

Stock exchange demutualization, market performance and market quality

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Abstract

This paper examines the effects of the mutual-to-privately held conversion phenomenon on market performance and market quality. Using several experiments of exchanges' corporate governance conversion during the period 2004-2014, I find that demutualized exchanges have performed better than their mutual counterparts in term of profits. From a market quality perspective, I document evidence of increasing trading activity and decreasing of transaction costs. I also find that the ownership conversion induces to a sharp increase of price volatility but no deterioration in efficiency as captures by price informativeness measure. Overall, results suggest that while stock exchange's ownership conversion improves its financial performance, it may also benefit market liquidity but harms its volatility.

Keywords: Stock exchange, Corporate Governance, Demutualization, Financial Performance, Market quality.

1 Introduction

Stock exchanges are the “invisible hand” that connects issuers with investors by listing stocks on the primary market and organizing trading on the secondary market. Their customers are firms that want to be listed, financial intermediaries, institutional and private investors who want to trade. Traditionally, the financial intermediaries, members of the stock exchange, were often its owners. Under the increase of competition and technological advances, many exchanges experienced a corporate governance restructuring. They converted from a mutual company owned by members in which there are no shares, and every member has one vote into a company limited by shares and one vote per share. Some of them went a step further and became a publicly listed company.

Empirical evidence suggests that the stock exchange conversion from mutual-to-privately held company is value enhancing for the exchange and its shareholders (Azzam, 2010) and that its financial performance tends to be improved after the change in governance (O’Hara and Mendiola, 2003). In this context, Aggarwal (2002) mentions that over the long run, for-profit stock exchanges run by entrepreneurs and disciplined by profit-seeking investors should produce better-financed organizations. The reason is that they have a greater ability to respond quickly to challenges in order to preserve the value of their franchises. However, while the stock exchange’s demutualization is proved to enhance its own profits, its impact on the exchange’s market participants namely, the issuers and the investors remains un-explored. The aim of this paper is to address the following question: Does this governance conversion impact the issuers and the investors by affecting market quality?.

As most of the literature on exchanges demutualization and subsequent publicly listing

focuses on market performance, there is relatively scant literature studying the impact of this ownership conversion on market quality. A notable exception is the paper of Domowitz and Steil (1999) who provide an analytical description of industry developments in the context of the automation, suggest theoretical paradigms to explain observed changes, and to assist in anticipating future changes, in trading market structure. The authors also guide empirical investigations to compare trading costs for trades executed through traditional brokers with those incurred through non-intermediated trading in automated markets. They argue that members of mutual stock exchanges have incentives to oppose innovations even if they increase the exchange's value if it might reduce demand on their intermediation services. An important implication of their argument is that demutualized stock exchanges should provide a better financial performance and quality market than mutual ones. Krishnamurti et al. (2003) compare the transaction costs of two stock exchanges which have similar trading systems, trade essentially identical stocks, and follow the same trading hours but differ in their governance structure. Using the Hasbrouck (1993) measure of market quality they show that National Stock Exchange (NSE), a demutualized stock exchange, provides a better quality market than Bombay Stock Exchange (BSE) which is mutual. A closely related paper is Kobana and Otchere (2016) which focuses on liquidity implications of stock exchange demutualization. The authors find that demutualized exchanges achieve significant improvements in transaction costs in the five years following demutualization.

Simultaneously, Boussetta (2016) who analyzes theoretically the effect of competition between stock exchanges on their offered roles, in particular, the certification role of listings, claims that the for-profit motive which is driven by demutualization, may lead the exchange to act strategically and consequently, harms market quality.

This paper complements the literature on the impact of stock exchanges demutualization on both market performance and market quality by proposing an empirical analysis of several demutualization experiences during the period 2004-2014. To investigate the effect of ownership conversion on market performance, I first identify demutualization experiences and match each demutualized stock exchange with a mutual one based on stock exchanges' characteristics and economic factors. Second, I match stocks traded in an exchange which experienced a corporate governance conversion with stocks traded in the corresponding mutual exchange matched, based on the exchanges' matching, and employ the difference-in-difference methodology. This approach captures the impact of demutualization on market performance and market quality since the only difference between the treated and the control samples is due to changes in governance of stock exchanges.

Results indicate that once exchanges become privately held, their net profit margin improves. Moreover, compared to the control group, the demutualized exchanges become more profitable and efficient than mutual exchanges consistently with the existing literature. The mutual-to-demutualized conversion seems also to increase the revenue from non-traditional sources and decrease the listing's revenue. This indicates that the ownership conversion seems to lead into an income diversification to offset the loss of listing revenue. In addition, I document evidence of increased number of new listed companies particularly domestic companies that list through IPOs after the exchanges' demutualization.

Concerning the market quality analysis, results indicate that turnover increases following the ownership conversion and spreads decrease. The price range volatility significantly increases in the post-conversion period. Apropos of the price informativeness, it is measured through the variance ratio which corresponds to the ratio of long term volatility over the short

term. Naturally, the variance ratio is smaller than one if prices exhibit short-term reversals. Results indicate no significant difference in variance ratio after the ownership conversion is implemented.

The paper is organized as follows. Section 2 describes the process of exchanges demutualization and develops the testable hypotheses. Section 3 describes the data source, matching methodology, variables and descriptive statistics of the performance and market quality analyses. Section 4 presents the results of the impact on market performance and Section 5 presents the results of univariate and multivariate analyses of market quality. In Section 6, I conclude.

2 The stock exchanges demutualization and hypotheses development

This section provides an overview of the stock exchanges ownership conversion and testable hypotheses. The first part of the analysis presents the drivers and advantages of the exchanges demutualization. The second part concerns the hypotheses development and exhibits a brief account of the specific arguments and observations related to each hypothesis made and related to market quality.

2.1 Stock exchanges demutualization

Demutualized stock exchanges are those that experience a change in their governance structure and convert from mutually-owned organizations where members are also owners of the exchange with all the voting rights given by ownership to a shareholder owned company.

Some exchanges have gone a step further to list their shares on the stock exchange that they organize.

Among the key drivers of changes in the exchanges environment figure globalization tendencies which led to less home-biased investors and issuers and consequently stronger competition between national exchanges for order-flow and listings (Serifsoy and Tyrell, 2007). Today, exchanges are no longer the unique intermediaries or the service providers of trade execution due to the proliferation of Alternative Trading System (ATS) and Electronic Communication Networks (ECN). Since exchanges have higher building and facilities costs compared with the ATS, they need to achieve more profitability and economies of scale, while offering competitive services and fees compatible to those being provided by the ECNs (Akhtar, 2002).

Steil (2002) claims that another driver is to reduce the control of the intermediaries which seek to maximize their own profits from trade intermediation at the expense of the market participants' efficiency. As the aim of a demutualized and subsequent publicly listed stock exchange is to expand direct trading access to foreigners or institutional investors, or to merge with other exchanges, the members of a mutual exchange are frustrated to implement less intermediated trading structures as it will reduce the demand of their services. Under such circumstances, the user-owned nature of the mutual form constrains management's ability to respond to the needs of competition and becomes inadequate to respond to the resulting challenges. Simultaneously, demutualization makes sense for members, as it makes their asset liquid, which the member can easily sell. In fact, the shares of the mutual exchange are not traded in the secondary markets at floating prices; they are bought from and sold to the members at book values. As an exchange conducting its affairs on cooperative principles,

it is difficult for the owners to realize the portfolio value of their shares (Otchere, 2006). If members do not sell their shares, since demutualized stock exchange becomes a profit-making entity, members get a share of the profits made by the exchange through dividends. Meanwhile, their trading rights remain intact. Implicitly, mutual-to-privately held conversion permits to unlock the value of membership for all members without loss of trading rights. By separating the rights to trade from ownership rights, members would be able to retain their trading rights and to be free to sell shares of demutualized exchange.

At the same time, ownership conversion allows the exchange to have access to economic capital which is needed to modernize the trading systems and may yield to an improved platform in response to potential competitors in the form of alternative trading systems (Mehra, 2010). Stock exchanges can raise capital from many sources of income as new shareholders, institutions and individuals. A demutualized and subsequent publicly listed exchange can have funds from conventional lenders such as banks whereas mutual stock exchanges which are user-owned, user-controlled and user-financed, have to rely on their guarantor for financing since they obtain most of their equity capital through capital retention imposed on members (Zulfigar, 2014). Moreover, demutualized structure yields to a better governance and management structure as ownership rights are separated from membership. This results in a more flexible governance structure to adjust to changes in the industry and market conditions (Lee, 2003). In fact, the benefits of separation of ownership and control have been examined through an abundant literature which claims that besides the separation permits a more efficient decision making, it yields to an optimal firm size which can be quite large (see, among others, Fama and Jensen (1983); Coase (1937); Williamson (1988)). Another benefit is the removal of barrier to entry for new brokers which may

help the exchange to improve its competitiveness by offering more attractive services and fees. Finally, the ownership conversion may increase the ability to tap foreign expertise to enhance the strategic interests of the exchange and opportunities for greater inflow of foreign direct investment from potential alliances leading to the improvement of its perception and recognition.

2.2 Hypotheses development

In an environment of increased competition ownership structure matters and efficiency gains might lie in ownership status (Parker et al., 1991). Indeed, demutualization and the attendant change of business model (commercialization) can provide incentives for management to be efficient which generally exhibit higher levels of profitability and operating efficiency with improved financial performance and size (Azzam, 2010; Otchere, 2006). I therefore state the following hypothesis:

Hypothesis 1 *The operating efficiency of the privately held, demutualized exchange is better than that of the mutually owned, cooperative exchange.*

The new business structure with a profit motive for growth and development may enable the exchange to put in place programs and incentives that will increase order flow to the exchange (Oldford and Otchere, 2011). Some exchanges are providing subsidies to market makers in order to attract them to their trading platforms (Lee, 2003). Demutualization may also imply a technology improvement or an innovation such as greater latency and more sophisticated crossing networks. In this context, Krishnamurti et al. (2003) when comparing the main structural differences between a mutual and a demutualized structures, argue that

this structure enables a stock exchange to score higher on technology, internal control systems, transparency and investor protection. The use of technology enhances market quality by attracting more international intermediaries and institutional investors to the market and the increase in trading volume go along with reduction in bid-ask spread (Arnold et al., 1999) and enhance the quality of the market.

Simultaneously, the greater trading activity of institutional investors attracted by the technological improvements, could yield to a greater production of information. Institutions that hold stocks of a firm may increase research efforts and the number of analyst may increase accordingly (Otchere and Abou-Zied, 2008). Boehmer and Kelley (2009) assert that the number of analysts covering the market may affect the intra-day information environment of a firm. Institutional trading could result in price adjustment toward fundamental value in response to private information revealed by institutional traders order flow (Kyle, 1985). Building on these arguments, I test the following hypothesis:

Hypothesis 2 *Demutualized stock exchanges should provide a better quality market than mutual ones.*

The conversion to a demutualized structure, although benefits accrue, brings new conflicts of interest due to the commercial nature of the exchanges and their explicit objective to maximize profits (Padilla Angulo et al., 2013). Profit-maximizing exchanges place high emphasis on the revenues that customers bring in the form of listing fees paid by listed firms, trading fees paid by investors and by selling market data. More listings means more transactions and hence more fees, and data that the exchange can sell. For instance, a company which aims to maximize profits and dividends for its shareholders is tempted to loosen its

listing requirements in order to attract new listings and increase their profits (Fama et al., 2004). This situation raises questions about the ability of a for-profit exchange to develop and implement appropriate listing, trading and admission standards, market surveillance and equitable treatment of customers (Padilla Angulo et al., 2013). In this context, Boussetta (2016) argues that profit-maximizing and competing stock exchanges place a high emphasis on short-term profits which can lead them to induce the market participants in error in order to receive the fees at the expense of their reputations. As result, investors may conduct their orders to alternative exchanges and the associated flight of order flow will decrease liquidity, increase bid-ask spreads and volatility and hence, worsen the quality of the market overall.

3 Data and Empirical design

This section presents data, sample selection criteria, measurement issues and research design. I also comment on the matching of stock exchanges during the demutualization year and the matching of stocks traded in each stock exchanges.

3.1 Sample selection and data

This study focuses on all equity markets that demutualized from 2004 to 2014 (treated group). In the first part of the study, I compare the post-conversion period performance of the demutualized stock exchanges to that of a control group. For this purpose, I form a portfolio of mutual stock exchanges (control group) whose performance is used as a benchmark. For each demutualized exchange, a mutual exchange is selected based on their domestic market capitalization, geographical proximity, their countries' income economy and GDP during the

year of the demutualization. The treated group and control group members are identified from the World Federation of Exchanges reports. The final sample includes 11 exchanges that experienced a demutualization. Three demutualization experiences are removed from the analysis because of non-finding of suitable mutual exchanges.

My second objective is to analyze the effect of the mutual-to-privately held conversion on market quality. To do so, I select each stock traded on a demutualized exchange and match it with a stock traded on a mutual exchange based on the exchanges' matching done in the performance's analysis. Table 1 illustrates the matching of stock exchanges, the time-line of the exchanges' demutualization, the income economy of the country in which the exchange is located and its region. My sample includes on average 30% of firms listed on the demutualized stock exchanges. The final panel consists of 269,920 firm-day observations derived from over 1,002 unique firms listed on 16 stock exchanges over the 2004-2014 period and a maximum of 240 trading days.

[insert **Table 1** here]

The operating performance data including total assets, total liability, total operating revenue, revenue breakdown, total revenue, total cost of the demutualized and mutual exchanges are obtained from the respective exchanges annual reports. The financial data namely, domestic market capitalization, number of listed firms, value of share trading and investment flows are from the World Federation of Exchanges. The daily information on prices (close price, high and low, bid and ask, dividend), market capitalization, outstanding shares and volume used for the matching of stocks and market quality analysis are from Datastream over our sample period. The economic data which includes the GDP of each country in which the

stock exchange is located and the income economy are from World Bank database.

3.2 Market performance Measures

Consistent with previous literature, the market performance analysis focuses on the operating performance of the demutualized exchanges and in particular, on the profitability, cost efficiency, growth and product market factors (Otchere, 2006; Otchere and Abou-Zied, 2008; Azzam, 2010; Oldford and Otchere, 2011). I examine the net income margin, return on assets (ROA), return on equities (ROE) to ascertain whether privately-held exchanges become more profitable after their ownership conversion. The cost efficiency measure is the total cost-to-total-income ratio which analyses whether exchanges become more cost efficient after demutualization. I also explore the effects of ownership conversion on growth by analyzing the ratio of year-end market capitalization-to-GDP and market turnover defined as the market volume of listed stocks including domestic and foreign stocks to GDP.

The product market indicators namely, trading revenue, listing revenue, information revenue and non-traditional revenue are analyzed to examine whether demutualized exchanges reduce their dependence on traditional sources of revenue and diversify their income stream. In this context, Otchere (2006) claims that demutualization could enhance the exchanges' capacity to aggressively pursue business opportunities.

Moreover, I examine whether the ownership conversion increases the number and the value of new listings by splitting them in domestic and foreign.

To analyze the relative performance of the demutualized exchanges, a matched-pair methodology is employed in order to control for contemporaneous events. In particular, I compare the mean and median performance ratios for the demutualized exchanges to that

of the mutual exchanges during the demutualization's year.

Summary statistics for the exchanges' matching are reported in Table 2.

[insert **Table 2** here]

Results of Table 2 confirm the suitability of matched exchanges since the demutualized exchanges have a median domestic market capitalization of \$190.70 million and the mutual exchanges have a domestic market capitalization of \$115 million, an average size of 12 corresponding to the natural logarithm of total assets and an average trade value of 8.2 which is the natural logarithm of turnover by value of stocks traded. Moreover, the statistics show that the countries' economies are comparable since the country's GDP in which the demutualized exchanges are located is \$501.73 million, compared to 587.12 for the mutual exchanges' countries. Next, the market quality methodology is presented.

3.3 Market quality

On the following, I present the matching methodology of stocks traded in each structure and present the market quality measures and the research design.

3.3.1 Matching Methodology

My treated sample consists of the stocks traded in a stock exchange that experiences demutualization. I match each treated sample stock with a stock that is traded in a mutual exchange using market capitalization and daily turnover.¹ Market capitalization and daily turnover is calculated over the estimation period (one month) which corresponds to one year

¹As a robustness check, the matching is repeated using three alternative algorithms as suggested by Venkataraman (2001): (a) price and market capitalization; (b) price, market capitalization and volume; (c) price, market capitalization, volume and industry.

before the conversion event. Specifically, following Huang and Stoll (1996) and Bacidore and Sofianos (2002), the match for each treated sample stock minimizes the following expression:

$$Distance = \sum_{i=1}^2 \left[\frac{factor_i - factor_i^{matched}}{(factor_i + factor_i^{matched})/2} \right]^2, \quad (1)$$

where $factor_i$ denotes the value of the i th matching variable for the treated stock and $factor_i^{matched}$ denotes the value of the i th matching variable for the control stock. For each matching characteristic i , this minimization is done subject to the constraint:

$$Min \left| \frac{factor_i - factor_i^{matched}}{(factor_i + factor_i^{matched})/2} \right|; \forall i \in \{1, 2\}. \quad (2)$$

This matching allows for the closest similarity between both samples. Each stock is matched by sampling without replacement which can reduce size distortion as suggested by Venkataraman (2001). The event study corresponds to six months before and after the demutualization's date.² Table 3 provides descriptive statistics for the treated and matched samples.

[insert **Table 3** here]

Both sets of stocks have an average market capitalization of about \$250 million and an average turnover of 0.45%. Stocks in the control group display however on average, lower prices. Paired *t-test* indicate that the means of the treated and control samples are not statistically different from one to another for any of the two matching characteristics expect the significant difference in the mean price. The median values confirm the suitability of the matching with a median turnover of 0.2% and market capitalization of \$160 million.

²Other horizons are also studied. In particular, I narrow first the event window to three months before and after the demutualization's implementation and second I extend it to one year. Results are available upon request.

3.3.2 Market quality measures

Market quality refers to a market’s ability to meet its dual goals of liquidity and price discovery (O’hara, 1995). This paper examines market quality using three dimensions: liquidity, volatility and efficiency. Liquidity refers to the immediacy of the investor’s satisfaction. Volatility reflects to the absence of excess prices’ variance and efficiency is related to price informativeness.

Liquidity

This study considers standard low-frequency measures of liquidity and trading activity. In particular, I compute the trading turnover as a direct measure of trading activity and a measure of trading costs, the quoted spreads.³ Turnover is computed as the ratio of the daily volume traded divided by the number of shares outstanding. The relative spread represents the ratio of daily average of the bid-ask spread divided by the midquote.

Volatility

The impact of stock exchanges’ demutualization on price volatility is analyzed through the ratio of the price range volatility measure of Alizadeh et al. (2002) defined as:

$$\text{Price range volatility}_{i,t} = \frac{1}{2\sqrt{\ln(2)}} * \ln\left(\frac{High_{i,t}}{Low_{i,t}}\right), \quad (3)$$

where $High_{i,t}$ and $Low_{i,t}$ are the highest and lowest trade prices for stock i on day t , respectively.

³The Amihud Illiquidity measure could not be computed because the turnover by value is not available in many exchanges that figure in my sample.

Efficiency

To analyze whether stock exchanges' ownership structure conversion impacts information in prices, I measure the variance ratio which is the ratio of long term volatility over short term volatility. This enables us to see whether there is any effect on "pricing errors", that is, transitory shocks to prices (Lo and MacKinlay, 1988). The variance ratio is defined as follows:

$$Variance\ ratio_{i,t} = \frac{\sigma_{Return_{i,w}}^2}{5 * \sigma_{Return_{i,t}}^2} \quad (4)$$

where $\sigma(Return_{i,w})$ refers to the standard deviation of the return of stock i during the week w and $\sigma(Return_{i,t})$ refers to the standard deviation of the return of stock i on day t . Naturally, the variance ratio is smaller than one if prices exhibit short-term reversals. A ratio of one is consistent with stocks following a random walk. Hence, a greater number is better in term of efficiency.

3.3.3 Research Design

A panel data model is estimated after controlling for the exchanges' characteristics and macro-economic factors. The date when the stock exchange demutualization is implemented is taken as the event date. The event window corresponds to 6 months before and after the demutualization's implementation. To identify the mechanism that results in the impact on market quality, the following regression is estimated:

$$m_{i,t} - m_{i,t}^{match} = \alpha_i^{pair} + \beta_1 Post_t + \gamma \Delta X_{i,t} + \epsilon_{i,t} \quad (5)$$

where $m_{i,t}$ is the liquidity measurement of stock i at date t ; $m_{i,t}^{match}$ is the liquidity measurement of the stock that is matched for stock i ; α_i^{pair} is the pair fixed effect, so any difference that does not change between the treatment and the control group can be controlled in the regression; $Post_i$ is a dummy variable which equals to one after exchanges' demutualization is implemented; $\Delta X_{i,t}$ stands for stock level variables such that natural logarithm of market capitalization, lag return volatility and GDP. Thus, $\Delta X_{i,t}$ are the differences of these characteristics between a treated stock and a control one. The strategy here is to identify the effect of exchanges' demutualization on a particular measure of liquidity by comparing the treated stocks with the matched ones during the periods before and after the ownership structure is converted.

4 Impact on market performance

The operating performance of the privately-held and that of the control group are presented in Table 4. It contains the mean pre- and post-demutualization ratios of both demutualized and mutual exchanges.

[insert **Table 4** here]

4.1 Profitability

The results presented in Panel A of Table 4 indicate that the mean net profit margin of the demutualized exchanges is significantly improved in the post-demutualization period. The increase in assets issues resulting from the ownership conversion led to a significant increase in return on assets of the demutualized exchanges in the post-period. A comparison between

the post-period and the pre-period shows that demutualized exchanges have performed better than mutual exchanges in the post-period, as the *t-test* for differences in performance measures are significant in favor of the treated sample.

4.2 Cost efficiency

Given the for-profit motive, one would expect that efficiency of demutualized exchanges improves in the post-period. Results show that total cost ratio of the demutualized exchanges decreases significantly in the post-conversion period. Despite the decrease of the cost ratio for the mutual exchanges in the post-period, the difference between the treated and the control groups has narrowed during the post-period. The exchanges's ownership conversion seems to improve cost efficiency.

Those findings provide considerable support to previous studies that document significant overperformance for demutualization. For instance, O'Hara and Mendiola (2003) find that the performance of the exchanges that become privately held improves after the change in corporate governance. Otchere (2006) who finds the same results, submits that better monitoring of managerial performance, the potential threat of takeover from the market for corporate control that accompanies demutualization and the reduction in agency costs associated with the mutual form of exchange contribute to unlock growth opportunities and value for the privately held stock exchanges.

4.3 Product Market

Results of Panel C from Table 4 show that the change in the product market appears to not being an industry phenomenon since the control group does not experience the same pattern than the treated one. While trading revenue increases (7%) for the treated group in the post-demutualization period, it decreases (7.9%) for the control group. The proportion of the demutualized exchanges' listing revenue to total revenue has fallen from 24.3% to 21.1%. Simultaneously, this ratio has in contrast increased for the control group in the post-demutualization period. Overall, demutualization seems to increase the ratio of trading revenue and decrease the listing revenue's ratio. The decrease in the weight of the listing fee income to the total revenue could be due a reduction in listing fees by the demutualized exchanges in order to attract more companies specially in an area where competition has reached its almost. In section 4.5, I study whether the reduction in listing revenue is due to a decrease in new listings.

4.4 Growth

In Panel D, one can see that the growth of the treated sample has also improved following the conversion from mutual to privately held exchange. The demutualized exchange has recorded a significant higher market turnover ratio in the post-demutualization period, a proof of a growth in the stock market activities.

4.5 New listings

In this section, I examine the effects of conversion from a member-controlled to privately held exchange on the number of newly listed companies and their value and by splitting between domestic and foreign.

[insert **Table 5** here]

Panel A presents the number of newly listed companies through an IPO, split between domestic and foreign. Results of Panel A show evidence of an increased number of domestic new companies listed through an IPO while in the mutual exchange the total number of new listing decreases. In Panel B, where the number of listed companies is represented, one can see that the number of listed companies both domestic and foreign increases significantly when the exchange becomes privately held. On the value basis, the value of share trading increases following the ownership conversion. Implicitly, the strategy of the demutualized exchanges to reduce listing fees seems to be efficient since new companies are attracted for listings. Consistent with the discussion above about the advantages of demutualization, the ownership conversion and the new for-profit business model seems to help the exchange attract more listings and in particular more foreign companies as the exchange's perception and recognition are improved.

4.6 Revenue diversification

Demutualization and subsequent self-listing allows the exchange to have access to economic capital which is needed to face potential competitors (Mehra, 2010). In fact, income diversification becomes a key imperative for exchanges under the pressure of the traditional source

of revenues. Table 6 reports the revenue sources of demutualized exchanges before and after their ownership conversion.

[insert **Table 6** here]

Panel A presents the growth in revenue breakdown while Panel B presents the ratios of the revenue breakdown to total revenue. Results of Panel A show that the post growth in trading income increases from 4.3% to 30% while the growth in listing revenue, decreases in the post-demutualization period. Consistent with Otchere and Abou-Zied (2008)'s finding, the other income significantly raises over the 3-years post-demutualization. On a proportion to the total revenue basis, only the ratio of listing fees-to-total revenue decreases when the demutualization is implemented. These results indicate that to offset the loss of listing fee income, the demutualized exchanges has been generating significant revenue from non-traditional sources. For instance, the clearing and settlement revenue of the Bursa Malaysia two years after its demutualization increased by 14% compared to the exchange clearing and settlement revenue two years before its ownership conversion.⁴

Overall, results suggest that the stock exchanges' operating performance is improved after the demutualization, in line with our Hypothesis 1.

⁴Annual reports of Bursa Malaysia of 2002 and 2006.

5 Impact on market quality

5.1 Univariate analysis

Table 7 presents summary statistics of the market quality measures for the treated sample and the control sample during the pre-event (Panel A) and the post-event (Panel B). Both panels report mean and median values and their differences.

[insert **Table 7** here]

5.1.1 Liquidity

Results show that the relative spread is always higher in the treated sample both in the pre-event and in the post-event periods and the difference is statistically significant. The difference-in-difference between both periods while it decreases, it is not significant. However, there is a significant change in trading activity since turnover and volume by stock are significantly higher after the demutualization's implementation.

5.1.2 Stability

Following the exchanges governance conversion, the price range volatility measure of treated stocks rises relative to the control group. The increase in volatility is economically significant at 1%. The return volatility also increases in the post-event period.

5.1.3 Informational Efficiency

Concerning the price informativeness, while the difference in the pre-event window is significantly lower in the treated group, the difference between the post and the pre-events period is not significant.

Overall, results of the univariate analysis are interpreted as generally supporting the hypothesis that the mutual-to-privately held conversion while it improves trading activity, it increases volatility.

Next, I examine whether the difference in quality measures is statistically significant once I introduce controls.

5.2 Multivariate Analysis

Though the stocks are matched on stock-specific characteristics, the heterogeneity in economic variables could explain the differences in market quality measures. In this section, I introduce a panel regression framework. In each analysis, the regression specifications are run: (1) with stock-pair fixed effect; (2) with control variables including the market capitalization, and (3) with control variables and stock-pair fixed effects. Standards errors are clustered over time.

5.2.1 Liquidity

Table 8 displays the estimation results, where the corresponding liquidity measure acts as the dependent variable. Following the exchanges governance conversion, relative spread in treated stocks shows a significant decrease, a systematic evidence of change in trading costs.

This effect is economically significant across the three regressions at a level of 1%. Concerning turnover, it significantly increases, as trading costs vary inversely with trading volume reflecting economies of scale, lower inventory control costs and lower adverse selection costs (Venkataraman, 2001).

[insert **Table 8** here]

Consistent with previous findings, trading activity raises after exchanges demutualization, and liquidity is improved.

5.2.2 Volatility

Could exchanges' governance conversion improve other aspects of market quality such as market volatility?

Table 9 reports the estimation results for the regression model where the dependent variable in Panel A, is the price range volatility. Following the exchanges demutualization, the price range volatility of treated stocks increases relative to the control group, an evidence of lower stability. This decline is economically significant at level of 5%.

[insert **Table 9** here]

5.2.3 Informational Efficiency

Panel B of Table 9 displays the empirical results of the efficiency's regression analysis where the variance ratio is the dependent variable. The intuition of this test is that if the stock price follows a random walk then the variance of two-interval log returns should be twice as large as the variance of one-interval log returns. Results show that the governance conversion has a insignificant effect on variance ratio.

Empirical results obviously suggest that demutualization improves liquidity, but worsens volatility. In fact, trading activity increases significantly after the implementation of the corporate governance conversion and spreads narrow, consistent with Hypothesis 2.

5.3 Robustness checks

A number of robustness tests are conducted to evaluate the sensitivity of the results to alternative specifications and measures. First, the matching is repeated using three alternative algorithms as suggested by Venkataraman (2001): (a) price and market capitalization; (b) price, market capitalization and volume; (c) price, market capitalization, volume and industry. The alternative matching algorithms lead to the same results than the main findings. Second, other horizons are studied. In particular, I narrow first the event window to three months before and after the demutualization's implementation and second I extend it to one year. I find that demutualization leads to decreases in spreads and increases of trading activity for firms listed on the demutualized stock exchanges.

While the multivariate analysis is addressed to firm-level analysis in order to implement the stock-pair fixed effect, I also estimate the regression by aggregating data at the exchange level. The results of the exchange-level regressions are similar to the firm-level regressions. I find that demutualization leads to decreases in spreads, increases in trading activity but higher price volatility.

Given that the results of the various robustness tests are similar to the main findings, I contend that stock exchange demutualization robustly leads to significant improvements in liquidity and trading activity.

6 Conclusion

In the last decades, the stock exchange industry

has experienced significant changes in their organizational form. Stock exchanges demutualized and in most cases become listed. While previous literature focuses on the demutualization impact on the exchange performance, its impact on the issuers and investors remains unexplored.

In this paper, I investigate whether the conversion from mutual to privately held exchange improves market performance and market quality. I focus on exchanges demutualization experiences from 2004 to 2014. I employ a difference-in-difference approach which is based on two stage approach. In the first stage, a conversion in the stock exchange corporate governance is identified. Each demutualized exchange is matched with a similar mutual exchange based on stock exchanges' characteristics and countries' economic factors. In the second stage, and based on the exchanges' matching, each stock traded in a demutualized exchange is matched with a stock traded in the control group based on stocks characteristics.

Results show that demutualized exchanges become more profitable than the mutual exchanges and tend to diversify their income base to derive significant revenue from non-traditional sources. It seems also that new listings increase after the ownership conversion particularly, new domestic companies that list through an IPO. Concerning the market quality, results indicate an evidence of liquidity improvement following the conversion of exchanges to privately held companies but not volatility. In particular, turnover increases, spreads decrease and high-low prices measure increases. Thus, the conversion from mutual to privately exchange seems to provide more profits to the exchange, better liquidity but at the expense

of volatility.

Given this significant improvement in market liquidity measures, additional explanations must be also explored. An important open question is whether this increase in market liquidity and mainly in trading activity affects certain traders more than others. Disentangling the traders' nature during the pre-and post periods remains an interesting issue for future research.

References

- Aggarwal, R., 2002. Demutualization and corporate governance of stock exchanges. *Journal of applied corporate finance* 15.
- Akhtar, S., 2002. Demutualization of stock exchanges: Problems, solutions, and case studies. Asian Development Bank.
- Alizadeh, S., Brandt, M. W., Diebold, F. X., 2002. Range-based estimation of stochastic volatility models. *The Journal of Finance* 57 (3), 1047–1091.
- Arnold, T., Hersch, P., Mulherin, J. H., Netter, J., 1999. Merging markets. *The Journal of Finance* 54 (3), 1083–1107.
- Azzam, I., 2010. Stock exchange demutualization and performance. *Global Finance Journal* 21 (2), 211–222.
- Bacidore, J. M., Sofianos, G., 2002. Liquidity provision and specialist trading in nyse-listed non-us stocks. *Journal of Financial Economics* 63 (1), 133–158.
- Boehmer, E., Kelley, E. K., 2009. Institutional investors and the informational efficiency of prices. *Review of Financial Studies* 22 (9), 3563–3594.
- Boussetta, S., 2016. Competition among exchanges and reputational concerns. Working paper.
- Coase, R. H., 1937. The nature of the firm. *economica* 4 (16), 386–405.
- Domowitz, I., Steil, B., 1999. Automation, trading costs, and the structure of the trading service industry. In: *Second Annual Brookings-Wharton Conference on Financial Services*.
- Fama, E. F., Jensen, M. C., 1983. Separation of ownership and control. *The Journal of Law & Economics* 26 (2), 301–325.

- Hasbrouck, J., 1993. Assessing the quality of a security market: A new approach to transaction-cost measurement. *Review of Financial Studies* 6 (1), 191–212.
- Huang, R. D., Stoll, H. R., 1996. Dealer versus auction markets: A paired comparison of execution costs on nasdaq and the nyse. *Journal of Financial economics* 41 (3), 313–357.
- Krishnamurti, C., Sequeira, J. M., Fangjian, F., 2003. Stock exchange governance and market quality. *Journal of banking & finance* 27 (9), 1859–1878.
- Kyle, A. S., 1985. Continuous auctions and insider trading. *Econometrica: Journal of the Econometric Society*, 1315–1335.
- Lee, R., 2003. Changing market structures, demutualization and the future of securities trading. In: 5th Annual Brookings/IMF/World Bank Financial Markets and Development Conference (4/2003). Citeseer.
- Lo, A. W., MacKinlay, A. C., 1988. Stock market prices do not follow random walks: Evidence from a simple specification test. *Review of financial studies* 1 (1), 41–66.
- Mehra, P., 2010. Demutualization of stock exchanges.
- O’hara, M., 1995. *Market microstructure theory*. Vol. 108. Blackwell Cambridge, MA.
- O’Hara, M., Mendiola, A. M., 2003. Taking stock in stock markets: the changing governance of exchanges. Available at SSRN 431580.
- Oldford, E., Otchere, I., 2011. Can commercialization improve the performance of stock exchanges even without corporatization? *Financial Review* 46 (1), 67–87.
- Otchere, I., 2006. Stock exchange self-listing and value effects. *Journal of Corporate Finance* 12 (5), 926–953.
- Otchere, I., Abou-Zied, K., 2008. Stock exchange demutualization, self-listing and performance: The case of the australian stock exchange. *Journal of Banking & Finance* 32 (4), 512–525.

- Padilla Angulo, L., Slimane, F. B., Alidou, D., 2013. The london stock exchange: Strategic corporate governance restructuring after demutualization. *Journal of Applied Business Research (JABR)* 30 (1), 211–226.
- Serifsoy, B., Tyrell, M., 2007. Investment behavior of stock exchanges and the rationale for demutualization-theory and empirical evidence. In: *EFA 2007 Ljubljana Meetings Paper*.
- Steil, B., 2002. Changes in the ownership and governance of securities exchanges: causes and consequences. *Brookings-Wharton papers on financial services* 2002 (1), 61–91.
- Vayanos, D., Wang, J., 2012. Market liquidity—theory and empirical evidence. Tech. rep., National Bureau of Economic Research.
- Venkataraman, K., 2001. Automated versus floor trading: An analysis of execution costs on the paris and new york exchanges. *The Journal of Finance* 56 (4), 1445–1485.
- Williamson, O. E., 1988. Corporate finance and corporate governance. *The journal of finance* 43 (3), 567–591.
- Zulfigar, S. T., 2014. Demutualization of stock exchanges and stock market growth: Broader economic investigation of demutualized exchanges. *Journal of Economics Finance and Accounting* 1 (4).

Table 1: Description of stock exchanges.

This table reports the list of the demutualized exchanges included in this study. Column 2 reports the date when the demutualization is implemented. Column 3 reports the matched stock exchange which has a mutual structure. Column 4 describes the income economy of the country where the exchange is located. Column 5 refers to the region of each exchange. Three demutualization experiences are removed due to matching limitations and are put in parentheses.

Stock exchange	Effective date	Matched exchange	Income Economy	Region
Bursa Malaysia	January 2004	Thailand SE	Upper middle	Asia
Korea SE	January 2005	Shanghai	High/Upper middle	Asia
Dubai Fin. Market	November2006	Abu-dhabi	High	Middle east
BOVESPA	August 2007	Buenos aires SE	Upper middle	America
Warsaw SE	November 2010	Wiener SE	High	Europe
Nairobi SE	June 2014	Nigeria SE	Lower middle	Africa
Istanbul SE	April 2013	Saudi SE	Upper middle/High	Europe & Central Asia
Malta SE	November 2007	Cyprus SE	High	Europe
(Bombay SE	May 2005	-	Lower middle	Asia)
(NYSE	April 2005	-	High income	America)
(Johansbourg SE	July 2005	-	Upper middle	Africa)

Table 2: **Descriptive statistics of exchanges' matching**

This table reports mean and median statistics of the demutualized exchanges and the control group of mutual exchanges. Size is natural logarithm of total assets. Trade value is natural logarithm of total value of trade for stocks. ROA is the ratio of net income to total assets. ROE is the ratio of net income to total equity. Net income margin is the ratio of net income over the total revenue. Market turnover is the ratio of the market volume of listed stocks including domestic and foreign stocks to GDP. The data are obtained from annual reports as of the year of demutualization. Apart from the ratios, the number of listed firms, all figures in million of \$. The last two columns test the hypothesis of no significant difference in means (*T-test*) and medians (Wilcoxon test) between the treated and control groups of exchanges. The symbols ***,** and * indicate significance at 1%, 5% and 10% level, respectively.

	Demutualized Exchanges		Mutual Exchanges		<i>T-test</i>	Wilcoxon test
	Mean	Median	Mean	Median		
Total Assets (\$m)	847.57	326.77	170.43	86.41	677.14	240.36
Total Liability (\$m)	169.07	45.82	13.86	13.71	155.21	32.12
Total Revenue (\$m)	219.95	66.91	40.58	35.70	179.37*	31.20
Listing Fees (\$m)	41.55	5.36	7.56	8.33	33.99*	-2.97
Trading Revenue (\$m)	138.96	31.67	14.56	14.35	124.39*	17.32
Total Cost (\$m)	166.03	51.72	22.00	18.52	144.02	33.20
Size	12.274	12.599	11.644	11.367	0.629	1.232
Domestic Market Cap (\$m)	383.92	190.70	161.72	115.39	222.19	75.31
Trade Value	8.421	8.672	7.925	8.462	0.495	0.209
Listing Fees/Nb.of firm listed (\$)	0.075	0.013	0.026	0.051	0.126	-0.012
Number of firm listed	554	404	284	163	269*	241
Trading Revenue/Total Revenue	0.497	0.624	0.418	0.416	0.079	0.208
ROA	0.095	0.078	0.109	0.125	-0.013	-0.047
ROE	0.108	0.091	0.145	0.197	-0.037	-0.106
NIM	0.284	0.304	0.281	0.351	0.003	-0.047
Total Cost/Total Revenue	0.697	0.643	0.471	0.519	0.226	0.124
Market Turnover Ratio	0.045	0.038	0.017	0.007	0.028	0.031
GDP	501.73	350.67	587.12	339.53	-82.39	11.14

Table 3: Descriptive statistics of stocks' matching

This table reports descriptive statistics for the treated sample and control sample stocks and differences between the samples. Market capitalization (in millions of US dollars) is the price times the number of shares outstanding. Share price is the average closing price, turnover is the average volume traded as a percentage of shares outstanding, and relative spread represents the ratio of daily average of the bid-ask spread divided by the midquote. All those measures are calculated over the estimation period (one month) corresponding to one year before the conversion event. Significance of differences in means (medians) is assessed using *t-test* (Wilcoxon rank test). The symbols ***,** and * indicate significance at 1%, 5% and 10% level, respectively.

	Treated		Control		<i>T-test</i>	Wilcoxon test
	Mean	Median	Mean	Median	(treated minus control)	
Volume	2,989	82	3,101	229	-112	-147
Price (\$)	11.747	2.157	5.159	0.589	6.588***	1,567
Market capitalization (\$m)	275.56	164.27	225.14	154.73	50.42	9.54
Turnover	0.004	0.002	0.005	0.002	-0.001	-0.0001
Relative spread	0.082	0.025	0.009	0.014	0.073	0,011

Table 4: **Difference in mean: Demutualized versus Mutual Exchanges**

This table contains the mean operating performance ratios for the demutualized exchanges and the mutual exchanges. The pre-demutualization ratios are the mean ratios for the 3-year period (-3 to -1) and the post-demutualization ratios are the mean ratios for years +1 to +3. ROA is the ratio of net income to total assets. ROE is the ratio of net income to total equity. Net profit margin is the ratio of net income over the total revenue. The cost-to-income is total cost-to-total revenue, Trad rev/Tot Rev is Trading revenue-to-total revenue, Listing fee/Tot Rev is listing revenue-to-total revenue, Market cap refers to Market capitalization and Market turnover ratio is the total value of shares traded as a percentage of GDP. Significance of differences in means is assessed using *t-test*. The symbols ***,** and * indicate significance at 1%, 5% and 10% level, respectively.

	Demutualized Exchanges			Mutual Exchanges			Difference		
	Post	Pre	Difference	Post	Pre	Difference	Post	Pre	Difference
<i>Panel A: Profitability</i>									
ROE	0.219	0.121	0.098*	0.019	0.042	-0.023	0.201	0.079	0.122
ROA	0.117	0.090	0.027**	0.015	0.034	-0.018	0.101	0.056	0.045**
Net Profit margin	0.437	0.322	0.115	0.064	0.096	-0.032	0.373	0.226	0.147**
<i>Panel B: Cost efficiency</i>									
Cost-to-income	0.479	0.848	-0.369*	0.806	1.156	-0.350	-0.327	-0.308	-0.019
<i>Panel C: Product Market</i>									
Trad rev/Tot Rev	0.507	0.437	0.070*	0.329	0.409	-0.079	0.177	0.028	0.149
Listing fee/Tot Rev	0.211	0.243	-0.032	0.313	0.096	0.217	-0.102	0.147	-0.249
<i>Panel D: Growth</i>									
Market cap/GDP	0.603	0.760	-0.158	1.845	0.453	1.391	-1.242	0.307	-1.549
Market Turnover ratio	0.032	0.027	0.005*	0.023	0.031	-0.008	0.009	-0.004	0.013

Table 5: New listings by company type

This table shows the breakdown of the new listings in number and value for the demutualized exchanges and the mutual exchanges. The pre and post-demutualization periods correspond to the 3-year period before/after ownership conversion. Panel A shows the number of newly listed companies through an IPO. The number of new companies listed through an IPO is the number of companies, split between domestic and foreign, whose shares were admitted to listing during the period through an offer of subscription and/or sales of shares (IPO). Panel B shows the number of listed companies overall. It shows also the change in number comparing with last year. Only companies admitted to listing are included in the data. Panel C represents the value of share trading (VST) which is the total number of shares traded multiplied by their respective matching prices. Significance of differences in means is assessed using *t-test*. The symbols ***, ** and * indicate significance at 1%, 5% and 10% level, respectively.

	Demutualized Exchanges			Mutual Exchanges			Difference		
	Post	Pre	Difference	Post	Pre	Difference	Post	Pre	Difference
Panel A: New listings									
<i>Number of new companies listed through an IPO</i>									
Domestic	36.08	30.49	5.58	2.33	7.50	-5.16	33.75	22.99	10.75
Foreign	3.25	5.67	-2.42	0.00	2.00	-1.00	3.25	3.66	-0.41
Total	39.33	36.17	3.17	2.33	8.50	-6.17	37.00	27.67	9.33
Panel B: Number of listed companies									
Domestic	699.83	406.94	292.89***	307.83	290.20	17.63*	392.00	116.74	275.26**
Foreign	8.77	7.27	1.49**	9.71	10.83	-1.12	-0.94	-3.56	2.61**
Total	706.17	411.65	294.52***	311.61	294.53	17.08*	394.55	117.11	277.44***
Change	0.084	0.058	0.026	-0.003	0.021	-0.025	0.087	0.037	0.050
Panel C: Value of share trading									
VST (\$m)	419.98	194.485	225.49*	486.43	152.75	333.68	-66.45	41.74	-108.19

Table 6: Revenue sources of the demutualized Exchanges

This table shows the breakdown of the revenue streams of the demutualized exchanges. Panel A shows the growth in the revenue streams in the pre- and post-demutualization periods. Panel B presents the ratios of the revenue streams to total revenue in the pre- and post-demutualization periods. The database obtained from the listed exchanges annual reports.

Source of revenue	Post-demutualization	Pre-demutualization	Difference
<i>Panel A: Growth in income</i>			
Stock trading income	0.297	0.043	0.254
Listing fees	0.077	0.305	-0.228
Market data	0.304	0.101	0.202
Other income	1.887	0.645	1.242**
<i>Panel B: Growth in revenue type as a ratio of total revenue</i>			
Stock trading income	0.511	0.488	0.022*
Listing fees	0.211	0.243	-0.032
Market data	0.079	0.064	0.016
Other income	0.169	0.133	0.036*

Table 7: Market quality measures

This table reports the mean market quality measures for the treated sample and Control sample stocks on the pre and post events. Panel A (B) reports this data for the pre event period (post event). Relative spread represents the ratio of daily average of the bid-ask spread divided by the midquote. Turnover is the ratio of the daily volume traded divided by the number of shares outstanding. Return Volatility is the standard deviation of returns. A second metric for volatility is the average of the price-range volatility measure in Alizadeh et al. (2002), which is given by $\frac{1}{2\sqrt{\ln(2)}} * \ln\left(\frac{High_{i,t}}{Low_{i,t}}\right)$, where $High_{i,t}$ and $Low_{i,t}$ are the highest and lowest trade prices for stock i on day t . Variance ratio is computed as the ratio between the weekly and five times the daily variance of equity returns. Differences between the different periods are also reported. Panel C reports the difference in the corresponding measures between the pre and post event for the treated and the control samples. Significance of differences in means is assessed using t -test. The symbols ***, ** and * indicate significance at 1%, 5% and 10% level, respectively.

	Treated	Control	Difference
<i>Panel A: Pre-event</i>			
Relative spread	0.036	0.021	0.015***
Turnover (%)	0.0048	0.0054	-0.0006**
Volume	2188	3853	-1664***
Price range volatility	0.0169	0.0166	0.0002
Return volatility	0.023	0.075	-0.052 ***
Variance ratio	0.354	0.364	-0.009***
<i>Panel B: Post-event</i>			
Relative spread	0.037	0.022	0.015***
Turnover (%)	0.0044	0.0042	0.0002
Volume	1960	2931	-970***
Price range volatility	0.017	0.016	0.001 ***
Return volatility	0.023	0.069	-0.045***
Variance ratio	0.348	0.353	-0.004
	Treated	Control	Difference
<i>Panel C: Post-event-Pre-event</i>			
Relative spread	0.015	0.015	-0.0006
Turnover (%)	0.0002	-0.0006	0.0008***
Volume	-970	-1664	694***
Price range volatility	0.001	0.0002	0.001***
Return volatility	-0.045	-0.052	0.007***
Variance ratio	-0.004	-0.009	0.005

Table 8: **Multivariate Analysis of Differences in Liquidity measures**

This table represents the impact of the stock exchanges' demutualization on various measures of market quality. The following regression is estimated:

$$m_{i,t} - m_{i,t}^{match} = \alpha_i^{pair} + \beta_1 Post_t + \gamma \Delta X_{i,t} + \epsilon_{i,t}$$

where $m_{i,t}$ is one of the market quality measures of stocks traded in a demutualized exchange for stock i in day t and $m_{i,t}^{match}$ is the value of this measure for the match of stock i in day t in the group of control stocks. In panel A, the dependent variable corresponds to the relative spread defined as the ratio of daily average of the bid-ask spread divided by the midquote. In panel B, the dependent variable is the turnover defined as the ratio of the daily volume traded divided by the number of shares outstanding. The independent variables are a dummy taking the value one after the exchanges demutualization (POST) and the logarithm of market capitalization. Standard errors are reported in parentheses and are clustered by time. The symbols ***,** and * indicate significance at 1%, 5% and 10% level, respectively.

Panel A: Dependent variable: Relative spread			
	(1)	(2)	(3)
Post	-0.0021*** (0.0003)	-0.0017*** (0.0004)	-0.0019*** (0.0003)
Ln(Market cap)		0.0007*** (0.0001)	0.0003** (0.0001)
Observations	192712	192712	192712
R^2	0.055	0.066	0.060
Stock-Pair FE	Yes	No	Yes
Time Clustering	Yes	Yes	Yes
Panel B: Dependent variable: Turnover			
	(1)	(2)	(3)
Post	0.0027*** (0.0003)	0.0026*** (0.0003)	0.0028*** (0.0002)
Ln(Market cap)		0.0005*** (0.00007)	0.0008*** (0.0001)
Observations	190389	190389	190389
R^2	0.028	0.002	0.022
Stock-Pair FE	Yes	No	Yes
Time Clustering	Yes	Yes	Yes

Table 9: **Multivariate Analysis of Differences in market quality measures**

This table represents the impact of the stock exchanges' demutualization on various measures of market quality. The following regression is estimated:

$$m_{i,t} - m_{i,t}^{match} = \alpha_i^{pair} + \beta_1 Post_t + \gamma \Delta X_{i,t} + \epsilon_{i,t}$$

where $m_{i,t}$ is one of the market quality measures of stocks traded in a demutualized exchange for stock i in day t and $m_{i,t}^{match}$ is the value of this measure for the match of stock i in day t in the group of control stocks. In panel A, the dependent variable is the price range volatility measure (Alizadeh et al, 2002), which is given by $\frac{1}{2\sqrt{\ln(2)}} * \ln(\frac{High_{i,t}}{Low_{i,t}})$, where $High_{i,t}$ and $Low_{i,t}$ are the highest and lowest trade prices for stock i on day t . In panel B, the dependent variable is the variance ratio, which is computed as the ratio between the weekly and five times the daily variance of equity returns. The independent variables are a dummy taking the value one after the exchanges demutualization (POST) and the logarithm of market capitalization. Standard errors are reported in parentheses and are clustered by time. The symbols ***, ** and * indicate significance at 1%, 5% and 10% level, respectively.

Panel A: Dependent variable: Price range Volatility			
	(1)	(2)	(3)
Post	0.0012** (0.0005)	0.0013** (0.0005)	0.0012** (0.0005)
Ln(Market cap)		-0.0001*** (0.00004)	-0.0002*** (0.0001)
Observations	192268	192268	192268
R^2	0.017	0.010	0.016
Stock-Pair FE	Yes	No	Yes
Time Clustering	Yes	Yes	Yes
Panel B: Dependent variable: Variance ratio			
	(1)	(2)	(3)
Post	0.008 (0.010)	0.002 (0.009)	0.0019 (0.009)
Ln(Market cap)		-0.001* (0.0006)	-0.0004 (0.001)
Observations	242212	242212	242212
R^2	0.021	0.034	0.022
Stock-Pair FE	Yes	No	Yes
Time Clustering	Yes	Yes	Yes