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ABSTRACT

We examine whether firms switching listings from the Korean growth market (KOSDAQ) to the main board (KOSPI) experienced improved trading-related market quality. We focus on *market macrostructure* and use a difference-in-difference technique with nearest matching. Contrary to previous research and practitioners' opinions, we find that trading-related market quality mostly deteriorated or remained unchanged following the switch, indicating that the specific market macrostructure of a country matters. Listing switches produce a negative externality by weakening KOSDAQ and thereby impairing funding for innovative new firms, suggesting that policymakers should encourage firms whose characteristics fit the standalone growth market to remain listed there.

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1. Introduction

KOSDAQ, a part of the Korea Exchange (KRX), is one of the very few successful "growth markets" in the world (see Section 2 for details);[1] most other growth markets in the advanced major industrial countries have languished or failed, confirming that growth markets need to be nurtured if they are to survive and provide social benefits. In spite of its success, many of the most successful KOSDAQ start-ups, including flagship firms, have steadily switched their listings to KOSPI, the main board of the KRX.

In this paper, we specifically examine whether the post-switch trading-related market quality delivered by KOSPI is better than that provided by KOSDAQ for the 38 firm which switched their listings from KOSDAQ to KOSPI between January 1999 and April 2010. Along with these sample firms, we also utilize 38 matched firms which kept their listings on KOSDAQ during the sample period for our study. We use both trade and quote (TAQ) data for 100 days and daily market data for 250 trading days, both before and after the listing switch from KOSDAQ to KOSPI. For our methodology, we employ the difference-in-difference (DID) technique with nearest matching in order to take into account the possible sample-selection bias in the listing switch event. We also control for the substantial fluctuations in price and trading patterns of the associated underlying stocks in our samples on so-called witching days.

Our main finding is, contrary to previous research and practitioners' opinions in other countries, trading-related market quality mostly deteriorated or remained unchanged following the switch. This indicates that, unlike most world growth markets, KOSDAQ has managed to provide trading-related market quality generally comparable to that of the main board, KOSPI, conditional on the characteristics of each firm. While trading-related market quality is higher overall among KOSPI-listed stocks than among KOSDAQ-listed stocks, this appears to represent different distributions of firm characteristics on the two boards rather than better quality for any given firm. Weak growth markets have been found in previous research to deliver inferior trading-related market quality, compared to main boards. KOSDAQ demonstrates that a strong growth

[1] The term "new market" originally referred to those European stock markets modeled after Nasdaq and founded in the 1990s. Recently, the term "growth market" has largely replaced the term "new market." In this paper, we use the term "growth market" to include both European and U.S. (Nasdaq before 2006) versions of new markets and to prevent unnecessary confusion which could arise from the word "new" in the context of a listing switching situation.

market can deliver trading-related market quality comparable to the main board. In other words, the *market macrostructure*—the hierarchy of stock markets in a country—matters; a strong growth market can deliver trading-related market quality superior to that of a weak growth market.[2]

Our main finding has significant policy implications, which can only be understood from the macrostructure perspective. As the literature summarized in Section 3 has established, the presence of an active growth market is very important to nurturing innovation. Black and Gilson (1998) emphasize the importance to venture capitalists and entrepreneurs of the ability of the venture capitalists to exit ownership through a successful initial public offering (IPO). However, typical firms at the IPO stage find it difficult to meet the listing standards for the main board. A strong growth market is the ideal environment for an IPO.

Successful firms which remain listed on the growth market contribute to a self-reinforcing cycle that strengthens the growth market. A vibrant market creates a positive network externality, drawing traders and dealers and thereby improving liquidity; see, for example, Economides (1993, 1996) (providing the conceptualization of this network externality) and Barclay and Hendershott (2004) (quantifying the magnitude of the liquidity externality).

However, growth markets have proven to be quite fragile.[3] Firms that switch their listings from the growth market to the main board reduce the market capitalization and liquidity of the growth market, diminishing the liquidity externality and thereby reducing the ability of the growth market to nurture innovation. Indeed, listing switches could lead to a total collapse of the growth market. Because firms considering switching their listings do not take the liquidity externality into account, listing switches

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[2] Pirrong (2002) first named "the macrostructure of a securities market," defining it as "the number of trading venues, their size, their market shares, and the policies they adopt" (see page 386). Drawing on practical usage in the field, we include also the hierarchical relationships among markets in the definition of market macrostructure. A typical country's market macrostructure consists of a main board, a growth market, and an organized over-the-counter (OTC) stock market.

[3] Growth markets such as Germany's Neuer Markt and France's Nouveau Marché have dissolved, and many other attempts to establish vibrant self-sustaining growth markets have failed. Nasdaq gradually changed from an organized OTC stock market to a growth market and ultimately a main board in the period leading up to 2006. While KOSDAQ's market capitalization is 10% of that of KOSPI, the U.K.'s growth market (AIM) has 5.5% of LSE's, Canada's TSX Venture Exchange has 3.23% of TSX's, and Japan's JASDAQ has 0.3% of TSE's; all other countries are lower (World Federation of Exchanges, 2012). China's ChiNext is not included since it was founded in October 2009.

result in a negative macrostructure externality. It is the macrostructure that is affected by the listing switches; the externality cannot be understood in a microstructure context.

Of course, this negative macrostructure externality could be offset if the main board provided the switching firms with significantly improved trading-related market quality, following the switch. This is the question we address in this paper. We examine whether or not a firm switching its listing from the growth market (KOSDAQ) to the main board (KOSPI) of the KRX experienced an improvement in trading-related market quality. In other words, we investigate whether the main board confers trading-related market quality over and beyond what the switching firms was experiencing in the growth market. We are interested in quantifying the total improvement in trading-related market quality; in particular, we are not interested in the motives of the switching firms (which would be microstructure issues); see also section 4.1, and especially footnote 15, which discusses the motives for switching.[4]

The literature on listing switching can be generally classified into papers from the *firm's standpoint* and papers from the *market's standpoint*; see Section 3.2 for more details. Papers from the firm's standpoint analyze the switching firm's benefits, motives, or performance before and after the switching event. This is the traditional approach and almost all the previous research has adopted it; however, it suffers from the limitations enumerated in Section 3.3. In contrast, the analysis from the market's standpoint considers differences in trading-related market quality before and after the switch. This approach has appeared in only two previous papers, Bennett and Wei (2006) and Jenkinson and Ramadorai (2013). Bennett and Wei (2006) examined the NYSE and Nasdaq, which handled orders in significantly different ways in the study period (2002-2003). At that time, Nasdaq combined the functions of a growth market (with many young technology firms) with a main board, since it included mature technology giants such as Microsoft. In other words, NYSE and Nasdaq had different market microstructures, and somewhat different roles in the macrostructure. Bennett and Wei found that firms switching from Nasdaq to NYSE experienced improvements in trading-related market quality; they attributed this to the microstructure differences, but did not discuss the macrostructure differences. Jenkinson and Ramadorai (2013) analyzed the

[4] Also, we are not interested in determining the exact mechanism by which the benefit is obtained. Our focus is on whether the main board provides benefits to the switching firms that could possibly offset the macrostructure externality.

announcement and one-year performances of firms switching listings between the Alternative Investment Market (AIM), growth market, and the Main Market (MM) of the London Stock Exchange (LSE). They found that the returns of firms switching listings from AIM (the MM) to the MM (AIM) were positive (negative) right after the listing switch announcement, whereas their returns were broadly neutral (strongly positive) the year after the switches. They argued that a lighter regulatory environment may be appropriate for some companies and their investors, but did not consider the market macrostructure issues.

Like Bennett and Wei (2006), the present paper examines trading-related market quality following a listing switch. However, KOSDAQ and KOSPI have essentially the same trading mechanisms; they have the same market microstructure, but play very different roles in the market macrostructure, as reflected by their divergent listing and delisting standards, and by the characteristics of their listed firms. This setting allows us to focus on the effect of macrostructure.

Our Null Hypothesis is that the trading environment provided by KOSPI is no better than that provided by KOSDAQ for firms that switch. Previous work in the U.S. and practitioners' opinions in other countries suggest that our Null Hypothesis should be easily rejected. However, our tests, based on a multitude of trading-related market quality measures, do not reject the Null Hypothesis. This indicates that there is no evidence of the existence of firm benefits that offset the macrostructure externality. It provides evidence that the specific market macrostructure of the country matters.

The reality is that the most successful KOSDAQ start-ups, including the flagship firms, ultimately switched their listings to KOSPI. This suggests that the switch was motivated by the perceived reputation of KOSDAQ,[5] rather than a desire for improved trading-related market quality. Our results show that KOSDAQ trading function remains competitive with that of KOSPI. However, the continuing switch of firms may threaten KOSDAQ's future ability to remain competitive.

The switching firms do not consider the externality that switching weakens

[5] Despite its great success, KOSDAQ has repeatedly experienced problems of market integrity common to growth markets: high (transitory) volatility, speculative trading behavior, stock price manipulation, managers' embezzlement, and so on. These phenomena seriously threaten to erode investor confidence in KOSDAQ. The vulnerability of a growth market in market integrity is documented in Cumming and Johan (2013), who report that litigated cases of fraud in Canada, the U.K., and the U.S. occurred more frequently in growth markets with lower listing standards than in main boards with higher listing standards.

KOSDAQ and threatens its ability to continue nurturing innovation. Only policymakers can address this externality through their ability to influence market design. In the end, the results suggest that policymakers should encourage those firms whose characteristics fit the standalone growth market to remain listed on that market.

Our more specific findings are as follows:

First, for the overall sample period, we find that the trading-related market quality mostly deteriorated or remained unchanged following the switch from KOSDAQ to KOSPI; we find reductions in most of the trading-related market quality dimensions such as liquidity (relative spread, market depth, trading volume, and number of trades), trade-execution cost, and institutional investors' trading activity. In particular, although the result was not statistically significant, price *declined* after the switch; thus, there is no evidence that the switch caused an increase of the equity value. The only market statistic that improved with statistical significance was volatility, measured by the difference between highest and lowest prices on a single day. However, another measure of volatility, transient volatility, as defined in Ranaldo (2004), deteriorated with statistical significance. The effects of listing switches on price efficiency were not uniform, and were not statistically significant; as a result of the switch, the accuracy of price discovery increased with the 5-minute variance ratio closer to 1 from below, whereas the adverse selection cost increased more than the decrease in transitory cost.

Second, the deterioration in trading-related market quality caused by the listing switch became more pronounced following the consolidation of KOSDAQ and KOSPI into KRX in 2005.

Third, our main empirical results are mixed in terms of signs and statistical significance. At first glance, this may appear to be a weakness, but it is actually a strength. The firms that chose to switch presumably expected to benefit as a result, and we should expect to find evidence of that benefit. The results from almost all the previous studies showed that a firm switching its listing from a smaller exchange such as Nasdaq to NYSE achieved a significant improvement in market statistics. The failure to find statistically significant improvements in trading-related market quality following the switch from KOSDAQ to KOSPI indicates there is *no evidence* that the firms benefit from the switch.[6] In most cases, we find different signs from those in the previous

[6] The relationship between KOSDAQ and KOSPI is somewhat different from the relationship between Nasdaq and the NYSE. Unlike Nasdaq, KOSDAQ's trading mechanism is exactly the same as that of

literature, with weak statistical significance. Only in rare cases do we find the same signs with statistical significance. Our results have very different implications from the previous literature, indicating that the specific market macrostructure of a country matters.

The remainder of this paper is as follows. In Section 2, we briefly introduce KOSDAQ and its domestic and international status. Section 3 reviews the literature regarding the importance of growth markets to innovation and listing switching, and details the rationale why the market's standpoint and the macrostructure point of view are important. Section 4 describes our hypothesis, data, testing model, definitions and measurements of variables, and estimation method. In Section 5, we report the empirical results and their implications. Section 6 provides a summary of our results.

2. KOSDAQ's domestic and international status

2.1. KOSDAQ, the Korean standalone growth market

KOSDAQ was established in 1996 as an organized OTC stock market in Korea. Since its inauguration, KOSDAQ has achieved remarkable growth in market capitalization as a result of the boom in IPOs around 2000. KOSDAQ evolved into a growth market independent of the Korea Stock Exchange (KSE). KOSDAQ and KSE were later consolidated into the KRX in 2005 under a government policy to build up the Korean stock markets, with the KSE renamed as KOSPI. Since then, KOSDAQ and KOSPI have been divisions of KRX and have served complementary roles in the Korean capital market macrostructure.

KOSDAQ has served primarily as a capital market for information technology (IT)-related innovative small and medium enterprises (SMEs) that have reached the level of revenue or profitability specified in the listing standards. Meanwhile, KOSPI is the flagship capital market in Korea for firms that are established and larger, and belong to

KOSPI. The main differences between KOSDAQ and KOSPI are the listing and delisting standards, which are looser on KOSDAQ than KOSPI, and the characteristics of the listed firms. Most of the switching firms are big fish in the small pond of KOSDAQ, but only small fish on KOSPI. These facts may explain why listing switches from KOSDAQ to KOSPI do not deliver the same benefits as switches from Nasdaq to the NYSE.

traditional industries.[7] KOSDAQ functions as a standalone market.[8] Even though their roles are different in the Korean stock markets, KOSDAQ and KOSPI share a common market microstructure, including a common trading mechanism. The main differences between them are the listing and delisting standards, which are looser on KOSDAQ than on KOSPI, and the characteristics of the listed firms.[9]

2.2. KOSDAQ, one of very few successful growth markets in the world

Domestically, the market activities of KOSDAQ are comparable to KOSPI by many measures; for example, the number of listed firms and the turnover ratio (using the number of shares) were 131% and 166% of those of KOSPI, respectively.

Internationally, KOSDAQ has been also considered one of the very few successful growth markets in the world; besides Nasdaq, AIM and KOSDAQ are usually named as the most successful growth markets. As of 2011, the market capitalization of KOSDAQ was US$92bn and it ranked fifth in the world among growth markets, with only Nasdaq (US$3,845bn), ChiNext (US$118bn), JASDAQ (US$110bn), and AIM (US$101bn) ahead. Nasdaq is now a main board; ChiNext and JASDAQ serve much bigger economies than does KOSDAQ. The number of listed firms, trading volume, and number of IPOs ranked fourth, second, and fifth, respectively (World Federation of Exchanges, 2012). The ratio of KOSDAQ's market capitalization to that of KOSPI, at 10%, is the highest ratio of growth market to main board in the world; see footnote 3. Growth markets other

[7] Until recently, FreeBoard completed the Korean capital market macrostructure as the organized OTC stock market especially for *intermediate-mature* unlisted firms. In sharp contrast to KOSDAQ, however, FreeBoard had not functioned well in its assigned role, one of the main concerns that Korean policymakers have struggled to resolve. In July 2013, Korean policymakers moved the best-performing part of FreeBoard into KONEX, a newly-formed independent submarket of KOSDAQ. In August, 2014, they also restructured FreeBoard and renamed it as K-OTC. The Korean capital market macrostructure now consists of KOSPI, KOSDAQ, KONEX, and K-OTC.

[8] Within a market macrostructure, the growth market can act as a stepping stone through which a growth firm is encouraged to migrate to the main board once mature; TSX Venture Exchange and GEM at HKEx are examples. Alternatively, the growth market can function as a standalone, independent market, retaining mature firms while attracting new growth firms. From the outset, KOSDAQ was intended to be a standalone market similar to Nasdaq, reflecting the high proportion of IT firms in the Korean economy. Currently, KOSDAQ remains a standalone growth market, even though since its consolidation into KRX in 2005, it no longer has an independent ownership structure. As of the end of 2011, 459 (about 46.9%) firms out of 978 firms met the listing standards for KOSPI, but remained in KOSDAQ, confirming that KOSDAQ has fulfilled its market macrostructural role as a standalone market rather than acting as a stepping stone market.

[9] Details on the listing and delisting standards for KOSPI and KOSDAQ are shown in the Appendix.

than AIM and KOSDAQ have remained subordinate markets, making only limited contributions to their countries' growth. KOSDAQ's successful development as a strong growth market within a short period of time, while Korea was transitioning from an emerging to an advanced market, makes it a good model for advanced or emerging industrial countries which aspire to establish a strong growth market.

3. Literature review and rationale for the market macrostructure point of view

3.1 The importance of growth markets in innovation

Black and Gilson (1998) emphasize the importance to venture capitalists and entrepreneurs of the ability of the venture capitalists to exit ownership through an IPO:

> "Other countries have openly envied the U.S. venture capital market and have actively, but unsuccessfully, sought to replicate it. We offer an explanation for this failure: We argue that a well developed stock market that permits venture capitalists to exit through an initial public offering (IPO) is critical to the existence of a vibrant venture capital market." …
>
> "First, we explain the importance of exit—why venture capital providers seek to liquidate their portfolio company investments in the near to moderate term, rather than investing for the long-term like Japanese or German banks. Second, we explain the importance of the form of exit: why the potential for the venture capital provider to exit from a successful start-up *through an IPO*, available only through a stock market, allows venture capital providers to enter into implicit contracts with entrepreneurs concerning future control of startup firms, in a way not available in a bank-centered capital market." (Black and Gilson, 1998, page 245.)

Note, however, that typical firms at the IPO stage find it difficult to meet the listing standards for the main board. A strong growth market is the ideal environment for an IPO. Thus, the presence of a strong growth market is important in supporting a strong venture capital sector.

Successful firms which remain listed on the growth market contribute to a self-reinforcing cycle that strengthens the growth market. A vibrant market creates a positive network externality, drawing traders and dealers and thereby improving liquidity; see, for example, Economides (1993, 1996) (providing the conceptualization of this network externality) and Barclay and Hendershott (2004) (quantifying the magnitude of the liquidity externality). If firms switched from the growth market to the main board,

liquidity in the growth market would suffer.

This scholarly work is also supported by practitioner sentiment. Grant Thornton (2015, page 5) reports "AIM plays a key role in the UK's SME funding environment, allowing companies to raise external finance at different stages in their lifecycle and providing an exit route for early stage investors (such as for the company founder(s) or private equity investors). It also offers a regulatory framework designed specifically for smaller, growing companies, proving less prescriptive than for companies listing on the Premium segment of the London Stock Exchange's Main Market. As companies continue to grow, they also benefit from the advisory and investor support network that has developed around AIM over the last 20 years and benefit from the ease with which they can return to the market to raise further funds."

The HKEx and the Hong Kong Securities and Futures Commission (SFC) considered a variety of options for the Hong Kong Growth Enterprise Market (GEM). Practitioners favored the development of a standalone market similar to AIM. Typical was Hong Kong Stockbrokers Association (2007), "As responded in our submission to the Discussion Paper in 2006, we considered that the GEM Board should be positioned as a place where SMEs can raise funds and maintain their listing status without any pressure to transfer to the Main Board or the stigma of staying on a 'second rate' board. Setting higher admission requirements would adversely affect GEM as a capital formation platform for SMEs, particularly for those high and new technology enterprises with only minimum cashflow and tangible assets but seeking to raise capital on GEM to commercialize their products research and development."[10]

3.2. Literature on listing switching

As briefly described in the introduction, there are two strands of research on listing switching: the firm's standpoint and the market's standpoint. Regardless of the standpoint, all but one paper so far on listing switching has been conducted on the U.S. stock markets; the exception is Jenkinson and Ramadorai (2013) on the U.K. stock markets.[11]

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[10] The practitioners' advice was not accepted, on the grounds that the regulatory structure in Hong Kong was "not yet ready for the AIM model" (Hong Kong Exchanges and Clearing Limited, 2008).

[11] We are interested only in listing switches from the growth market to the main board, so the literature review discusses only papers dealing with such switches. However, there is another set of literature

All research from the firm's standpoint has focused on what motivated firms on the Nasdaq and/or American Stock Exchange (AMEX) to switch the listings to NYSE and/or AMEX, what benefits they obtained from switching, or how much the stock returns or operating returns changed after switching.[12] The main results of the research on the motives and specific benefits from the firm's standpoint are as follows. First, switching a listing from Nasdaq or AMEX to NYSE increased liquidity and improved price discovery. As reported in most of the related papers (e.g., Christie and Huang, 1994; Kadlec and McConnell, 1994; Elyasiani et al., 2000), this result is considered to be the most important motive for listing switching from the Nasdaq and/or AMEX to NYSE. Second, switching the listing to NYSE has helped firms to expand their investor bases and increase their visibility (Kadlec and McConnell, 1994; Jain and Kim, 2006). Third, the firms which switched their listings to NYSE obtained a type of bonding effect associated with the tighter regulatory standards on NYSE (Kadlec and McConnell, 1994; Elyasiani et al., 2000; Jain and Kim, 2006). Fourth, after switching their listings to NYSE, the firms issued more debt and equity, and engaged in more asset transactions such as acquisitions, suggesting that the firms' listing switching decisions are often not isolated, but rather related to other important corporate objectives (Kedia and Panchapagesan, 2011).[13] All of these studies on the motives and benefits from listing switches exhibit methodological limitations, in that they infer the motives of a switch from the results of the switch.

The results on performance are as follows. Right after the listing switch, the firm's stock returns increase (Jain and Kim, 2006; Jenkinson and Ramadorai, 2013) or decrease (Papaioannou et al., 2009) and operating returns decrease (Papaioannou et al., 2003), perhaps because of the timing hypothesis, in which the manager selects the timing of

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examining the listing switch from the main board and/or the growth market to OTC stock markets. This strand of research focuses on the firms which were delisted from NYSE and/or Nasdaq to OTCBB and/or Pink Sheets (Harris et al., 2008; Macey et al., 2008).

[12] According to the persons in charge of listing on Nasdaq, about 15 to 20 firms have switched their listings from NYSE to Nasdaq since the inception of Nasdaq, whereas about 20 Nasdaq firms have switched their listings to NYSE every year. Almost all the listing switches from NYSE to Nasdaq, except for Aeroflot, occurred in recent years, indicating that Nasdaq has recently started to aggressively compete with NYSE.

[13] The firms which switch their listings to the main board may expect investors to view them as having better corporate governance after the switch (see Claessens and Yurtoglu, 2013). However, this benefit is not relevant for this paper since KOSPI and KOSDAQ have almost the same listing standards for minimum float, the only listing standard related to the corporate governance in these two markets.

listing switching to match the peak in the firm's financial situation. The firm's stock returns decrease over mid- and long-term time-horizons; this phenomenon is particularly evident for firms that switched their listings from Nasdaq to AMEX (Dharan and Ikenberry, 1995). De Carvalho and Pennacchi (2011) find that Brazilian firms that voluntarily migrated to the premium exchange segment, which has more stringent disclosure and governance requirements, achieved abnormal positive stock returns, supporting a bonding effect.

Now, we turn to the two papers from the market's standpoint: Bennett and Wei (2006) and Jenkinson and Ramadorai (2013).[14] First, analyzing 39 firms switching their listings from Nasdaq to NYSE between January 2002 and March 2003, Bennett and Wei (2006) report that the firm's trading-related market quality and price efficiency improved after the switch. They argue that the improvement arose from the difference in trading mechanism (i.e., market microstructure). More specifically, they argue that the post-switch improvement of trading-related market quality and price efficiency came from the lower degree of order flow fragmentation under the NYSE specialist mechanism compared to the Nasdaq dealer mechanism. Next, Jenkinson and Ramadorai (2013) examine the consequences of listing switching from AIM (exchange regulated market) to the MM (EU regulated market), and vice versa. They find that firms switching listings from AIM with lighter regulation to the MM with higher regulation experienced, on average, significantly positive announcement returns of about 5%, while the returns of these firms were broadly flat for a year thereafter. In contrast, the firms moving down from the MM to AIM experienced, on average, negative announcement returns of about 5% and a strong positive return drift thereafter, with about 25% cumulative abnormal returns one year following the switch. They attribute the results to the observation that the market capitalization of listing switch firms are generally small. That is, if a small firm switches its listing to the less-regulated market, its operating cost will reduce and,

[14] Johan (2010) and Cumming and Johan (2013) study listing standards from the market's standpoint, but do not study firms that switch listing. Analyzing the main boards and growth markets in Canada, the U.K., and the U.S., Johan (2010) and Cumming and Johan (2013) argue that the listing standards are the foremost determinant of IPO performance and preparedness, and the frequency of fraud cases, which are elements of market quality. Park, Nam, and Eom (2007) examine the market efficiency of AIM, KOSDAQ, and Nasdaq from the market macrostructure point of view, focusing on volatility. Decomposing volatility of the major indices of the main boards and the growth markets in Korea (KOSPI 200, KOSPI 50), the U.K. (FTSE 100, FTSE AIM), and the U.S. (S&P 500, Nasdaq 100) into permanent and transitory components, they insist that the market efficiency of KOSDAQ is comparable to Nasdaq and AIM.

in turn, affect its returns eventually.

The present paper is also from the market's standpoint. It analyzes the effect of a firm's listing switch from a smaller market to the main board on its trading-related market quality. The market's standpoint analyzes market statistics and interprets the results from the switch as the market's responses; this is very different from the analyses carried out from the firm's standpoint. Hence, the market's standpoint for the analyses on the listing switch is valuable in overcoming the methodological weaknesses inherent in the firm's standpoint.

However, this paper differs from Bennett and Wei (2006) in that we focus on market macrostructure, rather than on market microstructure. Bennett and Wei attribute their findings to the microstructure differences between NYSE and Nasdaq, and do not consider the possibility that the macrostructure differences play a role. Because KOSPI and KOSDAQ had identical trading mechanisms, we can control for microstructure differences in a way that Bennett and Wei could not, and focus on the effect of macrostructure. This paper also differs from Jenkinson and Ramadorai (2013). Their argument is mainly based on the difference of listing standards; they do not consider market macrostructure. Our finding indicates that a vibrant growth market like KOSDAQ can provide trading-related market quality to its listed firms similar to the trading-related market quality they would obtain after a switch to KOSPI. If trading-related market quality is higher overall for firms listed on KOSPI, it is because KOSPI-listed firms have different characteristics from KOSDAQ-listed firms.

3.3. Rationale for the market macrostructure point of view

Why is it important to understand the listing switch phenomenon of the KOSDAQ firms to KOSPI from the market's standpoint by the market macrostructure point of view? The rationale is as follows:

First, analysis from the firm's standpoint has a methodological flaw. As mentioned above, studies from the firm's standpoint are intended to explain the switching firm's motives (such as benefits or performance) for the switch. To do this, the analysis from the firm's standpoint tests the differences of market statistics (including some trading-related market quality measures) between before and after the switching event, while it interprets the *results* from the differences of market statistics as the *motives* of the switch.

The inference about motives is at best indirect.

Second, there is a self-selection issue arising from the fact that firms that choose to switch listings from KOSDAQ to KOSPI may differ systematically from those that choose not to switch. Indeed, the firms that switch are presumably those that anticipate benefits from switching with their current market characteristics, future expectations of corporate cash flow, plans of capital structure and investment, current and future ownership and control structure, etc. Any approach which ignores this endogeneity problem would be biased in the direction and magnitude of finding benefits to switching. Of the previous research, the only paper that addresses this endogeneity problem is Bennett and Wei (2006), who analyzed the question from the market's standpoint. However, Bennett and Wei dealt with only one aspect of market microstructure, the difference in trading mechanism.

Third, the analysis of the listing switch phenomenon from the market macrostructure point of view enables us to get economically meaningful insights for the design of a country's market macrostructure. There is an important positive externality that regulators need to take into account. KOSDAQ provides important social benefits in its function as a growth market, providing capital to IPOs and IT-related SMEs. A new firm receives these benefits when it initially lists on KOSDAQ, and the prospect of receiving such benefits in the future should help in attracting venture capital. When the firm matures, its continued listing on KOSDAQ helps KOSDAQ in providing a market for new firms. When a firm switches its listing from KOSDAQ to KOSPI, it undermines KOSDAQ's ability to provide these benefits to new firms. An individual firm contemplating switching will not take this externality into account, but regulators should. If KOSPI provides only modest or no meaningful benefits to firms that switch, regulators should encourage firms to retain their listings on KOSDAQ in order to maintain it as a strong standalone growth market.

4. Empirical analyses

4.1. Hypothesis

As mentioned in the introduction, this paper focuses on the exchange's functioning (i.e., providing trading-related market quality) for the switching firms, which is a market

macrostructure issue, rather than on the switching firms' motives.[15] Thus, we address the following specific question: Does KOSPI provide a superior trading environment to KOSDAQ for firms that switch?

From the market's point of view, a superior trading environment would be reflected in the various trading-related market quality measures; see Section 4.3.4. Since KOSDAQ and KOSPI differ only in the listing and delisting standards and the characteristics of the listed firms, the only possible benefits to switching are either driven by firm characteristics, or are reputational (the firm is recognized as large or established as a result of a KOSPI listing), or arise from the bonding effect associated with KOSPI's tighter listing standards. The matching technique allows us to control for firm characteristics. However, the reputational and bonding effects cannot be measured directly, and in particular we cannot distinguish between them. And in any case, our goal is not to determine either firm's motives or the specific nature of the benefits from switching. However, using the market macrostructure view allows us to measure the total benefit through trading-related market quality measures: sophisticated investors' (institutional/foreign investors') trading activity and a general trading-related market quality measure, full-information transaction cost (*FITC*) (see Section 4.3.4). This allows us to address our main policy question: Are there market-quality benefits to individual firms from switching that offset the negative macrostructure externality that arises when firms switch, thereby likely weakening KOSDAQ's ability to foster innovation? *Our Null Hypothesis is: The trading environment provided by the main board, KOSPI, is no better than that would be provided by the established standalone growth market, KOSDAQ, for firms that switch.*

4.2. Methodology

With the listing switch as a treatment, we test our Null Hypothesis using difference-in-difference (DID) methodology, for the following reasons:

[15] With assistance from KRX, we undertook an informal survey on the motivation for firms switching from KOSDAQ to KOSPI. The responses are as follows: *(1) Weakness of the stable investor base due to the lack of institutional/foreign investors, (2) Lack of representative stocks (e.g., large and blue chips) in KOSDAQ to play a leading role, (3) Persistence of the negative image of KOSDAQ.* All of these motives are eventually related to a belief that stocks might be undervalued on KOSDAQ, and that switching the listing to KOSPI might increase the price. However, as we found, switching listings did not result in increases in stock prices.

If we could carry out a randomized controlled experiment, we could easily measure the treatment effect. That is, if we could randomly force a listing switch on some firms, while forcing other firms to remain on KOSDAQ, the listing switching effects on trading-related market quality could be derived. Unfortunately, anyone cannot conduct such a randomized controlled experiment.

Our data is based on those firms that chose to switch voluntarily, where the decision to switch is endogenous and not randomly assigned. As a result, a two sample difference test or OLS estimation of the regression with a dummy for switching is potentially affected by sample selection bias. However, if the switching decision is based only on observable characteristics, i.e., selection-on-observables, then we can remove the sample selection bias by controlling for those observables.

The matching technique used in this paper is one of a large number of methods for controlling for sample selection bias. To utilize the matching technique, we construct our sample with the 38 firms which *actually switched* their listings from KOSDAQ to KOSPI and 38 KOSDAQ firms matched based on price, trading volume, market capitalization, and volatility. The former set of firms can be considered the treatment group and the latter the control group. The major assumption of the matching technique is that once we control for the observed characteristics affecting the decision, whether the decision is made or not is determined randomly without any systematic factors.

With daily or intraday unbalanced panel data for all 76 firms, we get DID estimates of the effect of listing switching on trading-related market quality. Meanwhile, we can also remove the unobserved time-invariant firm specific effects which potentially cause the listing switch, by applying fixed-effects panel data estimation.

Now, we turn to the meaning of treatment effect and the computation of DID in our specific setting. For a firm i, the individual treatment effect would be defined as $y_i(1) - y_i(0)$, where the $y_i(1)$ is the observed response for treatment and $y_i(0)$ is the response (or outcome) for no treatment. However, the fact that we cannot observe the quantity $y_i(0)$ makes it difficult to measure the treatment effect. So we should estimate or recover the counterfactual outcome $y_i(0)$. On the other hand, we are ultimately interested in the mean effect, specifically, the average conditional on receiving the treatment. This is called ATT (average treatment effect on the treated). The ATT is defined as follows: $ATT = E\,[y_i(1) - y_i(0)|i \in T]$, where $i \in T$ means that subject i is

treated.

Under the assumption that we have properly matched the treatment and control groups, ATT is equal to the following DID: $DID = E[y_i(1,a) - y_i(0,b)|i \in T] - E\left[y_j(0,a) - y_j(0,b)\middle|j \in C\right]$, where T and C denote the treatment group and the control group, respectively and $y_i(1,a)$, $y_i(0,b)$, $y_j(0,a)$ and $y_j(0,b)$ is the responses of treated i after the treatment, of treated i before the treatment, of non-treated j after the treatment, and of non-treated j before the treatment, respectively. These quantities can all be observed before and after the treatment and for the treated and non-treated subjects.

In this paper, we use an applied version of the DID technique. Suppose a firm i switched its listing from KOSDAQ to KOSPI and $y_{i,s}^b$ and $y_{i,t}^a$ are the observed values of a trading-related market quality measure before and after the listing switch, respectively.[16] Moreover, suppose a firm $j(i)$ is the firm best matched to firm i under a distance criterion defined from price, trading volume, market capitalization, and volatility (see the details in Section 4.3.2). Similarly, $y_{j(i),s}^b$ and $y_{j(i),t}^a$ are the observed trading-related market quality measures for firm $j(i)$ before and after the listing switch of firm i. Then, we compute the individual listing switch effect as $\left(\widetilde{\ln y_{i,t}^a} - \widetilde{\ln y_{i,s}^b}\right) - \left(\widetilde{\ln y_{j(i),t}^a} - \widetilde{\ln y_{j(i),s}^b}\right)$, where the upper tilde denotes a time average before or after the listing switch.

If we get a positive DID estimate implying positive causal effect, it should have come from a superior trading environment (e.g., more traders, more analysts, more liquidity, higher visibility, higher expected rate of returns, lower volatility, or more efficient market operation) of KOSPI compared to KOSDAQ as trading venue.

4.3. Data, empirical models and their estimation, and measurements of major variables

4.3.1. Data

This paper examines all 38 firms which switched their listings from KOSDAQ to KOSPI in the period from January 1999 to April 2010. KOSDAQ was founded in 1996, but we think that it was not well established as a growth market before our sample period.

The dates of listing switching for the 38 firms are all different. Hence, we undertake

[16] The subscripts *s* and *t* denote trading days before and after the listing switch event, respectively.

an event study framework, and replace the actual calendar dates with relative calendar dates around the announcement of the listing switch and the actual re-listing on KOSPI. Let t_1^i and t_2^i respectively be the dates of the announcement of listing switch and the actual re-listing on KOSPI of firm i. In the period from t_1^i to t_2^i, trading is occurring on KOSDAQ but the exchanges and traders are aware that the switch to KOSPI will occur, and this knowledge could affect the trading-related market quality. Thus, this middle period reflects clearly neither trading-related market quality on KOSDAQ nor on KOSPI, so we exclude the interval $[t_1^i, t_2^i]$ from our analysis. The first date of re-listing on KOSPI is also removed as traders' behavior could be unusual. Therefore, we take $[t_1^i - 100, t_1^i - 1]$ and $[t_2^i + 1, t_2^i + 100]$ as the pre-period and post-period around the listing switching treatment, respectively. In addition, for the matched firm $j(i)$ of the firm i, we get the data of the same period $[t_1^i - 100, t_1^i - 1]$ and $[t_2^i + 1, t_2^i + 100]$, as the firm i's. Note that $t_1^i = t_1^{j(i)}$ and $t_2^i = t_2^{j(i)}$.

In the end, we use the TAQ and daily market data of the 38 firms that switched listing and their corresponding 38 matched firms for the period [-100, -1] before the announcement of listing switch and the period [+1, +100] after the re-listing on KOSPI. The TAQ data was provided by KRX and the daily market data were extracted from Data Guide Pro of FnGuide, a stock market data provider. Due to missing and different calendar dates, our data does not have a conventional panel data structure. However, the panel data structure allows us to control for unobserved fixed-effects in the individual firms.

4.3.2. Matching criterion

For a matched firm $j(i)$ and listing switching firm i, we select the firm j with the shortest distance from i, $d(j, i)$, among KOSDAQ listed firms. The distance is defined as the following non-commutative metric, which is similar to that used by Hatch and Johnson (2002):[17]

[17] We do not try to match SIC codes. If we were to do so, it would greatly increase the distance between the listing switching firm and its matched firm. The components of the Hatch and Johnson distance in Equation (1) are firm characteristics that are recognized as affecting trading-related market quality. By minimizing this distance, we are choosing a matched firm whose trading-related market quality characteristics are as close as possible to the listing switch firm.

$$d(j,i) = \left(1 - \frac{\overline{MV}_j}{\overline{MV}_i}\right)^2 + \left(1 - \frac{\overline{TV}_j}{\overline{TV}_i}\right)^2 + \left(1 - \frac{\bar{P}_j}{\bar{P}_i}\right)^2 + \left(1 - \frac{s_j}{s_i}\right)^2 \quad (1)$$

where the distance $d(j,i)$ is computed during the period $[t_1^i - 150, t_1^i - 101]$ before the announcement date t_1^i. The upper bar denotes the daily average of (available) data for this period. MV, TV, P, and s represent market capitalization, trading volume, price, and standard deviation of daily returns, respectively.

Table 1 reports the announcement date of the listing switch and the date of re-listing on KOSPI for 38 firms that switched their listings and their corresponding matched firms with the distance metric between them. The listing switches from KOSDAQ to KOSPI occurred relatively more often in 1999 and 2002 than other years, and generally they have steadily increased since 2003 except in the year 2005 when KRX was formed. The average distance between the listing switching firm and its matched firm is 0.33 and its standard deviation is 0.56. The mode is around 0.3. Hence, our matched firms are appropriately selected.

Table 1

Sample firms and distance metrics for matching. This table reports the announcement dates and the dates of re-listing on KOSPI for all 38 firms which switched their listings from KOSDAQ to KOSPI between January 1999 and April 2010. For each listing switching firm, the name of the matched firm and the distance metric between the listing switching firm and its matched firm are provided. As of the end of 2010, 459 (about 46.9%) firms out of 978 firms met the listing standards for KOSPI, but remained in KOSDAQ.

Name of the listing switching firm	Announcement date	Date of re-listing on KOSPI	Matched firm	Distance
DCM Corp.	7/5/99	8/18/99	Finetec	0.01416
Hyundai Heavy Industries	6/8/99	8/24/99	Blumum Co., Ltd.	1.33895
Kira Telecom	9/3/99	11/18/99	Bitcomputer	0.04125
UNIMO C&C	6/10/99	11/26/99	KB Autosys	2.37846
Daewon Pharm. Co. Ltd.	8/31/99	12/15/99	Paradise Industry	0.10803
TLC Leisure	11/4/99	1/6/00	Choa Pharm	0.19291
Hansae Yes24 Holdings	9/27/99	1/6/00	Genexel	0.15705
Korea Refractories	9/8/00	10/16/00	Kores	0.04534
Woongjin Coway Co., Ltd.	6/28/01	8/7/01	G.I. Blue Co., Ltd.	0.05541
Feelux Corp.	11/28/01	12/26/01	Depassion	0.02654
Kolmar Korea	1/3/02	4/9/02	Taechang	0.07482
Wooshin System Co., Ltd.	4/12/02	5/28/02	Turbotek	0.02381
Shinsegae E&C	4/16/02	6/17/02	Jautour	0.04805
Kyobo Securities	5/27/02	7/18/02	Edu Ark Co., Ltd.	0.06676
Sejong Industrial Co., Ltd.	6/3/02	9/25/02	Wonik Co., Ltd.	0.00732
S&T Holdings	9/18/02	10/22/02	Seoul Semiconductor	0.25765
Maniker Co., Ltd.	7/4/02	10/29/02	DASAN Networks, Inc.	0.04286

Tae Kyung Chemical Co., Ltd.	5/29/02	1/28/03	Yangjisa Co., Ltd.	0.08973
NCsoft Corp.	10/11/02	5/22/03	GHS	0.25028
SBS	4/3/03	6/25/03	Hantong Data	1.64257
Kangwon Land	3/5/03	9/4/03	Daum Communications	0.89802
Isupetasys Co., Ltd.	2/28/03	10/7/03	Dongjin Semichem Co., Ltd.	0.03197
IBK	2/12/03	12/24/03	Hantong Data	1.64257
KTF	3/8/04	4/29/04	Humax Holding Co., Ltd.	0.84178
Infac Corp.	3/8/04	9/21/04	SAMIL Co., Ltd.	0.22184
Sangshin Brake	2/24/04	10/27/04	Dong Yang S-Tec	0.04412
Samho Development	12/16/04	5/12/05	GK Power Co., Ltd.	0.00988
Shinsegae I&C	2/10/06	5/18/06	Dae Sun Shipbuiliding & Engineering Co., Ltd.	0.35299
Woojin Plaimm Co., Ltd.	3/3/06	5/24/06	Testech Inc.	0.00937
Cosmax	7/13/06	11/13/06	Eyedream	0.02788
Korea United Pharm Inc.	10/10/07	10/23/07	Cell Biotech	0.00495
Asiana Airlines	1/28/08	3/28/08	Interpark Int.	0.55144
LG U-Plus	2/26/08	4/21/08	SK Broadband	0.51482
Bukook Steel Co.	8/6/08	10/10/08	Woojeon & Handan	0.02802
NHN	10/2/08	11/27/08	Seoul Semiconductor	0.25765
Kiwoom Securities Co.	5/12/09	8/3/09	Neowiz Games	0.06899
Hwang Kum Steel & Technology Co., Ltd.	5/18/09	10/29/09	Sewoonmedical Co., Ltd.	0.02700
Shinsegae Food Co., Ltd.	2/17/10	4/29/10	Credu Co., Ltd.	0.17378

4.3.3. Main and complementary empirical models and their estimation

Main analyses. — To obtain DID estimates from the *main* analyses, we employ a regression framework with dummy variables. We specify the regression model as follows:

$$ln(y_{i,\tau}) = \alpha + \beta D_i^T + \gamma D_{i,\tau}^{KOSPI} + \delta\left(D_i^T \times D_{i,\tau}^{KOSPI}\right) + \theta' D_{i,\tau}^{month} + \varphi' z_{i,\tau} + \mu_i + \epsilon_{i,\tau}$$
$$(\tau = t_1^i - 100,\ \cdots, t_1^i - 1, t_2^i + 1, \cdots, t_2^i + 100) \qquad (2)$$

In equation (2), the dependent variable $y_{i,\tau}$ is a trading-related market quality measure, an element of an exchange's trading environment, in each analysis. So $y_{i,\tau}$ is relative spread, market depth, price, trading volume, volatility, trade-execution cost, or sophisticated investors' trading activity. We use the natural logarithms of the dependent variables to ensure that the units do not matter. Letting T and C in equation (2) be the treatment group of 38 listing switching firms and the control group of 38 matched firms, respectively, the dummy D_i^T is 1 if firm i is in T, 0 if the firm is in C. So for a listing switching firm i, $D_i^T = 1$ and for the matched firm $j(i)$ of the firm i, $D_{j(i)}^T = 0$. The dummy $D_{i,\tau}^{KOSPI}$ denotes the trading venues for the pre-period $[t_1^i -$

$100, t_1^i - 1]$ and the post-period $[t_2^i + 1, t_2^i + 100]$ around the listing switching of a firm i, so that it is 1 if the relative date τ is after the date of re-listing on KOSPI of the firm i, 0 otherwise. For the matched firm $j(i)$, $D_{j(i),\tau}^{KOSPI}$ is 1 if τ is after the date of re-listing on KOSPI of the firm i, 0 otherwise. We should note the interaction term $D_i^T \times D_{i,\tau}^{KOSPI}$, since its coefficient δ embodies DID. That is, the estimate of δ is the DID estimate.

On the other hand, $D_{i,\tau}^{month}$ is a set of dummies representing the actual calendar months. With these monthly dummies, we can control for the monthly common effects. The variable $z_{i,\tau}$ would include other control variables. In this study, to control for the witching-day effect, we use a dummy variable which indicates whether or not the date τ is a witching day. We define a witching day to be a day with simultaneous expiration of KOSPI200 index futures and options.[18] With this variable, we control for the substantial fluctuations in price and trading patterns of the associated underlying stocks in our sample on witching days.[19] The variable μ_i represents unobserved fixed-effects (or time-invariant effects) of firm i. Although our data is not conventional panel data, we can apply fixed-effects estimation as well as random-effects estimation in the regression.

To get the DID estimate in regression equation (2), we primarily employ fixed-effects techniques. Controlling for the listing switch selection with the matching framework under the assumption of selection-on-observables will reduce and might eliminate the selection bias. However, if there still remains a correlation between the listing switching decision and unobserved firm-specific characteristics, not all of the bias will be eliminated by matching. Since fixed-effects estimation removes the unobserved time-invariant effects μ_i, fixed-effects estimates are robust to the bias resulting from the correlation of μ_i and listing switching decision.

However, if there is an unobserved effect μ_i which is not related to the listing switching decision, random-effects estimation can be more efficient than fixed-effects

[18] As of 2012, trading volumes (using the number of contracts) for KOSPI200 index futures and options ranked ninth and second, respectively, in the world (World Federation of Exchanges, 2012).

[19] Barclay et al. (2008) argue that prior to November 2004 when Nasdaq introduced the opening call auction, the NYSE's opening call performed better than Nasdaq on non-witching days and much better than Nasdaq on witching days, which generate large liquidity shocks at the open as a result of the U.S. settlement procedure. We can infer from their results that the main board might be more efficient than the growth market in liquidity crunch time such as witching days. By including the witching-day dummy variable in our analyses, we control for this possibility.

estimation.[20] Hence, the fixed-effects estimation is the most appropriate for our analytic situation, but we cannot rule out the potential benefits of the random-effects estimation. Therefore, we report both estimates for our empirical results.

Complementary analyses on price efficiency. — To obtain DID estimates from the *complementary* analyses on price efficiency, we use two components (adverse selection cost and transitory cost) of the implied spread of Madhavan et al. (1997, hereafter "MRR") and the 5-minute variance ratio proposed by Lo and MacKinlay (1988) for our dependent variables. Since we can estimate only a statistic for the periods before and after the listing switch for these variables, we cannot use regression equation (2). Hence, we employ the following regression equation to test the effect of listing switch from KOSDAQ to KOSPI on price efficiency.

$$ln(y_{i,u}) = \alpha + \beta D_i^T + \gamma D_{i,u}^{KOSPI} + \delta\left(D_i^T \times D_{i,u}^{KOSPI}\right) + \mu_i + \epsilon_{i,u} \quad (u = 0,1) \qquad (3)$$

In equation (3), the dependent variable $y_{i,u}$ is *MRR ratio*, *Theta*, *Phi*, and *VR*. *MRR ratio* denotes the ratio of adverse selection cost to the MRR implied spread; *Theta* and *Phi* denote adverse selection cost and transitory cost of the MRR implied spread, respectively. *VR* denotes the 5-minute variance ratio provided by Lo and MacKinlay (1988).

The dummy variable D_i^T is defined the same way as in equation (2). That is, the dummy D_i^T is 1 for a listing switching firm i or 0 for the matched firm $j(i)$. In the dummy variable $D_{i,u}^{KOSPI}$, the time index u represents the pre- (coded by 0) or post- (coded by 1) period of re-listing of a listing switching firm i and its matched firm $j(i)$. So $D_{i,u}^{KOSPI}$ is 0 for the pre-listing-switching period or 1 for the post-re-listing period. As mentioned above, we can get only one value for the dependent variable for each pre-listing-switching and post-re-listing period by the estimation of equation (3). This is the reason why the time index u denotes only two periods.

We should note the interaction term $D_i^T \times D_{i,u}^{KOSPI}$, since its coefficient embodies DID. We cannot include the monthly dummies or witching day dummy. The variable μ_i represents unobserved fixed-effects of firm i. As in the estimation for regression

[20] If there were no unobserved effect μ_i, OLS estimation could be adequate. However, it would be difficult for such an assumption to hold in our data.

equation (2), although our data is not conventional panel data, we can apply fixed-effects estimation as well as random-effects estimation for the regression.

On the other hand, in our fixed-effects and random-effects estimations for equations (2) and (3), we apply a robust estimation to compute the standard errors taking the heteroscedasticity of errors into account. Hence, we deliberately do not carry out the Hausman test for the null of exogeneity of all covariates. Even under homoscedasticity, as noted in Baltagi (2005, p. 19), the Hausman test cannot identify whether a random-effects or fixed-effects estimation is suitable. With heteroscedasticity, it is doubly inappropriate to use the Hausman test to select between random-effects and fixed-effects estimations.[21]

4.3.4. Measurements of trading-related market quality

In this paper, various variables representing trading-related market quality are used as dependent variables $y_{i,\tau}$ in regression equations (2) and (3). The DID estimate in a regression for each variable measures the effect of listing switching on that trading-related market quality variable. We use several liquidity measures, price, volatility, trade-execution cost, investors' trading activity, and price efficiency measures.

We categorize our variables into four groups. The first group includes the variables computed directly from the market statistics.[22] These variables are computed as follows:

- *Relative spread*: Daily average (over time) of intraday relative spreads. Intraday relative spread is defined as (best ask price – best bid price) / {(best ask price + best bid price) / 2}.[23]
- *Market depth*: Daily average (over time) of intraday market depth. Market depth is defined as the sum of the order size at the best bid price and the order size at the best ask price.

[21] This point seems poorly understood among applied researchers, many of whom seem to misunderstand the role and meaning of the Hausman test in panel data analysis. In the same vein, the Hausman test cannot identify whether the endogeneity problem still remains after the instrumental variable (IV) estimation. However, unfortunately, many scholars use the test to confirm the validity of instruments.

[22] Transient volatility does not belong to this group, but we include this variable here to compare it with high-low volatility.

[23] We do not use (absolute) spread for our analyses since it varies significantly depending on the market's characteristics and responds sensitively to price changes. Since many previous works in market microstructure have used this variable, however, we make some comments on the results referring to (absolute) spread for comparison.

- *Trading volume*: Daily total amount of trading in Korean won.
- *Number of trades*: Daily total number of trades.
- *Price*: Daily closing price which is adjusted to control for discontinuous changes of price.[24]
- *High-low volatility*: (daily highest price – daily lowest price) / {(daily highest price + daily lowest price) / 2}.
- *Transient volatility*: Daily average of the transient volatilities of transactions (beginning with the twenty-first) that occurred on that day. We use transient volatility using a transaction time of 20 trades, as in Ranaldo (2004) and Eom et al. (2007). For a given transaction *t* on a given day, we consider the 20 transactions t, $t-1$, $t-2$, $\cdots$, $t-19$, which yield 19 continuously-compounded returns; the transient volatility at transaction t is defined to be the standard deviation of these 19 returns.

We use two measures for volatility, high-low and transient volatility. Transient volatility better reflects the idiosyncratic characteristics of a given market than high-low volatility, and hence is more important for our purposes.

The second group comprises trade-execution cost for which we use full-information transaction cost (*FITC*) of Bandi and Russell (2006). After decomposing the transaction price into the full-information price (or true price) and error due to microstructural effects,[25] they provide a consistent estimator (based on intraday data) of *FITC* which is essentially the standard deviation of the error with autocorrelation considered. A decrease in *FITC* indicates an improvement in trading-related market quality.

The third group consists of two measures of investors' trading activity: *institutional investors' trading activity* and *foreign investors' trading activity*. These variables serve as proxies for the visibility of a stock to sophisticated investors (or the level of sophistication of investors), which is viewed in the existing literature as one of the main motives for firms to switch their listings. The more sophisticated investors such as institutional or

[24] Events which may cause a discontinuous trend of stock price include M&A, seasoned equity offering, capital reduction, ex-dividend, ex-rights, stock split, and so on.

[25] According to Bandi and Russell (2006), the true price is defined as the full-information price reflecting both public and private information at a given time. Market microstructure effect includes price discreteness, inventory costs that the market maker passes on to traders in the form of the bid-ask spread, and the systematic losses that uninformed traders incur when trading with the better informed (Eom et al., 2007).

foreign investors in Korean stock markets improve the trading-related market quality since they facilitate price discovery or price efficiency. The level of sophistication of investors in the existing literature is measured by the number of analyst reports or institutional investors' shareholding (Kadlec and McConnell, 1994; Jain and Kim, 2006), variables that have little to do with the characteristics of the exchange. Since we are looking at the change in trading-related market quality for a given firm in switching their listing, we need to define the level of sophistication of investors in terms of trading-related market quality. Hence, we define the following two measures of investors' trading activity:

- *Institutional investors' trading activity*: 100 × (institutional investors' daily buy and sell) / (daily total trading volume).
- *Foreign investors' trading activity*: 100 × (foreign investors' daily buy and sell) / (daily total trading volume).

Finally, the variables in the fourth group reflect price efficiency on the exchanges. We use two components (adverse selection cost and transitory cost) of the MRR implied spread and the 5-minute variance ratio proposed by Lo and MacKinlay (1988). These final group variables differ from the variables in the other three groups in that we cannot compute daily values of the variables. Instead, we obtain a statistic for the periods before and after the listing switch. Hence, as mentioned in Section 4.3.3, we utilize the test results based on the MRR implied spread and variance ratio as complementary results to the others.

5. Empirical results

5.1. Results from the analyses for the overall sample period

Table 2 presents the DID estimates based on the fixed-effects estimation of equation (2), which are the main results of this paper. We focus on the fixed-effects estimates because they control for the correlation of the unobservables with the listing switching decisions. However, as a robustness check, the Table also shows the DID estimates based on random-effects estimation.

As noted in Section 4.3.3, our attention in equation (2) is focused on the coefficient δ of the interaction term $D_i^T \times D_{i,\tau}^{KOSPI}$, which represents the effect of the treatment of listing

switching on the dependent variable. The DID estimates based on fixed-effects estimation for the overall sample period are as follows:

First, the listing switching from KOSDAQ to KOSPI resulted mostly in a reduction in liquidity. More specifically, after the switch to KOSPI, the relative spread increased,[26] both the trading volume and the number of trades decreased, so that the liquidity in terms of spread and volume deteriorated. Meanwhile, the liquidity in terms of market depth marginally improved. However, the effects on all the liquidity measures except the number of trades were statistically insignificant. Thus, we cannot reject our Null Hypothesis that the trading environment is no better on KOSPI than on KOSDAQ with respect to liquidity.[27]

Second, price declined after the switch, although the decrease was not statistically significant. It has generally been believed that firms traded on KOSDAQ trade at a discount to their true values. However, our analysis shows that switching does not increase the stock's value. Volatility was the only market characteristic for which all measures (in this case, high-low and transient volatility) were statistically significant, but the effects of the listing switching on these two types of volatility go in opposite directions. After the switch, high-low volatility improved at the 5% significance level while transient volatility deteriorated at the 10% level. This implies that the total volatility decreased (improved) after the switch, but the transient volatility, which provides a better measure of the market's idiosyncratic characteristics, increased (deteriorated). Again, we cannot reject our Null Hypothesis that the trading environment is no better on KOSPI than on KOSDAQ with respect to price or volatility.

Third, trade-execution cost measured by Bandi and Russell (2006), *FITC*, increased (deteriorated) after the switch, but the result marginally missed the 10% statistical significance level. Hasbrouck (1993) argued that trade-execution cost is an estimate which reflects general trading-related market quality; once again, our Null Hypothesis is

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[26] There may be a concern that this result on the relative spread could be affected by a change in the relative spread during the post-switching period that is unrelated to the stock's switch to KOSPI. We think that 100 days of the post-switching period effectively controls for it. For a robustness check, however, we added to equations (2) and (3) trading volume, stock price, and the stock price volatility as the main determinants of the relative spread (see Brockman and Chung, 2003; Narayan et al., 2014), and checked the DID estimates. The results were qualitatively similar to those from our main and complementary analyses. So were the results for *FITC* and *MRR*, for which there may be similar concerns. Detailed results are available from the authors on request.

[27] Most of the switching firms become small fish on KOSPI, so that investor inattention might be a factor in this result.

not rejected with respect to trade-execution cost.

Fourth, the results are mixed on whether KOSPI provided a better environment for expanding the sophisticated investor base. While institutional investors' trading activity decreased, foreign investors' trading activity increased. Considering foreign investors' strong influences as informed traders on the Korean stock markets (Kho, 2011), we might infer that price efficiency improved, but the results on both investor groups' trading activity are not statistically significant.

Table 2

Regression results from the analyses for the overall sample period. This table provides the results of estimations by fixed-effects (FE) and random-effects (RE) for each dependent variable in equation (2). Dependent variables are (absolute) spread, relative spread, market depth, price, trading volume, number of trades, high-low volatility, transient volatility, Bandi and Russell's (2006) full-information transaction cost (*FITC*), institutional investors' trading activity, and foreign investors' trading activity. We use logarithms of all the dependent variables so that the unit of each dependent variable is not an issue. The DID estimate multiplied by 100 indicates the effect of listing switching measured in percentage terms. The sample firms include all 38 firms which switched their listings from KOSDAQ to KOSPI in the period from January 1999 to April 2010 and their corresponding firms matched with a distance criterion defined from price, trading volume, market capitalization, and volatility. The daily values derived from either their daily or intraday data are used. We consider relative dates from -100 to -1 before the announcement date of listing switching and from +1 to +100 after the re-listing date; we include a date in our sample only if we can obtain data for both the listing switching firm and its matched firm on that date. Our interest is focused on the coefficient estimate of the interaction term, $D_i^T \times D_{i,\tau}^{KOSPI}$, since it represents DID for the effect of listing switching. D_i^T is a dummy representing whether firm i is a listing switcher or its matched firm $j(i)$. $D_{i,\tau}^{KOSPI}$ is a dummy which is 1 if the relative date τ is after the date of re-listing on KOSPI of the firm i, 0 otherwise. $D_{witching}$ is a dummy for a witching day, defined as a day of simultaneous expiration date of both futures and options on the KOSPI200 index. Monthly dummies for calendar-based months are included in all regressions. Note that the coefficient of D_i^T cannot be identified under fixed-effects estimation. The figures in the parentheses below the estimates are z-values. *, **, and *** denote the two-sided 10%, 5%, and 1% statistical significances, respectively. All standard errors are computed through Huber-White robust estimation.

	ln(*absolute spread*)		*ln*(*relative spread*)		*ln*(*market depth*)		*ln*(*price*)	
	FE	RE	FE	RE	FE	RE	FE	RE
D_i^T		0.1188		-0.1579		-0.0765		-0.6516*
		(0.434)		(-0.989)		(-0.273)		(-1.860)
$D_{i,\tau}^{KOSPI}$	-0.0425	-0.0968	-0.1488*	-0.1849***	-0.1451	-0.0423	0.0222	0.0236
	(-0.254)	(-0.810)	(-1.755)	(-2.691)	(-0.755)	(-0.278)	(0.231)	(0.256)
$D_i^T \times D_{i,\tau}^{KOSPI}$	-0.0038	-0.0030	0.0441	0.0446	0.0071	0.0061	-0.1211	-0.1211
	(-0.029)	(-0.023)	(0.511)	(0.515)	(0.042)	(0.036)	(-1.517)	(-1.516)
$D_{witching}$	0.0004	-0.0007	-0.0147	-0.0159	0.0164	0.0185	0.0117*	0.0117**
	(0.021)	(-0.039)	(-0.841)	(-0.912)	(0.643)	(0.720)	(1.983)	(1.992)
Monthly dummies	included	included	included	included	included	included	included	included
N	14,541	14,541	14,541	14,541	14,540	14,540	14,722	14,722
R^2	0.3473		0.3287		0.1982		0.4705	
#(firms)	76	76	76	76	76	76	76	76

Table 2 (*continued*)

	ln(*trading volume*)		*ln*(*number of trades*)		*ln*(*high-low volatility*)		*ln*(*transient volatility*)	
	FE	RE	FE	RE	FE	RE	FE	RE
D_i^T		0.0201		-0.1151		-0.2055***		-0.1224
		(0.045)		(-0.376)		(-4.224)		(-0.908)
$D_{i,t}^{KOSPI}$	0.3715	0.4368**	0.3123	0.3412**	0.1205*	0.0428	-0.1016	-0.1540**
	(1.349)	(2.306)	(1.503)	(2.435)	(1.698)	(1.048)	(-1.260)	(-2.008)
$D_i^T \times D_{i,t}^{KOSPI}$	-0.1937	-0.1933	-0.2902*	-0.2911*	-0.0976**	-0.0979**	0.1533*	0.1590*
	(-1.066)	(-1.054)	(-1.947)	(-1.946)	(-2.234)	(-2.231)	(1.688)	(1.731)
$D_{witching}$	-0.0133	-0.0089	-0.0192	-0.0163	-0.0863***	-0.0873***	0.0192	0.0172
	(-0.280)	(-0.188)	(-0.517)	(-0.442)	(-2.926)	(-2.958)	(0.489)	(0.442)
Monthly dummies	included	included	included	included	included	included	included	included
N	14,661	14,661	14,606	14,606	14,448	14,448	13,639	13,639
R^2	0.3641		0.3231		0.1141		0.0858	
#(firms)	76	76	76	76	76	76	76	76

	ln(*FITC*)		*ln*(*institutional investors' activity*)		*ln*(*foreign investors' activity*)	
	FE	RE	FE	RE	FE	RE
D_i^T		-0.1726		-0.2149		0.0284
		(-1.260)		(-0.639)		(0.074)
$D_{i,t}^{KOSPI}$	-0.0704	-0.1367**	-0.7968	-1.0759***	0.4643	0.1280
	(-1.035)	(-2.429)	(-1.644)	(-3.467)	(1.411)	(0.527)
$D_i^T \times D_{i,t}^{KOSPI}$	0.0915	0.0920	-0.1435	-0.1746	0.3456	0.3227
	(1.563)	(1.547)	(-0.422)	(-0.518)	(1.586)	(1.447)
$D_{witching}$	-0.0271	-0.0292*	0.1943	0.1909	-0.1084	-0.1115
	(-1.586)	(-1.718)	(1.239)	(1.219)	(-0.937)	(-0.961)
Monthly dummies	included	included	included	included	included	included
N	13,733	13,733	8,380	8,380	6,369	6,369
R^2	0.1950		0.1285		0.0949	
#(firms)	76	76	75	75	75	75

Fifth, the complementary results reported in Table 3 show that the effects of listing switching on price efficiency were not uniform, and were not statistically significant. More specifically, the accuracy of price discovery measured by variance ratio improved after the listing switch to KOSPI. In addition, the variance ratio after the switch (0.6031) is larger than that before the switch (0.5641), which implies that the post-switch price in KOSPI over-reacted less than did the pre-switch price in KOSDAQ to information at the 5-minute horizon.[28] In contrast, the results from the analyses of the MRR implied spread components show that price efficiency deteriorated. After the switch to KOSPI, the transitory cost component decreased, suggesting that trading-related market quality improved, whereas the adverse selection cost component increased, suggesting that trading-related market quality got worse. However, the ratio of adverse selection cost to the MRR implied spread increased, which implies that the increase in adverse selection cost is larger than the decrease in transitory cost, and overall price efficiency after the switch to KOSPI deteriorated.

Lastly, the results from the DID estimates based on random-effects estimation are not qualitatively different from those based on fixed-effects estimation. This implies that our main results are robust to failure of the assumptions underlying the fixed-effects estimation. We also tested our hypothesis with a different set of matched firms selected using the interval of 100 days (not 50 days), but the results were qualitatively the same as our main results.[29]

All together, we fail to reject our Null Hypothesis that the trading environment is no better on KOSPI than on KOSDAQ for firms that switch. Contrary to the previous literature from the U.S. and practitioners' opinion in other countries, there is no evidence that KOSPI provides higher trading-related market quality to firms that switch their listings from KOSDAQ. This indicates that the specific market macrostructure of a country matters.

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[28] If stock returns follow a random walk process, the estimator of Lo and MacKinlay's (1988) variance ratio would converge to 1 in a large sample. Thus, values of the variance ratio closer to 1 indicate greater efficiency of price discovery (see Bessembinder, 2003; Chordia et al., 2008; among many others). If the process of stock returns deviates from the random walk process statistically significantly, however, then we may conclude that there is price distortion at a certain horizon (e.g., the 5-minute horizon in the case of our paper). Moreover, if the variance ratio is substantially higher (lower) than 1, then we may conclude that the market price under-reacts (over-reacts) to information at a certain horizon (e.g., the 5-minute horizon in the case of our paper).

[29] Detailed results are available from the authors on request.

Table 3

Regression results from tests on price efficiency—complementary results. This table provides the results of estimations by fixed-effects (FE) and random-effects (RE) for each dependent variable in equation (3). The dependent variable is *MRR ratio*, *Theta*, *Phi*, and *VR*. *MRR ratio* denotes the ratio of adverse selection cost to the MRR (Madhavan et al., 1997) implied spread; *Theta* and *Phi* denote adverse selection cost and transitory cost of the MRR implied spread, respectively. *VR* denotes the 5-minute variance ratio provided by Lo and MacKinlay (1988). Since we cannot estimate daily values of these variables, we estimate a statistic for the periods before and after the listing switch, unlike the variables used in Table 2. We use logarithms of all the dependent variables so that the unit of each dependent variable is not an issue. The DID estimate multiplied by 100 indicates the effect of listing switching measured in percentage terms. The sample firms include all 38 firms which switched their listings from KOSDAQ to KOSPI in the period from January 1999 to April 2010 and their corresponding firms matched with a distance criterion defined from price, trading volume, market capitalization, and volatility. We consider relative dates from -100 to -1 before the announcement date of listing switching and from +1 to +100 after the re-listing date; we include a date in our sample only if we can obtain data for both the listing switching firm and its matched firm on that date. The dummy D_i^T is 1 for a listing switching firm i or 0 for the matched firm $j(i)$. In the dummy variable $D_{i,u}^{KOSPI}$, the time index u represents the pre-listing-switching (coded by 0) period or post-re-listing (coded by 1) period of a listing switching firm i and its matched firm $j(i)$. So $D_{i,u}^{KOSPI}$ is 0 for the pre-listing-switching period of relative [-100, -1] dates or 1 for the post-re-listing period of [+1,+100] dates. We should note the interaction term, $D_i^T \times D_{i,u}^{KOSPI}$, since its coefficient embodies DID. Note that the coefficient of D_i^T cannot be identified under fixed-effects estimation. The figures in the parentheses below the estimates are z-values. *, **, and *** denote the two-sided 10%, 5%, and 1% statistical significances, respectively. All standard errors are computed through Huber-White robust estimation.

	ln(MRR ratio)		*ln(Theta)*		*ln(Phi)*		*ln(VR)*	
	FE	RE	FE	RE	FE	RE	FE	RE
D_i^T		-0.1796		-0.0064		0.1712		-0.0502
		(-1.177)		(-0.017)		(0.491)		(-0.445)
$D_{i,u}^{KOSPI}$	-0.2128*	-0.2092*	-0.5607***	-0.5594***	-0.3175***	-0.3092***	0.0690	0.0667
	(-1.782)	(-1.765)	(-3.933)	(-3.905)	(-2.739)	(-2.641)	(1.120)	(1.088)
$D_i^T \times D_{i,u}^{KOSPI}$	0.2241	0.2241	0.1641	0.1744	-0.1072	-0.1076	0.1109	0.1125
	(1.327)	(1.337)	(0.814)	(0.861)	(-0.659)	(-0.654)	(1.273)	(1.299)
N	150	150	150	150	149	149	150	150
R^2	0.0424		0.2438		0.2308		0.1197	
#(firms)	76	76	76	76	76	76	76	76

5.2. Results from the analyses for the subsample periods

Prior to their consolidation into KRX in January 27, 2005, KOSDAQ and KOSPI operated independently and competed for the listings of SMEs. Since the consolidation, they no longer compete. Therefore, a comparison of subsamples before and after the consolidation allows us to infer the effect of the consolidation on the effects of listing switching on trading-related market quality.

The fixed-effects estimates shown in Table 4 suggest that the post-switch trading-

related market quality provided by KOSPI deteriorated more after the 2005 consolidation than before.[30] These results are robust to random-effects estimation. The results from complementary tests on price efficiency are not uniform, but they also continue to suggest that the overall post-switch price efficiency deteriorated more after the 2005 consolidation; for brevity, we do not report details of these complementary tests.

Despite the deterioration in trading environment following a listing switch from KOSDAQ to KOSPI, many of the most successful KOSDAQ start-ups, including the flagship firms, have steadily switched their listings to KOSPI. This confirms the conventional wisdom that, after the 2005 consolidation, KOSDAQ has been losing the growth-market dynamism which it once enjoyed.[31] This also supports the argument that the switch was motivated by the perceived reputation of KOSDAQ, rather than a desire for improved trading-related market quality. By all accounts, the consolidation of KOSDAQ and KOSPI into KRX has turned out to be unfavorable for the firms that switched listings from KOSDAQ.[32,33]

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[30] In interpreting the results from these subsample periods, we should keep in mind that most of the coefficients are statistically insignificant as in the analyses for the overall sample period. Once again, however, the statistical insignificance strengthens our argument. Contrary to expectations, we fail to reject the Null Hypothesis that the trading environment on KOSPI is no better than on KOSDAQ for firms that switch. Thus, the specific market macrostructure of a country matters.

[31] Starting a few years after the consolidation, media have reported that KOSDAQ was losing its dynamism and had become a second tier market of KOSPI. This issue was discussed in the National Assembly of Korea on October 15, 2009 (see http://news.inews24.com/php/news_view.php?g_serial=450190&g_menu=022600).

[32] The overall evaluation of the 2005 consolidation should be carried out in a comprehensive way based on the exchanges' numerous functions, and not just the effect on firms that switched listings. We reemphasize that our discussion is restricted to the effects on firms that switched listings from KOSDAQ to KOSPI.

[33] To complement our results, we implemented case studies for NCsoft and NHN, both of which were the KOSDAQ flagship firm at the time of the listing switch. NCsoft switched before and NHN after the consolidation of KRX. There exist striking differences in results from these two important firms. For NCsoft, the trading-related market quality in market depth, trading volume, number of trades, price, trade-execution cost, and institutional investors' trading activity improved, whereas the trading-related market quality in relative spread, high-low volatility, transient volatility, and foreign investors' trading activity deteriorated. In contrast, for NHN, the trading-related market quality improved only in market depth, trade-execution cost, and foreign and institutional investors' trading activity, whereas all other dimensions of the trading-related market quality deteriorated. These results provide evidence supporting a positive individual treatment effect for NCsoft, but not for NHN; this complements our main analysis. Detailed results are available from the authors on request.

Table 4

Regression results from the analyses for the subperiods. This table provides the results of fixed-effects (FE) and random-effects (RE) estimations for each dependent variable in equation (2), where we separately analyze the listing switching firms and their matched firms for each sub-period before and after the consolidation of KOSDAQ and KOSPI into KRX on January 27, 2005. Dependent variables are (absolute) spread, relative spread, market depth, price, trading volume, number of trades, high-low volatility, transient volatility, Bandi and Rusell's (2006) full-information transaction cost (*FITC*), institutional investors' trading activity, and foreign investors' trading activity. We use logarithms of all the dependent variables so that the unit of each dependent variable is not an issue. The DID estimate multiplied by 100 indicates the effect of listing switching measured in percentage terms. The sample firms include all 38 firms which switched their listings from KOSDAQ to KOSPI in the period from January 1999 to April 2010 and their corresponding firms matched with a distance criterion defined from price, trading volume, market capitalization, and volatility. The daily values derived from either their daily or intraday data are used. We consider relative dates from -100 to -1 before the announcement date of listing switching and from +1 to +100 after the re-listing date; we include a date in our sample only if we can obtain data for both the listing switching firm and its matched firm on that date. Our interest is focused on the coefficient estimate of the interaction term, $D_i^T \times D_{i,\tau}^{KOSPI}$, since it represents DID for the effect of listing switching. D_i^T is a dummy representing whether firm i is a listing switcher or its matched firm $j(i)$. $D_{i,\tau}^{KOSPI}$ is a dummy which is 1 if the relative date τ is after the date of re-listing on KOSPI of the firm i, 0 otherwise. $D_{witching}$ is a dummy for a witching day, defined as a day of simultaneous expiration date of both futures and options on the KOSPI200 index. *Monthly dummies* for calendar-based months are included in all regressions. Note that the coefficient of D_i^T cannot be identified under fixed-effect estimation. The figures in the parentheses below the estimates are z-values. *, **, and *** denote the two-sided 10%, 5%, and 1% statistical significances, respectively. All standard errors are computed through Huber-White robust estimation.

	ln(*absolute spread*)				*ln*(*relative spread*)				*ln*(*market depth*)			
	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
	Before 2005.1.27.		After 2005.1.27.		Before 2005.1.27.		After 2005.1.27.		Before 2005.1.27.		After 2005.1.27.	
D_i^T		0.2087		-0.0641		-0.0600		-0.3619		-0.0726		-0.0903
		(0.672)		(-0.122)		(-0.317)		(-1.368)		(-0.276)		(-0.133)
$D_{i,\tau}^{KOSPI}$	0.0043	-0.0243	-0.1628	-0.3825**	-0.1616*	-0.1169	-0.0294	-0.1300	-0.0949	-0.0632	-0.4848**	0.0400
	(0.021)	(-0.158)	(-0.759)	(-2.137)	(-1.735)	(-1.479)	(-0.146)	(-0.848)	(-0.393)	(-0.314)	(-2.312)	(0.150)
$D_i^T \times D_{i,\tau}^{KOSPI}$	-0.0829	-0.0814	0.1540	0.1540	-0.0040	-0.0036	0.1403	0.1403	0.0530	0.0508	-0.0847	-0.0847
	(-0.474)	(-0.464)	(0.861)	(0.860)	(-0.046)	(-0.041)	(0.727)	(0.727)	(0.228)	(0.219)	(-0.442)	(-0.439)
$D_{witching}$	-0.0309	-0.0310	0.0591*	0.0568*	-0.0600***	-0.0593***	0.0689**	0.0660**	0.0394	0.0394	-0.0208	-0.0168
	(-1.612)	(-1.624)	(1.751)	(1.686)	(-3.225)	(-3.170)	(2.158)	(2.057)	(1.568)	(1.572)	(-0.382)	(-0.305)
Monthly dummies	included	included	included	included	included	included	included	included	included	included	included	included
N	9,768	9,768	4,773	4,773	9,768	9,768	4,773	4,773	9,768	9,768	4,772	4,772
R^2	0.3905		0.2397		0.3781		0.2690		0.1650		0.3058	
(firms)	52	52	24	24	52	52	24	24	52	52	24	24

Table 4 (*continued*)

	ln(*price*)				*ln*(*trading volume*)				*ln*(*number of trades*)			
	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
	Before 2005.1.27.		After 2005.1.27.		Before 2005.1.27.		After 2005.1.27.		Before 2005.1.27.		After 2005.1.27.	
D_i^T		-0.7972*		-0.3405		-0.0148		0.0783		-0.1283		-0.0926
		(-1.844)		(-0.578)		(-0.027)		(0.098)		(-0.352)		(-0.162)
$D_{i,t}^{KOSPI}$	0.0246	0.0243	-0.0463	-0.0477	0.6042*	0.3581	-0.9342***	0.2416	0.4821*	0.3238*	-0.5502**	0.2907
	(0.208)	(0.214)	(-0.498)	(-0.511)	(1.857)	(1.401)	(-3.304)	(0.644)	(1.927)	(1.689)	(-2.184)	(1.050)
$D_i^T \times D_{i,t}^{KOSPI}$	-0.0854	-0.0853	-0.1939*	-0.1939*	-0.0726	-0.0712	-0.4400*	-0.4402*	-0.2544	-0.2553	-0.3627*	-0.3629*
	(-0.804)	(-0.803)	(-1.772)	(-1.772)	(-0.303)	(-0.296)	(-1.743)	(-1.703)	(-1.261)	(-1.266)	(-1.841)	(-1.795)
$D_{witching}$	0.0267***	0.0267***	-0.0155*	-0.0155*	0.0193	0.0175	-0.0646	-0.0528	-0.0144	-0.0157	-0.0205	-0.0097
	(3.807)	(3.826)	(-1.958)	(-1.959)	(0.310)	(0.283)	(-0.914)	(-0.743)	(-0.334)	(-0.368)	(-0.285)	(-0.135)
Monthly dummies	included	included	included	included	included	included	included	included	included	included	included	included
N	9,946	9,946	4,776	4,776	9,885	9,885	4,776	4,776	9,836	9,836	4,770	4,770
R^2	0.3786		0.6736		0.3626		0.3987		0.3438		0.2841	
#(firms)	52	52	24	24	52	52	24	24	52	52	24	24

	ln(*high-low volatility*)				*ln*(*transient volatility*)				*ln*(*FITC*)			
	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
	Before 2005.1.27.		After 2005.1.27.		Before 2005.1.27.		After 2005.1.27.		Before 2005.1.27.		After 2005.1.27.	
D_i^T		-0.1522***		-0.3160***		-0.0150		-0.3492		-0.0990		-0.3133
		(-2.864)		(-4.032)		(-0.087)		(-1.628)		(-0.639)		(-1.237)
$D_{i,t}^{KOSPI}$	0.2021**	0.1323**	-0.2183**	-0.0903	-0.1084	-0.0986	-0.0787	-0.1536	-0.0578	-0.0313	-0.0388	-0.2517*
	(2.476)	(2.521)	(-2.327)	(-1.266)	(-1.119)	(-0.981)	(-0.481)	(-1.164)	(-0.726)	(-0.519)	(-0.296)	(-1.734)
$D_i^T \times D_{i,t}^{KOSPI}$	-0.1247**	-0.1251**	-0.0442	-0.0441	0.1603	0.1639	0.1415	0.1460	0.0285	0.0287	0.2090*	0.2097*
	(-2.344)	(-2.358)	(-0.574)	(-0.571)	(1.270)	(1.298)	(1.227)	(1.244)	(0.424)	(0.424)	(1.912)	(1.908)
$D_{witching}$	-0.1364***	-0.1374***	0.0080	0.0089	-0.0082	-0.0073	0.0697	0.0645	-0.0535**	-0.0528**	0.0205	0.0167
	(-3.935)	(-3.989)	(0.165)	(0.183)	(-0.172)	(-0.157)	(0.982)	(0.909)	(-2.291)	(-2.254)	(0.988)	(0.812)
Monthly dummies	included	included	included	included	included	included	included	included	included	included	included	included
N	9,683	9,683	4,765	4,765	8,978	8,978	4,661	4,661	9,052	9,052	4,681	4,681
R^2	0.0937		0.1641		0.0887		0.0808		0.1869		0.2249	
#(firms)	52	52	24	24	52	52	24	24	52	52	24	24

Table 4 (*continued*)

	ln(*institutional investors' activity*)				*ln*(*foreign investors' activity*)			
	FE	RE	FE	RE	FE	RE	FE	RE
	Before 2005.1.27.		After 2005.1.27.		Before 2005.1.27.		After 2005.1.27.	
D_i^T		-0.1491		-0.3183		0.6573		0.8159*
		(-0.395)		(-0.559)		(1.198)		(1.703)
$D_{i,t}^{KOSPI}$	-0.9042*	-1.7561***	0.9206	-0.5736	0.1518	-0.5102	0.8087**	0.3430
	(-1.757)	(-3.739)	(1.244)	(-1.496)	(0.275)	(-0.780)	(2.229)	(1.122)
$D_i^T \times D_{i,t}^{KOSPI}$	-0.1359	0.0955	-0.1825	-0.2491	0.5697	0.1481	0.2192	0.2176
	(-0.327)	(0.228)	(-0.301)	(-0.418)	(1.197)	(0.215)	(0.917)	(0.914)
$D_{witching}$	0.0634	0.1323	0.4554*	0.4337*	0.0381	-0.1040	-0.1960	-0.1947
	(0.306)	(0.626)	(2.054)	(1.936)	(0.180)	(-0.406)	(-1.423)	(-1.411)
Monthly dummies	included	included	included	included	included	included	included	included
N	5,497	5,497	2,883	2,883	2,569	2,569	3,800	3,800
R^2	0.1302		0.1279		0.1077		0.0916	
#(firms)	51	51	24	24	51	51	24	24

6. Concluding remarks

In this paper, focusing on market macrostructure, we examined whether or not firms switching their listings from KOSDAQ, the growth market, to KOSPI, the main board, experienced an improvement in trading-related market quality sufficient to justify the switch. We examined all 38 firms that switched their listings from KOSDAQ to KOSPI between January 1999 and April 2010. For the analysis, we applied the DID technique with nearest matching under the regression framework to consider the potential sample selection bias in the listing switch of a firm.

Using the daily values of various trading-related market quality measures, elements of an exchange's trading-related environment, which were derived from either their daily or intraday data, we found the following results. First, for the overall sample period, the trading-related market quality (including price efficiency) mostly deteriorated or remained unchanged following the switch from KOSDAQ to KOSPI. There is no evidence that KOSPI provides higher trading-related market quality to firms that switch their listing from KOSDAQ. Second, the post-switch trading-related market quality delivered by KOSPI deteriorated more after the consolidation of KRX in 2005. Third, contrary to the expectations from the previous literature in the U.S. and practitioners' opinions in other countries, our main empirical results are mixed in terms of signs and statistical significance, strengthening our argument, and indicating that the specific market macrostructure of a country matters.

All together, the post-switch trading-related services delivered by KOSPI turned out to be unfavorable, and this phenomenon became more prominent after the 2005 consolidation. This indicates that, unlike most world growth markets, KOSDAQ has managed to provide trading-related market quality generally comparable to that of the main board, KOSPI, conditional on the characteristics of each firm. While trading-related market quality is higher overall among KOSPI-listed stocks than among KOSDAQ-listed stocks, this appears to represent different distributions of firm characteristics on the two boards rather than better quality for any given firm.

Furthermore, the fact that many of the most successful KOSDAQ start-ups, including flagship firms, have steadily switched their listings to KOSPI confirms the conventional wisdom that KOSDAQ has been losing its growth-market dynamism. This likely results in a negative externality, reducing KOSDAQ's ability to nurture innovation. Our results

show that KOSDAQ has not *yet* fallen behind KOSPI in terms of trading environment. However, the continuing migration of KOSDAQ firms to KOSPI may threaten KOSDAQ's future ability to maintain competitive.

Overall, our results suggest that firms whose characteristics fit the standalone growth market should continue to be listed and traded on the standalone growth market. Moreover, policymakers should carefully contemplate and monitor the possible dynamic changes in characteristics and range of the target firms of the growth market from the market macrostructure point of view, in order to nurture innovation and maintain a healthy market macrostructure.

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Appendix A. Listing requirements for KOSPI and KOSDAQ in the Korean stock markets

Panel A and Panel B of this table report the listing requirements for the main board, KOSPI (as of June 30, 2014), and the growth market, KOSDAQ (as of February 22, 2013), in the Korean stock markets, respectively. * denotes "Limited to the sales of goods and provision of services (In case of a holding company, it refers to the sales amount stated in the consolidated financial statements.)" ** denotes "In the case of a company subject to the preparation of consolidated financial statements, the consolidated financial statements shall be used as the basis, but the non-controlling interests shall be excluded from equity capital." ROE (Return on Equity): 100 × [net income / equity capital]. Growth technical company: A company that has received a higher grade than 'A' in the assessment of technology capability by the professional appraisal agency. Large-sized Company: A company with equity capital over KRW 100 billion or base market capitalization of at least KRW 200 billion (as of the submission date of application for listing eligibility review.)

Panel A: The listing requirements for the main board, KOSPI		
Criteria		Listing requirements
Years in operation since incorporation		At least 3 years
Business size	Equity capital*	At least KRW 30 billion
	Number of shares to be listed	At least 1 million shares
Minimum float		To meet all of the following requirements: ① To meet any one of the following shares requirements · At least 25% of shares or 5 million shares held by public shareholders · At least 25% of shares or 5 million shares to be publicly offered (including no. of shares before submission of application for listing eligibility review) · At least 10% of shares to be publicly offered after submission of application for listing eligibility review and at least the number of the publicly offered shares should be as follows - 1 million shares: in case of KRW 50 billion equity capital ~ KRW 100 billion, or in case of KRW 100 billion market capitalization ~ KRW 200 billion - 2 million shares: in case of KRW 100 billion equity capital ~ KRW 250 billion, or in case of KRW 200 billion market capitalization ~ KRW 500 billion - 5 million shares: in case of Equity Capital over KRW 250 billion, or market capitalization over KRW 500 billion · In case of the simultaneous offering in Korea and abroad, at least 10% of shares and 1 million shares to be publicly offered ② At least 700 public shareholders (※ No restriction placed on transfers of shares)
Business performance (sales*, profit**, total market capitalization)		To meet any one of the following requirements: ① To meet all of the following sales and profit requirements · Sales: Higher than KRW 100 billion of the latest fiscal year and KRW 70 billion in average of the recent 3 fiscal years · Profit - Net Income: Higher than KRW 3 billion of the latest fiscal year and KRW 6 billion in total of the recent 3 fiscal years - ROE: Higher than 5% of the latest fiscal year and 10% in total of the recent 3 fiscal years - In case of Large-sized Company (the company with equity capital over KRW 100 billion): Higher than 3% at ROE, or higher than 5 billion at net income, and operating cash flow is positive ② Sales amount: Higher than KRW 200 billion at the latest fiscal year and total market capitalization: Higher than KRW 400 billion
Auditor's opinion		① The latest fiscal year: Unqualified ② 2 fiscal years before the latest fiscal year: Unqualified or qualified (excluding qualified opinion due to the limit placed on the scope of audit) (※ Including the audit opinion on the consolidated financial statement, if the company is subject to the preparation of consolidated financial statement)
Merger or split		In case of merger, split, etc. : Financial statements in relevant fiscal year should be determined (If the term between the merger date and the end of the fiscal year is less than 3 months, semi-annual financial statements in the following fiscal year should be determined)
Restriction on disposal of shares held by largest shareholder, etc.		For 6 months after listing

Source: http://eng.krx.co.kr/m7/m7_2/m7_2_2/m7_2_2_1/UHPENG07002_02_01_01.html.

Appendix A. Listing requirements for KOSPI and KOSDAQ in the Korean stock markets (*continued*)

Panel B The listing requirements for the growth market, KOSDAQ				
Criteria		General company	Venture company	Growth technical company
Years in operation since incorporation		At least 3 years	n/a	n/a
Business size (① or ②)	① Equity capital**	At least KRW 3 billion*	At least KRW 1.5 billion**	
	② Base market capitalization	At least KRW 9 billion		
Minimum float		To meet any one of the following requirements: ① Number of minority shareholders at least 500; At least 25% of shares held by minority shareholders; At least 5% of shares to be publicly offered after submission of application for listing eligibility review (if minority shareholders hold less than 25% of shares, at least 10% of shares to be publicly offered) ② Equity capital at least KRW 50 billion; Number of minority shareholders at least 500; At least 10% of shares to be publicly offered after submission of application for listing eligibility review and higher than a certain number of shares by size of capital or market capitalization ③ At least 25% shares to be publicly offered and number of minority shareholders at least 500		
Financial status**		No impairment of capital stock** (※ Not applicable to Large-sized Company)		
Audit opinions of CPA auditor		Unqualified opinion on the financial statements of the latest fiscal years (Including the audit opinion on the consolidated financial statements, if the company is subject to the preparation of consolidated financial statements)		
Earnings		Positive Income from ongoing business (※ Not applicable to Large-sized Company) (If the company is subject to the preparation of consolidated financial statements, it shall be based on the consolidated financial statements)		n/a
Profit size**, sales amount* and total market capitalization		To meet any one of the following : ① ROE**: Higher than 10% ② Net Income**: Higher than KRW 2 billion ③ Sales amount*: Higher than KRW 10 billion and total market capitalization: Higher than KRW 30 billion ④ Sales growth: Higher than 20% and sales amount: Higher than KRW 5 billion	To meet any one of the following : ① ROE**: Higher than 5% ② Net income**: Higher than KRW 1 billion ③ Sales amount*: Higher than KRW 5 billion and total market capitalization: Higher than KRW 30 billion ④ Sales growth: Higher than 20% and sales amount: Higher than KRW 5 billion	n/a
Restriction on disposal of shares held by largest shareholder, etc.		For 1 year period after listing (Large-sized Company: For 6 months)		
Other qualitative requirement		To be par value stock, No restriction placed on transfers of shares		

Source: http://eng.krx.co.kr/m7/m7_2/m7_2_3/m7_2_3_2/UHPENG07002_03_02.html.

Appendix B. Delisting criteria of KOSPI and KOSDAQ in the Korean stock markets

This table reports the delisting criteria for the main board, KOSPI (as of June 30, 2014), and the growth market, KOSDAQ (as of February 22, 2013), in the Korean stock markets.

	KOSPI	KOSDAQ
Sales amount	・ Less than KRW 5 billion in 2 consecutive fiscal years	・ Less than KRW 3 billion in 2 consecutive years
Impaired capital	・ Impairment of entire capital at the end of the most recent fiscal year ・ When the capital impairment ratio exceeds 50% for 2 consecutive fiscal years	・ Total impairment of capital at the end of the latest fiscal year ・ After coming under A or C, sustained over 50% of capital impairment at the end of fiscal year (semiannual period) ・ After coming under B or C, the equity capital fell below KRW 1 billion at the end of fiscal year (semiannual period) ・ After coming A or B or C, have failed to submit the semiannual report within 10 days after the submission deadline of semiannual report or the audit opinion thereon is adverse, disclaimer of opinion or qualified due to the limit placed on audit scope
Stock price	・ When failing to satisfy the requirement that the stock price must be higher than 20% of face value for 10 consecutive days and total of 30 days during the 90 days following the designation as administrative issue	・ No requirements
Market capitalization	・ When failing to satisfy the requirement that the market value must be higher than KRW 5 billion for 10 consecutive days and total of 30 days during the 90 days following the designation as administrative issue	・ Failure to meet the requirement of market capitalization to be higher than KRW 4 billion for 10 consecutive days and for 30 days out of 90 days after having been designated as administrative issue
Audit opinion	・ When the audit opinion on the annual report is adverse or disclaimer of opinion - In case where the audit opinion is due to the uncertainty about going concern, the delisting is postponed until the end of semi-annual period if the cause of the uncertainty has been resolved ・ When the audit opinion on the annual report is qualified opinion due to the limit placed on the scope of audit 2 consecutive fiscal years	・ Adverse or disclaimer of opinion, or qualified due to the limit placed on audit scope - If the audit opinion is due to the concern about going concern, provided that the elimination of the auditor's concern has been confirmed, the delisting is postponed to the end of the next semiannual period
Trading volume	・ When the average monthly trading volume in the semi-annual period dropped below 1% of number of floating shares and such situation continued for another semi-annual period	・ Average quarterly trading volume fell less than 1% of floating shares for 2 consecutive quarters
Minimum float	・ When the number of public stockholders is less than 200 for consecutive last 2 years ・ When the share of public stockholders with at most 2 million shares is less than 10 percent for consecutive last 2 years	・ Failure to meet the minimum float requirement for 2 consecutive years
Unfaithful disclosure	・ (Subject to Listing Maintenance Review) When the penalty points more than 15 has been accumulated in recent 1 year after designation as administrative issue ・ Case of being designated as unfaithful disclosure corporation, because of intentionally or by major mistake violating the disclosure requirement of matter that may have serious influence on corporate management	・ (Subject to qualitative delisting examination)
Disclosure documents	・ When failing to submit the quarterly report, semi-annual report and annual report 2 consecutive times ・ When failing to submit the annual report within 10 days of legal submission deadline	・ Failure to submit quarterly or semiannual business reports 3 times in 2 years ・ Failure to submit business report within 10 days after the submission deadline ・ After coming under A (sustained submission failure) or B, in case where A or B occurs again in the next term reporting period
Outside directors, etc.	・ When failing to satisfy the requirement that for composition of outside directors / audit committee for 2 consecutive years	・ Failure to meet the requirement for 2 consecutive years
Application for rehabilitation / bankruptcy	・ (Subject to Listing Maintenance Review) When the application for commencement of rehabilitation procedure is dismissed, the decision on the commencement of rehabilitation procedure is cancelled, the rehabilitation plan is disapproved, or the decision is made to retract the commencement of rehabilitation procedure	・ (Subject to Qualitative Delisting Examination) when application for commencement of rehabilitation procedures is turned down. Decision on commencement of rehabilitation procedures is cancelled, or rehabilitation plan is disapproved
Others (Immediate delisting)	・ Case of final bankruptcy or suspension of bank transactions ・ Case where the cause of dissolution has occurred under the laws ・ Case of restricting transfer of stocks ・ Case where the concerned company becomes a wholly owned subsidiary of a holding company and the stocks of concerned holding company is initially listed ・ In the event of backdoor listing, case of violating the regulations related backdoor listing	・ Final bankruptcy or suspension of bank transactions ・ Company dissolution (merged into another company, bankruptcy) ・ When the article of incorporation was amended to include the restrictions on stock transfer ・ When listing on the KOSPI Market ・ When violating the regulations concerning the backdoor listing
(Growth technical company)	・ No requirements	・ Failure to submit the report or organize the investor relations conference in the next semiannual period
Loss from on-going business before taxes	・ No requirements	・ In the year after having been designated as administrative issue, sustained the loss greater than 50% (and KRW 1 billion) of equity capital
Prolonged operating loss	・ No requirements	・ Operating loss for 5 consecutive years

Source: For KOSPI, http://eng.krx.co.kr/m7/m7_2/m7_2_2/m7_2_2_5/UHPENG07002_02_05.html. (We correct some mistakes on the website by referring to the KRX Regulations.) For KOSDAQ, http://eng.krx.co.kr/m7/m7_2/m7_2_3/m7_2_3_6/UHPENG07002_03_06.html.

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