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Are super stock exchange mergers motivated by efficiency or market power gains?

Isaac Otchere^{a,*}, Kobana Abukari^b^a *Sprott School of Business, Carleton University, Ottawa, ON K1S 5B6, Canada*^b *Laurentian University, Sudbury, ON P3E 2C6, Canada*

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ABSTRACT

Stock exchange mergers can lead to increased efficiency; however, increasing levels of concentration can potentially lead to the exercise of market power. We investigate the market power repercussions of stock exchange mergers and find that the industry's concentration levels have not significantly increased and the concentration levels do not influence exchanges' profitability in the post-merger period. The profitability of the merging exchanges in the post-merger period is largely influenced by efficiencies in revenue generation and cost management. The absence of evidence that stock exchange mergers lead to the exercise of market power suggests that there does not appear to be an immediate need for regulatory agencies to be overly concerned about mergers among stock exchanges leading to the exploitation of market power to the detriment of consumer welfare.

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1. Introduction

Financial markets have witnessed a wave of mergers among leading stock exchanges involving the NYSE, Euronext, Nasdaq, London Stock Exchange (LSE), and Deutsche Boerse, among others. Stock exchange mergers and acquisitions continue to gain prominence largely because of the expected gains from these combinations. Although there are several sources of gains that can emanate from mergers and acquisitions,¹ efficiency gains and market power gains are two of the most important sources of gains widely discussed in the extant literature (e.g., White, 1987; Bhattacharyya and Nain, 2011; Devos et al., 2016). Whereas efficiency gains are positively perceived because of the possibility that improvements in efficiency can lead to lower prices, gains resulting from market power are regarded in a negative light because they lessen competition and can lead to restricted output, higher prices, and consequently allocative inefficiency (De Loecker and Eckhout, 2018).

The conventional expectation is that mergers and acquisitions, especially horizontal mergers among a subset of firms in the same market, may reduce competition and increase market concentration (Levin, 1990; Bhattacharyya and Nain, 2011; Bernile and Lyandres, 2019). Consequently, the merged firms as well as rivals can potentially exercise market power by

* Corresponding author.

E-mail address: isaac.otchere@carleton.ca (I. Otchere).

¹ In their comprehensive review of the literature on mergers and acquisitions from several disciplines, Haleblan et al. (2009) identify several reasons why firms acquire others, which they group into (i) value creation motives such as market power, efficiency, resource redeployment and market discipline of ineffective managers; (ii) managerial self-interest (i.e., value destruction) drivers such as compensation, hubris and target defense tactics; (iii) environmental factors such as environmental uncertainty, resource dependence, imitation, regulation and network ties; and, (iv) firm characteristics such as acquisition experience and firm strategy and position.

either charging higher prices or restricting output. Thus, if market power is exercised, then it is not only the merging exchanges that gain but rivals as well, and therefore, the latter will react positively to mergers involving competitors. According to [Eckbo \(1985\)](#), the level of industry concentration is a reliable indicator of the industry's market power, and as such, a horizontal merger is more likely to be collusive, and anticompetitive the greater the merger-induced change in industry concentration. Other authors, for example, [Carbó-Valverde et al. \(2008\)](#), also highlight the reliance on concentration as an indicator of market power in the literature.

The theoretical predictions of the market power doctrine are validated empirically by evidence gleaned from industries such as airlines and banking which, in general, link mergers to the exercise of market power, with its attendant negative welfare consequences for consumers. In the banking industry, [Berger et al. \(1999\)](#) and [Karceski et al. \(2005\)](#) conclude that banks in more concentrated markets charge higher rates. [Kim and Singal \(1993\)](#) also find that airline mergers lead to airfare increases of about 10%, and [Maudos and Guevara \(2007\)](#) report that welfare loss from the misallocation of resources attributable to market power represent about 0.54% of the GDP of the European Union in 2002. In fact, the detrimental (anticompetitive) effects of significant market power stemming from mergers and acquisitions are so much frowned upon that a number of countries, including the U.S. and Canada, have antitrust laws that can be invoked to quash proposed mergers that potentially can increase market power and significantly dampen competition in a market. It is in light of this that in 2012, the European Commission vetoed the proposed merger between Deutsche Boerse and NYSE Euronext on the grounds that the merger would hurt competition by creating a quasi-monopoly (with a combined market share of over 90%) in the area of European financial derivatives traded globally on exchanges ([European Commission, 2012](#)). Other high-profile proposed stock exchange mergers that have been blocked by regulators for antitrust concerns include the 2017 LSE and Deutsche Boerse proposed merger, the 2011 Nasdaq OMX's \$11 billion (joint bid with Intercontinental Exchange (ICE)) for NYSE Euronext, and the 2010 Singapore Exchange (SGX) - Australian Securities Exchange (ASX) \$8 billion deal which was rejected in 2011 by the federal government of Australia.

However, while the popular belief is that merging firms (in highly concentrated industries) wielding considerable market power may be apt to exploiting the consumer in the form of higher prices or reduced output, it is also possible that such mergers could positively impact consumer welfare if their "bigness" leads to lower costs and greater efficiency. Indeed, [Eckbo \(1985\)](#), [Eckbo and Wier \(1985\)](#), [Fee and Thomas \(2004\)](#) and [Devos et al. \(2009\)](#), among others, demonstrate empirically that mergers and acquisitions do not necessarily lead to the exercise of market power.

Facilitated by the wave of demutualization, consolidation in the stock exchange industry has gained momentum in recent years, including the 2006 Paris-based Euronext and NYSE \$10.2 billion merger deal and the Nasdaq-OMX (Nordic bourse) \$4.1 billion deal in 2007. Since these cross-border mergers could reduce competition ([Levin, 1990](#); [Bernile and Lyandres, 2019](#)), the possibility that the stock exchange mergers could lead to significant market concentration and the exercise of market power, with the attendant reduction in competition in the industry cannot be discounted (e.g., [Kokkoris and Olivares-Caminal, 2008](#); [Hasan et al., 2012](#)). Given the current increase in consolidation in the industry, it is important to establish empirically, whether or not stock exchange mergers indeed generate market power effects. This analysis is important because of the highly public nature of a stock exchange. As an organization that is responsible for operating the critical infrastructure of a country's economy, the announcement of any consolidation raises competition concerns among citizens and regulators, especially consolidation involving an overseas exchange.²

There are other reasons why our study, the first empirical study to examine the implications of stock exchange mergers on market concentration and market power, is important. First, it is not certain that an increase in market concentration results in increased market power. While some industries are susceptible to increased market power as a result of increased market concentration, other industries seem to be immune to this irrespective of the level of market concentration. For example, [Richards et al. \(2018\)](#) provide evidence suggesting that retailing, particularly the grocery industry, remains highly competitive even with consolidations in the industry. Because of the special role stock exchanges play in the allocation of resources in market economies, there is the chance that higher concentration could affect market efficiency and the economy as a whole. It is therefore crucial to establish empirically, whether or not the stock exchange industry is an industry that enjoys market power as a result of possible increased market concentration resulting from mergers and acquisitions. Second, even when there is increased market power resulting from mergers, it does not mean that it will be used in ways inimical to consumer welfare. [Ito and Reguant \(2016\)](#) contend that full arbitrage may remove the ability of a monopolist to dynamically exercise market power across sequential markets. It is in this regard that [Holt \(1989\)](#) argues that empirical work is needed to establish whether or not market power is exercised as a result of mergers.

To ascertain whether or not stock exchange mergers are leading to the exercise of market power, we investigate the market power implications of six major financial exchange mergers using data on some 53 stock exchanges. The six mergers are the NYSE-Euronext merger, the Nasdaq-OMX merger, the London Stock Exchange and Borsa Italiana merger, the Deutsche Boerse-International Securities Exchange Holdings, Inc. merger, the NYSE-Archipelago merger, and the Chicago Mercantile Exchange's merger with Chicago Board of Trade. Our choice of these mergers involving exchanges with average monthly value of share trading of at least US\$100 billion is hinged on the fact that these mergers are likely to have significant effects on competitors in the industry, and are therefore good candidates for finding any market power effects, if indeed there is the exploitation of market power as a result of stock exchange mergers. Our rationale is similar to that of [Houston et al. \(2001\)](#)

² See [Di Noia \(2001\)](#) for a detailed discussion of the role and functions of stock exchanges.

who analyze only large bank mergers because those mergers would allow them to more readily detect any valuation consequences.

Our results show that the six large stock exchange mergers have not led to any significant increase in industry concentration as proxied by the Herfindahl-Hirschman index (HHI) and four-firm concentration ratio (CR4). These measures decrease by 24.7% and 12.9% respectively in the five years following the mergers. Also, using market share as our proxy for market power, we find that average market share fell in the post-merger period. Conversely, we observe that the mergers have led to improved cost efficiency among the merging exchanges.

When we estimate separate multivariate regressions for the merging exchanges and rivals, our results show that the profitability of the merging exchanges in the post-merger period is largely related to sales efficiency and cost efficiency but not to industry concentration or the merging stock exchanges' market share (our proxy for market power). These findings broadly signify that the stock exchange mergers have largely delivered efficiency gains to the exchanges involved. For the rivals, we do not find evidence of efficiency gains. Our results are therefore supportive of arguments advanced by prior researchers, including [Economides \(1993\)](#) and [Di Noia \(2001\)](#) – that financial exchange consolidations are likely hinged on grounds other than the exercise of market power.

With the central aim of enhancing our understanding of the market power ramifications of stock exchange mergers, we believe that our study makes important contributions to the literature and management practice. By examining the market power implications of stock exchange mergers, our study has bridged a significant gap in the literature. While mergers and market power have been examined in other industries, including the banking industry (e.g., [Hankir et al., 2011](#)) and airline industry (e.g., [Kim and Singal, 1993](#)), our study, to the best of our knowledge, is the first study to empirically examine market power effects of mergers in the stock exchange industry, an important sector of the economy. The only study on the stock exchange industry that focuses on the effect of mergers on competition/market power, to our knowledge, is by [Kokkoris and Olivares-Caminal \(2008\)](#), but their study is a survey of the professional as well as a review of the academic literature with no empirical testing of the market power hypothesis in the stock exchange industry. Our results therefore add to the developing literature on stock exchange mergers and the proliferating literature on market power. In addition, the results of our study have important policy implications for regulators. Given that we do not find evidence to support the contention that stock exchanges are merging to exploit market power, future consolidations in the stock exchange industry should be assessed for their possible efficiency gains as well as their potential anticompetitive effects.

The rest of the paper proceeds as follows. Section two is devoted to a review of the relevant literature. The research questions we address are outlined in section three. Section four highlights the data and methodology and section five presents our results. Section six concludes the paper.

2. Literature review

Mergers, especially horizontal mergers, increase concentration because they reduce the number of firms in a field ([Bhattacharyya and Nain, 2011](#)). While companies that engage in mergers usually argue that the combinations are intended to improve efficiency, there is a growing body of literature that suggests that the increasing concentration resulting from mergers usually lead to the exercise of significant market power in industries such as banking and airline. Theoretical support for the market power contention is provided by a number of authors including [Eckbo and Wier \(1985\)](#), who argue that horizontal mergers can lead to accumulations of market power. The concern is that when firms amass significant market power, they typically tend to use it in ways that can be inimical to consumer welfare. The rest of the review focuses on market power and its potential benefits.

2.1. Overview of market power

Market power is the ability of a firm or a group of firms, acting jointly, to raise price above the competitive level without rapidly losing so many sales that the price increase becomes unprofitable and must be rescinded ([Landes and Posner, 1981](#)). Since the exercise of market power involves charging prices above marginal costs or the competitive level, the general consensus seems to be that firms with significant market power tend to use it in ways that are detrimental to consumer welfare. [Shaffer \(2004\)](#) notes the fundamental policy concern over market power as being the elevation of prices above marginal cost, with the attendant reduction in output quantity below the competitive level. The negative consequences of market power on consumer welfare are generally frowned upon and regulators typically challenge proposed mergers that are likely to result in significant increases in market power.

Empirical studies of market power have generally followed two main strands of inquiry, viz., the structure-conduct-performance (SCP) tests or the new empirical industrial organization (NEIO) models ([Shaffer, 2004](#)). In this study, we use structure-conduct-performance (SCP) tests because of data availability. Since the new empirical industrial organization (NEIO) models require data that we do not have access to (e.g., elasticity of demand information, prices of factors of production, etc.), we are unable to use these NEIO models. In view of the fact that this study is conducting the market power analysis only in the stock exchange industry, the study is not heir to the main criticism of the SCP paradigm, i.e., that SCP tests based on multiple industries are problematical because they do not consider the industry-specificity that is relevant to tests of market power ([Gallet, 1996](#)). Consequently, we review literature relevant to the SCP framework.

Usually used to demonstrate the effect of market concentration on competition, structure-conduct-performance tests typically measure the level of concentration in a market and relate it to performance (e.g., price, profits, etc.). The SCP paradigm, which is based on the notion that structure affects the conduct of firms, which ultimately determines their performance, predicts an increasing relationship between the level of market concentration and market power (Cetorelli, 1999), and suggests that increasing market concentration results in less competitive conduct (e.g., higher prices or less output) and leads to higher profits (Park, 2009). Thus, the SCP paradigm postulates that fewer and larger firms are more likely to engage in anticompetitive behavior (Cetorelli, 1999).

The SCP framework is the most widely used methodology in studies of market power. In fact, regulatory agencies use the SCP methodology in assessing the antitrust implications of proposed mergers and acquisitions. Theoretical and empirical expositions on the SCP paradigm have been advanced by a number of authors. Bain (1951), for instance, hypothesizes that the average profit rate of firms in industries with high concentration will tend to be significantly larger than that of firms in less concentrated industries. Several authors, including Pilloff and Rhoades (2002) find empirical support for the SCP framework. However, the positive linear relationship between market concentration and market power espoused by the SCP paradigm has been critiqued on a number of grounds. Demsetz (1973) provides an alternative explanation that is counter to the SCP paradigm's prediction that a positive relationship between concentration and profits is symptomatic of the exercise of market power. According to the author, competitive superiority in producing and marketing products could explain the increased concentration and profitability (and not the exercise of market power). However, Rhoades (1985) finds evidence contrary to the view that high profits of market leaders are due to efficiency rather than to some form of market power.

Several other studies have not found evidence to support the market power hypothesis. Jensen and Ruback (1983) assert that merger gains do not come from market power, but from efficiencies that also appear to be available to rival firms in the industry. Eckbo (1985) finds evidence of significant negative correlation between the industry wealth effect of merger announcements and merger-induced changes in concentration. Ghosh (2004) finds that the median market share of merging firms increased from 2.77% to 4.39% following acquisitions (reflecting a 58% increase relative to the market share in the previous year) while the median industry concentration only increased from 0.120 to 0.124 over the same period (i.e., a 3% relative increase). Fee and Thomas (2004) find little evidence of increased monopolistic collusion. Devos et al. (2009) decompose synergies into different components and do not find market power to significantly contribute to synergies. Becher et al. (2012) find that while mergers involving utilities create wealth for the combined firm (evidence that is consistent with both synergy and collusion), the returns to rivals are positive in the regulated 1980–1992 period but negative in the deregulated 1993–2004 period (evidence that is inconsistent with collusion).

A number of measures have been used in studies employing SCP tests including the Herfindahl-Hirschman index (HHI) and concentration ratios. The Herfindahl-Hirschman index (HHI), which gauges an industry's concentration in a given market, represents the sum of squared market shares (Giroud and Mueller, 2011). The HHI gained international prominence when it was adopted as the primary market concentration guide by the U.S. Department of Justice in 1982 (White, 1987).

By showing the proportion of an industry's sales accounted for by the largest firms, concentration ratios (CR) have also been used to determine industry concentration and the potential for the exercise of market power. Though several variants of concentration ratios have been used including CR2, CR4, CR8, by far, CR4 is the most widely used concentration ratio. White (1987) notes that the four-firm concentration ratio (CR4) represents the percentage of an industry's sales that are accounted for by the largest four sellers. The author argues that when the CR4 exceeds the 50% to 60% range, there is the increased likelihood that an industry's behavior might change (e.g., higher prices).

Market share is the dominant measure used in the literature to determine the extent of market power enjoyed at the firm level. As Berger (1995) notes, firms with large market shares generally have well-differentiated products and may be able to exercise market power in the pricing of these products. Market power effects of mergers have been extensively examined in the banking, airline and other industries, and these studies provide a good setting for this paper. While most of this literature concludes that mergers and acquisitions lead to the exercise of market power, usually in the form of unfavourable prices and/or reduced output such as cutting off borrowers (e.g., Kim and Singal, 1993; Singal, 1996; Berger et al., 1999; Sapienza, 2002, Hankir et al., 2011; Ryan et al., 2014; Fraise et al., 2018), there are studies that provide evidence to the contrary (e.g., Focarelli and Panetta, 2003; Shaffer, 2004; Weinberg, 2005; Park, 2009; Coccoresse, 2009; Delis et al., 2017). The contradictory results notwithstanding, the majority of the evidence seems to support the conclusion that increase in market concentration more often leads to the exercise of market power in these industries.

2.2. Potential benefits of market power

As the foregoing discussion demonstrates, the early conventional wisdom has been that mergers that increase market power or market concentration are always bad for society (e.g., Weinberg, 2005). However, this argument has become contentious over the years and many authors have cautioned against wholesale classification of every merger that increases market concentration or power as bad. In his seminal work, Williamson (1968) demonstrates that for a merger that generates efficiencies and also enhances market power, a relatively modest cost reduction (or efficiency increase) "is usually sufficient to offset relatively large price increases" (pp. 23). White (1987) however takes issue with the efficiency argument, asserting that efficiencies are easy to promise but difficult to deliver, especially as diseconomies of large scale can easily set in due to managerial limitations, unexpected clashes in corporate culture and difficulties in melding different managerial and production systems.

Some authors have also identified specific benefits of market power. On the theoretical front, [Peress \(2010\)](#) hypothesizes that firms with greater market power have less volatile profits and returns, less dispersed earnings forecasts, and their stock price is less sensitive to noise shocks, which enhances their stock liquidity. The theoretical conjectures of the benefits of greater market power on liquidity have been bolstered by a number of empirical studies. [Kale and Loon \(2011\)](#), for example, find that product market power improves stock liquidity by lowering the variability of cash flows and returns. Other benefits of market power have been highlighted in a number of empirical studies, including evidence showing that firms with greater product market power generate higher excess stock returns ([Jory and Ngo, 2017](#)) and that market power leads to improved monitoring and evaluation as well as bank stability in some environments.³

3. Research questions and hypotheses

As with mergers in other industries, market power gains and/or efficiency gains are two plausible outcomes that may be possible with stock exchange mergers. [White \(1987\)](#) parsimoniously captured the dichotomy of mergers in his main and alternative hypotheses of mergers. On the one hand, the “more easily a group of sellers (who collectively might have market power) can coordinate and police their mutual actions, the more likely are they to approximate a monopoly outcome” with its potential effects of increases in prices and profits. Yet on the other hand, it is possible that “it only takes two to make a horse race” ([White, 1987, pp. 14](#)). Therefore, while there is the possibility that stock exchange mergers are helping the exchanges to become more efficient, it is also possible that the mergers creating mega exchanges are leading to the exercise of market power to the detriment of consumers.

From the literature review and the foregoing discussion, while merger gains can come from the exercise of market power in some industries, we argue that gains from stock exchange mergers will not come from market power but instead from improvements in efficiencies. This contention is partly based on the nature of competition in the stock exchange industry. It has been indicated that stock exchanges compete on a number of factors including price and non-price factors such as technology, speed of order execution, depth of liquidity visible to market participants, likelihood of order execution and chances of order settlement ([Kokkoris and Olivares-Caminal, 2008](#)). Due to the multiple competitive forces in the stock exchange industry, mergers that are motivated by market power benefits could jeopardize the competitive position of the merging exchanges because the intense competition will likely induce most rival exchanges (especially low cost rivals such as electronic communications networks (ECNs)) to “stay the course” and not partake in market power exploitation in order to attract order flow and market share from merging exchanges exploiting market power. The desire to maintain and/or improve their own competitive position will therefore motivate exchanges to merge for efficiency reasons rather than for market power exploitation. This argument is reinforced by some indirect evidence on stock exchange mergers from [Arnold et al. \(1999\)](#) and [Nielsson \(2009\)](#), who document a narrowing of trading costs (bid-ask spreads) in the post-merger period for stock exchange mergers, evidence that is inconsistent with the exercise of market power. Additionally, competition in the stock exchange industry has significantly increased in recent years because of technological advancements, the emergence of electronic communication networks (ECNs), and financial liberation and globalization, among others. As a result, entry barriers into the industry are reducing, and the likelihood of market power exploitation following mergers and acquisitions are declining. Accordingly, we hypothesize that:

H1. Stock exchange mergers will not lead to the exercise of market power.

H2. Gains for stock exchanges involved in mergers will come from improved efficiencies and not from the exercise of market power.

4. Data and methodology

4.1. Data

Given our objective of examining the market power ramifications of major financial exchange mergers, we use product market and financial statement data for all World Federation of Exchanges (WFE) members for which we could get data. We use data over the five years pre-merger and five years post-merger periods after skipping the first year of the merger completion. We skip the first year because [Rhoades \(1993\)](#) notes that sufficient time is required for efficiency improvements to materialize following the consummation of the deal. One potential issue with using a long time window is the possibility of other confounding factors contaminating the results. However, [Rhoades \(1993\)](#) observes that comparing the merger firms to a large control group should essentially control for other factors that affect the data. Therefore, by controlling for other known determinants of profitability and using all other non-merging WFE member exchanges in constructing our control sample, any potential contamination is minimized.

³ For example, [Delis et al. \(2017\)](#) find that within reasonable limits, bank market power improves performance of borrowing firms while [Turk-Ariss \(2010\)](#), using a sample of 821 banks in 60 developing countries, find a significant positive relationship between market power and bank profit efficiency as well as overall stability.

To test our hypotheses, we collected exchange-level data (in U.S. dollars) on several variables including value of share trading, aggregate domestic market capitalization of firms listed on the stock exchanges, revenues, cost of goods sold, total assets, etc. from two main sources. The product market data were collected from the World Federation of Exchanges (WFE) website (<http://www.world-exchanges.org/statistics>) and the financial statement data were collected from Capital IQ.

4.2. Measures and methodology

We conduct univariate analysis as well as multivariate analysis of the market power hypothesis using both industry-level and stock exchange-level measures of market power. Methodologically, we proceed by first calculating the various measures of market concentration which are needed for inferring market power. We then perform univariate analysis including t-tests of means and nonparametric z-tests of medians to determine if the means and medians of the various measures have significantly changed in the post-merger period compared to the pre-merger period. We next undertake multivariate analysis (using the exchange fixed effects panel data approach)⁴ by regressing profits (our measure of firm performance) on a number of variables including measures of industry concentration, exchange-level market power and a number of control variables. Further details about our methodology are provided below.

4.2.1. Key measures

4.2.1.1. Herfindahl-Hirschman index (HHI). The HHI is the most widely used measure of market concentration. Most market power studies, including White (1987), Kim and Singal (1993), and Singal (1996), have used the HHI. The HHI, which measures an industry's concentration in a given geographic market, represents the sum of squared market shares (Giroud and Mueller, 2011) and is given as:

$$HHI = \sum_{i=1}^N (100s_i)^2 \quad (1)$$

where s_i represents market share.

4.2.1.2. Concentration ratios. A number of studies have used concentration ratios to measure an industry's concentration level and market power (e.g., White, 1987; Berger et al., 1999). Concentration ratios, defined as the proportion of an industry's sales accounted for by the largest firms, can be represented as:

$$CR = \sum_{i=1}^N s_i \quad (2)$$

where s_i is market share. For the 4-firm and 8-firm concentration ratios, for example, N will be set equal to 4 and 8 respectively.

4.2.1.3. Market share. Market share is used as our proxy for exchange-level market power. We compute market share using monthly as well as yearly value of share trading. To obtain the market share for each month for each exchange, we take the exchange's value of share trading (in USD) and divide it by the sum of all the exchanges' value of share trading (in USD). The market shares for the exchanges involved in the mergers were calculated by summing their individual data to get the data for each combined exchange.

4.2.2. Methodology

Once the key measures are calculated, we perform univariate analysis using trend analysis and parametric and nonparametric tests of mean and median differences to determine if the key measures are significantly different between the pre- and post-merger periods. In addition, we carry out multivariate exchange fixed effects panel data analysis to gain further insights. We employ Binder's (1985) and Acharya's (1993) dummy variables approach for two main reasons. First, because of the inherently small population of stock exchanges, the sample size of studies using stock exchanges are naturally small. Using the dummy variables approach allows us to use data over both the event and non-event windows, which will help increase the number of observations for our regressions. Second, the dummy variables approach is one of the preferred approaches when firms experience the same event more than once in the sample period. Given that NYSE is involved in two of the mergers (i.e., with Archipelago and Euronext), the dummy variables approach is appropriate for our study.

It has been argued that in order to avoid spurious correlations in structure-conduct-performance studies, tests of market power should control for efficiency (Choi and Weiss, 2005). We address this requirement in our regressions by incorporating variables for expense efficiency and revenue efficiency. Given our quest to determine the presence or otherwise of market power effects and the extent to which the exercise of market power in the stock exchange industry has become inimical to consumer welfare, we regress our measure of profitability (ROA) for stock exchanges on the measures of market concentra-

⁴ We would like to thank an anonymous reviewer for suggesting that we use the fixed effects panel data regression technique on annual data.

tion (HHI, 4-firm concentration ratio), proxies for efficiency (ratio of total expenses-to-total assets,⁵ revenues-to-total assets ratio), proxy for exchange-level market power (i.e., market share) and other control variables. The exchange fixed effects panel data regression model we estimate is of the general form:

$$\begin{aligned}
 \text{Profit}_{it} = & \\
 & \alpha + \beta_1 \text{Market Share}_{it} + \beta_2 \text{Market Concentration Measure}_t + \beta_3 \text{Expenses} - \text{to} - \text{Assets}_{it} \\
 & + \beta_4 \text{Revenues} - \text{to} - \text{Assets}_{it} + \beta_5 \text{Post} - \text{Merger Dummy} + \beta_6 \text{Market Share}_{it} * \text{Post} - \text{Merger Dummy} \\
 & + \beta_7 \text{Market Concentration Measure}_t * \text{Post} - \text{Merger Dummy} + \beta_8 \text{Expenses} - \text{to} - \text{Assets}_{it} * \text{Post} \\
 & - \text{Merger Dummy} + \beta_9 \text{Revenues} - \text{to} - \text{Assets}_{it} * \text{Post} - \text{Merger Dummy} + \gamma_k \sum Z_{kit} + \varepsilon_{it} \quad (3)
 \end{aligned}$$

where profit represents return on assets (ROA), market concentration measures are, HHI or CR4, expenses-to-assets ratio is our measure of cost efficiency, revenues-to-assets ratio represents the measure of sales efficiency, market share is our proxy for exchange-level market power, post-merger dummy (takes the value of 1 in the post-merger period and zero otherwise) and Z_k is a vector of control variables including long-term debt-equity ratio, capital expenditures (CAPEX) to sales ratio and log of domestic market capitalization of firms listed on the exchanges. The post-merger dummy is also interacted with the measures of efficiency, market concentration and market power to determine whether or not market concentration, market power and/or efficiencies are the main drivers of profitability in the post-merger period.

The rationale for our multivariate fixed effects panel data regression equations is that after controlling for market concentration and efficiency, the coefficient of market share, the market power measure, will reflect market power exercised (Rhoades, 1985; Choi and Weiss, 2005). If industry concentration has improved the profitability of stock exchanges following the mergers, then the coefficients of the measures of industry concentration (i.e., HHI and CR4) interacted with the post-merger dummy variable will be significantly positive. A significantly positive HHI * Post-Merger Dummy coefficient or CR4 * Post-Merger Dummy coefficient provides support for the SCP hypothesis, which postulates that as industry concentration increases as a result of mergers, the firms may undertake anticompetitive actions such as restricting output and/or raising prices (e.g., listing fees) – so as to improve their performance. If there is the exercise of market power at the exchange-level, then we expect the coefficient of the market share variable interacted with the post-merger dummy variable to be significantly positive. However, because we argue that the threat of competition from multiple sources is lowering entry barriers, we expect the coefficient of the post-merger market power proxy to be insignificant. In addition, we expect the measure of sales efficiency in the post-merger period, proxied by the revenues-to-assets ratio interacted with the post-merger dummy variable to be significantly positively related to ROA, while the measure of cost efficiency in the post-merger period, proxied by the total expenses-to-assets ratio interacted with the post-merger dummy variable will be negatively related to ROA.

The additional control variables included in our multivariate analyses are motivated by theory and empirical evidence. A positive relationship between size and profitability has been noted in the literature (e.g., Athanasoglou et al., 2008). As such, we control for exchange size by including the log of domestic market capitalization of firms listed on the exchanges. Short (1979) notes that leverage is a potential determinant of profitability and Angbazo (1997) asserts that leverage is a proxy measure for the risk of insolvency. We control for leverage using the total long-term debt-equity ratio. The positive effect of capital/infrastructure investments on profitability has been recognized by authors such as Williams (2003). As a result, we include the CAPEX-to-sales ratio as a control variable in our regressions.

5. Results

5.1. Stock exchange industry concentration and market power

5.1.1. Univariate analysis: descriptive statistics and correlations

Presented in Table 1 are descriptive statistics of key variables as well as the Pearson's correlations between pairs of the key variables. As demonstrated in Panel A, the means and medians of the key measures of market concentration, market power and efficiencies appear to be reasonable.

The return on assets (ROA) of the average exchange in our sample is about 6.1% while the average market share is about 9%. Given White's (1987) finding that four-firm concentration ratios exceeding the 50–60% range increase the likelihood of anticompetitive behavior, the concentration ratio (CR4) of 73% that we report for our sample appears to be high. We argue, however, that this is not unexpected when one considers the fact that the stock exchange industry is dominated by a few super exchanges such as NYSE, Nasdaq OMX, Tokyo Stock Exchange Group, London Stock Exchange and Deutsche Boerse. The average HHI of 2038 suggests that the industry is moderately concentrated because according to the U.S. Department of Justice and the Federal Trade Commission (2010), HHI lower than 1500 signifies unconcentrated markets, HHI greater than 2500 indicates highly concentrated markets, while HHI between 1500 and 2500 represents moderately concentrated markets.

⁵ See Rhoades (1993).

Table 1
Descriptive statistics and Pearson correlations.

Panel A: Descriptives						
Variable	Mean	Median	Std. Dev.	Min	Max	
ROA	0.0609	0.0625	0.0380	0.0022	0.1419	
Market Share	0.0898	0.0756	0.0831	0.0050	0.2008	
HHI	2038	2059	315	1510	2652	
CR4	0.7342	0.7274	0.0564	0.6458	0.8223	
Expenses-to-Assets	0.1145	0.0846	0.0875	0.0372	0.3449	
Revenues-to-Assets	0.2805	0.2627	0.0952	0.1333	0.5052	
Panel B: Correlations						
	ROA	Market Share	HHI	CR4	Expense-to-Assets	Revenues-to-Assets
ROA	1.0000					
Market Share	-0.8574 (**)	1.0000				
HHI	-0.0217	0.0729	1.0000			
CR4	-0.0463	0.0748	0.9818 (***)	1.0000		
Expenses-to-Assets	-0.1825 (***)	0.4361 (**)	0.6052 (***)	0.6235 (***)	1.0000	
Revenues-to-Assets	0.1860 (**)	0.1536 (**)	0.6359 (**)	0.6462 (**)	0.8852 (**)	1.0000

This table presents descriptive statistics and Pearson correlations of key variables for all exchanges. Panel A presents descriptive statistics while Panel B reports the Pearson correlations.

** Represent significance at the 5% level.

*** Represent significance at the 1% level.

Panel B of [Table 1](#) presents the Pearson's correlations between the pairs of key variables. Some preliminary insights can be deciphered from the relationships between the independent variables and ROA. The insignificant negative relationships between ROA and the measures of market concentration (HHI and CR4) provides preliminary support for our hypothesis that exchanges do not exploit industry concentration to enhance their bottom-lines. Similarly, the negative relationship between market share and ROA is suggestive of the fact that exchanges are not exploiting market share for higher profits. The negative (positive) relationship between ROA and expense (sales) efficiency measures demonstrate operational efficiencies in the stock exchange industry, as improved cost management and revenue generation are significantly related to profitability. In general, the low correlations between the pairs of independent variables indicate that multicollinearity is not an issue. The 98% correlation between HHI and CR4 is indicative of the fact that one can expect very similar results by using any one of these measures of market concentration.

5.1.2. Univariate analysis: trends in industry concentration

We trended HHI, our key measure of market concentration, in order to gain further insights into industry concentration levels following the mergers. We present, in [Fig. 1](#), the trend chart of monthly HHI (based on value of share trading). The chart tracks the HHI starting five years before the merger completion dates and ending six years after the merger completions.

The trend chart above does not indicate any significant increase in market concentration following the stock exchange mergers. As evident, while the HHI inched up about 200 points in the first twelve months, following the mergers' conclusions, from 2022 in month zero to 2235 in month twelve, it fell significantly in the next five years to about 1800 in year six. The decline in industry concentration is not unexpected given the heightened competition from not only traditional exchanges but alternative platforms such as low-cost electronic communications networks (ECNs) and dark pools (see for example, [Buti et al. \(2017\)](#)).

5.1.3. Univariate analysis: pre- and post-merger industry analysis

The HHI trend chart does indicate changes in the post-merger values of industry concentration. To determine whether or not these preliminary results are statistically significant, we performed univariate tests of difference in means and medians in the pre- and post-merger periods. The results are reported in [Table 2](#).

Although the mean and median ROA increased in the post-merger period, the increases are statistically indistinguishable from zero. Preliminarily, this suggests that the exchanges did not exploit the mergers to reap "supernormal" profits as the profit rate remained statistically the same in the pre- and post-merger periods. Both measures of industry concentration decreased in the post-merger period, with the mean (median) HHI decreasing by about 24.7% (25.3%), while the mean (median) CR4 reduced by about 12.9% (14.4%) after the mergers were completed. While the decrease in industry concentration appears counter-intuitive, the increasing trading volume being captured by electronic communications networks and dark pools⁶ at the expense of traditional exchanges in recent years is likely contributing to this outcome. The expense efficiency metric (expenses-to-assets ratio) significantly improved in the post-merger period compared to the pre-merger period. Sales efficiency declined for all exchanges, likely because of competition from electronic communication networks. Overall, the

⁶ See [Buti et al. \(2017\)](#).

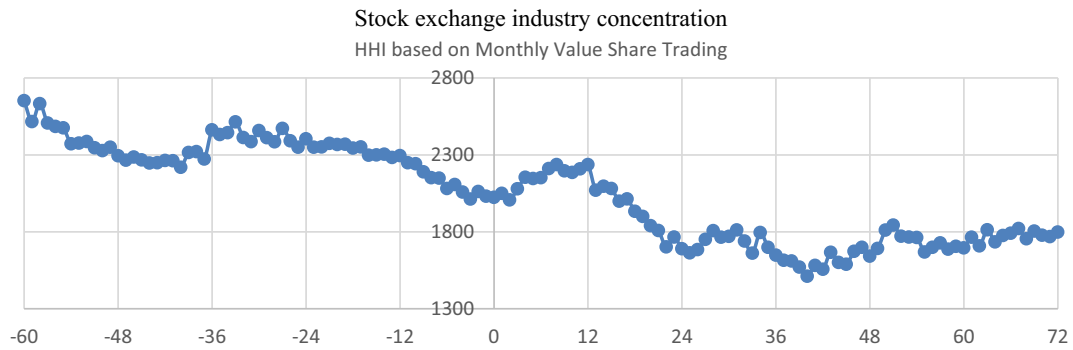


Fig. 1. This figure shows monthly Herfindahl Index (HHI) from 5 years before to six years after the merger completion dates.

Table 2

Univariate tests of means and medians.

Portfolio	Mean				Median			
	Before	After	% Difference	Paired T-Test of Difference	Before	After	% Difference	Wilcoxon signed-rank test
ROA	0.0596	0.0622	4.22%	(1.18)	0.0604	0.0864	42.97%	(0.90)
Market Share	0.0950	0.0845	-11.06%	(-7.70) ^{***}	0.0880	0.0756	-14.13%	(-4.27) ^{***}
HHI	2324.98	1751.77	-24.65%	(-27.11) ^{***}	2344.82	1751.85	-25.29%	(-9.44) ^{***}
CR4	0.7850	0.6834	-12.94%	(-25.17) ^{***}	0.7946	0.6804	-14.37%	(-9.37) ^{***}
Expenses-to-Assets	0.1656	0.0634	-61.74%	(-9.59) ^{***}	0.0995	0.0666	-33.08%	(-8.32) ^{***}
Revenues-to-Assets	0.3373	0.2236	-33.72%	(-8.81) ^{***}	0.2977	0.2489	-16.39%	(-8.11) ^{***}

Table 2 presents the results of the univariate tests of means and medians five years before and five years after the merger completion dates. The results are presented for the industry (i.e., all stock exchanges). Test statistics are in parentheses.

^{***} Represent significance at the 1% level.

univariate trend analysis and test of differences in means and medians do not raise any serious concerns related to increasing concentration and exploitation of market power in the stock exchange industry following the consummation of the six transformational mergers examined in this study. However, these univariate results should be interpreted with caution as they are merely suggestive and do not account for other factors that influence the exercise of market power.

5.2. Multivariate analysis of market power: industry- and firm-level

5.2.1. Market power effects in the absence of efficiency measures

Our multivariate regression analyses of market power are aimed at determining the extent to which market power, efficiencies and market concentration have contributed to profitability of stock exchanges after controlling for the influence of other important determinants of profitability. It has been noted that models of market power that do not include efficiency measures could (wrongly) signal the presence of market power (Berger, 1995) even when that may not be the case. We first test the extent to which profits are impacted by measures of market concentration and market power when efficiency measures are not explicitly accounted for and report the results in Table 3.

The regression models that use only market concentration and market power measures without including efficiency measures show that stock exchanges may have exercised market power as HHI and CR4 in the post-merger period are significantly positively related to profitability (ROA) at 1% and 5% levels of significance for all exchanges, rival exchanges and the merging exchanges. Although not significant, the positive coefficient of the market share variable in the post-merger period (i.e., Market Share * Post-Merger Dummy) for the merging firms further raises the possibility that profitability of the merging exchanges in the post-merger period may have been positively influenced by market share (a measure of exchange-level market power).

5.2.2. Incorporating efficiency measures in market power analysis

Studies of the market power effects of mergers need to incorporate measures of efficiency (Berger, 1995) if the wrong conclusions are to be avoided. The results of our multiple regressions that incorporate measures of efficiency (cost efficiency and sales efficiency) are presented in Table 4.

The results indicate that there is no evidence of market power exploitation when efficiency measures are incorporated into the regression models. The measures of market concentration (HHI and CR4) in the post-merger period are either significantly negative or insignificant for all exchanges and the merging exchanges. Although HHI is significantly positive and

Table 3
Market power effects without controlling for efficiency effects.

	All		Merging Companies		Others	
	ROA	ROA	ROA	ROA	ROA	ROA
Market Share	-0.0499 (-0.37)	0.0483 (0.34)	-0.1412 (-0.76)	0.0050 (0.03)	-0.1737 (-0.84)	0.1376 (0.61)
Market Share * Post-Merger Dummy	-0.0994 (-1.56)	-0.0885 (-1.35)	0.0701 (0.79)	0.0993 (1.07)	0.4004* (1.75)	-0.0670 (-0.28)
HHI	0.0000 (0.00)	-	0.0004 (1.51)	-	-0.0003** (-2.36)	-
HHI * Post-Merger Dummy	0.0011*** (5.08)	-	0.0010*** (2.91)	-	0.0011*** (6.46)	-
CR4	-	-0.1080 (-1.10)	-	0.0702 (0.47)	-	-0.3466*** (-4.10)
CR4 * Post-Merger Dummy	-	0.4626*** (4.19)	-	0.4117** (2.42)	-	0.5427*** (6.09)
Post-Merger Dummy	-0.2106*** (-4.68)	-0.3428*** (-4.16)	-0.1889*** (-2.69)	-0.3132** (-2.45)	-0.2252*** (-6.28)	-0.3967*** (-6.11)
CAPEX-to-Revenues	0.5933*** (2.89)	0.6479*** (3.07)	1.0543*** (2.95)	1.0888*** (2.91)	-0.0267 (-0.17)	0.0408 (0.28)
Debt-Equity	-0.0059** (-2.55)	-0.0051** (-2.13)	-0.0035 (-1.27)	-0.0022 (-0.76)	0.0068 (0.17)	0.0229 (0.57)
Log Market Cap Exchange	0.0161 (1.46)	0.0147 (1.18)	0.0302 (1.57)	0.0349* (1.70)	0.0326** (3.53)	0.0228** (2.10)
Constant	-0.2672 (-1.14)	-0.1640 (-0.56)	-0.6263 (-1.52)	-0.7148 (-1.52)	-0.5349*** (-2.63)	-0.1578 (-0.60)
Exchange Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	334	334	170	170	164	164
R ²	0.0510	0.1619	0.2735	0.4159	0.1224	0.1432

In this table, we present the results of exchange fixed effects panel data regression equations that regress ROA on measures of market power, exchange-level variables and other control variables. The variables include exchange market share (with and without interaction with the post-merger dummy), HHI or CR4, log of domestic market capitalization, long-term debt to equity ratio, CAPEX-to-revenues ratio and post-merger dummy. We estimate the regressions using yearly data that start 5 years before the year of the merger completions, skip one year and end 5 years after the skipped year. T-statistics are in parentheses.

* Represent significance at the 10% level.

** Represent significance at the 5% level.

*** Represent significance at the 1% level.

CR4 is positive over the entire period for all exchanges (columns C and D), when these measures are interacted with the post-merger dummy variable, the interaction variables are insignificant in the combined sample regression, indicating that the exchanges did not leverage market concentration to drive up profitability following the mergers. When separate regressions are estimated for merging exchanges and rival exchanges, the measures of market concentration interacted with the post-merger dummy variable are significantly negative at the 1% level (for HHI interaction) and 5% level (for CR4 interaction) for the merging exchanges (columns E and F) but significantly positive at the 1% level for both HHI and CR4 interaction for the rival exchanges (columns G and H). These results support our hypothesis that the mergers did not lead to the exploitation of market power to enhance profit rates in the industry.

The exercise of market power in the post-merger period for profitability can be directly inferred from the market share interacted with post-merger dummy variable. If exchanges exercised market power in the post-merger period, the relationship between ROA and the interaction between market share and the post-merger dummy variable would have been significantly positive. For all the exchanges (columns C and D), merging exchanges (columns E and F) and rivals (columns G and H), the Market Share * Post-Merger Dummy variable is significantly negative. These results also support our hypotheses that stock exchanges did not exercise market power as a result of the mergers. We conjectured that because technological advancements, internationalization and liberalization are lowering entry barriers in the industry, stock exchanges that want to succeed in this highly competitive environment are better served by being efficient rather than exercising market power, since some competitors, especially low-cost competitors such as ECNs, can afford to forgo exercising market power in order to siphon business from rivals. The empirical results are consistent with this conjecture.

Given that our results do not provide support for the market power exploitation hypothesis following the mergers, we next turn our attention to the efficiency hypothesis, in light of the fact that the mergers are usually sold to stakeholders partly on the grounds of efficiency and synergy gains. If the mergers resulted in efficiency improvements, then the measure of cost efficiency in the post-merger period, Expenses-to-Assets post-merger, would be negatively related to profitability. We would also expect the sales efficiency measure in the post-merger period (Revenues-to-Assets * Post-Merger Dummy) to be positively related to profitability. Examination of our results for all exchanges (columns C and D) shows that while the coefficient of the Revenues-to-Assets * Post-Merger Dummy is positive (as expected) but insignificant, the Expenses-to-Assets * Post-Merger Dummy is significantly positive, contrary to our expectations. However, since we argue that the efficiency gains

Table 4
Efficiency and market power effects of exchange mergers.

	Expected Sign	All		Merging Companies		Others	
		ROA	ROA	ROA	ROA	ROA	ROA
Market Share	?	0.6991 ^{***} (4.55)	0.6551 ^{***} (4.24)	0.9115 ^{***} (4.45)	0.7818 ^{***} (4.30)	1.3336 ^{***} (3.91)	1.0486 ^{***} (3.17)
Market Share * Post-Merger Dummy	?	-0.6394 ^{***} (-7.22)	-0.6232 ^{***} (-6.75)	-0.5873 ^{***} (-5.53)	-0.6365 ^{***} (-5.46)	-1.2147 ^{***} (-4.21)	-1.1486 ^{***} (-4.07)
HHI	?	0.0003 [†] (2.36)	-	0.0008 [†] (4.70)	-	-0.0005 [†] (-4.78)	-
HHI * Post-Merger Dummy	?	-0.0002 (-1.32)	-	-0.0007 [†] (-2.62)	-	0.0009 [†] (6.17)	-
CR4	?	-	0.0488 (0.65)	-	0.4053 ^{***} (4.17)	-	-0.2909 ^{***} (-5.59)
CR4 * Post-Merger Dummy	?	-	-0.0247 (-0.28)	-	-0.2711 ^{**} (-2.29)	-	0.3674 ^{***} (6.36)
Expenses-to-Assets	-	-0.3012 ^{***} (-5.31)	-0.2825 ^{***} (-4.71)	-0.2914 ^{***} (-3.85)	-0.2667 ^{***} (-3.68)	-0.9464 ^{***} (-5.30)	-0.5618 ^{***} (-3.55)
Expenses-to-Assets * Post-Merger Dummy	-	0.5996 ^{***} (4.12)	0.5840 ^{***} (3.92)	-0.6197 ^{***} (-2.92)	-0.7540 ^{***} (-3.39)	0.8870 ^{***} (3.38)	0.8760 ^{***} (3.38)
Post-Merger Dummy	+	0.0602 (1.55)	0.0218 (0.32)	0.1586 ^{**} (2.73)	0.2118 ^{**} (2.31)	-0.1330 ^{***} (-3.85)	-0.2406 ^{***} (-5.01)
CAPEX-to-Revenues	+	-0.0186 (-0.11)	0.0598 (0.37)	0.4878 [*] (1.91)	0.5885 ^{**} (2.30)	0.1850 [*] (1.70)	0.0359 (0.39)
Debt-Equity	-	-0.0078 ^{***} (-4.56)	-0.0072 ^{***} (-4.06)	-0.0070 ^{***} (-4.19)	-0.0077 ^{***} (-4.33)	-0.1403 ^{***} (-4.50)	-0.1146 ^{***} (-4.14)
Revenues-to-Assets	+	0.1679 ^{***} (6.13)	0.1521 ^{***} (5.52)	0.0273 (0.51)	-0.0245 (-0.52)	0.2420 ^{***} (6.20)	0.2120 ^{***} (5.52)
Revenues-to-Assets * Post-Merger Dummy	+	0.0096 (0.34)	0.0243 (0.83)	0.2101 ^{***} (3.80)	0.2605 ^{***} (5.09)	-0.1863 ^{***} (-4.42)	-0.1074 ^{***} (-2.64)
Log Market Cap Exchange	+	0.0019 (0.25)	0.0009 (0.11)	0.0029 (0.24)	0.0078 (0.61)	0.0124 [*] (1.80)	-0.0033 (-0.43)
Constant	?	-0.1148 (-0.69)	-0.0628 (-0.30)	-0.2480 (-0.90)	-0.4565 (-1.50)	-0.1373 (-0.92)	0.2856 (1.57)
Exchange Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
N		328	328	170	170	158	158
R ²		0.5349	0.5567	0.6735	0.8372	0.0942	0.5097

We present the results of exchange fixed effects panel data regression equations that regress ROA on measures of market power, exchange-level variables and other control variables in this table. The variables include exchange market share (with and without interaction with the post-merger dummy), HHI or CR4, expenses-to-assets ratio, revenues-to-assets (with and without interaction), log of domestic market capitalization, long-term debt-equity ratio, CAPEX-to-revenues ratio and post-merger dummy. We estimate the regressions using yearly data that start 5 years before the year of the merger completions, skip one year and end 5 years after the skipped year. T-statistics are in parentheses.

^{*} Represent significance at the 10% level.

^{**} Represent significance at the 5% level.

^{***} Represent significance at the 1% level.

will be disproportionately in favor of the merging exchanges because of synergies but potentially punitive to the rivals because they have to compete with better resourced merged entities, the results for all the exchanges is not unexpected (because of the possibility of offsetting effects). Thus, because of the asymmetric nature of the efficiency gains, we analyze the separate regressions for the merged exchanges and rivals to find the real efficiency gains of the mergers.

As expected, the coefficient of the Expenses-to-Assets * Post-Merger Dummy variable is significantly negative at the 1% level for the merging exchanges and the Revenues-to-Assets * Post-Merger Dummy variable is significantly positively related to ROA at the 1% level. These findings suggest that the merging firms improved their competitive standing following the mergers, as improvements in cost management and revenue generation significantly positively impacted profits. Our results are consistent with [Houston et al. \(2001\)](#) who, using only large bank mergers, find that the primary sources of merger gains are cost savings and to a lesser extent, revenue enhancements. Our results are also consistent with [Focarelli and Panetta \(2003\)](#) who find that efficiency gains dominate the market power effects in the long term. However, our results are inconsistent with other studies that find mergers in the banking industry (e.g., [Ryan et al., 2014](#)) and airline industry (e.g., [Kim and Singal, 1993](#)) to have resulted in the exercise of market power.

The other control variables in our regressions have coefficients that are intuitive and in line with our expectations. The post-merger dummy variable is positive (and mostly significant) for all exchanges and the merging exchanges but negative and significant for rivals. This means that profitability has generally increased for the merging exchanges in the post-merger period. The debt-equity ratio is significantly negative for the exchanges, indicating that as debt servicing cost increases with increasing leverage, profitability declines. Capital expenditures are positively related to profitability for the merging exchanges and rival exchanges. The coefficient of the log of domestic market capitalization variable is mostly positive but largely insignificant.

From our results and consistent with our hypotheses, we conclude that there is no evidence that the mergers have resulted in the exploitation of market power in the stock exchange industry. This is not unexpected because with technological advancement, globalization and liberalization, entry barriers in the stock exchange industry are falling. Consequently, stock exchanges are losing the monopoly status that they enjoyed in the past, and as such, if they exploit market power following mergers, competitors, especially low-cost rivals such as ECNs, could take away market share from the exchanges. Therefore, the merging exchanges are better off pursuing mergers for efficiency reasons.

5.3. Robustness tests

5.3.1. Market power analysis without skipping a year

To test the sensitivity of our results to alternative specifications, we conducted a number of robustness tests and discuss the results of these tests in this section. We estimate our baseline regressions by skipping one year after the merger completion dates because it takes time for efficiencies to materialize. For robustness purposes, we also estimated our exchange fixed effects panel data regression equations without skipping a year following the merger completion dates. The results of the regressions are presented in Table 5.

Whether we skip a year after the merger completion dates or not, our results remain essentially the same. In the post-merger period: (i) market share is negative and mostly significant for all exchanges, the merging exchanges and rival exchanges; (ii) both measures of post-merger market concentration are insignificant for all exchanges and the merging exchanges but significantly positive for rivals; (iii) the expense efficiency ratio is significantly negative for the merging exchanges but positive for rivals at the 1% level of significance; and, (iv) sales efficiency is significantly positive for the exchanges engaged in mergers and acquisitions but either negatively significant or insignificant for competitors.

5.3.2. Addressing potential endogeneity using two-stage least squares (2SLS)

The issue of endogeneity has been raised in the literature by authors including Turk-Ariss (2010). While the fixed effects panel data regression approach helps address some endogeneity concerns (Turk-Ariss, 2010), including endogeneity emanat-

Table 5

Efficiency and market power effects without skipping a year.

	All		Merging Companies		Others	
	ROA	ROA	ROA	ROA	ROA	ROA
Market Share	0.6043 ^{***} (3.76)	0.5732 ^{***} (3.57)	0.4337 ^{***} (2.62)	0.4935 ^{***} (3.05)	0.1870 (0.69)	0.2415 (0.97)
Market Share * Post-Merger Dummy	-0.7037 ^{***} (-7.18)	-0.6860 ^{***} (-6.78)	-0.4824 ^{***} (-4.35)	-0.5484 ^{***} (-4.54)	-0.3747 (-1.45)	-0.4581* (-1.97)
HHI	0.0002 (1.56)	-	0.0006 ^{**} (3.62)	-	-0.0004 ^{***} (-3.70)	-
HHI * Post-Merger Dummy	-0.0001 (-0.68)	-	-0.0003 (-1.10)	-	0.0007 ^{***} (5.49)	-
CR4	-	0.0463 (0.51)	-	0.3950 ^{***} (3.79)	-	-0.2942 ^{***} (-5.12)
CR4 * Post-Merger Dummy	-	0.0249 (0.24)	-	-0.1822 (-1.49)	-	0.4256 ^{**} (6.98)
Expenses-to-Assets	-0.3214 ^{***} (-4.88)	-0.3071 ^{***} (-4.43)	-0.1527 ^{**} (-2.18)	-0.1890 ^{***} (-2.67)	-0.5204 ^{***} (-2.90)	-0.2853* (-1.84)
Expenses-to-Assets * Post-Merger Dummy	0.2911 ^{**} (2.25)	0.2787 ^{**} (2.14)	-1.2313 ^{***} (-7.21)	-1.2290 ^{***} (-7.16)	1.5697 ^{***} (7.13)	1.3838 ^{***} (6.95)
Post-Merger Dummy	0.0460 (1.09)	-0.0033 (-0.04)	0.0582 (1.13)	0.1428 (1.50)	-0.1699 (-4.57)	-0.3325 ^{***} (-6.46)
Revenues-to-Assets	0.1615 ^{***} (5.49)	0.1501 ^{***} (5.01)	-0.0959 ^{**} (-2.08)	-0.0979 ^{**} (-2.27)	0.1184 ^{***} (3.59)	0.1076 ^{***} (3.56)
Revenues-to-Assets * Post-Merger Dummy	0.0289 (0.97)	0.0383 (1.25)	0.3438 ^{***} (7.27)	0.3455 ^{***} (7.66)	-0.0574 ^{**} (-1.99)	-0.0348 (-1.27)
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Exchange Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	337	337	180	180	157	157
R ²	0.7230	0.7251	0.5518	0.5315	0.3690	0.3795

Presented in this table are the results of exchange fixed effects panel data regression equations that regress ROA on measures of market power, exchange-level variables and other control variables. The variables include exchange market share (with and without interaction with the post-merger dummy), HHI or CR4, expenses-to-assets, revenues-to-assets (with and without interaction), log of domestic market capitalization, long-term debt-equity ratio, CAPEX-to-revenue ratio and post-merger dummy. We estimate the regressions using yearly data that start 5 years before the year of the merger completions and end 5 years after the merger completion dates. T-statistics are in parentheses.

* Represent significance at the 10% level.

** Represent significance at the 5% level.

*** Represent significance at the 1% level.

Table 6
Efficiency and market power effects using 2-stage least squares regressions.

	All		Merging Companies		Others	
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Market Share	0.4496 ^{***} (3.56)	0.5063 ^{***} (3.47)	1.3695 ^{***} (11.39)	1.4554 ^{***} (11.19)	4.0854 ^{**} (2.45)	3.8372 ^{**} (2.11)
Market Share * Post-Merger Dummy	-0.6193 ^{***} (-4.61)	-0.6929 ^{***} (-4.48)	-1.1067 ^{***} (-6.07)	-1.2569 ^{***} (-6.50)	-6.3306 ^{**} (-2.40)	-5.8335 ^{**} (-2.25)
HHI	0.0000 (0.20)	-	0.0008 ^{**} (5.01)	-	0.0014 [*] (1.98)	-
HHI * Post-Merger Dummy	-0.0002 (-0.53)	-	-0.0006 ^{**} (-2.10)	-	-0.0009 (-1.38)	-
CR4	-	-0.0387 (-0.34)	-	0.4343 ^{***} (4.43)	-	0.5972 (1.62)
CR4 * Post-Merger Dummy	-	-0.0432 (-0.26)	-	-0.2927 ^{**} (-2.06)	-	-0.5387 (-1.44)
Expenses-to-Assets	-0.0125 (-0.12)	-0.0494 (-0.39)	-0.2426 ^{***} (-3.42)	-0.2660 ^{***} (-3.45)	2.0480 (0.78)	-0.4092 (-0.20)
Expenses-to-Assets * Post-Merger Dummy	-0.0387 (-0.25)	-0.0409 (-0.23)	-1.3721 ^{**} (-2.20)	-1.0366 [*] (-1.66)	-1.7205 (-0.67)	0.6996 (0.34)
Post-Merger Dummy	0.0044 (0.08)	-0.0016 (-0.01)	0.1478 ^{**} (2.84)	0.2499 [*] (2.47)	0.6265 [*] (2.18)	0.7666 [*] (1.81)
Revenues-to-Assets	-0.1186 [*] (-1.83)	-0.1288 [*] (-1.87)	-0.2720 ^{***} (-6.38)	-0.2799 ^{***} (-6.53)	1.6104 ^{***} (2.92)	2.0402 ^{***} (3.07)
Revenues-to-Assets * Post-Merger Dummy	0.3982 ^{***} (3.80)	0.4370 ^{***} (3.70)	0.5374 ^{***} (6.87)	0.5135 ^{***} (5.34)	-1.6340 ^{***} (-2.69)	-2.0402 ^{***} (-2.82)
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
N	337	337	180	180	157	157
R ²	0.7230	0.7251	0.5518	0.5315	0.3690	0.3795

This table presents final stage results of 2-stage least squares (2SLS) regressions that regress ROA on measures of market power, exchange-level variables and other control variables. The variables include market share (and its interaction with the post-merger dummy), HHI or CR4, expenses-to-assets, revenues-to-assets, log of domestic market capitalization, long-term debt-to-equity ratio, CAPEX-to-revenues ratio and post-merger dummy. We treat efficiency and market power measures as endogenous variables and use the lag values of the dependent variable (ROA) as well as the lag values of the revenue efficiency, cost efficiency, and market power measures as instruments. We estimate the regressions using yearly data that start 5 years before the year of the merger completions, skip one year and end 5 years after the skipped year. T-statistics are in parentheses.

^{*} Represent significance at the 10% level.

^{**} Represent significance at the 5% level.

^{***} Represent significance at the 1% level.

ing from omitted exchange-level heterogeneity (Brown et al., 2011), we also employ the two-stage least squares (2SLS) technique to help address some of the potential endogeneity concerns. Since Turk-Ariss (2010) highlighted the possibility of endogeneity between firm performance and market power and efficiency, we use the 2SLS technique and treat the market power and efficiency measures in our models as endogenous variables. We follow the intuition in Brown et al. (2011) and use the lagged values of the market power variables, lagged values of the efficiency variables and lagged values of ROA (our performance measure) as instruments in the 2SLS regressions.⁷ The second stage results of the 2SLS regressions are presented in Table 6.

As evident from Table 6, the results of the 2SLS regressions are similar to our baseline results using exchange fixed effects panel data regressions. Market share in the post-merger period is significantly negative. If exchanges had exercised market power following the mergers, the coefficient of the market share variable should have been significantly positive in the post-merger period. HHI and CR4 in the post-merger period are either insignificant or significantly negative. After the merger completion dates, cost efficiency is significantly negative (5% and 10% levels of significance) for the merging exchanges but insignificant for rivals while revenue efficiency is significantly positive for the merging exchanges (1% level of significance) but significantly negative for rivals. Thus, using the 2SLS estimation technique does not alter the essence of our results.

Additionally, we analyze return on equity (ROE) and an alternative variant of ROA, which we define as pretax income divided by total assets (i.e., pretax ROA). Although not reported for brevity sake, our conclusions based on the alternative measures of performance remain the same. We also use a monthly data frequency and the results are similar to our baseline annual results. Thus, our findings that the six mergers were primarily undertaken for efficiency gains but not for market power exploitation are robust and are not sensitive to alternative specifications, definitions or frequencies of measuring variables.

⁷ The first stage regressions use the lagged values of ROA, lagged values of efficiency measures and lagged values of market power variables, together with the control variables. The fitted values from the first stage regressions and the control variables are then used in the second stage regressions.

6. Conclusion

While creating efficiencies is often the professed motive for mergers and acquisitions, some mergers lead to the exercise of market power and impose detrimental effects (such as increased prices or reduced output or both) on consumer welfare. Despite the possibility that the recent spate of stock exchange mergers could lead to the exercise of market power in the stock exchange industry, there has been no empirical testing of the market power hypothesis in the industry. To fill this gap, we examine the market power effects of six major stock exchange mergers.

Our results show that the six transformational mergers we investigated did not result in the exercise of market power. Our measures of industry concentration (HHI and CR4) and market power (market share) are not significantly positively related to profitability in the post-merger period, findings which are inconsistent with market power exploitation. Instead, we find that the mergers resulted in significant gains in efficiencies for the merging firms, with expense efficiency being significantly negative and sales efficiency being significantly positive for the merging exchanges. These results are consistent with efficiency gains for the merging exchanges. This is probably, in part, because technological advancements, globalization and liberalization in the industry are lowering entry barriers and stock exchanges have to compete on several dimensions of competition including price, speed of order execution, etc. This heightened level of competition makes merging for efficiency reasons critical. On the contrary, we do not find evidence that rival exchanges not undertaking mergers and acquisitions experience similar efficiency gains in the post-merger period. Our results are robust to different specifications, definitions and frequencies of measuring variables.

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