-Assessment-Program-FSAP-China-FSAP-2017-DAR-IOSCO.pdf>.

the Shanghai Stock Exchange (“**SSE**”) and the Shenzhen Stock Exchange (“**SZSE**”).⁷³ In addition, the SSE has established an independent trading platform, the Science and Technology Innovation Board (“**STAR Board**”), that has more lenient trading regulations than the main SSE board but restricts investor access.⁷⁴

European Union: off-exchange trading is permitted on multilateral trading venues and through broker-dealer internalization, so there is competition across different types of trading venues for stock trading.⁷⁵ In addition, the relevant authorities across the E.U. have approved several stock exchanges that are permitted to compete with each other for trading volume as part of the E.U. single market for investment services.⁷⁶ So there is also competition among exchanges.

Hong Kong: off-exchange trading is permitted on multilateral trading venues and through broker-dealer internalization, so there is competition among different types of trading venues for stock trading. However, there is no competition among stock exchanges, as only one stock exchange, the HKEx, is approved by the SFC.

Japan: off-exchange trading is permitted on multilateral trading venues and through broker-dealer internalization, so competition among different types of trading venues for stock trading is permitted.⁷⁷ However, in practice, such competition is limited as broker-dealers may comply with their best execution obligation by routing to the TSE. Furthermore, there is no competition among national stock exchanges, as only one national stock exchange, the TSE is approved by the FSA.⁷⁸ Finally, a lack of a standardized tick size for the same stock across different trading venue types can also complicate trading venue competition.

United States: off-exchange trading is permitted on multilateral trading venues and through broker-dealer internalization, so there is competition among different types of

⁷³ PIFS Report: Phase I, *supra* note 2, at 1; SHANGHAI STOCK EXCHANGE (May 4, 2018) <https://www.investopedia.com/terms/s/shanghai-stock-exchange.asp>; SHENZHEN STOCK EXCHANGE, *About: Overview* (last visited Apr. 12, 2019) <http://www.szse.cn/English/about/overview/index.html>.

⁷⁴ PIFS Report: Phase I, *supra* note 2, at 1-2.

⁷⁵ PIFS Report: Phase I, *supra* note 2, at 3.

⁷⁶ PIFS Report: Phase I, *supra* note 2, at 39.

⁷⁷ PIFS Report: Phase I, *supra* note 2, at 2; FINANCIAL MARKETS DIVISION, FINANCIAL SERVICES AGENCY (JAPAN), *Agenda for competition among trading venues and alternative trading platforms* (June 15, 2016), <https://www.fsa.go.jp/en/news/2016/20160513-1/03.pdf>.

⁷⁸ PIFS Report: Phase I, *supra* note 2, at 2. As of April 2019, there were 3,665 companies listed on the TSE versus 292 on the Nagoya Stock Exchange (of which only 66 were listed exclusively), 109 on the Fukuoka Stock Exchange (of which 26 were listed exclusively), and 57 on the Sapporo Securities Exchange (of which 16 were listed exclusively). JAPAN EXCHANGE GROUP (JPX), *Number of Listed Companies/Shares* (Apr. 12, 2019), available at <https://www.jpx.co.jp/english/listing/co/index.html> (TSE); NAGOYA STOCK EXCHANGE, *Listed Companies* (Apr. 16, 2019), available at <http://www.nse.or.jp/e/meigara/stockcount/>; FUKUOKA STOCK EXCHANGE, *About Us: Introduction*, <https://www.fse.or.jp/english/about/index.php>; SAPPORO SECURITIES EXCHANGE, *About Sapporo Securities Exchange* (January 1, 2019), available at <https://www.sse.or.jp/about>.

trading venues for stock trading.⁷⁹ In addition, several stock exchanges have been approved by the SEC, each permitted to trade stocks regardless of their primary listing exchange, so there is competition among stock exchanges for trading volume.⁸⁰

As to off-exchange trading, only in the E.U. and U.S. does off-exchange trading constitute a sizable share of overall equity trading volume, representing 46 percent⁸¹ and 35 percent,⁸² respectively, of overall trading volume. In Japan, off-exchange trading represents only 15 percent of overall trading volume, while Hong Kong's off-exchange trading is only 1 percent and Mainland China bans off-exchange trading entirely.⁸³

b. Discussion and analysis of trading venue competition

Regulations should aim to promote both competition among individual *markets* and competition among individual *orders*.⁸⁴ Market competition helps improve the efficiency and innovation of trading services (e.g., fees imposed by the venue, resiliency of the venue, etc.), while order competition (e.g., order price and depth) helps improve price efficiency of individual stocks. The regulatory challenge lies in balancing these inherently conflicting objectives: market competition is best served by decentralized markets, while order competition is best served by more centralized markets. For example, in a centralized market, exchange fees may be relatively high due to a lack of competition that would help reduce such fees. At the other extreme, a highly decentralized market introduces the risk of trading venue isolation and general lack of order competition, whereby an order may be executed on a trading venue without being matched against a better priced order on another trading venue. In that case, investors will not necessarily receive the best execution price that would otherwise be available to them. However, broker-dealers, including those that execute high-frequency trading strategies, provide market liquidity that seeks to minimize such pricing discrepancies across trading venues in a decentralized market structure.

The E.U. and U.S. strike a balance between the benefits of decentralization and the benefits of centralization primarily through the disclosure obligations imposed on broker-dealers and trading venues that allow broker-dealers to achieve best execution across multiple trading venues. Relative to the three other jurisdictions, the E.U. and U.S. impose robust disclosure requirements on broker-dealers in order to promote best execution, mandating that broker-dealers disclose the trading venues that they route to and how they make such routing decisions, including quantitative execution quality

⁷⁹ PIFS Report: Phase I, *supra* note 2, at 3; *Regulation of Exchanges and Alternative Trading Systems*, Exchange Act Release No. 40760, File No. S7-12-98 (Dec. 8, 1998) <https://www.sec.gov/rules/final/34-40760.txt>.

⁸⁰ PIFS Report: Phase I, *supra* note 2, at 3; U.S. SEC. & EXCH. COMM'N, *National Securities Exchanges* (March 2. 2021), <https://www.sec.gov/fast-answers/divisionsmarketregmrexchangesshtml.html>.

⁸¹ As of September 2020. PIFS Report: Phase II, *supra* note 3, at 8.

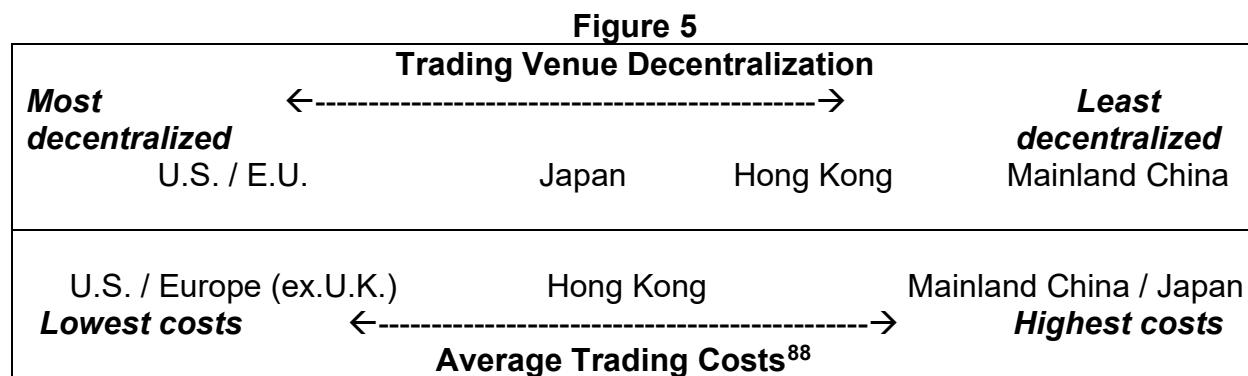
⁸² In 2019. PIFS Report: Phase II, *supra* note 3, at 8.

⁸³ PIFS Report: Phase II, *supra* note 3, at 8.

⁸⁴ See U.S. Sec. & Exch. Comm'n, Regulation NMS (2005).

considerations.⁸⁵ The U.S. also requires that payment for order flow arrangements be disclosed.⁸⁶ Furthermore, trading venues in the E.U. and U.S. must disclose quantitative metrics as to their execution quality (e.g. execution prices on the trading venue as compared to the best price available across all trading venues) that further facilitate investors' ability to assess the execution quality achieved by their broker-dealers.⁸⁷ Due in part to these robust disclosure mandates, orders can be efficiently routed in a decentralized market.

A comparison of the relative degree of decentralization versus average institutional trading costs among the five jurisdictions is consistent with the benefits of decentralization, particularly by fostering competition that lowers overall costs. As illustrated in **Figure 5**, the most decentralized jurisdictions – United States and European Union – also have the lowest transaction costs among the five jurisdictions.



c. Empirical literature on decentralized markets

The empirical literature on decentralized markets (most often referred to as “fragmented” markets in the literature) largely confirms the benefits of a more decentralized market structure for the E.U. and U.S. Overall, several studies find that the increased competition among trading venues in a fragmented market leads to improved market quality, primarily through lower transaction costs and increased depth at the best prices. Additionally, decentralized markets are operationally stable as there is no single point of failure.

Numerous studies focused on the E.U. suggest a positive impact of fragmentation on market quality. Gresse (2012) analyzed the effect of fragmentation in E.U. markets on various market quality metrics, including bid-ask spreads, effective spreads and displayed

⁸⁵ PIFS Report: Phase I, *supra* note 2, at 6, 60, 96. RTS 28, Article 1; 17 C.F.R. § 242.606.

⁸⁶ PIFS Report: Phase I, *supra* note 2, at 95-96; 17 C.F.R. § 242.606(a)(1)(iii).

⁸⁷ PIFS Report: Phase I, *supra* note 2, at 60, 89; MiFIR, Article 23; RTS 27, Articles 3-8; 17 C.F.R. § 242.605.

⁸⁸ See Figure 1.

depth.⁸⁹ The study found that fragmentation generally leads to narrower bid-ask spreads, which reduces transaction costs. In addition, displayed depth at the best prices also improves with increased fragmentation, which can also lower transaction costs by reducing the price impact of larger trades. However, the improvement in depth does not extend to small cap stocks, which saw a reduction in depth as a result of fragmentation.

Spankowski, Wagener & Burghof (2012) also study the effect of market fragmentation in the E.U. on market quality, noting that the London Stock Exchange ("LSE") ceded significant trading volume to competitor trading venues in 2009.⁹⁰ The study finds that the shift in trading volume from the LSE to other venues was correlated with improved market quality measures across all trading venues. Quoted and effective bid-ask spreads declined on all venues, thus resulting in reduced transaction costs. In addition, price impact costs also declined across all trading venues, while order book depth at the best price (and within three ticks of the best price) increased significantly on the LSE.

Similarly, Chlistalla and Lutat (2011) also find benefits of market fragmentation in the E.U. by analyzing the impact of a new trading venue competitor, Chi-X, on the existing stock market, Euronext Paris.⁹¹ The study determines that the additional competitor, Chi-X, improved the liquidity of the most actively traded stocks in their sample, resulting in narrower bid-ask spreads, thus reducing transaction costs. However, the same benefits were not conferred on less actively traded stocks as their trading volume on Chi-X was relatively low.

Finally, in yet another empirical study of fragmentation in the E.U., Degryse, de Jong, and van Kervel (2013) study the effect of fragmentation on market quality in Dutch stocks. The study finds that fragmentation led to narrower bid-ask spreads, and thus lower transaction costs, in Dutch stocks over a 4-year period from 2006 – 2009. While the study also finds that quoted depth at the best prices declined due to fragmentation, the authors note that the post-fragmentation best prices reflected narrower spreads.

Studies of the effect of decentralization in the U.S. show similar results as their E.U. counterparts. For example, O'Hara and Ye (2011) study the effect of fragmentation in U.S. markets by analyzing the impact of increased off-exchange trading.⁹² The study finds that increased fragmentation, as proxied by the relative increase in off-exchange

⁸⁹ Carole Gresse, *Effects of Lit and Dark Trading Venue Competition on Liquidity: The MiFID Experience* (July 2012), [https://www.louisbachelier.org/wp-content/uploads/Effects%20of%20Lit%20and%20Dark%20Trading%20Venue%20Competition%20on\(1\).pdf](https://www.louisbachelier.org/wp-content/uploads/Effects%20of%20Lit%20and%20Dark%20Trading%20Venue%20Competition%20on(1).pdf).

⁹⁰ Ulli Spankowski, Martin Wagener, Hans-Peter Burghof, *The Role of Traditional Exchanges in Fragmented Markets* (Jan. 2012), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1980951.

⁹¹ Michael Chlistalla & Marco Lutat, *Competition in Securities Markets: The Impact on Liquidity*, 25(2) FINANCIAL MARKETS AND PORTFOLIO MANAGEMENT (June 2011), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1865768.

⁹² Maureen O'Hara & Mao Ye, *Is Market Fragmentation Harming Market Quality?*, 100(3) JOURNAL OF FINANCIAL ECONOMICS 459 (2011), https://econpapers.repec.org/article/eeejfinec/v_3a100_3ay_3a2011_3ai_3a3_3ap_3a459-474.htm.

trading, leads to lower transaction costs by narrowing effective spreads and leads to improved price efficiency for all stocks. In addition, execution speeds were also reduced for all stocks.

Jiang, McInish and Upson (2012) also examine the effect of fragmentation in the U.S. The study finds that fragmentation, also proxied by increases in off-exchange trading, leads to improved price efficiency on the exchanges. In addition, the study finds that transactions costs were relatively lower off-exchange, as bid-ask spreads narrowed. Haslag and Ringgenberg (2020) find that fragmentation in U.S. markets is beneficial to investors with respect to larger cap stocks. The study finds that fragmentation leads to lower spreads and improved price efficiency for large cap stocks. However, the study finds the opposite for small cap stocks that are not highly liquid as fragmentation leads to higher spreads and reduced price efficiency.

Finally, the competition among trading venues that arises in a decentralized market serves to not only foster innovation and lower transaction costs, but also improve the stability of equity markets with respect to operational resilience. Claessens (2019) notes that fragmented markets “help in diversifying (operational) risks,” thus strengthening market resiliency and removing the single-point-of-failure concerns of concentrated markets.⁹³

Overall, empirical studies of both the E.U. and U.S. show positive impacts of market decentralization for investors. Transactions costs in the form of bid-ask spreads are reduced, while price impact costs also decline as a result of decentralization. Price efficiency of stocks is also improved, further benefiting all investors. However, certain studies suggest that the benefits of decentralization are less clear for small capitalization stocks that are not highly liquid.

(2) Dark Trading

The cornerstone of all equity markets is that there are one or more “lit” exchanges that provide or contribute to the price discovery process. As noted earlier, “lit” trading is trading that involves the public display of orders, whereas “dark” trading involves the trading of shares without the public display of an order (that is, no pre-trade transparency).⁹⁴ As noted in Part I, however, post-trade execution data – the price and size of each trade – must be publicly disclosed for all trades in the five jurisdictions that we reviewed, so there is no entirely “dark” trading.⁹⁵

By permitting so-called “dark” trading alongside lit trading, retail investors can achieve execution prices that are superior to the national best bid and offer (“NBBO”) which is the best publicly displayed price across all markets (known as price

⁹³ Stijn Claessens, *Fragmentation in Global Financial Markets: Good or Bad for Financial Stability?*, BIS Working Papers No 815, 12 (Oct. 2019), <https://www.bis.org/publ/work815.htm>.

⁹⁴ PIFS Report: Phase I, *supra* note 2, at 4.

⁹⁵ PIFS Report: Phase I, *supra* note 2, at 4. Mainland China does not permit dark trading, so post-transparency for dark trading is not relevant to that jurisdiction.

improvement).⁹⁶ Institutional investors can also benefit from dark trading, as institutional investors frequently submit large block orders that exceed the available depth at the NBBO. If other traders in the market were aware of the large order, prices would likely move against that order, thus imposing significant price impact costs on the institutional investor.⁹⁷ Dark trading allows institutional investors to more efficiently trade large blocks of stock without publicly exposing the size of the order, thus minimizing the potential losses suffered from the negative price impact that occurs with large orders.⁹⁸ As a result, both price improvement for retail investors and the facilitation of efficient block trades for institutional investors are key benefits of dark trading that help contribute to an efficient equity market structure.

However, dark trading also introduces some concerns, particularly as the prevalence of dark trading as a percentage of overall transaction volume increases.⁹⁹ The primary concern with dark trading is that a lack of pre-trade transparency could have a negative impact on price discovery.¹⁰⁰ Trade execution prices for dark trading rely upon the price and volume quotations provided in the lit market (that is, execution prices for dark trading are generally based on the lit quotations).¹⁰¹

The regulation of dark trading differs significantly among the five jurisdictions we reviewed with the U.S. being the most permissive, while Mainland China prohibits dark trading entirely.

⁹⁶ For example, if the NBBO for a stock were a bid of \$10.01 and an ask of \$10.02, the execution price for the dark trade may be \$10.015, which would be an improvement over the NBBO that is possible due to sub-penny pricing.

⁹⁷ See also Commissioner Luis A. Aguilar, *Shedding Light on Dark Pools*, U.S. SEC. & EXCH. COMM’N (Nov. 18, 2015), https://www.sec.gov/news/statement/shedding-light-on-dark-pools.html#_edn9.

⁹⁸ See U.S. SEC. & EXCH. COMM’N, *Regulation of NMS Stock Alternative Trading Systems*, 80 FED. REG. 80997, 81008 (Dec. 28, 2015), <https://www.federalregister.gov/documents/2015/12/28/2015-29890/regulation-of-nms-stock-alternative-trading-systems> (“Dark pools originally were designed to offer certain market participants, particularly institutional investors, the ability to minimize transaction costs when executing trades in large size[.]”).

⁹⁹ For example, dark trading of NYSE stocks increased from 13% of total trading volume in 2005 to 37% by 2016. See U.S. SEC. & EXCH. COMM’N, *Memorandum from SEC Division of Trading and Markets to SEC Market Structure Advisory Committee, Rule 611 of Regulation NMS*, 11-12 (Apr. 30, 2015), available at <https://www.sec.gov/spotlight/emsac/memo-rule-611-regulation-nms.pdf>; and see TABB Group, Equities Liquidity Matrix May 2016, available at http://mm.tabbforum.com/liquidity_matrices/187/documents/original_2016-05_Equities_Liquidity_Matrix_May_2016.pdf.

¹⁰⁰ See U.S. SEC. & EXCH. COMM’N, *Equity Market Structure Literature Review, Part I: Market Fragmentation* (Oct. 7, 2013).

¹⁰¹ See U.S. SEC. & EXCH. COMM’N, Securities Exchange Act Release No. 34-61358, 75 FED. REG. 3594 (Jan. 21, 2010).

a. Regulatory overview

Mainland China: dark trading is prohibited.¹⁰²

European Union: exchanges and multilateral trading venues may engage in dark trading with limits determined by the total amount of dark trading in a stock *per venue* and across *all venues*.¹⁰³ Dark trading conducted through broker-dealer internalization is permitted only for orders above the standard market size.¹⁰⁴

Hong Kong: dark trading is prohibited on the HKEx but permitted on multilateral trading venues and through broker-dealer internalization.¹⁰⁵

Japan: dark trading is prohibited on the TSE but permitted on multilateral trading venues and through broker-dealer internalization.¹⁰⁶

United States: dark trading is permitted on exchanges, multilateral trading venues and through broker-dealer internalization.¹⁰⁷ However, multilateral trading venues must publicly display orders in a specific stock if they display orders to participants on the trading venue and execute more than 5% of total trading volume across all trading venues in that stock (a high threshold that is not met, in practice).¹⁰⁸

A comparison of the relative permissibility of dark trading versus price impact costs among the five jurisdictions is consistent with the notion that dark trading helps to reduce transaction costs, particularly by reducing the price impact of large trades. As illustrated in **Figure 6**, the most permissive jurisdictions – the E.U. and U.S. – also have the lowest price impact costs among the five jurisdictions.

¹⁰² PIFS Report: Phase I, *supra* note 2, at 4.

¹⁰³ PIFS Report: Phase I, *supra* note 2, at 4; MiFID 2 Regulation, Article 5.

¹⁰⁴ “Standard market size” is the average value of transactions for each financial instrument over the preceding year in the EU, subject to certain adjustments. PIFS Report: Phase I, *supra* note 2, at 49.

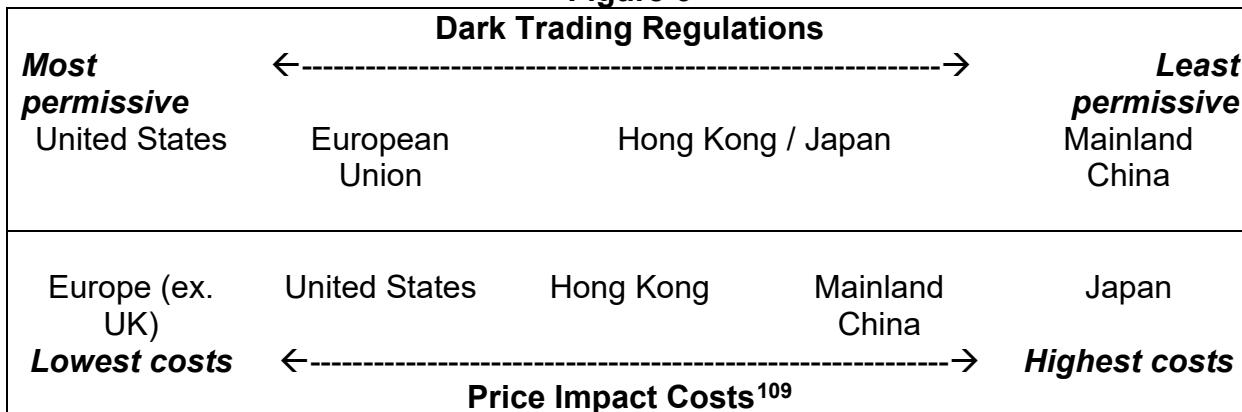
¹⁰⁵ PIFS Report: Phase I, *supra* note 2, at 4; INTERNATIONAL MONETARY FUND, MONETARY AND CAPITAL MARKETS DEPARTMENT, *People’s Republic of China–Hong Kong Special Administrative Region: Financial Sector Assessment Program-IOSCO Objectives and Principles of Securities Regulation-Detailed Assessment of Observance*, Country Report No. 14/205, 212 (July 16, 2014); IMF, Hong Kong: *IOSCO Objectives and Principles of Securities Regulation* at 214.

¹⁰⁶ PIFS Report: Phase I, *supra* note 2, at 4; INTERNATIONAL MONETARY FUND, MONETARY AND CAPITAL MARKETS DEPARTMENT, *Japan: IOSCO Objectives and Principles of Securities Regulation— Detailed Assessment of Implementation*, IMF Country Report No. 12/230, 7 (August 2012).

¹⁰⁷ PIFS Report: Phase I, *supra* note 2, at 4; OECD, *Changing business models of stock exchanges and stock market fragmentation*, in OECD Business and Finance Outlook 2016, 127, 130-31 (2016), available at <https://www.oecd.org/daf/ca/BFO-2016-Ch4-Stock-Exchanges.pdf>.

¹⁰⁸ PIFS Report: Phase I, *supra* note 2, at 5; Requirements for Alternative Trading Systems, 17 C.F.R. § 242.301(b)(3).

Figure 6



b. Empirical literature on dark trading

A substantial body of empirical literature finds that dark trading (as a complement to lit trading) has an overall positive effect on investors, particularly with respect to minimizing trading costs and ensuring that the market price of a stock accurately reflects the current market-wide supply and demand for the stock, known as “price discovery.”

Empirical studies have shown that dark trading leads to narrower bid-ask spreads and increased market depth, each of which directly lowers costs for *all* investors – both institutional and retail. Certain studies focus on an assessment of “dark pools,” which they generally define as multilateral trading venues that operate without pre-trade price transparency—such as alternative trading systems in the U.S. and multilateral trading facilities in the E.U.¹¹⁰ Other studies evaluate “dark trading,” which they generally define as including trading on multilateral trading venues that operate without pre-trade transparency and trades that are internalized by broker-dealers.

Buti, Rindi, and Werner (2011) examine the effect of dark pools¹¹¹ on various market quality measures in U.S. markets, using data voluntarily provided by several dark

¹⁰⁹ See Figure 1.

¹¹⁰ This is consistent with the SEC’s definition of dark pools. U.S. SEC. & EXCH. COMM’N, *Regulation of NMS Stock Alternative Trading Systems*, 80 FED. REG. 80997, 81008 (Dec. 28, 2015), <https://www.federalregister.gov/documents/2015/12/28/2015-29890/regulation-of-nms-stock-alternative-trading-systems> (“Another significant aspect of the increased role of NMS Stock ATSs in equity market structure is the proliferation of ATSs that trade NMS stocks but do not publicly display quotations in the consolidated quotation data, commonly referred to as ‘dark pools.’”).

¹¹¹ Buti, Rindi, and Werner (2011) appear to define “dark pools” as alternative trading systems that do not display quotations in the consolidated quotation data, because they refer to the SEC Concept Release on Equity Market Structure (2010) that uses that definition. They exclude internalized trades from their analysis. Sabrina Buti, Barbara Rindi, Ingrid M. Werner, *Diving Into Dark Pools*, Fisher College of Business Working Paper No. 2010-03-010, 4 (March 2016), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1630499.

pool operators over a one-year period in 2009.¹¹² The study generally finds that increased dark pool trading activity leads to narrower bid-ask spreads and increased depth at best prices.

The CFA Institute conducted an empirical study of dark trading,¹¹³ examining the link between dark trading and market quality in the U.S. from 2009 through early 2011.¹¹⁴ The study finds that increased dark trading leads to narrower bid-ask spreads and increased best price depth. The authors additionally note a threshold effect by which market quality improves with increased dark trading up until a certain threshold, beyond which market quality begins to deteriorate. The authors estimate that the threshold turning point is approximately 46.7% of total equity trading volume conducted through dark trading.¹¹⁵ In the U.S., as of February 2021, approximately 40% of total equity trading by dollar volume is executed in the dark on off-exchange trading venues.¹¹⁶

In addition to reducing transactions costs and increasing depth, dark trading has also been shown to benefit investors through its positive impact on price discovery. Comerton-Forde and Putnins (2015) examine the impact of dark trading¹¹⁷ on price discovery, using highly granular data on equity trading in Australia.¹¹⁸ The study finds that dark trading introduces a degree of self-selection among traders with relatively more informed traders transacting in lit markets and less-informed traders transacting in dark markets. The result is better-informed trades in lit markets as fundamental information is incorporated into prices by informed trades, thus improving price discovery in those markets. In addition, since dark trading relies on prices in the lit market, the improved price discovery benefits investors transacting through dark trading as well. The authors find that overall dark trading has a positive impact on price discovery.

¹¹² Sabrina Buti, Barbara Rindi, Ingrid M. Werner, *Diving Into Dark Pools*, Fisher College of Business Working Paper No. 2010-03-010 (March 2016), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1630499.

¹¹³ The CFA Institute includes both dark pools and broker-dealer internalizers in its analysis of dark trading, and it defines “dark pools” as “systematized execution facilities that operate without full pre-trade transparency.” CFA INSTITUTE, *Dark Pools, Internalization, and Equity Market Quality*, 60 (Oct. 2012), <https://www.cfainstitute.org/-/media/documents/article/position-paper/dark-pools-internalization-equity-market-quality.ashx>.

¹¹⁴ CFA INSTITUTE, *Dark Pools, Internalization, and Equity Market Quality* (Oct. 2012), <https://www.cfainstitute.org/-/media/documents/article/position-paper/dark-pools-internalization-equity-market-quality.ashx>.

¹¹⁵ CFA INSTITUTE, *Dark Pools, Internalization, and Equity Market Quality*, 58 (Oct. 2012), <https://www.cfainstitute.org/-/media/documents/article/position-paper/dark-pools-internalization-equity-market-quality.ashx>.

¹¹⁶ See Alexander Osipovich, *GameStop Mania Highlights Shift to Dark Trading*, Wall Street Journal, February, 12, 2021. Available at: <https://www.wsj.com/articles/gamestop-mania-highlights-shift-to-dark-trading-11613125980>.

¹¹⁷ The study does not clearly distinguish between dark pools and dark trading, stating that: “Dark trading of old includes block orders managed by upstairs brokers and orders in the pockets of floor brokers not yet revealed to the market. Today’s dark pools systematically match orders without providing any pre-trade transparency.” Carole Comerton-Forde & Talis J. Putnins, *Dark Trading and Price Discovery*, 118 JOURNAL OF FINANCIAL ECONOMICS 70, 2-3 (June 2015), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2183392.

¹¹⁸ See Carole Comerton-Forde & Talis J. Putnins, *Dark Trading and Price Discovery*, 118 JOURNAL OF FINANCIAL ECONOMICS 70, (June 2015), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2183392.

Anganostidis, Papachristou and Varsakelis (2019) find a similar result in an empirical examination of dark trading in E.U. equity markets.¹¹⁹ The study analyzes the impact of a 2018 European Securities and Markets Authority ban on dark trading of securities whose dark trading volume exceeds certain thresholds. The study finds that the ban led to an increase in volatility for the affected stocks and led to a decrease in price efficiency for all other stocks in the lit market. The authors argue that the ban led to a migration of uninformed investors from the dark to lit markets, similar to the findings in Comerton-Forde and Putnins (2015). The overall result of the ban on dark trading was a deterioration in price discovery, further illustrating the beneficial effect of dark trading on efficient markets.

Finally, empirical research has also determined that institutional investors further benefit from improved trade execution quality on block trades resulting from dark trading on certain off-exchange trading venues. Boni, Brown and Leach (2013) study the impact of dark pools¹²⁰ on trade execution quality for U.S. equity trading.¹²¹ The study finds that dark pools specifically designed for institutional investors resulted in superior execution quality for block trades, including reduced price impact costs.

Not all empirical research fully supports the positive impact of dark trading with respect to market efficiency, however. For example, Hatheway, Kwan and Zheng (2013) also examine the effect of dark trading¹²² on market quality in U.S. equity markets.¹²³ The study finds that non-block dark trading leads to wider effective spreads, thus increasing transaction costs for non-block trades. In addition, the study finds that nearly half of dark trades are executed without price improvement over the NBBO. These results, however, are not conclusively negative with respect to dark trading. First, the study uses off-exchange trading volume to estimate dark volumes, which is a poor proxy for dark trading, because dark trading also occurs on exchanges.¹²⁴ Second, the lack of price improvement over the NBBO is not necessarily a suboptimal result, since dark trading may be reducing price impact costs, even at the NBBO. Furthermore, the study's results are mixed, as it also finds that large block trades conducted in the dark are associated with narrower spreads, thus decreasing transaction costs in those instances, and benefiting institutional investors.

¹¹⁹ See Panagiotis Anganostidis, George Papachristou & Christos Varsakelis, *Market Quality and Dark Trading in the Post MiFID II Era: What Have We Learned So Far?*, 184 ECONOMIC LETTERS (Nov. 2019), <https://www.sciencedirect.com/science/article/abs/pii/S0165176519303106>.

¹²⁰ The study defines "dark pools" as alternative trading systems that do not disseminate their quotes to the public. Leslie Boni, David C. Brown, J. Chris Leach, *Dark Pool Exclusivity Matters*, 2 (Dec. 2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2055808.

¹²¹ See Leslie Boni, David C. Brown, J. Chris Leach, *Dark Pool Exclusivity Matters* (Dec. 2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2055808.

¹²² Frank Hatheway, Amy Kwan & Hui Zheng, *An Empirical Analysis of Market Segmentation on U.S. Equities Markets*, working paper, 2 (2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2275101.

¹²³ See Frank Hatheway, Amy Kwan & Hui Zheng, *An Empirical Analysis of Market Segmentation on U.S. Equities Markets*, working paper (2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2275101.

¹²⁴ Off-exchange trading includes lit trades. In addition, dark trading can occur on exchanges. So off-exchange trading is a poor proxy for dark trading activity.

Although “lit” trading on stock exchanges forms the bedrock of equity markets, the empirical evidence shows that “dark” trading as a complement to lit trading can provide retail and institutional investors with lower transaction costs and even enhance the price discovery process.

(3) High Frequency Trading

As noted in Phase I of PIFS’ *International Review of Equity Market Structure*, in modern equity markets, aspects of the trading process that were traditionally done manually, such as execution and order-routing, are now automated (electronic). Algorithmic trading—trading in which computers are involved in making trading decisions with limited human involvement—has become increasingly common.¹²⁵ High frequency trading (“HFT”) refers to a subset of algorithmic trading that relies on processing information from trading venues and entering orders at trading venues at high speed. Accordingly, HFT is characterized by the use of special infrastructure to minimize latencies—the time it takes to send data to a particular end point (and potentially back again).¹²⁶

HFT strategies fall into three basic categories that have always existed in equity markets.¹²⁷ First, market making which involves providing liquidity to the market by maintaining limit orders on both sides of trades.¹²⁸ Market makers must be able to quickly assess changes in supply and demand for stocks and promptly update the prices at which they are willing to buy and sell. Second, arbitrage strategies, whereby arbitrageurs identify price discrepancies that arise between portfolios of assets or the same assets on different trading venues and conduct trades that bring those prices back in line.¹²⁹ Third, directional HFT strategies that involve trading rapidly as new information regarding the supply and demand for a stock becomes available from exchange market data. Directional HFT strategies help make the price discovery process more efficient and improve the accuracy of stock prices.¹³⁰ HFT strategies typically feature a high volume of orders (which, in line with the strategies described, may be revised or cancelled shortly after submission) and very low average profits per trade.¹³¹ They also usually involve ending the trading day with as relatively neutral a position as possible (that is, not carrying significant, unhedged positions overnight).¹³² Thus, HFT strategies are high-speed variations of manual trading strategies and represent the application of technology to further automate and enhance how these strategies are deployed in the market.

¹²⁵ See PIFS Report: Phase I, *supra* note 2, at 10. Terrence Hendershott, Charles M. Jones, and Albert J. Menkveld, *Does Algorithmic Trading Improve Liquidity?*, 66:1 J. OF FIN. 1, 2 (February 2011).

¹²⁶ See PIFS Report: Phase I, *supra* note 2, at 10. Maureen O’Hara, *High frequency market microstructure*, 116:2 J. OF FIN. ECON. 257, 258-60 (2015).

¹²⁷ PIFS Report: Phase I, *supra* note 2, at 10-11.

¹²⁸ PIFS Report: Phase I, *supra* note 2, at 10.

¹²⁹ PIFS Report: Phase I, *supra* note 2, at 10.

¹³⁰ PIFS Report: Phase I, *supra* note 2, at 10-11.

¹³¹ PIFS Report: Phase I, *supra* note 2, at 11.

¹³² See STAFF OF THE DIVISION OF TRADING & MARKETS, US. SEC. & EXCH. COMM’N, *Equity Market Structure Literature Review – Part II: High Frequency Trading*, 4 (March 18, 2014), available at https://www.sec.gov/marketstructure/research/hft_lit_review_march_2014.pdf.

The regulatory approach to HFT strategies differs significantly among the five jurisdictions we reviewed with Mainland China being the most restrictive, effectively prohibiting HFT activity entirely. On the other hand, HFT strategies are subject to extensive regulations in the other markets that we review.

a. Regulatory overview

Mainland China: HFT strategies are effectively prohibited, given that equity trading is subject to settlement regulations that forbid selling securities until they are settled – typically on a T+1 basis.¹³³ In other words, a market participant cannot resell a stock the same day that it initially purchases that stock.¹³⁴ As a result, HFT strategies, which inherently involve extremely short holding periods (of seconds), are effectively prohibited.

European Union: Algorithmic traders (including those employing HFT strategies) must notify regulators and implement extensive risk controls, while also complying with comprehensive recordkeeping requirements.¹³⁵ Firms that employ market making algorithms must agree to employ risk controls and recordkeeping requirements on a continuous basis.¹³⁶ Finally, HFT strategies specifically are subject to additional recordkeeping requirements.¹³⁷

Hong Kong: HFT strategies effectively are regulated as part of the general regulation of electronic trading.¹³⁸ Firms engaged in electronic trading (including HFT strategies) must adopt risk controls and provide clients with adequate risk disclosures.¹³⁹ In addition, the SFC imposes testing and recordkeeping requirements on algorithmic traders.¹⁴⁰

Japan: Firms engaged in HFT strategies (so determined by the physical proximity of the firm's trading system to a trading venue) are required to register with the FSA, provide the FSA with trading information, and adopt risk controls in supervisory guidelines.¹⁴¹

United States: Firms engaged in algorithmic trading or HFT are either regulated as broker-dealers or subject to supervision and risk controls by their broker-dealer if the broker-dealer provides the firm “sponsored access,” whereby the trader can trade on an

¹³³ PIFS Report: Phase I, *supra* note 2, at 25; Chapter III (Securities Trading), 3.1.4.

¹³⁴ Note that the T+1 settlement period itself does not prevent short-holding periods, since a trader can still buy and sell a security on the same day with both sides of the trade settling the following day (T+1). However, Mainland China mandates that the sale not occur until after the T+1 settlement period, so the sale cannot occur on the same day as the purchase.

¹³⁵ PIFS Report: Phase I, *supra* note 2, at 12; Commission Delegated Regulation (EU) 2017/589 of 19 July 2016 supplementing Directive 2014/65/EU of the European Parliament and of the Council with regard to regulatory technical standards specifying the organizational requirements of investment firms engaged in algorithmic trading ('RTS 6'); MiFID 2 Directive, Article 17.

¹³⁶ PIFS Report: Phase I, *supra* note 2, at 65; MiFID 2 Directive, Article 17(3).

¹³⁷ PIFS Report: Phase I, *supra* note 2, at 66; MiFID 2 Directive, Article 17; RTS 6, Article 28.

¹³⁸ PIFS Report: Phase I, *supra* note 2, at 11, 35-37.

¹³⁹ PIFS Report: Phase I, *supra* note 2, at 11; HK Code of Conduct, § 18.1-18.6.

¹⁴⁰ PIFS Report: Phase I, *supra* note 2, at 11; HK Code of Conduct, § 8.10-8.11, Schedule 7, 3.2-3.4.

¹⁴¹ PIFS Report: Phase I, *supra* note 2, at 80; Financial Instruments Exchange Act Articles 66-50, 66-51; Cabinet Office Order on Financial Instruments Business, etc., Articles 327-329..

exchange using the broker-dealer's access to the exchange.¹⁴² In either case, the firms must comply with stringent risk controls and disclosure requirements to prevent erroneously disruptive trading activity.¹⁴³

b. Empirical literature on high frequency trading

The empirical literature examining the relationship between HFT strategies and market quality, including transaction costs and price efficiency, generally find a positive impact of HFT on equity market structure performance. In a survey of empirical literature, Jones (2013) finds that the vast majority of empirical studies show that HFT strategies are associated with reductions in transaction costs, improved liquidity (and thus, lower price impact costs), and improved price discovery.¹⁴⁴ In addition, Gomber et al. (2011) find that "the majority [of academic literature] argues that HFT [strategies] generally contribute to market quality and price formation and finds positive effects on liquidity and short-term volatility."¹⁴⁵

Several empirical studies show that HFT strategies are associated with reduced transaction costs, primarily through the narrowing of bid-ask spreads. For example, Jovanovic and Menkeld (2012) study the effect of HFT on transaction costs in the Dutch equity market. The study finds that the entry of a large firm, primarily engaged in HFT, was associated with an overall 15 percent narrowing of effective spreads, thus reducing transaction costs for all investors.¹⁴⁶ Similarly, Bershova and Raklin (2013) examine the effect of HFT activity on long-term institutional investors, using data in the Tokyo and London equity markets, finding that HFT leads to a significant reduction in transaction costs, primarily from a narrowing of spreads.¹⁴⁷

Malinova, Park and Riordan (2018) also examine the impact of HFT on trading costs by analyzing the effect of changes in regulatory fees in Canadian equity markets that affected HFT market-making strategies.¹⁴⁸ The study found that the negative impact of such fees on HFT market-making led to a widening of bid-ask spreads by 13 percent and 9-percent increase in the effective spreads for retail investors. Finally, with respect

¹⁴² PIFS Report: Phase I, *supra* note 2, at 98; U.S. SEC. & EXCH. COMM'N, *Guide to Broker-Dealer Registration* (Apr. 2008), <https://www.sec.gov/reportspubs/investor-publications/divisionsmarketregbdguidehtm.html#I>; U.S. SEC. & EXCH. COMM'N, *SEC Proposes Rule to Require Broker-Dealers Active in Off-Exchange Market to Become Members of National Securities Association* (Mar. 25, 2015), <https://www.sec.gov/news/pressrelease/2015-48.html>.

¹⁴³ PIFS Report: Phase I, *supra* note 2, at 99; 17 C.F.R. § 240.15c3-5; U.S. SEC. & EXCH. COMM'N, *Risk Management Controls for Brokers or Dealers with Market Access*, Exchange Act Release No. 34-63241 (Nov. 3, 2010), <https://www.sec.gov/rules/final/2010/34-63241.pdf>.

¹⁴⁴ See Charles M. Jones, *What Do We Know about High-Frequency Trading?*, Columbia Business School Research Paper No. 13-11 (Mar. 2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2236201.

¹⁴⁵ See Peter Gomber et al., *High-Frequency Trading*, Goethe-Universitat Working Paper (2011).

¹⁴⁶ See Boyan Jovanovic & Albert J. Menkeld, *Middlemen in Limit-Order Markets*, Working Paper (2012), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1624329.

¹⁴⁷ See Nataliya Bershova & Dmitry Raklin, *High-Frequency Trading and Long-Term Investors: A View from the Buy-Side*, 2(2) JOURNAL OF INVESTMENT STRATEGIES 25 (Spring 2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2066884.

¹⁴⁸ See Katya Malinova, Andreas Park & Ryan Riordan, *Do Retail Investors Suffer from High Frequency Traders?* (Jan. 11, 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2183806.

to the positive impact of HFT on transaction costs, Hendershott, Jones and Menkveld (2011) study the implementation of the automated quote at the New York Stock Exchange, which enabled HFT activity on the exchange.¹⁴⁹ The study finds that the auto-quote led to an increase in electronic message traffic, a key characteristic of HFT strategies, which reduced transaction costs by narrowing effective spreads.¹⁵⁰

Not all empirical research on the relationship between HFT and transaction costs is positive, however. For example, Tong (2015) studies HFT activity in U.S. equity markets, using NASDAQ data and a proprietary dataset of institutional trading activity.¹⁵¹ The study finds that increased HFT activity is associated with higher price impact costs.

Empirical research has also found that HFT improves price discovery. Brogaard, Hendershott and Riordan (2013) analyze NASDAQ data in U.S. equity markets to examine the effect of HFT activity on price efficiency.¹⁵² The study finds that aggressive HFT activity improves the price efficiency of stocks by reinforcing permanent price changes and counteracting transitory errors in pricing. Similarly, Benos and Sagade (2013) also examine the impact of HFT on price discovery and find that more aggressive liquidity taking HFT activity contributes positively to price discovery.¹⁵³ Finally, Carrion (2013) analyzes the impact of aggressive liquidity taking HFT activity on price efficiency, finding that price efficiency improves significantly with increased liquidity taking HFT activity.¹⁵⁴

Thus, the benefits of HFT strategies for modern equity markets has been well demonstrated across a variety of markets.

C. Discussion and Recommendations

Each of the three regulatory areas outlined above—the effective regulation of trading venue competition, dark trading (as a complement to lit trading) and electronic, algorithmic and HFT—contribute to the relatively strong equity market structure performance in the U.S. and E.U.

¹⁴⁹ Terrence Hendershott, Charles Jones, and Albert Menkveld, *Does Algorithmic Trading Improve Liquidity?* 66(1) JOURNAL OF FINANCE (Feb. 2011), <https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1540-6261.2010.01624.x>.

¹⁵⁰ Terrence Hendershott, Charles Jones, and Albert Menkveld, *Does Algorithmic Trading Improve Liquidity?* 66(1) JOURNAL OF FINANCE 30-31 (Feb. 2011), <https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1540-6261.2010.01624.x>.

¹⁵¹ Lin Tong, *A Blessing or a Curse? The Impact of High Frequency Trading on Institutional Investors*, European Finance Association Annual Meetings 2014 Paper Series (Oct. 2015), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2330053.

¹⁵² Jonathan Brogaard, Terrence Hendershott & Ryan Riordan, *High Frequency Trading and Price Discovery* (2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1928510.

¹⁵³ Evangelos Benos and Satchit Sagade, *High-frequency trading behaviour and its impact on market quality: evidence from the UK equity market*, Bank of England working paper (2013).

¹⁵⁴ Allen Carrion, *Very Fast Money: High-Frequency Trading on the NASDAQ* (2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2122716.

First, market decentralization encourages competition among trading venues that leads to improved market quality, primarily through lower transaction costs, increased depth at the best prices and improved price efficiency. Additionally, decentralized markets are also more operationally stable as there is no single point of failure.

Second, dark trading (as a complement to lit trading) benefits investors by providing execution prices that reduce trading costs, while also allowing institutional investors to minimize price impact costs when trading large blocks of stock. Price discovery in lit markets is also improved by the increased prevalence of dark trading, further benefitting *all* investors.

Finally, an active presence of electronic trading, algorithmic trading and particularly HFT activity is another important characteristic of efficient markets. HFT improves overall market quality and helps to reduce transaction costs through lower bid-ask spreads. In addition, HFT can contribute to increased liquidity, while also improving price discovery in equity markets. Each of these positive effects serves to benefit *all* investors.

Given the importance of the regulations that enable these three characteristics of the E.U. and U.S. equity market structure – trading venue competition, dark trading, and electronic, algorithmic and HFT – and their positive impact on equity market structure performance, we recommend that policymakers in jurisdictions that lack such trading activity consider implementing similar regulations. The following are our recommendations for three key principles that should guide the regulation of trading venue competition, dark trading (as a complement to lit trading) and electronic, algorithmic and HFT.

Policy Recommendations

- (1) Regulations should support a decentralized market structure and encourage competition by permitting multiple stock exchanges, multilateral trading venues, and broker-dealer internalization. Enhanced transparency requirements for broker-dealer routing and trading venue execution performance can facilitate competition and lower transaction costs.
- (2) Trading without pre-trade transparency can act as a complement to lit trading and should be permitted on all trading venues, including stock exchanges and off-exchange trading platforms, including multilateral trading venues and through broker-dealer internalization.
- (3) Electronic trading, algorithmic trading and high frequency trading should be recognized as important aspects of efficient markets. Regulations such as registration requirements, risk controls, disclosure obligations, and prohibitions on manipulative trading practices (e.g., spoofing) should be applied to such trading activity as they are applied to manual trading.

Program on International Financial Systems (PIFS)
134 Mount Auburn Street, Cambridge, MA 02138
www.pifsinternational.org