Has stock exchange demutualization improved market quality? International Evidence

Kobana Abukari[1] & Isaac Otchere[2]

Abstract

We investigate the market quality effects of stock exchange demutualization and find that demutualized exchanges have achieved significant improvements in market quality following their conversion from mutual to for-profit structure. Demutualized exchanges have realized significant reductions in transaction costs in the post-demutualization period. The benefits are unevenly distributed, with those in developed countries realizing most of the benefits of demutualization. We explore the potential sources of the reductions in spreads on demutualized exchanges and find that, consistent with the predictions of the laws of demand and supply, the increased order flow, market share, and increased listings following demutualization, contribute to the falling spreads. Interestingly, we also find that demutualized exchanges that subsequently go public after demutualization experience incremental improvements in market quality. Our results are robust to different measures of market quality, different model specifications and placebo event date.

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Corresponding author: Isaac Otchere: isaac.otchere@carleton.ca

[1] Laurentian University, Sudbury, ON, P3E 2C6, Canada

[2] Sprott School of Business, Carleton University, Ottawa, ON, K1S 5B6, Canada

1 Introduction

The current business environment in which stock exchanges operate is characterized by unprecedented levels of competition. Technological advancements and globalization have contributed to the heightened competition in the industry. The increased competition emanates from within (i.e., among exchanges themselves) and from electronic communications networks (ECNs), as well as dark pools. In response to these competitive threats, the major stock exchanges have resorted to demutualization, among others, as a strategy for coping with the increased competition. Since 1993 when the Stockholm stock exchange became the first financial exchange to convert from not-for-profit to for-profit entity, demutualization among stock exchanges has become widespread. Data from the World Federation of Exchanges (WFE) shows that the percentage of WFE members that are mutual has reduced dramatically from 40% in 1999 to only 15% in 2013. During the same period, the number of demutualized stock exchanges has increased from 10% in 1999 to 62% in 2013 (WFE 2013). The prevalence of stock exchange demutualization is largely based on the anticipated benefits that the conversion brings to stock exchanges. These benefits include the capacity to tap into new sources of financing for expansion and technology investment, the ability to pursue business opportunities without being constrained by members' self-interest and to control costs, enhance flexibility, efficiency and competitiveness (Steil 2002; Serifsoy 2008), as well as the ability to use the exchange's shares as a currency to finance acquisitions.

Stock exchanges are in the business of matching buyers and sellers of securities and providing a mechanism for price discovery (Hasan et al. 2003), hence market quality is fundamentally important to them so much that they are constantly looking for ways to improve it. Given that market quality is central to everything that the stock exchange does, we conjecture that demutualization will affect

market quality. This conjecture is predicated on a number of reasons.

First, the profit motive that accompanies demutualization will drive the converted exchanges to improve organizational performance and market quality, a key intangible asset of stock exchanges. The quest to maximize profits will motivate demutualized stock exchanges to adopt measures that increase order flow and trading volume in order to grow their businesses and improve their profitability. As order flow and trading volume increase, liquidity improves and the laws of demand and supply predict that there would be a decrease in bid-ask spreads as a result. Demutualized stock exchanges use an array of tactics to increase order flow, including providing incentives to market makers to use their trading systems (Lee 2002). Malinova and Park (2015) note that North American stock exchanges[1] have introduced incentive schemes for traders to post attractively priced limit orders (maker-taker pricing) as a strategy for competing for trading volume.[2]

Second, one central reason for demutualizing is to improve the governance and performance of the exchange. Mendiola and O'Hara (2003) assert that replacing exchanges' cooperative structure with a corporate structure provides a better governance framework that allows the exchange to compete effectively. Effective governance structures have several benefits including improved financial and operational transparency and accountability (Chung et al. 2010). Therefore, by decoupling trading rights from ownership and management, demutualization may signal to market participants that the exchange is a transparent organization. This signal of transparency could bolster the confidence of issuers and investors, which can be instrumental in attracting order flow, thereby increasing trading volume and liquidity on the demutualized stock exchanges.

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[1] It should be noted that almost all the major North American stock exchanges have demutualized.

[2] In contrast, mutual stock exchanges may not be equally motivated to adopt measures that will enhance the exchanges' value and quality since the self-interest of their members is their primary goal (and not profit maximization). Domowitz and Steil (2001) argue that the incentive structure of mutual exchanges differs from that of demutualized exchanges because the former derives profits from intermediating non-member transactions. This dependence could induce members of mutual stock exchanges to resist "innovations that reduce demand for their intermediation services, even if such innovations would increase the value of the exchange" (pp. 366).

Third, demutualized stock exchanges typically invest in technology and automation (Domowitz and Steil 2001; Lee 2002; Krishnamurti et al. 2003),[3] investments that a mutual exchange may not be able to undertake easily. Investments in technology and automation improve transparency of an exchange and ultimately market quality since the dissemination of high quality information to market participants can be done cheaply, quickly and easily. As Jain (2005) notes, through the transparent display and efficient archiving of quotes, depths, orders, and transactions, computerized trading systems can increase the amount of publicly available information about the demand for and supply of stocks. The increased transparency makes an exchange an attractive location for investors to trade because it reduces information asymmetry. The attendant increase in order flow to the exchange could generate higher trading volume, reduce bid-ask spreads and ultimately improve market quality. Investments in technology and automation also directly improve market quality by reducing the speed of execution and lowering trading costs (Riordan and Storkenmaier 2012).[4]

Based on the foregoing discussion, we postulate that stock exchange demutualization will improve market quality, an important aspect of demutualization that has not received much attention in the literature. To the best of our knowledge, only Krishnamurti et al. (2003), using firm-level data, demonstrate that transaction cost on the National Stock Exchange in India improved following demutualization. While this study provides preliminary evidence on the market quality implications of stock exchange demutualization, it has limited generalizability because it examines only one demutualized stock exchange in one country (India). Thus, whether or not demutualization leads to improvements in market quality in other countries remains unresolved, a gap which we hope to fill.

[3] Domowitz and Steil (2001) note that demutualization usually begins with a conversion from traditional floor trading technology to automated trade execution.

[4] On the contrary, members of mutual stock exchanges may resist automation because it would allow the exchange to grant trading access directly to investors which will not be in the best interest of the members since that creates direct competition for members who derive revenues from intermediating non-member trades.

An even more important reason for examining the link between demutualization and market quality is that improvements in market quality have implications for the wider investment community, in particular, investors and issuers. When the quality of the market improves because of enhanced liquidity and reduced bid-ask spreads, investors benefit from reductions in transaction costs and issuers also experience decreases in cost of capital. Several studies (including Amihud and Mendelson 1986) have demonstrated that greater liquidity of a security leads to lower cost of capital.

We use a large dataset of daily data of firms listed on 41 stock exchanges to examine the effects of stock exchange demutualizations completed between 1993 and 2013. Given the available data, we analyze the cost dimension of market quality (using effective bid-ask spreads and quoted bid-ask spreads) over a six-year period starting one year before, and up to five years after the date of demutualization. We find that effective (and quoted) spreads decrease by 4.7% (and 5.5%) on demutualized stock exchanges following the conversion. The reductions in transaction costs are asymmetrically distributed, with the benefits accruing almost exclusively to developed exchanges.

We also find that demutualized stock exchanges experience significant reductions in risk, with standard deviation of returns (high-minus-low) of listed firms decreasing by about 7.1% (5.7%) on demutualized exchanges in the post-conversion period. While demutualized exchanges in developed countries experienced reductions in both measures of risk following the conversion to for-profit entities, those in emerging markets experienced a reduction in only standard deviation of about 3% in the post-demutualization period. We contend that the competitive threats that demutualized stock exchanges in developed countries face provide strong incentives for them to undertake value-enhancing actions that increase order flow (and maximize profits), improve liquidity, and reduce spreads.

We also examine the potential sources of the reduction in spreads on demutualized stock

exchanges and find that increased market share, increased listings and technology investments, all of which increase (the supply of) order flow, contribute to the reduction in spreads in the post-demutualization period as predicted by the laws of demand and supply. Interestingly, firms listed on demutualized exchanges that subsequently become publicly traded entities themselves experience additional reductions in spreads in the post-IPO period. We carry out a series of robustness tests to confirm our key findings of reduction in spreads following stock exchange demutualization.

Our paper makes important contributions to the academic literature. It provides the only comprehensive empirical evidence on the impact of stock exchange demutualization on market quality at the firm level in a multi-exchange and multi-country setting. As a result, the study enriches the literature on both demutualization and market quality. In addition, our findings have several implications for practitioners. Investors can use the empirical evidence on the cost of transacting on demutualized and mutual stock exchanges to inform their trading location decisions. Also, managers of stock exchanges considering demutualization and/or undertaking initial public offering can use the evidence provided in this paper to justify their decision. Similarly, managers of firms interested in raising capital can inform themselves (using the results of this study) of the types of stock exchanges that may provide the lowest cost of raising capital.

The rest of the paper proceeds as follows. Section two is devoted to a review of the relevant literature. Section three focuses on hypotheses development and section four outlines the data and methodology. The results are presented in section five and summary and conclusion are provided in section six.

2 Background review

2.1 Related work on stock exchange demutualization

Demutualization, the process of converting a not-for-profit, mutually owned organization to a for-

profit, investor-owned corporation, is generally undertaken to improve governance and organizational performance. There is theoretical and empirical support for the important role that organizational form in general, and demutualization in particular, plays in firm performance. The link between organizational form and performance has long been established in the literature. Jensen and Meckling (1976) argue that the probability distribution of future cash flows of an organization is not independent of the capital or ownership structure. Hart and Moore (1996) provide theoretical justification for the increased level of demutualization that we observe in the stock exchange industry in recent times when they show that outside equity ownership is more efficient than member cooperatives.

Prior studies examine the effect of demutualization on different aspects of an entity's performance including stock market performance, operating performance and product market performance. Mendiola and O'Hara (2003) study stock exchanges that demutualize and subsequently undertake initial public offering (IPO) and find that while stock exchange IPOs exhibit first day underpricing, unlike other IPOs, they perform well in the months and years after the IPO. The authors conclude that changing the exchange governance structure from cooperative to a corporation is value-enhancing. Otchere (2006) also finds that demutualized and publicly listed exchanges become more profitable and diversify their income base to derive significant revenues from non-traditional sources after demutualization and subsequent IPO. The author also finds that self-listed exchanges significantly outperform the stock market indexes as well as a control sample of non-exchange firms that also went public in the same year. Otchere and Abou-Zied (2008) find that the Australian Stock Exchange (ASX) experienced increased trading activity by foreign investors after their demutualization and self-listing.

Demutualization usually leads to investments in technology and automation (Domowitz and

Steil 2001; Lee 2002; Krishnamurti et al. 2003). Technology and automation reduce the speed of transaction execution and lower trading costs. Hendershott et al. (2011) examine the effect of algorithmic trading on market quality and find that algorithmic trading improves liquidity for large-cap stocks. Riordan and Storkenmaier (2012) examine the impact of technology on speed of execution following Deutsche Boerse's upgrade of its Xetra software and document a significant decrease in latency from 50 milliseconds to 10 milliseconds.[5] The authors also find that both quoted and effective spreads fall, especially for small- and medium-sized stocks as a result of the changes.

In addition, because technology and automation can increase the amount of publicly available information on the demand for and supply of stocks through transparent and efficient display and archiving of quotes, depths, orders and transactions (Jain 2005), investments in technology can lead to improvements in transparency which will in turn reduce information asymmetry, attract order flow, improve liquidity, reduce bid-ask spreads and ultimately improve market quality. The notion that transparency improves market quality has been demonstrated theoretically by Madhavan (1996) and buttressed empirically by Boehmer et al. (2005) who examine the trade transparency effect of the introduction of NYSE's OpenBook service in January 2002 and find smaller deviations of transaction prices from the efficient (random walk) prices, thus implying more efficient prices.[6] Similarly, Chung and Chuwonganant (2009) find that both bid-ask spreads and return volatility significantly declined after the implementation of NASDAQ's SuperMontage – a fully integrated order display and execution system. We expect that the increased transparency that accompanies demutualization and investment in technology will increase order flow and liquidity, which will in turn lead to

[5] Riordan and Storkenmaier (2012) define latency as the amount of time it takes for an investor to submit and receive feedback on an order.

[6] The OpenBook service provides limit-order book information (i.e., information about quotes and trading interest) and "allows traders off the NYSE floor to observe depth in the book in real time at each price level for all securities" (Boehmer et al. 2005, pp. 784).

improvements in market quality. However, other studies present mixed results on the impact of technology and automation on market quality. Hendershott and Moulton (2011) study the NYSE's introduction of its Hybrid Market (at the end of 2006) which increased automation and helped drive down execution time for market orders from 10 seconds to less than one second. The authors find that the Hybrid Market raises the cost of immediacy (the effective spread) by about 10% relative to its pre-Hybrid level but reduces the noise in prices, thus making prices more efficient.

2.2 Literature on market quality

Market quality is a multi-dimensional concept which has variously been defined. O'Hara and Ye (2011) define market quality as the ability of the market to meet its dual goals of liquidity and price discovery, while Domowitz and Steil (2001) perceive market quality as a three-dimensional concept hinging on liquidity, informational efficiency and volatility. Verousis et al. (2018) also define market quality as being represented by liquidity, transaction costs and volatility. A common theme that cuts across the different definitions relate to the market's ability to effectively and efficiently provide liquidity and price discovery. Three dimensions of market quality emerge from the literature, namely liquidity, informational efficiency and pricing efficiency. Several proxies have been used for the different dimensions, including bid-ask spreads, turnover, and Amihud (2002) illiquidity as measures of the liquidity dimension of market quality, execution speed as a measure of the informational efficiency dimension, and pricing error as well as volatility as measures of the pricing efficiency dimension of market quality. For the purpose of this study, we review only the relevant market quality literature.

Liquidity has long been regarded as a key dimension of market quality. While liquidity is considered by some authors as either the time required to trade an asset for cash at a reasonable price or the cost of trading an asset for cash quickly (Hasbrouck and Schwartz 1988), others view it as the

ability to trade large quantities quickly at low cost without moving the price (Pástor and Stambaugh 2003). The latter definition highlights the three components of liquidity, namely, cost, trading volume and price impact. For the purpose of this study, we use cost as a measure of liquidity.

Several measures have been used in the literature as a proxy for the cost dimension of liquidity. Bid-ask spreads, defined as the mark-up paid for predictable immediacy of exchange in organized markets (Demsetz 1968), are by far the most widely used measures of cost. Variants of bid-ask spreads, including quoted spreads, effective spreads and realized spreads have been employed by several authors (e.g., Harris 1994; Bessembinder and Kaufman 1998; Peterson and Sirri 2003; Charoenwong et al. 2016; Du 2019; Liu et al. 2019) to examine liquidity. Quoted spreads measure trade execution costs if trades are executed at the quote; effective spreads measure trading costs that reflect savings due to trading inside the quotes, while realized spreads measure traders' temporary price impacts (Bessembinder and Kaufman 1997). We follow prior studies and use bid-ask spreads as measures of market quality in this study.

While prior studies have examined the effects of demutualization on different aspects of the exchanges' operations, there is a dearth of studies on the effects of the recent stock exchange demutualization on market quality. The only exception is Krishnamurti et al. (2003) who examine the impact of stock exchange demutualization on market quality using companies simultaneously listed on both the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE) of India. Employing both univariate and multivariate tests, Krishnamurti et al. (2003) find that transaction costs on the NSE (a demutualized stock exchange) are lower than those on the BSE (a mutual stock exchange), with the mean standard deviation of the Hasbrouck (1993) pricing error being 0.27% and 0.64% on the NSE and the BSE respectively. However, this is a one demutualized stock exchange sample study in a single emerging country setting, hence the results have limited generalizability.

3 Hypotheses development

The profit motive and the shareholder value maximization objective that accompany demutualization will motivate managers of demutualized stock exchanges to undertake actions that will increase order flow and revenues to the exchange (including incentivizing market participants to trade on the exchange). As order flow and trading volume increase, the exchange will become more liquid and the increased liquidity will reduce bid-ask spreads, which will lead to improvements in market quality. Also, demutualization is intended to improve stock exchange governance; and effective governance signals to market participants that the stock exchange is a transparent organization. Indeed, Krishnamurti et al. (2003) have shown that demutualized stock exchanges are more transparent than mutual stock exchanges. The desire to protect the interest of their members usually results in lax enforcement and weak internal control systems in mutual exchanges; however, this is not the case with demutualized stock exchanges whose primary goal is to maximize firm value and profits. Reiffen and Robe (2011) analyze the relationship between a self-regulatory financial exchange's (SRO) ownership structure and its incentives to protect customers trading on the exchange from dishonest agents and demonstrate that a for-profit SRO carries out more investigations than does a mutual SRO. The authors contend that because the goal of a mutual exchange is to maximize members' income, they are less likely to enforce trade rules that govern how agents such as securities dealers carry out their customers' trades. However, because demutualized stock exchanges are less concerned about members' income, they have greater incentives to enforce trade practice rules. As a result, demutualized stock exchanges will provide a more transparent trading environment. Since investors and issuers may have more confidence in trading on transparent stock exchanges, this signal of transparency can be very influential in attracting order flow to demutualized stock exchanges.

Additionally, the desire to effectively respond to increased competition (especially from ECNs), coupled with enhanced sources of financing (through the sale of equity to others through private placements) invariably make it financially feasible for demutualized exchanges to invest in technology. Given that investments in technology will lead to the effective and efficient dissemination of information to all market participants, we argue that demutualization will lead to reduction in information asymmetry and improve transparency. With improvements in transparency, issuers and investors will find demutualized exchanges their preferred location for listing their shares and for trading, and order flow and trading volume will increase as a result. As order flow migrates to demutualized stock exchanges, positive network externalities will be realized as other market participants may be attracted to the demutualized exchanges. For these reasons, we contend that stock exchange demutualization will lead to improvements in market quality.[7]

It should be noted, however, that demutualization could lead to a deterioration in overall market quality. For instance, the profit maximization objective could motivate managers of demutualized exchanges to loosen their listing requirements so as to encourage more firms to list in order to improve their bottom-lines. If this happens, then the overall quality of the market could be impacted negatively, since the presence of low quality firms listed on the exchanges may turn investors away from these exchanges, and the associated flight of order flow could decrease liquidity and increase bid-ask spreads. While this possibility exists, we argue that it is less likely, especially given the high value stock exchanges attach to market integrity and the intense regulation by securities and exchange commissions (Otchere 2006). We therefore hypothesize that:

Hypothesis 1 Measures of market quality for demutualized stock exchanges are better in the post-demutualization period.

[7] While demutualized stock exchanges have many options for raising funds for technological investments, mutual stock exchanges can mostly source additional funds from members, who may be unable to provide more funds because of their own business needs.

As argued earlier, the vested interest of members may dissuade mutual exchanges from undertaking innovations (e.g., technological innovations) that will improve transparency and open up the exchange to other (non-member) market participants, since that will decrease members' revenues from intermediating non-member trades. More importantly, given that from a global standpoint, changes in order flow are zero-sum game whereby one group's gain is another group's loss (Arnold et al., 1999), the migration of order flow to transparent demutualized stock exchanges could come at the expense of mutual stock exchanges. Accordingly, we hypothesize that:

Hypothesis 2 Measures of market quality for mutual stock exchanges will deteriorate in the post-demutualization period.

A significant number of demutualized stock exchanges corporatize their structure by undertaking initial public offering and becoming publicly traded firms. This phenomenon, which Otchere (2006) characterized as self-listing, results in the complete decoupling of ownership from control. As publicly traded firms, corporatized stock exchanges come under intense pressure to create value for their shareholders. As a result, we argue that publicly traded stock exchanges are more motivated to implement strategies that increase order flow and trading volume than privately-held demutualized stock exchanges (and mutual exchanges); hence, market quality of publicly traded demutualized stock exchanges will improve more than that of their privately-held counterparts. Also, becoming publicly listed requires that corporatized exchanges continue to publicly disclose a significant amount of information. These disclosure requirements make them more transparent than privately held demutualized exchanges and mutual exchanges. This enhanced transparency makes publicly traded stock exchanges even more attractive to investors and issuers, which will in turn attract more order flow and improve market quality. Consequently, we hypothesize that:

Hypothesis 3 Market quality measures for publicly traded demutualized stock exchanges are better than those of privately held demutualized stock exchanges (and mutual stock exchanges).

4 Data and methodology

4.1 Data

We use firm-level daily data, exchange-level and country-level data to investigate the effects of demutualizations on market quality of 41 exchanges (30 demutualized and 11 mutual exchanges). The demutualizations, which occurred between 1993 and 2013, are analyzed over a six-year window starting one year before and five years after the demutualization date.[8] The country- and firm-level data were obtained from Bloomberg and Capital IQ, while the exchange-level data (e.g., number of listed firms, domestic market capitalization, value of share trading, etc.) were obtained from the World Federation of Exchanges.[9] The dates of demutualization were obtained from different sources including the stock exchanges themselves, Mondo Visione, and the WFE .[10]

Given the number of stock exchanges and the relatively high frequency of data (daily data) that we use, it is not feasible to include all firms listed on all the sample stock exchanges in this study. As Domowitz and Steil (2001) observe, the data requirements for studies of market quality are too large for any single research project and consequently, any study of market quality may have to be narrowed. To make the data collection task manageable, we included about 15% of firms listed on the sample stock exchanges in the study. In order to obtain a representative sample from each stock exchange, we randomly selected 5% of stocks in each size tercile (i.e., large, medium and small) from each sample exchange. Our final sample consists of over 4,500 unique firms listed on 41 stock

[8] Since there are no comparable mutual exchanges for the large demutualized stock exchanges, we averaged data for the 11 mutuals into a portfolio of rivals and this portfolio is analyzed against each demutualization. See the appendix for the list of exchanges used in this study.

[9] Although our sample is made up of WFE member exchanges, we excluded exchanges (e.g., Dubai Financial Markets) that had incomplete or no data in any one (or more) of our data sources.

[10] We would like to acknowledge the invaluable help of Mr. Herbie Skeete of Mondo Visione for providing the demutualization dates for some of the stock exchanges and also the help of Ms. Eleanor Penistone of the World Federation of Exchanges and several individuals from a number of stock exchanges.

exchanges over the 1993-2013 period.[11]

4.2 Methodology

We employ a multi-step methodology to examine the market quality effects of stock exchange demutualization. We first compute the measures of market quality and other variables at the firm level and aggregate the data to obtain averages at the exchange level. We then analyse trends in the key variables to understand their behaviour over time. We next perform univariate analysis of the key variables. In the final step, we carry out multivariate analysis that involves regressing bid-ask spread measures on a demutualization dummy and a number of firm-level, exchange-level, country-level, and other control variables.

4.2.1 Market quality measures: quoted and effective bid-ask spreads

We use quoted and effective bid-ask spreads as measures of market quality. Following Bessembinder and Kaufman (1997) and Venkataraman (2001), we estimate quoted spreads as:

$$Quoted\ Spread_{it} = \frac{Ask_{it} - Bid_{it}}{Mid_{it}} \tag{1}$$

where Ask_{it} is the closing ask price of security *i* at time *t*, Bid_{it} is the closing bid price of security *i* at time *t* and Mid_{it} is the midpoint quote. Following Blume and Goldstein (1992), Bessembinder and Kaufman (1998) and Peterson and Sirri (2003), we compute effective spreads by comparing transaction prices to the midpoint of the quoted spread as follows:

$$Effective\ Spread_{it} = 2 * \left| Transaction\ Price_{it} - \left(\frac{Ask_{it} + Bid_{it}}{2} \right) \right| \tag{2}$$

[11] It should be noted that most market quality studies investigating the effects of an issue (e.g., decimalization) on U.S. stocks usually use intraday data obtained from the TAQ (trade and quotations) database. However, intraday data for firms trading on the majority of the demutualized stock exchanges included in this study is not publicly available. Consequently, we use daily data to gauge the market quality implications of stock exchange demutualization. There is empirical justification for using daily data in studies of market quality. Goyenko et al. (2009) demonstrate, based on a sample of 400 randomly selected stocks over the period 1993 to 2005, that low-frequency measures (based on daily data) parsimoniously capture high-frequency measures of transaction costs (based on intraday data).

Given that our sample is a multi-exchange sample consisting of small and large firms, we use relative effective spreads which, following Harris (1994), we estimate as effective spreads expressed as a percent of the stock price. In robustness tests, we also express relative spreads as a percent of the quote midpoint (following Diether et al. 2009).

4.2.2 Multivariate regression analysis

A number of factors impact bid-ask spreads. Madhavan (2000) finds that volume, risk, price and firm size explain most of the variability in bid-ask spreads. In order to ensure that any reported univariate results are not merely a reflection of the impact of these factors on market quality, we estimate the following multivariate regression (and several variants of the model) while accounting for the effects of the control variables:

$$Spread_{it} = \beta_0 + \beta_1 MktCap_{it} + \beta_2 InvPrice_{it} + \beta_3 StdDev_{it} + \beta_4 Volume_{it} + \beta_5 Demutual + \beta_6 Developed\ Dummy + \beta_7 Post\ Demutualization\ Dummy + \beta_8 Demutual * Post + \beta_9 GDP\ per\ Capita_{it} + \beta_{10} Time\ Trend_t + \gamma_k \sum Z_{k_{it}} + \varepsilon_{it} \quad (3)$$

where $Spread$ represents effective spread or quoted spread, $MktCap$ is the log of the firm's market capitalization, $InvPrice$ represents price inverse (i.e., 1/price), $StdDev$ is standard deviation (of 3-month daily stock returns), $Volume$ represents log of trading volume, $Demutual$ is demutualization dummy which takes a value of one if the stock exchange is demutualized and zero otherwise, $Developed\ Dummy$ takes a value of one if the stock exchange is from a developed country (based on OECD classifications) and zero otherwise, $Post\ Demutualization\ Dummy$ takes a value of one in the post-demutualization period and zero otherwise, $GDP\ per\ Capita$ is lag of GDP per capita, $Time\ Trend$ is a linear time trend and Z_k is a vector of exchange-specific control variables that have been shown to affect spreads, including log of domestic market capitalization, log of number of listed firms, log of capital expenditures and market share. Also included in the regression are interactions between the exchange-level

variables and the post demutualization dummy to establish the extent to which these exchange-level variables impact spreads following demutualization. Due to potential endogeneity between spreads and volume (Dewenter et al. 2017), we use two-stage least squares (2SLS) for our multivariate regression analysis. We follow Harris (1994) and Dewenter (2017) and use the prior values of spreads and volume as the instrument variables in our first stage regressions. The fitted values from the first stage regressions, together with the other variables, are then used in the second stage regressions.

The variables in the multivariate regression model are informed by theory and/or empirical evidence. Demsetz (1968) finds that the cost of exchanging a security declines as trading in that security increases, while McInish and Wood (1992) assert that because of economies of scale in trading costs, greater trading activity may lead to lower spreads. Stoll (2000) notes that as "a matter of empirical regularity, quoted spreads are negatively related to measures of trading activity, such as volume and stock price, and positively related to a stock's volatility" (pp. 1481). Keim and Madhavan (1998) find that trading cost decreases monotonically with market capitalization, and Harris (1994) predicts a negative relationship between trading volume and bid-ask spreads, noting that simple demand theory implies smaller spreads will be associated with larger volumes. While researchers including Harrris (1994) show that stock price impacts bid-ask spreads, Madhavan (2000) suggests the use of price inverse to control for the effect of price on bid-ask spreads because the minimum tick induces convexity in percentage spreads. Stoll (2000) observes that volatility is positively related to spreads.

We include a number of stock exchange-level variables (used in earlier studies such as Arnold el al. 1999; Mendiola and O'Hara 2003; Otchere 2006; Otchere and Abou-Zied 2008) as well as the interactions of these variables with the demutualization and post demutualization dummies.

Exchanges with high market share are likely to experience increased liquidity and consequently lower bid-ask spreads. As a result, we include market share as a control variable in our bid-ask regressions. Following Arnold el al. (1999) and Nielsson (2009), we use value of share trading (in U.S. dollars) to derive market share, which we calculate as the ratio of the exchange's monthly value of share trading to the total monthly value of shares traded on all members of the World Federation of Exchanges. Similarly, exchanges that significantly invest in technology are expected to attract order flow which will help reduce bid-ask spreads. We control for the effects of technology using the log of capital expenditures. With virtualization and the emergence of ECNs, capital expenditures of many stock exchanges are likely to be in the form of technology investments. As a result, log CAPEX is a good, albeit an imperfect proxy to capture the effects of technology on spreads. Based on the network externality argument that the consolidation of order flow would lead to positive network externalities because of the presence of large numbers of counterparties for trade execution (see Pagano, 1989), we expect the number of firms listed on the exchange, our proxy for network externalities, to be negatively related to spreads. We also control for the size of exchanges using the log of domestic market capitalization of firms traded on the exchanges. As firms find it more attractive to list on transparent demutualized exchanges, domestic market capitalization, which could increase in the post-demutualization period, is expected to be negatively related to spreads. We follow Arnold el al. (1999) and include a linear time trend as a control variable to capture changes in other variables over time. To control for differences in country growth, we include GDP per capital. We lag GDP per capital by a year because it is usually reported with delay. As argued earlier, we expect the demutualization dummy to be negatively related to bid-ask spreads in the post-demutualization period because of our contention that demutualization will improve market quality by lowering transaction costs. We employ two-stage least squares technique for our multivariate analysis. Also, given the

inherently small sample sizes for the exchange level analysis, we use Acharya's (1993) dummy variables approach, which allows for the use of data over both the event and non-event windows, thus ensuring a large number of observations for the regressions.

4.2.3 Averaging methods

We analyze the long-term market quality effects of stock exchange demutualization over a six-year window starting 250 days before and ending 1,250 days after the demutualization. To compare the one-year pre-demutualization period to the five-year post-demutualization period, we adopt a number of averaging/aggregation methods used in prior market quality studies. Following Boehmer et al. (2005), we split the post-demutualization period into years and then compare the market quality measures in the split-up post-demutualization periods (e.g., [day +1, +250] or [day +251, +500]) to that of the pre-demutualization period ([day -250, -1]). As the authors note, using different post-event periods allows for the examination of how a new equilibrium emerges over time. Since the effects of demutualization are long term in nature, splitting the post-demutualization period into years allows us to establish when the market quality effects of demutualization materialize over time. Based on our hypotheses, we expect the post-demutualization spreads relative to the pre-demutualization spreads to be lower over time because significant improvements in liquidity may take a longer time to materialize. Following McInish and Wood (1992), Chung and Chuwonganant (2009) and Diether et al. (2009), we also averaged the post-demutualization spreads to establish whether spreads in the post-demutualization period, on average, are generally lower. To do this, we follow the intuition behind McInish and Wood (1992) to convert the five years' post demutualization daily data into one year average daily data for comparison with the one year pre-demutualization data. The post-demutualization bid-ask spreads averages are expected to be lower if market quality has improved. The advantage of this

approach is that it allows us to create an average 250-day symmetrical window from the 5-year post-demutualization period's data for easy comparison with the 250-day pre-demutualization data. The third approach involved pooling the data in the post-demutualization period.

5 Results

5.1 Trends in spreads and measures of risk

We begin the analysis with a graphical presentation of key variables before presenting the results of the statistical tests. While statistical tests show the significance or otherwise of variables, trend analysis provides the additional benefit of describing the behavior of the variables over time – in visually insightful ways that enhance our understanding of the phenomenon. Therefore, to provide preliminary insights into the behavior of spreads and measures of risk on mutual and demutualized stock exchanges, we present charts of transaction costs and standard deviation. Fig. 1 and Fig. 2 display trends in effective spreads and standard deviation respectively from one year (250 trading days) prior to the demutualization date to five years (1,250 trading days) after the date of demutualization. Fig. 1a shows that firms listed on demutualized stock exchanges experienced decreasing effective spreads in the post-demutualization period. Chart 1b highlights the increases in effective spreads for firms listed on mutual stock exchanges following the demutualizations, an outcome we conjecture, is likely due to the competitive disadvantages mutual stock exchanges face in the post-demutualization period as order flow migrates to more transparent (and less opaque) demutualized exchanges. Fig. 1c, which displays the industry-adjusted effective spreads (defined as effective spreads of demutuals minus effective spreads of mutuals), shows that demutualized exchanges had relatively higher spreads in the pre-demutualization period. However, the spreads on demutualized exchanges monotonically decline in the post-demutualization period, signifying improvement in market quality on these exchanges compared to that of mutual

exchanges. Fig. 1d shows that while effective spreads on developed demutualized exchanges were flat in the one year before demutualization, they began to decline in the post-demutualization period, falling almost 33% from 4.9% on day zero (i.e., date of demutualization) to 3.3% five years after the demutualization.

Fig. 1 about here

Fig. 1 shows that stock exchange demutualization has resulted in improvements in the cost dimension of market quality for the converted exchanges. Fig. 2 shows that risk on demutualized exchanges declined in the post-demutualization period. Similar observations are made about the industry-adjusted (demutuals minus mutuals) standard deviation, which has also trended downward in the post-demutualization period.[12] On the whole, the charts demonstrate that transaction costs and measures of risk improved on the demutualized exchanges after the conversion. The improvements in spreads and standard deviation are even more marked for firms listed on demutualized exchanges operating in developed markets. For the mutual exchanges, however, the charts show either worsening or flat performance in the post demutualization period.

Fig. 2 about here

5.2 Univariate analysis

5.2.1 Impact of demutualization on market quality

To provide preliminary evidence on changes in market quality and other key attributes over the pre- and post-demutualization period, we present results of mean and median tests in Table 1. The

[12] Though not shown here for the sake of brevity, we observe similar trends for quoted spreads and high-minus-low measures as well.

univariate results are substantially consistent with the trend analyses results. Panel A shows that the demutualized stock exchanges experienced reductions of about 4.7% (significant at the 1% level) in both the mean and median effective bid-ask spreads (expressed as % of price). Mean and median quoted spreads also decreased by 5.5% and 6.4% respectively on demutualized exchanges in the post-demutualization period and the changes are significant at the 1% level. The measures of risk for the converted exchanges also show significant improvements in the post-demutualization period. The mean (median) standard deviation decreased by 7.1% (6.5%), while mean (median) high-minus-low decreased by 5.7% (5.3%) on demutualized exchanges. The results presented in Panel B of Table 1 indicate that the market quality and risk measures of mutual stock exchanges deteriorated in the post-demutualization period. The means (medians) of effective spreads, quoted spreads, standard deviation and high-minus-low increased by 1.8% (4.3%), 1.8% (1.1%), 1.3% (1.5%) and 3.5% (3.2%) respectively on the mutual exchanges in the period following the demutualization of their counterparts, and the increases are significant at 1%. The significantly negative difference-in-difference tests results reported in Panel C confirm our conjecture that demutualization has improved the market quality and risk profiles of the demutualizing exchanges.

Table 1 about here

5.2.2 Differential impact of demutualization: developed vs. emerging stock markets

We argue that the market quality effects of demutualization will be stronger in developed countries because, among other things, the deepened financial markets in advanced countries will lead to increased competition for the demutualizing exchanges, including competition from low-cost ECNs

and dark pools.[13] The increased competition in developed markets will provide an added incentive for demutualized exchanges in developed countries to improve market quality than their counterparts in emerging markets that do not face similar levels of competition. However, since spreads are generally lower on the developed capital markets than they are on emerging markets, demutualization could have a much bigger impact on spreads/liquidity in emerging markets than on already liquid (developed) markets with lower spreads. To gain a deeper understanding of which types of exchanges benefit more from demutualization, we categorize the demutualizing stock exchanges into developed demutualized and emerging demutualized stock exchanges using the OECD classifications and estimate the market quality measures. The results are presented in Table 2.

As evident from Panels A and B of Table 2, the reductions in spreads and the other measures of risk documented for the sample primarily occur on developed demutualized exchanges. For these exchanges, mean (median) effective spreads, quoted spreads, standard deviation and high-minus-low decreased by 11.2% (10.8%), 11.4% (10.2%), 10.1% (8.1%) and 10.7% (10.2%) respectively in the post-demutualization period. For demutualized stock exchanges in emerging countries, Panel B shows that apart from the significant declines in mean (median) standard deviation of 3% (1.3%), increase in high-minus-low, the two measures of transaction costs are not significantly different from zero. Therefore, it appears that the benefits of demutualization are disproportionately higher on developed demutualized exchanges. This is confirmed in Panel C where the difference-in-difference test results are negative and statistically significantly at 1%.

Table 2 about here

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[13] As alternative equity trading systems that do not publicly display orders (Zhu, 2014), dark pools have grown and have been capturing market share at the expense of traditional exchanges in recent years (Preece 2012; Foley and Putniņš 2016; Buti et al. 2017; Gresse 2017; Comerton-Forde et al. 2018).

5.3 Multivariate analysis of stock exchange demutualization

5.3.1 Effects of stock exchange demutualization on market quality

The difference in mean tests are only suggestive, as the tests have no explanatory power and imply that demutualization is the only factor that accounts for the observed changes in spreads. To test our conjecture that demutualization leads to improvements in market quality in an econometrically rigorous manner, we employ a multivariate cross-sectional estimation technique to examine the impact of demutualization on market quality while controlling for other factors that affect market quality. Specifically, we estimate Equation 3 above using 2SLS and report the results in Table 3 columns 3 and 5. Our variable of interest, *Demutual * Post*, is negative and strongly related to effective spreads at the 1% level of significance, irrespective of whether we use a simple regression model of only the relevant demutualization variables (as presented in column 3) or a comprehensive regression model that includes firm-level, exchange-level and other control variables. The significantly negative coefficient of *Demutual * Post* implies that the univariate results that demutualization leads to significant reductions in bid-ask spreads holds even after controlling for factors deemed to affect bid-ask spreads. These findings support our hypothesis that demutualization leads to improvements in market quality. Our results are consistent with those of Krishnamurti et al. (2003) who find in their single country study that demutualization of the National Stock Exchange in India led to improvements in market quality.

Table 3 about here

Our regression results reported in column 5 of Table 3 include firm-level, exchange-level and other determinants of bid-ask spreads and market quality. The firm-level explanatory variables are generally significant and mostly have the expected signs. Trading volume is significantly negatively

related to spreads (at the 1% level), suggesting that an increase in trading volume leads to lower bid-ask spreads. While we expected size to be negatively related to spreads, log of firm market capitalization is positive and significant, and is similar to Riordan and Storkenmaier's (2012) findings that reductions in spreads were more pronounced for small- and medium-sized stocks than for large cap stocks. Standard deviation, our measure of risk, is significant and positive, as expected, thus signifying that as risk increases, bid-ask spreads increase as well. Price inverse is also significant and positive as expected.

The exchange-level control variables are also all significantly negative as expected. The coefficient of market share is negative and significant, signifying that as order flow and market share increase, liquidity improves and bid-ask spreads fall. Log of CAPEX is also significant and negative, suggesting that investments in technology generally lead to reductions in spreads. The significantly negative relationship between log of listed firms and spreads implies that as the number of listed firms increase, liquidity improves and spreads fall. The significantly negative coefficient of the log of domestic market capitalization, our proxy for exchange size, demonstrates that spreads are lower on the biggest (and probably most liquid) stock exchanges.

It has been argued that developed stock exchanges are more liquid and therefore they are expected to exhibit lower spreads irrespective of whether or not they are demutualized. From Table 3, however, the developed dummy is insignificant (e.g., column 5). In general, the variables hypothesized to affect bid-ask spreads are significantly impactful in the regressions.

5.3.2 Potential channels of improvements in bid-ask spreads and market quality

We argue that demutualization will enhance the exchanges' ability to raise funds to invest in technology, attract more firms and investors to the exchange, thereby increasing order flow and enhancing market quality. In this section, we examine how changes in these variables influence

the demutualized exchanges' market quality after the conversion.

First, although technological advancements could reduce the cost of trading and improve the speed of execution, the effect of technology investments on market quality remains a contested issue. For instance, Riordan and Storkenmaier (2012) find that investments in technology improve market quality by reducing the speed of execution and lowering trading costs, but Hendershott and Moulton (2011) find that NYSE's introduction of its hybrid market (which increased automation) drove down execution time for market orders from 10 seconds to less than one second but it increased the cost of immediacy (i.e., effective spreads) by about 10% relative to its pre-hybrid level. However, as we argued earlier, investments in technology could reduce bid-ask spreads.

Second, as argued earlier, we expect order flow to migrate to transparent demutualized exchanges following the conversion. The increased order flow/market share and liquidity would lead to reductions in bid-ask spreads. Third, the network externality argument suggests that as more firms are listed on demutualized exchanges, the network grows and the probability of finding a counterparty for trade execution increases. As a result, inventory holding costs will decline and this will lead to reductions in bid-ask spreads. Fourth, as market share and listed firms increase following the improvements in governance through demutualization, we expect the size of the exchanges to increase, which could improve liquidity and lower bid-ask spreads. To identify potential sources or channels through which bid-ask spreads on demutualized exchanges can reduce, we first present pre- and post-demutualization period means and medians of these variables and then estimate a multivariate regression that incorporates the interactions of these variables with the demutualized and post-demutualization dummy variables.

5.3.2.1. Univariate results We provide evidence of changes in the four exchange-level variables over the pre- and post-demutualization period for our sample in Panel A of Table 4. The results of

the univariate tests of means (using the t-test) and medians (using the Wilcoxon signed-rank test) are consistent with our conjecture that the exchange-level variables will significantly improve for the demutualized exchanges in the post-demutualization period compared to those of the mutual exchanges. Panel A1 shows that the demutualized stock exchanges experienced significant increases (at the 1% level) in technology investments, market share, number of listed companies and domestic market capital in the post-demutualization period. While the results presented in Panel A2 also indicate that the mutual exchanges experienced increases in market share, number of listed firms and domestic market capitalization (but a reduction in technology investments) in the post-demutualization period, the significantly positive (at the 1% level) difference-in-difference tests results presented in Panel A3 point to significant improvements in these product market variables for demutualized stock exchanges that can enhance market quality.

Table 4 about here

5.3.2.2. Multivariate results To assess the effects of technology and the other exchange-level variables on bid-ask spreads following demutualization, we estimate a multivariate regression as in Equation 3 and interacted the four variables, namely investments in technology (proxied by the log of CAPEX), market share, log of listed companies and log of domestic market capitalization with the demutualized dummy and the post-demutualization dummy. If investments in technology and the improvements in the other exchange-level variables following demutualization lead to reductions in bid-ask spreads, we would expect the coefficients of the post-demutualization interaction variables to be negatively related to spreads.

As evident in Panel B of Table 4, the technology interaction variable is consistently negative and significantly related to spreads at the 1% level. The significantly negative coefficient of the *Log*

*CAPEX*Demutual*Post* variable supports our argument that technology investments by demutualizing exchanges in the post-demutualization period will lead to reduction in spreads. The significantly negative coefficient (at the 1% level) of the interaction of market share and the post-demutualization dummy variable (*Mkt Share*Demutual*Post*) supports our contention that improvements in order flow and market share in the post-demutualization period lead to a decline in bid-ask spreads for demutualized stock exchanges.

We also included the number of firms listed on the exchanges and its interaction with the demutualization dummy in the post-demutualization period (*Lstd Firms*Demutual*Post*) to test the network externality argument advanced by Pagano (1989). As more firms are listed and/or traded on the exchange, the network grows and the probability of finding a counterparty for trade execution increases. As a result, inventory holding costs will decline and this can lead to reductions in bid-ask spreads. Our results support the network externality argument since the coefficient of listed firms interaction variable (*Lstd Firms*Demutual*Post*) is significantly negative. The last exchange-level variable in our regression models, domestic market capitalization of firms listed on the exchanges, and its interaction with the demutualized dummy and the post demutualization dummy (*Mkt Cap Exch*Demutual*Post*), is positive and significantly related to spreads at the 1% level. We conclude that being a large exchange (as proxied by domestic market capitalization of listed companies) does not guarantee narrowing of spreads following demutualization.

The foregoing analysis shows that the exchange-level variables and their interactions, to a large extent, support our conjecture that demutualization, which usually leads to technology investments, will increase transparency, market share/order flow and liquidity, which ultimately leads to a narrowing of spreads in the post-demutualization period. Our results are also consistent with the predictions of the laws of supply, as the increase in order flow following demutualization leads to a

narrowing of spreads. Also, the significantly negative coefficient of *Demutual*Post* variable suggests that even after controlling for the effects of product market variables that influence bid-ask spreads, the market quality effects of demutualization remains significant. Consistent with the univariate results, developed demutual exchanges experience significant reductions in spreads (as the *Developed Demutual * Post* variable is significant and negative in Table 4 Panel B).

5.3.3 Timing of the effect of demutualization on market quality

Given that stock exchange demutualization involves a change in organizational structure, the long-term implications of the conversion is important to not only the management of the exchanges, but also to investors and security issuers as well. While our results, based on the average of the five-year post-demutualization data, demonstrate that demutualization leads to significant reduction in spreads, we also analyzed the data yearly to gain deeper insights into the effects of demutualization on market quality from year 1 through year 5 following the conversion. We report the year-by-year results in Table 5.

The reductions in bid-ask spreads continue from 1 year to 5 years following the completion of the demutualization. Comparing the pre-demutualization period to each of the post-demutualization years, we find that the demutualization dummy in the post-demutualization period continues to be significantly negatively related to spreads from year to year at the 1% level of significance. The regressions also have good fit with the data, with R^2 ranging from 46.4% to 60.4%.

Table 5 about here

5.3.4 Exchange demutualization, subsequent IPO and market quality

The current governance changes occurring in the stock exchange industry have been described by authors including Aggarwal (2002) and Oldford and Otchere (2011) as a progression, involving

demutualization (the conversion from not-for-profit to for-profit organization) to initial public offering, culminating in the stock exchange becoming a publicly-traded entity. As a result of the increase in the number of stock exchange IPOs in recent times,[14] it is imperative to determine whether going public generates incremental improvements in market quality beyond what demutualization generates. Given the higher disclosure requirements for publicly listed firms, we expect demutualized exchanges that subsequently undertake IPOs to experience further improvements in liquidity and market quality. In addition, the publicly traded exchanges, now accountable to shareholders, could become more aggressive in their quest to create value for their shareholders. Consequently, a publicly traded exchange has greater incentive to put in place measures that will attract more order flow. Thus, improvement in bid-ask spreads and trading volume is expected to be greater for publicly traded exchanges than demutualized but privately held exchanges. We investigate whether there are incremental improvements in market quality for the stock exchanges that become publicly traded entities after demutualization by re-estimating equation 3 after including *IPO dummy* (for the exchanges that became publicly traded) and interacting it with *post IPO* dummy. The results of the regression are presented in Table 6.

Table 6 about here

We find that the coefficient of *IPO dummy * Post IPO*, our variable of interest, is significantly negative in the average (of the Post IPO years) regression results presented in column 2. We also include our key dummy variable for demutualized exchanges in the post-demutualization period to determine whether after controlling for the effects of demutualization, the exchanges that go public

[14] Eighty percent of the demutualized stock exchanges in our sample subsequently became publicly listed exchanges, with the average elapse time between demutualization and IPO being about 600 calendar days or just under two years.

experience additional reductions in spreads and improvements in market quality. As shown in Table 6, both interaction variables are significantly negative at the 1% level. The significantly negative association between bid-ask spreads and both *IPO dummy*Post IPO* and *Demutual*Post* demonstrates that subsequently pursuing IPO after demutualization leads to further reductions in spreads. The yearly regression results (columns 3 to 7) also show that the *IPO Dummy*Post IPO* and *Demutual*Post* demutualization are significantly negatively related to spreads in each of the post-IPO years. These findings confirm our hypothesis that going public generates incremental improvements in market quality over and above the improvements associated with demutualization.

5.4 Robustness tests

We conduct a number of robustness tests to evaluate the sensitivity of our results to alternative specifications and measures.[15] First, we re-estimate our baseline regression using, as alternative measures of spreads, effective bid-ask spreads expressed as a percent of the quote midpoint instead (of as a percent of price) and also using quoted spreads and present the results in Panels A and B of Table 7 respectively. Consistent with our main findings, we observe that the coefficient of *Demutual*Post*, our variable of interest is significantly negative at the 1% level. Thus, our results are robust to alternative measures of bid-ask spreads.

Table 7 about here

Second, while our research objectives are best addressed by aggregating our data at the exchange level, firm-level analysis is common in the market microstructure literature. To evaluate the sensitivity of our results to the use of firm-level data, we estimated our main regression models using

[15] Although we do not report the detailed results of most of the robustness tests because of space constraints, they are available from the authors upon request.

the mean pre- and post-demutualization values of the variables at the firm-level.[16] The results of the firm-level regressions, which are similar to the exchange-level regression results, are reported in Table 8. We find that demutualization leads to decreases in spreads for firms listed on the demutualized stock exchanges. The coefficient of *Demutual*Post* is consistently negative in all the regressions.

Table 8 about here

Third, the possibility of confounding factors impacting our results cannot be discounted. Over the sample period, some major factors or events that occurred in the exchange industry including decimalization, the Euro conversion, mergers and acquisitions, and introduction of technology could affect our results. From our sample, four exchange demutualizations could be potentially impacted by confounding events. The Vienna Stock Exchange demutualized in 1999, a time which coincides with its Euro conversion; NASDAQ's demutualization in 2001 occurred in the same year that it implemented decimalization; Euronext's formation and its subsequent demutualization in 2001 was the result of the mergers of exchanges in Brussels, Paris and Amsterdam; and, the NYSE introduced its Hybrid system and was also involved in mergers with Archipelago and Euronext in 2006 and 2007, about the same time as its 2006 demutualization. To ensure that these events do not confound our results, we re-estimated our baseline regressions excluding these four stock exchanges. As shown in Table 9, excluding these exchanges from our analysis does not affect our conclusions.

Table 9 about here

Fourth, to further ensure that our results are not driven by chance, we follow Dewenter et al. (2017) and re-run our analysis using a placebo event date of January 3, 2004 as the date on which all

[16] More specifically, for the firm-level analysis, we aggregate the one year of pre-demutualization data and five years of post-demutualization data to obtain pre- and post-demutualization averages for each firm, which we then use in the regressions. Due to this aggregation of time series data to obtain firm-level averages, our sample size for the traditional firm-level analysis reduces.

demutualized exchanges demutualized. The placebo event date is a few months past the midpoint of our sample period. If our results are due to chance, we should observe significant reduction in spreads using this placebo event date. As evident from Table 10, the use of a placebo event date does not lead to reductions in spreads in the post-demutualization period (since the *Demutual*Post* is significantly positive in two instances and insignificant in the third instance).

Table 10 about here

Fifth, we run our baseline regression using exchange-level median values instead of mean values and the results are qualitatively similar to our main results. Sixth, we estimated our regression equations using pooled data and the results are similar to what we have reported for our baseline regressions. Seventh, we run separate regressions for demutualized stock exchanges and mutual stock exchanges and our results are similar to our main findings. Eighth, we also used exchange fixed effects regression setup and our results are similar to our main results, demutualized exchanges experience significant reductions in spreads.

6 Conclusion

Demutualization has become one of the most important strategic choices that stock exchanges are employing in the face of increased competition in the industry. Demutualization and the attendant quest to maximize profits, will among others, motivate demutualized exchanges to adopt measures that will increase order flow and trading volume. As order flow and trading volume increase, liquidity will improve, and this will lead to a decrease in bid-ask spreads and improvement in market quality. Despite the actively growing literature on stock exchange demutualization, not much is known about the effects of stock exchange demutualization on market quality. Motivated by the need to fill this gap and understand its empirical ramifications across many exchanges and

many countries, we assess the effect of stock exchange demutualization on market quality using stock exchange demutualizations completed between 1993 and 2013.

First, we find that bid-ask spreads dropped significantly on the demutualized exchanges in the five years following demutualization. On demutualized stock exchanges, effective spreads have declined on average by over 4.5% and standard deviation of returns has fallen by over 7% in the post-demutualization period. The effect is sustained over the long run. Second, the benefits of demutualization appear to be asymmetrically distributed, with demutualized stock exchanges from developed countries experiencing most of the documented reductions in spreads, whereas emerging demutualized exchanges do not experience the same across-the-board improvements in market quality following demutualization. Third, improvements in market share, listings and technology investments contribute to the reductions in spreads on converted exchanges in the post-demutualization period.

Fourth, firms listed on demutualized stock exchanges that subsequently undertake IPO experienced further reductions in spreads. Thus, our results show that moving along the governance continuum from demutualization to IPO does bring incremental improvements in market quality as far as transaction costs are concerned. On the whole, our results show that demutualization in the stock exchange industry results in robust and sustained improvements in market quality. Our results are robust to different measures of market quality and different model specifications.

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Table 1 Univariate tests of means and medians: demutualized vs. mutual exchanges

	Mean				Median			
Portfolio	Before	After	% difference	Paired t-test of difference	Before	After	% difference	Wilcoxon signed-rank test
Panel A: Demutuals								
Effective Spreads (% of Price)	0.0618	0.0589	-4.66%	(-10.33)***	0.0618	0.0589	-4.71%	(-8.72)***
Effective Spreads (% of Quote Midpoint)	0.0606	0.0583	-3.70%	(-8.67)***	0.0605	0.0582	-3.72%	(-7.40)***
Quoted Spreads	0.0657	0.0621	-5.48%	(-14.93)***	0.0663	0.0620	-6.43%	(-10.99)***
Standard Deviation	0.0339	0.0315	-7.06%	(-31.87)***	0.0337	0.0315	-6.46%	(-13.70)***
High minus Low	0.0411	0.0388	-5.67%	(-15.90)***	0.0409	0.0387	-5.27%	(-11.71)***
Panel B: Mutuals								
Effective Spreads (% of Price)	0.0761	0.0775	1.82%	(4.28)***	0.0741	0.0773	4.30%	(4.84)***
Effective Spreads (% of Quote Midpoint)	0.0779	0.0805	3.32%	(9.83)***	0.0759	0.0804	6.01%	(8.58)***
Quoted Spreads	0.0742	0.0755	1.76%	(10.96)***	0.0743	0.0751	1.06%	(9.51)***
Standard Deviation	0.0312	0.0316	1.27%	(6.82)***	0.0312	0.0316	1.50%	(6.00)***
High minus Low	0.0434	0.0449	3.45%	(14.09)***	0.0434	0.0448	3.20%	(10.75)***
Panel C: Difference-in-difference tests ((Demutualized Post - Demutualized Pre) minus (Mutual Post - Mutual Pre))								
Effective Spreads (% of Price)			-6.47%	(-9.99)***			-9.01%	(-9.65)***
Effective Spreads (% of Quote Midpoint)			-7.02%	(-13.09)***			-9.72%	(-11.62)***
Quoted Spreads			-7.24%	(-18.24)***			-7.50%	(-14.31)***
Standard Deviation			-8.34%	(-29.36)***			-7.96%	(-18.18)***
High minus Low			-9.12%	(-21.14)***			-8.47%	(-15.87)***

This table presents the results of the univariate tests of means and medians for the sample 250 trading days before demutualization compared to the 250-day average of the post-demutualization period. Panel A presents the results of the mean and median differences between the pre-demutualization and post-demutualization periods for the dumutualized stock exchanges. Panel B presents similar results for mutual stock exchanges. Panel C presents difference-in-difference results. Test statistics are in parentheses. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively

Table 2 Univariate tests of means and medians: developed vs. emerging demutuals

	Mean				Median			
Portfolio	Before	After	% difference	Paired t-test of difference	Before	After	% difference	Wilcoxon signed-rank test
Panel A: Developed Demutuals								
Effective Spreads (% of Price)	0.0548	0.0486	-11.22%	(-32.30)***	0.0547	0.0488	-10.76%	(-13.66)***
Effective Spreads (% of Quote Midpoint)	0.0516	0.0480	-7.07%	(-14.48)***	0.0510	0.0480	-5.81%	(-11.15)***
Quoted Spreads	0.0548	0.0486	-11.41%	(-27.86)***	0.0541	0.0485	-10.21%	(-13.61)***
Standard Deviation	0.0338	0.0304	-10.05%	(-19.83)***	0.0331	0.0304	-8.06%	(-13.27)***
High minus Low	0.0405	0.0362	-10.71%	(-18.98)***	0.0402	0.0361	-10.18%	(-12.43)***
Panel B: Emerging Demutuals								
Effective Spreads (% of Price)	0.0724	0.0733	1.30%	(1.62)	0.0725	0.0733	1.06%	(1.53)
Effective Spreads (% of Quote Midpoint)	0.0734	0.0733	-0.12%	(-0.16)	0.0720	0.0733	1.72%	(0.39)
Quoted Spreads	0.0814	0.0818	0.47%	(0.67)	0.0815	0.0817	0.26%	(0.59)
Standard Deviation	0.0341	0.0331	-2.99%	(-7.96)***	0.0335	0.0330	-1.34%	(-5.84)***
High minus Low	0.0420	0.0425	1.13%	(1.92)*	0.0415	0.0425	2.44%	(2.60)***
Panel C: Difference-in-difference tests ((Developed Demutualized Post-Pre) minus (Emerging Demutualized Post-Pre))								
Effective Spreads (% of Price)			-12.52%	(-11.89)***			-11.82%	(-12.39)***
Effective Spreads (% of Quote Midpoint)			-6.95%	(-6.00)***			-7.53%	(-6.26)***
Quoted Spreads			-11.88%	(-10.78)***			-10.47%	(-9.04)***
Standard Deviation			-7.06%	(-11.10)***			-6.72%	(-9.93)***
High minus Low			-11.84%	(-14.30)***			-12.62%	(-12.27)***

This table presents the results of the univariate tests of means and medians for the demutualized exchanges in developed and emerging markets before and after the demutualization. We use the OECD classification of countries to classify the stock exchanges into developed and emerging stock exchanges. We compare the average of the post-demutualization years to the pre-demutualization period. Panel A presents results of the mean and median differences between the pre-demutualization and post-demutualization periods for developed dumutualized stock exchanges. Panel B presents the mean and median results for demutualized stock exchanges in emerging markets. Panel C presents difference-in-difference results. Test statistics are in parentheses. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively

Table 3 Market quality effects of exchange demutualization

	Expected sign	Effective spreads	t statistic	Effective spreads	t statistic
Demutual Dummy	?	-0.0250***	(-26.33)	-0.0184***	(-21.49)
Developed Dummy	-	0.0264***	(34.87)	-0.0004	(-0.30)
Post Demutualization Dummy	?	-0.0005	(-0.91)	-0.0007*	(-1.80)
Demutual * Post	-	-0.0057***	(-5.65)	-0.0026***	(-2.94)
Log Mkt Cap Firm	-	-	-	0.0161***	(49.94)
Inv Price	+	-	-	0.0209***	(56.86)
Std Dev	+	-	-	1.1313***	(25.27)
Log Volume	-	-	-	-0.0136***	(-56.34)
Mkt Share	-	-	-	-0.0921***	(-18.62)
Log Domestic Mkt Cap Exch	-	-	-	-0.0078***	(-21.04)
Log Lstd Firms	-	-	-	-0.0041***	(-10.11)
Linear Trend	?	-	-	0.0018***	(7.54)
GDP per Cap	?	-	-	0.1256***	(16.20)
Log CAPEX	-	-	-	-0.0073***	(-18.41)
Constant	?	0.0711***	(169.82)	0.2246***	(59.62)
N		33687		26941	
R^2		0.0932		0.5786	

This table presents the results of the two-stage least squares regressions of effective bid-ask spreads (as % of price) on demutualization dummy (with and without interaction), developed dummy, post demutualization dummy and firm-level, exchange-level, country-level and other control variables. The control variables include log of firm market capitalization, price inverse, log of volume, return standard deviation, exchange market share, log of domestic market capitalization, log of listed firms, log of CAPEX, GDP per capita and a linear time trend. We estimate the regressions using the one year daily average data created from the post-demutualization period and the one-year pre-demutualization period's data. T-statistics, which are in parentheses, are based on White's heteroscedastic consistent robust standard errors. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively

Table 4 Impacts of exchange demutualization on market quality: potential channels

Panel A: Univariate test of means and medians

	Mean				Median			
Portfolio	Before	After	Difference	Paired t-test of difference	Before	After	Difference	Wilcoxon signed-rank test
Panel A1: Demutuals								
Investment in Technology (CAPEX (in US$ Millions))	25.29	31.06	5.77	(154.81)***	25.35	30.88	5.53	(13.71)***
Market Share	0.0392	0.0432	0.41%	(31.50)***	0.0390	0.0432	0.42%	(13.53)***
Number of listed firms	905.89	1210.75	304.86	(137.93)***	906.97	1209.70	302.72	(13.70)***
Domestic Market Cap of Listed Firms	1,179,739	1,287,895	108,156	(35.06)***	1,176,971	1,282,892	105,921	(13.70)***
Panel A2: Mutuals								
Investment in Technology (CAPEX (in US$ Millions))	27.30	26.59	(0.71)	(-30.50)***	27.24	26.72	(0.52)	(-13.71)***
Market Share	0.0031	0.0060	0.29%	(93.42)***	0.0032	0.0060	0.28%	(13.70)***
Number of listed firms	311.83	359.72	47.90	(98.66)***	310.63	361.61	50.98	(13.70)***
Domestic Market Cap of Listed Firms	118,595	206,766	88,171	(91.03)***	119,700	207,383	87,683	(13.70)***
Panel A3: Difference-in-difference tests ((demutualized post - demutualized pre) minus (mutual post - mutual pre))								
Investment in Technology (CAPEX (in US$ Millions))			6.47	(147.57)***			6.06	(19.35)***
Market Share			0.12%	(8.71)***			0.13%	(11.73)***
Number of listed firms			256.96	(113.56)***			251.75	(19.34)***
Domestic Market Cap of Listed Firms			19,985	(6.18)***			18,238	(3.39)***

Panel B: Multivariate regressions

	Expected sign	Effective spreads	t statistic	Effective spreads	t statistic
Demutual Dummy	?	-0.0101***	(-10.79)	-0.0145***	(-14.85)
Developed Dummy	-	0.0027**	(2.04)	0.0161***	(9.26)
Post Demutualization Dummy	-	0.0023***	(6.58)	0.0013***	(3.92)
Demutual * Post	-	-0.2208***	(-35.72)	-0.2058***	(-35.80)
Developed Demutual * Post	-	-	-	-0.0282***	(-17.15)
Mkt Share	?	-0.0195***	(-3.83)	-0.0669***	(-11.95)
Log Domestic Mkt Cap Exch	?	-0.0139***	(-38.98)	-0.0131***	(-36.31)
Log Lstd Firms	?	-0.0015**	(-2.48)	-0.0006	(-0.92)
Log CAPEX	?	-0.0037***	(-6.53)	-0.3878***	(-6.39)
Log CAPEX * Demutual * Post	-	-0.0135***	(-19.59)	-0.0137***	(-20.02)
Mkt Share * Demutual * Post	-	-0.1766***	(-28.43)	-0.1012***	(-14.01)
Log Lstd Firms * Demutual * Post	-	-0.0116***	(-15.99)	-0.0097***	(-14.73)
Log Mkt Cap Exch * Demutual * Post	-	0.0258***	(48.12)	0.0244***	(48.44)
Firm-level control variables		Yes		Yes	
Country-level GDP		Yes		Yes	
Time trend		Yes		Yes	
Constant		Yes		Yes	
N		26941		26941	
R^2		0.6280		0.6364	

This table presents univariate and multivariate results of the potential sources of improvements in market quality. Panel A presents the results of the univariate tests of means and medians in the pre-and post-demutualization periods. Panel A1 presents results of the mean and median differences between the pre-demutualization and post-demutualization periods for dumutualized stock exchanges. Panel A2 presents results of the mean and median differences for mutual stock exchanges. Panel A3 presents difference-in-difference results ((Demutualized Post - Demutualized Pre) minus (Mutual Post - Mutual Pre)). Panel B shows the results of the two-stage least squares regressions of effective bid-ask spreads (as % of price) on demutualization (with and without interaction), post-demutualization, developed demutualization as well as developed dummies and firm-level, exchange-level, country-level and other control variables. The control variables are log of firm market capitalization, price inverse, log of volume, return standard deviation, exchange market share, log of domestic market capitalization, log of listed firms, log of CAPEX, country GDP per capita and linear time trend. We estimate the regressions using the one year daily average data created from the post-demutualization period and the one-year pre-demutualization period's data. T-statistics, which are in parentheses, are based on White's heteroscedastic consistent robust standard errors. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively

Table 5 Effects of demutualization on market quality over time

	Effective spreads				
	Year 1	Year 2	Year 3	Year 4	Year 5
Demutual Dummy	-0.0151***	-0.0108***	-0.0168***	-0.0032***	-0.0053***
	(-13.73)	(-8.85)	(-14.51)	(-2.83)	(-4.41)
Developed Dummy	0.0170***	0.0168***	0.0183***	0.0373***	0.0322***
	(9.25)	(9.20)	(13.08)	(23.41)	(17.95)
Post Demutualization Dummy	-0.0080***	-0.0008	-0.0001	-0.0066**	-0.0174***
	(-9.14)	(-0.54)	(-0.05)	(-2.44)	(-4.99)
Demutual * Post	-0.0830***	-0.1428***	-0.1784***	-0.3160***	-0.3025***
	(-9.91)	(-21.23)	(-24.60)	(-50.21)	(-39.04)
Firm-level control variables	Yes	Yes	Yes	Yes	Yes
Exchange-level control variables	Yes	Yes	Yes	Yes	Yes
Exchange-level interactions	Yes	Yes	Yes	Yes	Yes
Country-level GDP	Yes	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
N	23478	23879	24184	24402	24911
R^2	0.4635	0.5493	0.5483	0.6040	0.5421

This table presents the results of the year-by-year two-stage least squares regressions of effective bid-ask spreads (as % of price) on post demutualization dummy, demutualization as well as developed dummies and firm-level, exchange-level, country-level and other control variables. The other independent/control variables are log of firm market capitalization, price inverse, log of volume, return standard deviation, exchange market share, log of domestic market capitalization, log of listed firms, log of CAPEX, GDP per capita and linear time trend. We estimate the regressions using yearly data in the post-demutualization period and the one-year pre-demutualization period's data (i.e., one year before vs. one year after, two years after, etc.). T-statistics, which are in parentheses, are based on White's heteroscedastic consistent robust standard errors. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively

Table 6 Demutualization, IPO and market quality

	Effective spreads					
	Average	Year 1	Year 2	Year 3	Year 4	Year 5
IPO Dummy	-0.0310***	-0.0401***	-0.0305***	-0.0173***	-0.0349***	-0.0289***
	(-15.41)	(-19.67)	(-15.36)	(-7.94)	(-16.74)	(-15.47)
Dumutual Dummy	0.0602***	0.0668***	0.0401***	0.0395***	0.0779***	0.0437***
	(24.06)	(25.49)	(15.53)	(13.73)	(29.34)	(15.54)
Developed Dummy	-0.0052***	-0.0117***	0.0000	-0.0080***	-0.0283***	-0.0251***
	(-3.67)	(-8.07)	(-0.04)	(-4.66)	(-18.06)	(-14.26)
Post IPO Dummy	0.0004	0.0022***	-0.0020*	0.0034**	0.0039	0.0120***
	(1.17)	(3.50)	(-1.76)	(1.97)	(1.64)	(4.06)
Post Demutualization Dummy	0.0084***	0.0007	0.0052***	0.0051***	0.0093***	0.0020***
	(11.61)	(0.93)	(7.04)	(6.49)	(11.50)	(2.73)
Demutual * Post Demutualization	-0.0671***	-0.0592***	-0.0544***	-0.0619***	-0.0825***	-0.0613***
	(-32.78)	(-27.06)	(-26.22)	(-28.43)	(-36.41)	(-28.13)
IPO Dummy * Post IPO	-0.3270***	-0.1059***	-0.2201***	-0.3494***	-0.3330***	-0.1480***
	(-44.21)	(-10.90)	(-36.16)	(-35.10)	(-38.39)	(-16.74)
Firm-level control variables	Yes	Yes	Yes	Yes	Yes	Yes
Exchange-level control variables	Yes	Yes	Yes	Yes	Yes	Yes
Exchange-level interactions	Yes	Yes	Yes	Yes	Yes	Yes
Country-level GDP	Yes	Yes	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
N	33853	32781	33437	33374	33136	33127
R^2	0.4987	0.5072	0.4628	0.3963	0.4326	0.3628

This table reports the results of the two-stage least squares regressions of effective bid-ask spreads (as % of price) on a number of variables including IPO dummy, post-IPO, post-demutualization, as well as developed dummies and firm-level, exchange-level, country-level and other control variables. The other independent/control variables are log of firm market capitalization, price inverse, log of volume, return standard deviation, exchange market share, log of domestic market capitalization, log of listed firms, log of CAPEX, GDP per capita and linear time trend. We estimate the regressions using the one-year pre-IPO period's data, the one year average of the post-IPO period's data as well as yearly data in the post-IPO period. T-statistics, which are in parentheses, are based on White's heteroscedastic consistent robust standard errors. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively

Table 7 Effects of exchange demutualization using alternative market quality measures

	Average	Year 1	Year 2	Year 3	Year 4	Year 5
Panel A: Effective spreads as % of quote midpoint						
Demutual Dummy	-0.0100***	-0.0132***	-0.0099***	-0.0171***	-0.0046***	-0.0089***
	(-9.92)	(-11.49)	(-8.11)	(-13.78)	(-3.91)	(-7.08)
Developed Dummy	-0.0027**	0.0177***	0.0103***	0.0127***	0.0371***	0.0236***
	(-2.14)	(9.96)	(6.05)	(9.06)	(24.45)	(12.92)
Post Demutualization Dummy	0.0029***	-0.0033***	0.0035**	-0.0004	0.0007	-0.0152***
	(8.01)	(-3.83)	(2.43)	(-0.19)	(0.25)	(-4.39)
Demutual * Post	-0.2271***	-0.0862***	-0.1415***	-0.1832***	-0.3695***	-0.2812***
	(-38.22)	(-11.06)	(-20.03)	(-20.78)	(-54.64)	(-33.95)
Firm-level control variables	Yes	Yes	Yes	Yes	Yes	Yes
Exchange-level control variables	Yes	Yes	Yes	Yes	Yes	Yes
Exchange-level interactions	Yes	Yes	Yes	Yes	Yes	Yes
Country-level GDP	Yes	Yes	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
N	26941	23478	23881	24182	24402	24908
R^2	0.6147	0.4756	0.5374	0.5204	0.6113	0.5050
Panel B: Quoted spreads						
Demutual Dummy	0.0107***	0.0036***	0.0092***	0.0023*	0.0130***	0.0129***
	(10.20)	(3.06)	(6.93)	(1.93)	(11.09)	(10.67)
Developed Dummy	0.0061***	0.0177***	0.0128***	0.0201***	0.0423***	0.0414***
	(4.53)	(9.60)	(6.91)	(13.31)	(26.46)	(22.62)
Post Demutualization Dummy	0.0014***	0.0005	0.0132***	0.0120***	0.0033	-0.0001
	(3.84)	(0.57)	(8.91)	(5.80)	(1.20)	(-0.04)
Demutual * Post	-0.1988***	-0.0529***	-0.1177***	-0.1114***	-0.2833***	-0.2740***
	(-34.08)	(-6.45)	(-15.16)	(-14.68)	(-44.88)	(-40.75)
Firm-level control variables	Yes	Yes	Yes	Yes	Yes	Yes
Exchange-level control variables	Yes	Yes	Yes	Yes	Yes	Yes
Exchange-level interactions	Yes	Yes	Yes	Yes	Yes	Yes
Country-level GDP	Yes	Yes	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
N	26941	23456	23833	24237	24569	24958
R^2	0.5982	0.4909	0.5235	0.4873	0.5900	0.5262

This table presents the results of the two-stage least squares regressions of quoted spreads and effective spreads (as % of quote midpoint) on post demutualization dummy, demutualization, as well as developed dummies and firm-level, exchange-level, country-level and other control variables. The control variables are log of firm market capitalization, price inverse, log of volume, return standard deviation, exchange market share, log of domestic market capitalization, log of listed firms, log of CAPEX, country GDP per capita and linear time trend. We estimated the regressions using the pre- and post-demutualization data. Panel A reports results for effective spreads expressed as a percent of the quote midpoint while Panel B reports results for quoted spreads. T-statistics, which are in parentheses, are based on White's heteroscedastic consistent robust standard errors. The symbols ***, **, * represent significance at 1%, 5%, and 10% respectively

Table 8 Firm-level regression results

	Effective (as % of price)	Effective (as % of quote midpoint)	Quoted
Demutual Dummy	-0.0077***	-0.0087***	-0.0018
	(-2.91)	(-3.57)	(-0.76)
Developed Dummy	0.0176***	0.0180***	0.0217***
	(6.93)	(7.15)	(8.91)
Post Demutualization Dummy	0.0010	0.0008	0.0021
	(0.70)	(0.56)	(1.28)
Demutual * Post	-0.1233***	-0.1126***	-0.1337***
	(-5.84)	(-5.27)	(-6.33)
Firm-level control variables	Yes	Yes	Yes
Exchange-level control variables	Yes	Yes	Yes
Exchange-level interactions	Yes	Yes	Yes
Country-level GDP	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	5731	5728	5722
R^2	0.4382	0.4267	0.4778

In this table, we report the results of the two-stage least squares regressions of bid-ask spreads on a demutualization dummy, post demutualization dummy, developed dummy as well as firm-level, exchange-level, country-level and other control variables. The other control variables are log of firm market capitalization, price inverse, log of volume, return standard deviation, exchange market share, log of domestic market capitalization, log of listed firms, log of CAPEX, and GDP per capita. We estimate the regressions using the one year pre-demutualization data and the one year average of the post-demutualization data. T-statistics, which are in parentheses, are based on White's heteroscedastic consistent robust standard errors. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively

Table 9 Regression results excluding exchanges with potential confounding events

	Effective (as % of price)	Effective (as % of quote midpoint)	Quoted
Demutual Dummy	-0.0147***	-0.0152***	0.0073***
	(-16.49)	(-16.18)	(7.24)
Developed Dummy	0.0060***	0.0005	0.0062***
	(4.51)	(0.37)	(4.64)
Post Demutualization Dummy	0.0021***	0.0022***	0.0010**
	(5.28)	(5.56)	(2.29)
Demutual * Post	-0.2384***	-0.2511***	-0.1729***
	(-37.89)	(-40.92)	(-27.78)
Firm-level control variables	Yes	Yes	Yes
Exchange-level control variables	Yes	Yes	Yes
Exchange-level interactions	Yes	Yes	Yes
Country-level GDP	Yes	Yes	Yes
Time trend	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	23448	23448	23448
R^2	0.6178	0.6098	0.5948

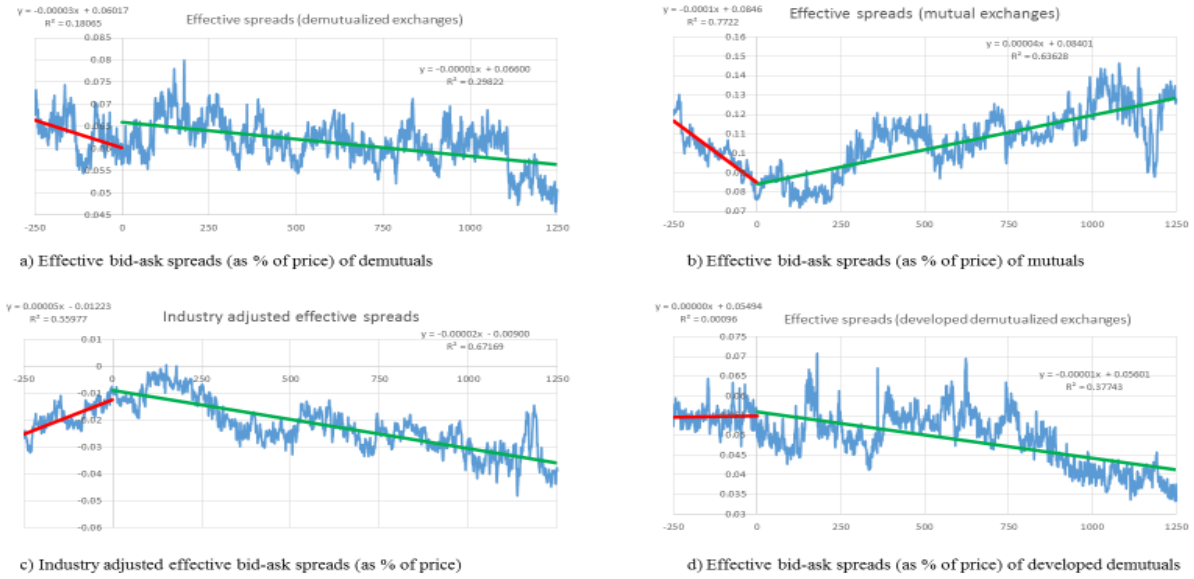
After excluding NYSE, NASDAQ, Euronext and Vienna Stock exchange because of the potential confounding effects of new technology, decimalization, mergers and Euro conversion respectively, we report, for the remaining stock exchanges, the results of the two-stage least squares regressions of bid-ask spreads on a demutualization dummy, post demutualization dummy, developed dummy as well as firm-level, exchange-level, country-level and other control variables. The other control variables are log of firm market capitalization, price inverse, log of volume, return standard deviation, exchange market share, log of domestic market capitalization, log of listed firms, log of CAPEX, GDP per capita and linear time trend. We estimate the regressions using the one year pre-demutualization data and the one year average of the post-demutualization data. T-statistics, which are in parentheses, are based on White's heteroscedastic consistent robust standard errors. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively

Table 10 Placebo event date regression results

	Effective (as % of price)	Effective (as % of quote midpoint)	Quoted
Demutual Dummy	-0.0130***	-0.0081***	0.0126***
	(-9.57)	(-6.07)	(8.69)
Developed Dummy	0.0321***	0.0443***	0.0550***
	(8.56)	(12.34)	(14.14)
Post Demutualization Dummy	-0.0091***	-0.0113***	-0.0071***
	(-8.06)	(-9.44)	(-6.77)
Demutual * Post	1.8075***	1.3210***	-0.0412
	(8.95)	(8.03)	(-0.30)
Firm-level control variables	Yes	Yes	Yes
Exchange-level control variables	Yes	Yes	Yes
Exchange-level interactions	Yes	Yes	Yes
Country-level GDP	Yes	Yes	Yes
Time trend	Yes	Yes	Yes
Constant	Yes	Yes	Yes
N	12418	12418	12418
R^2	0.5637	0.5823	0.5442

We use January 3, 2004 as a placebo event date on which all the stock exchange demutualizations occurred and report, in this table, the results of the two-stage least squares regression of bid-ask spreads on a demutualization dummy, post-demutualization dummy, developed dummy as well as firm-level, exchange-level, country-level and other control variables. The other control variables are log of firm market capitalization, price inverse, log of volume, return standard deviation, exchange market share, log of domestic market capitalization, log of listed firms, log of CAPEX, GDP per capita and linear time trend. We estimate the regressions using the one year pre-demutualization data and the one year average of the post-demutualization data. T-statistics, which are in parentheses, are based on White's heteroscedastic consistent robust standard errors. The symbols ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively

Fig. 1 Effective spreads of firms listed on demutualized and mutual exchanges



a) Effective bid-ask spreads (as % of price) of demutuals

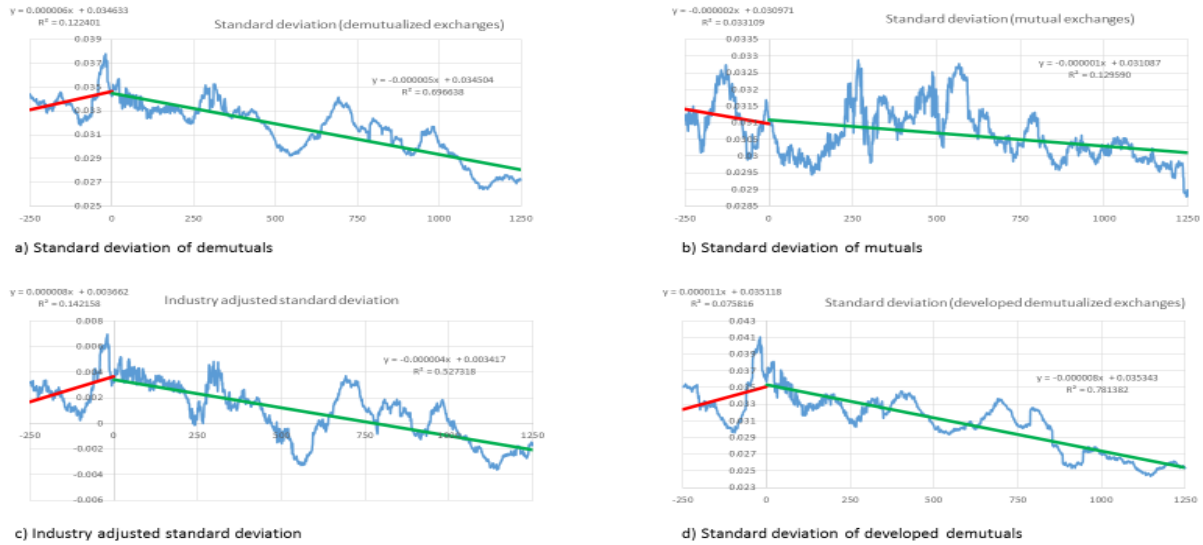
b) Effective bid-ask spreads (as % of price) of mutuals

c) Industry adjusted effective bid-ask spreads (as % of price)

d) Effective bid-ask spreads (as % of price) of developed demutuals

Fig. 1 shows the effective spreads (as % of price) of demutualized, mutual and developed demutualized exchanges from 250 days (one year) before the dates of demutualization to 1,250 days (5 years) after demutualization. Chart: a) presents effective spreads of all demutualized exchanges; b) plots effective spreads of mutual stock exchanges; c) graphs the industry adjusted (demutualized minus mutual exchanges) effective spreads; and, d) exhibits effective spreads of developed demutualized exchanges

Fig. 2 Standard deviation of firms listed on exchanges



a) Standard deviation of demutuals

b) Standard deviation of mutuals

c) Industry adjusted standard deviation

d) Standard deviation of developed demutuals

Fig. 2 presents standard deviations of demutualized, mutual and developed demutualized exchanges from 250 days (one year) before the dates of demutualization to 1,250 days (5 years) after demutualization. Chart: a) presents standard deviation of all demutualized exchanges; b) plots standard deviation of mutual stock exchanges; c) graphs the industry adjusted (demutualized minus mutuals) standard deviations; and, d) exhibits standard deviation of developed demutualized exchanges

Appendix List of demutualized and mutualized stock exchanges

Exchange	Demutualized	Demutualization date	IPO	Listing date
American SE	Yes	3/23/2006		
Amman SE	No			
Athens Exchange	Yes	7/13/1999	Yes	7/28/2000
Australian SE	Yes	10/13/1998	Yes	10/14/1998
BM&FBOVESPA	Yes	9/19/2007	Yes	11/28/2007
BME Spanish Exchanges	Yes	2/15/2002	Yes	7/14/2006
Bombay SE	Yes	5/19/2005		
Budapest SE	Yes	7/1/2002		
Buenos Aires SE	No			
Bursa Malaysia	Yes	4/14/2004	Yes	3/18/2005
Colombo SE	No			
Cyprus SE	No			
Deutsche B÷rse	Yes	2/5/2001	Yes	2/5/2001
Egyptian Exchange	No			
Hong Kong Exchanges	Yes	3/7/2000	Yes	6/27/2000
Indonesia SE	No			
Istanbul SE	Yes	1/2/2013		
Jasdaq	Yes	2/2/2001		
Johannesburg SE	Yes	7/1/2005	Yes	7/1/2005
Korea Exchange	Yes	1/19/2005		
Lima SE	Yes	1/4/2003		
London SE	Yes	3/15/2000	Yes	7/20/2001
Mexican Exchange	Yes	6/13/2008	Yes	6/13/2008
MICEX	Yes	12/8/2011	Yes	2/15/2013
NASDAQ OMX	Yes	1/18/2001	Yes	7/1/2002
NASDAQ OMX Nordic Copenhagen	Yes	1/2/1993		
New Zealand Exchange	Yes	12/31/2002	Yes	6/4/2003
NYSE Euronext (Europe)	Yes	9/22/2000	Yes	7/10/2001
NYSE Euronext (US)	Yes	3/7/2006	Yes	3/7/2006
OMX Nordic Exchange Copenhagen	Yes	1/2/1993	Yes	1/2/1993
Osaka SE	Yes	4/1/2001	Yes	4/2/2004
Oslo Børs	Yes	4/25/2001	Yes	5/28/2001
Philippine SE	Yes	8/3/2001	Yes	12/15/2003
Santiago SE	No			
Saudi Stock Market - Tadawul	No			
Shanghai SE	No			
Shenzhen SE	No			
The Stock Exchange of Thailand	No			
TSX Group	Yes	4/4/2000	Yes	11/12/2002
Warsaw SE	Yes	11/10/2010	Yes	11/10/2010
Wiener Börse	Yes	6/4/1999		