RANKING WORLD EQUITY MARKETS ON THE BASIS OF MARKET EFFICIENCY AND INTEGRITY

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Abstract

This study ranks twenty-five world equity markets from the North American, European, Middle-eastern and Asia-Pacific regions on the twin objectives of market efficiency and integrity. Though rhetoric from the chosen markets suggest that these are equally important goals we find evidence that their importance varies significantly across markets. The key findings of the study are that the Deustche Boerse and the New York Stock Exchange stand out among their international peers as markets of high efficiency and integrity. Notwithstanding the performance of these markets, European markets hold seven of the top ten places while the top three Asia-Pacific markets are Tokyo, New Zealand and Hong Kong exchanges ranked 10th, 12th and 14th respectively. While the Deutsche Boerse –floor trading in Frankfurt, holds the mantel as the market with the highest integrity, its ranking on efficiency is much lower at 14th. This is symptomatic of a more pervasive result, namely, that efficient markets are not necessarily markets with higher integrity and vice versa. Euronext Paris which is ranked 2nd on efficiency is only ranked 16th on integrity is evidence of the latter. Given the disparity between the two goals, scope appears to exist for international alliances among securities markets with the objective of enhancing one or the other goal.

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1. Background

The objective of this research is to discuss and ultimately construct a league table that helps international investors rate security markets on the basis of their demonstrated commitment to the twin goals of market efficiency and market integrity. More specifically we rate a broad cross-section of twenty-five world equity markets[3] representing North American, European, Middle-Eastern and Asia-Pacific sectors of the markets on these characteristics. Besides an overall ranking, we test whether there is any obvious relationship between market efficiency and market integrity.[4] In particular we pose the question - Are more efficient markets likely to display higher market integrity or vice versa?

Notwithstanding significant issues associated with such a comparison, we find it curious that there are no public "league rankings" on the two and in particular no attempt to relate one to the other. The closest to a market rating we can observe are implicit rankings by the World Federation of Exchanges on aspects such as the numbers of securities listed, market capitalisation and turnover. Aside from these rankings we also note a fair number of academic papers comparing transaction costs and volatility, but mostly for limited numbers, usually two, markets. The absence of a substantial cross-market ranking is the primary motivation for the current research.

Such a ranking might be useful for at least three reasons. First, it might provide tangible benefits, in terms of encouraging investor interest, in those markets making a "real" effort in

[3] The markets analysed represent lead exchanges in the North American (4), European (10 entries but 9 countries, 2 representing Deutsche Boerse), Middle-Eastern (2) and Asia-Pacific regions (9). In forthcoming research we will present additional evidence on South American, African and Middle Eastern Exchanges.

[4] That efficiency and integrity are key objectives of all major equity markets is clear from the web sites of the world's leading exchanges. Appendix 1 contains a sample of relevant statements.

these areas. Faced with uncertainty even institutional investors have little option but to increase their required rates of return, in turn increasing the cost of funds in markets/investments where efficiency and integrity are perceived problems. Second, such a league ranking might provide greater motivation for markets that have comparative problems with efficiency and financial integrity to be more proactive in these areas. Indeed it might help determine appropriate partners in international alliances. Finally, such a ranking may serve to motivate debate in order, ultimately, to achieve an acceptable basis for such a comparison.

We begin in the next section by examining the existing literature on market efficiency and integrity and the relationship between these two elements in the context of this research study. In sections 4 and 5, we form our hypotheses and describe the data set and its limitations. Section 6 discusses appropriate methods to proxy/measure these two elements before setting out the key findings in sections 7 and 8. We conduct a sensitivity analysis on the measurements used within the study before concluding the paper by highlighting possible research extensions in Section 10.

2. Prior Literature

Aitken and Berry (1993) suggest that academic textbooks typically refer to information when they define market efficiency to be where the market reacts in a speedy and unbiased fashion to information. Through the early works of Kendall (1957) where he argued that stock prices displayed 'random walk' behaviour, economists came to realize that random price movements indicated a well-functioning or efficient market. The three standard forms of efficiency come from broad consensus where evidence has shown that markets are at least weak form and often semi-strong form efficient under the Efficient Market Hypothesis (e.g. Fama *et al.*, Jensen (1978), Fama (1970, 1991, 1998), Malkiel (1992)). Grossman and Stiglitz (1980) argue that investors will have an incentive to spend time and resources to analyze and uncover new

information only if such activity is likely to generate higher investment returns. Thus, in market equilibrium, efficient information-gathering activity should be fruitful.

In their discussion paper about the context of market efficiency, Gilson and Kraakman (2004) came up with the following general conclusion: The level of market efficiency with respect to a particular fact is dependent on a number of mechanisms – universally informed trading, professionally- informed trading, derivatively informed trading, and uninformed trading - operated to cause that fact to be reflected in market price. Which mechanism was operative, in turn, depended on the breadth of the fact's distribution, which in turn depended on the cost structure of the market for information. They further argue that the lower the cost of information, the wider its distribution, the more effective the operative efficiency mechanism and, finally, the more efficient the market.

In order for a market to become efficient, investors must perceive that a market is inefficient and possible to beat. Investment strategies intended to manipulate inefficiencies are actually the fuel that keep a market efficient. However it is often these investment strategies that not only affect the level of efficiency but the integrity of the market place.

Financial integrity is often cited by numerous studies as the ability of the market to provide means by which all known information about a security and hence having it fully reflected in the security's price. The price of the security should, theoretically equal its fair intrinsic value. Furthermore, sellers and buyers of securities have reasonable expectations of a "level playing field". One such example is a study done by Gunn (2002). He argues that only under these conditions, are trades assured of open, authentic trading. This is the essence of market integrity.

A large body of research has sprouted from the broad notion of market integrity in areas such as market manipulation, anomalies in trading behaviour, securities fraud, enforcement etc. Allen and Gale (1992) argue that the natural asymmetry between liquidity purchases and liquidity sales leads to an asymmetry in price responses. Several researchers[5] have also shown that trade-based manipulation is possible when it is unclear the purchaser of shares has good information about the firm's prospects or is simply trying to manipulate the stock price for profit. Further results of trade-based manipulation were that effects of manipulation could be found in the last hour before expiration (during expiration-days with respect to derivative instruments), and the price effect was reversed in the first-hour of trading after expiration. (see Stoll and Whaley (1987), Chamberlain *et al.* (1989) and Stoll and Whaley (1991)). Given that trader performance is benchmarked against the closing price it is possible that traders try to influence the closing price especially if they have acquired a large net position in a stock during the trading day.

3. Efficiency and Financial Integrity Defined in this context

Our task is to define and relate market efficiency and market integrity such that they can be applicable in a practitioner's world. Appendix 1 provides evidence from a number of exchange web sites of the professed importance of both goals. Notwithstanding the use of slightly different terminology, it is clear from these statements that efficiency and integrity are of equal importance to most exchanges as one might expect. A question that we address in this paper is whether the rhetoric can be supported by hard evidence. Our answer is that it cannot.

[5] For example, Kumar and Seppi (1992) investigated the susceptibility of futures markets to price manipulation whilst Gerard and Nanda (1993) examined the potential for manipulation in seasoned equity offerings. Jarrow (1994) examined the impact of derivatives markets on market manipulation whilst Felix and Pelli (1999) examined closing price manipulation in the Finnish stock market. Mahoney (1999) examined stock price manipulation leading up to the Securities Exchange Act of 1934. Vitale (200) examined manipulation in the foreign exchange market.

3.1 Market Efficiency

We shy away from traditional academic notions of market efficiency that tend to focus on information efficiency as previously discussed to a more all encompassing definition which concerns itself with the ability to instantaneously convert cash into securities and back again. The more efficient the market the cheaper is the conversion process; or more conventionally, the lower are transaction costs.

In other words, an efficient market has to be large and liquid and information has to be widely available, in terms of accessibility and cost, and released to investors at more or less the same time. Transaction costs have to be cheaper than the expected profits of an investment strategy. Investors should also have enough funds to take advantage of inefficiency until, according to the EMH, it disappears again. Most importantly, an investor has to believe that she or he can outperform the market.

Based on this definition we need to measure transaction costs in order to measure market efficiency[6]. To do this we need to take account of two measurement complications. First, the fact that there are a large number of securities in each market each with quite a different transaction cost profile. Second, that there are a number of distinct components of transactions costs none of which can be easily observed and therefore measured.

Addressing the latter issue first – How do we measure transaction costs? Key components of transaction costs include brokerage costs, market impact costs, and opportunity costs. Unfortunately none of these is directly observable in the Reuters data available to us[7]. In the absence of data to measure transaction costs directly, we proxy transaction costs by measuring

[6] Under this definition efficiency can change as a consequence of changes in technology, regulation, participants, and financial instruments as well as changes in information.

[7] Note that this Reuters data provides intra-day trade and quote data for 240 world markets and so for the purpose of market comparison, it is the best available for the task at hand short of getting the data from each individual exchange, many of which provide no more than what Reuters has made available.

the time weighted relative spreads of securities[8]. While it would be preferable to have knowledge about the volume of securities available at the best bid/asks, this type of information is not freely available from most markets in order to foster a comparison, and neither is it available through the Reuters database we have at our disposal. Having said this, the relative bid/ask spread is a widely used and accepted measure to proxy transaction costs.

Addressing the second issue, the question is - How do we come up with an efficiency measure for a market that is made up of hundreds of different securities, each one of which potentially has their own efficiency measure? In the absence of an obvious method, we have adopted a simple averaging process based upon the combination of three different groups of securities. In the first group, we concentrate on estimating transaction costs for securities that make up the major 'investable' indices. We measure the average time weighted relative spreads of this group and compare the result across markets.

For the second and third groups we seek to take account of a wider group of securities than those in the major 'investable' indices. For this purpose, we isolate the top and bottom 10% of securities in each market based on trading turnover during the sample period and again estimate the time weighted relative spread for the top and bottom 10% of securities adopting a simple average for each group. Although it is customary in cross-market comparisons to compare the efficiency of securities with similar turnover/liquidity, or to weight comparative measures by turnover, because such comparisons ignore 99% of the securities in markets, we argue that such a measure does not provide a true picture of the costs for the average investor (other than institutional investors) dealing in that market. Irrespective of which method is

[8] The relative spread is simply the spread divided by the midpoint and then weighted by the time that particular spread was available over the estimation period.

preferred, we argue that adopting the same relative measure for each market mitigates potential comparison problems.

3.2 Market Integrity

Consistent with the overarching goal of maintaining market integrity, a key goal of a securities market must be to ensure that no one investor can manipulate prices for their benefit, that is, deliberately cause a short term supply/demand imbalance. The ability to manipulate a market would be difficult if individual investors were to invest primarily on their own account. However, given that investors now congregate in funds, the effective size of these new types of investors means that manipulation is possible if not probable. Although wide-ranging rules seek to preclude such behaviour, examples of such activity seem commonplace. A recent example follows:

> *On Friday, 29th June 2001 between 4 and 4.15pm the Standard & Poor's ASX 200 Index (SPI 200) increased 45.5 points following the closing single price auction (CSPA) on the ASX. By market open on the following Monday, this unusual increase was reversed. The last trading day of the financial year always pushes share prices a little higher, but on 29 June the All Ordinaries Index rose by 67 points, or two per cent, and the ASX is concerned market manipulation may have been involved. On 2 July, the index fell by 54 points, as the "ramping" buyers, believed to be fund managers and derivative players, withdrew (Rennie, 2001).*

Following this incident, the ASX and the SFE altered the method by which index futures contracts were settled breaking the link between the ASX closing price for the share market

and the settlement price for the index futures contract in November 2001[9]. Moreover, the Australian Securities and Investments Commission (ASIC) ruled on 22 January 2001 that the party attributed with causing the event adhere to certain restricted trading conditions under their license.

In another US example, a supermarket chain, Safeway, was to be added, as of the close, to the S& P 500 on November 12, 1998, following an announcement made the previous week. High demand by index funds seeking to add Safeway security to their portfolios at the closing price on this day resulted in a large order imbalance at the close. To accommodate the excess demand, the NYSE specialist for Safeway, Spear Leeds, set a closing price of $55, up 11% from the previous trade. In subsequent overnight trading Safeway security fell in price, closing at $51.1875 the following day. Many institutional investors who paid large premiums to acquire Safeway at the close on November 12 were highly critical of the manner in which the closing price was determined. These traders argued that the order imbalance should have been more widely publicised to alert potential buyers that they would trade at a substantial premium while simultaneously attracting counter-party interest to dampen the temporary price pressure at the close.

The high level of concern about the possibility of manipulation at the close is evident in recent decisions by a number of securities markets to implement special mechanisms for the determination of closing prices. Different markets have a range of different rules to inhibit or minimize manipulative behaviour. For example, the Australian Stock Exchange (ASX) has implemented a batch close in which the last price is the weighted average price of the last buy order and the last sell order matched just prior to the first non-overlapping bid and ask price.

[9] It is important to note that our data set includes this particular instance where index arbitrage was present. The cases were included because the eventual outcome by the court had deemed such actions as 'manipulative'.

The Stock Exchange of Hong Kong takes the median of 5 nominal prices in the last minute of the trading hour. Their system takes 5 snapshots on the nominal prices[10] at 15-second intervals starting from 3:59:00pm. Alternatively, the New Zealand Stock Exchange implements a random close for the day's trading between 3.55 – 4.00 pm.

Recently, even the New York Stock Exchange has begun to post the 'official' closing prices of its listed securities on its website.[11] They argue that the action was intended to ensure the availability of reliable pricing information that reflects the outcome of full market participation in the NYSE auction market. Previously, isolated off-NYSE small trades at anomalous prices after the NYSE close were being reported on the consolidated tape and via data vendors often as the last sale of the day and in some cases appeared in security tables of the newspapers the next day. Such price dislocations are not uncommon and should not be surprising in after-hours markets, where volumes are lower and specialists are not available to help maintain the balance in the market. These prices have been shown to be unrepresentative of the true market price in an affected security at the close of trading, which can mislead investors and substantially change a company's reported market valuation.

Based on these examples, we have determined that a useful way (although not the only way) to estimate the potential for a market to be manipulated is to observe pricing behaviour of index securities at the market close, particularly at month and quarter ends, when institutional investor mandates and management profit incentives are likely to provide the greatest chance of observing behaviour consistent with manipulation. Further, earlier studies of intradaily returns have round that stocks prices systemically increase prior to the close. (e.g. Wood *et al.* (1985), Norden (1993) and Cheung (1995)).

[10] Nominal price on the HKEx is determined by comparing the current bid price, the current ask price and the last recorded price in accordance with Rule 101 of the Rules of the Exchange.
[11] *The Exchange* April 2000, p4 , monthly magazine from the NYSE

The use of index securities is dictated by the current dominance of institutional investors in the market place and seeks to address a widely held view that manipulation is no longer the exception, but rather the rule. Further, while smaller securities can and are manipulated, it is the potential manipulation of larger securities that has the greatest potential to undermine the integrity of a marketplace. Note however, that we provide results for larger and smaller security groupings.

4. Hypotheses Development

Efficiency and integrity, though often referred to as the twin pillars of a properly functioning marketplace, do not necessarily go together[12]. Indeed there are situations when the two may be in conflict. For example, it may be efficient, in terms of encouraging greater liquidity, to reduce market transparency. However, reducing market transparency can also lead to perceived problems with market integrity. Further, while failure to prosecute insider trading would clearly be thought of as a problem for market integrity, plenty of academics (beginning with Henry Manne[13]) have been prepared to argue that permitting insider trading may actually lead to greater market efficiency by ensuring that prices fully reflect all available information. The point being made here is that market efficiency and market integrity are not necessarily good bedfellows. Accordingly, one objective in this research is to determine the extent to which they are related or not. We might expect better markets to show demonstrated commitment to both goals.

Based on the arguments above, the following hypotheses are developed:

[12] See Results section where we show a weak positive correlation between the measures of efficiency and integrity.

[13] Manne, Henry G., (1965), "Mergers and the Market for Corporate Control", *The Journal of Political Economy Vol 73, Issue 2 (April), 110-120;* (1966a), "Insider Trading and the Stock Market", *New York, NY : The Free Press*; (1966b) "In Defence of Insider Trading", *Harvard Business Review, Vol. 44 , 113-122.*

H1: Market efficiency and integrity are correlated based on the commitment demonstrated on the twin goals by lead exchanges in the world

H2: We expect better markets to be more committed to both goals, i.e. displaying better scores, due to their capabilities in advanced technology, research and economy

5. Data

The data is obtained from the Reuters database maintained by the Securities Industry Research Centre of Asia-Pacific (SIRCA). This database contains intra-day trade and quote data for seven years for more than 200 world markets including most of the equity markets. The period of analysis for this particular study extends from October 1999 to March 2002[14]. The period of September 1999 is used to generate initial benchmarks[15] and to provide general descriptive information about the markets such as average trading activity and typical trading periods. The ranking score is applied from the period of October 1999 to March 2002, encompassing 30 months and 10 quarter ends.

Three sets of securities are analysed in this study. The first set examines the most common stocks that are usually held by fund managers in each market. They usually constitute the commonly watched index, e.g. FTSE100 for the London Stock Exchange. The second set examines a wider group of securities that comprise the top 10% of securities from each market. The third group involves the bottom 10% of securities from each market. Transaction costs are estimated for all three groups with a view to estimating a comparative cost of dealing in each market.

[14] This period is arbitrary.
[15] Note however that we adopt a rolling benchmark in which test months are compared against the immediately preceding month.

6. Measurement

6.1 Efficiency

Time weighted relative spreads for the month of January 2002[16] are calculated to proxy for the costs of dealing in each market for the three groups of securities.

To calculate the relative spread for each security, the following formula is used:

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Relative spread  = ((ask-bid) / ((ask + bid)/2)) at each change
                                    in spread
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The time weight was calculated by taking the time that each spread existed during a trading day. A summation of the changes in spreads multiplied by the time it was available is created for each security for each trading day using the following:

$$\Sigma \text{ (time weights) x (relative spread)}$$

where :

$$\textit{time weight} = \frac{\textit{the amount of time the spread was in existence}}{\textit{total time during the day}}$$

To obtain the final estimates, the time weighted relative spreads are averaged across all trading days in the analysis period for each security and then each security group. Negative spreads and instances where one side of the spread was absent were removed from the sample.

We argue that the lower the spreads, the less costly it is for investors to convert their cash into securities and vice-versa, hence the greater the efficiency of the market.

6.2 Integrity

In order to practically determine the likelihood of a security being subject to manipulation at the close three conditions need to be met. The first condition is that the closing price is in the

[16] This month was selected randomly from the Reuters database. Shortly, we will present monthly updates of these metrics for these and other markets through the CMCRC website www.cmcrc.com .

far right hand tail of a distribution of traded prices taken from a previous trading period. A security is more likely to be the subject of ramping if the price change in the last minutes of a month is greater than the top 1 percent of price changes during a benchmark period. In this study, the benchmark period is the trading activity during the previous month. This approach is best explained using an example.

In order to identify the top 1 percent of price changes for a security during the benchmark period, returns (price changes) are sampled every 15 minutes during the day. Assuming that there are approximately 20 trading days in a month and twenty-four 15 minute intervals in each trading day (assuming 6 trading hours per day), there are approximately 480 return observations each month. If these observations are sorted, the largest 4.8 returns (or 1 percent of the distribution) can be identified. The value of the fifth return is where the threshold for ramping for that security is set. For example, if the fifth highest return for Microsoft was 0.5% during the September, then the security is deemed to have been subject to ramping if the return in the last 15 minutes of 31 October was greater than 0.5%. While not conclusive many exchanges use variants of such measures to identify potential price manipulation at the close.

The second condition that needs to be met is that the price breaks through the best ask to new price levels establishing new best ask prices. The larger the number of price steps that are broken through the greater the likelihood of manipulation. The third condition for ramping to be established is that the traded prices in the next trading session revert to levels approximately equal to the benchmark price (possibly the volume weighted average price over the last month) calculated in condition 1. In order to test this latter condition it is also important that the trades of the party accused of manipulation are excluded from the determination of whether the prices reverts to the original benchmark. Regrettably we do not have data to estimate the second condition (full order level details) and so we are forced to

adopt conditions 1 and 3 only as our proxies. In the absence of the ability to determine condition 2, our measures must therefore at best be indicative rather than conclusive. Accepting these limitations we argue that the lower the number of incidents of price reversals preceding potential ramping behaviour *and* the smaller the magnitude of price ramping, the higher the level of integrity in the market.

7. Descriptive Statistics

This section presents general information about the markets examined in this study. Table 1 shows the statistics for the first group – namely, index securities. It provides the details of the percentage trading activity for each sample of index securities against the entire market.

Table 1: MARKET SUMMARY AND SAMPLE TRADING ACTIVITY FOR INDEX SECURITIES DURING SEPTEMBER 1999

Market	Index Used	Market Trading Value* ('000,000)	Sample Security Trading Value* ('000,000)	Sample Trading Value as a % of Market Trading Value	Average Number of Trades per day in group	Number of Securities in Index
American Stock Exchange	Top 100+	39,725	38,478	97%	10,502	100
Australian Stock Exchange	ASX200	18,935	14,908	79%	19,134	200
Borsa Italia	MIB30	45,446	21,613	48%	19,813	30
Cairo & Alexandria Exchanges	CASE50	2,826	2,306	82%	2,448	50
Copenhagen Stock Exchange	KFX	40,439	568	14%	678	20
Cyprus Stock Exchange	CYSE100	171	116	68%	2,907	100
Deustche Boerse-Xetra (electronic)	DAX	43,356	27,840	64%	12,553	30
Deustche Boerse - Frankfurt (floor)	DAX	10,745	1,344	13%	1,760	30
Euronext Paris	CAC40	66,499	46,826	70%	54,306	40
Helsinki Stock Exchange	HEX	6,638	5,422	82%	3,254	20
Hong Kong Stock Exchange	Hang Seng	175,060	59,144	34%	7,592	33
Istanbul Stock Exchange	ISE100	2,099,110	1,639,650	78%	22,437	100
Jakarta Stock Exchange	LQ45	1,086,460	79,25,400	73%	8,628	45
Kuala Lumpur Stock Exchange	KLSE Composite100	9,346	4,826	52%	7,468	100
London Stock Exchange	FTSE100	106,117	55,860	53%	33,892	100
NASDAQ Stock Market	NASDAQ	864,530	493,609	57%	427,451	100
New York Stock Exchange	NYSE100	652,125	243,201	37%	80,911	100
New Zealand Stock Exchange	NZ40	1,295	956	74%	1,097	40
Oslo Børs	OSEBX	43,173	25,308	59%	2,597	55
Philippines Stock Exchange	PSE Composite	53,341	16,646	31%	540	33
Singapore Stock Exchange	Straits Times	11,457	6,073	53%	5,798	55
Stockholmsbörsen	OMX	271,803	74,093	27%	5,488	30
Taiwan Stock Exchange	TSEC Taiwan 50	2,143,000	1,862,000	87%	38,943	50
Tokyo Stock Exchange	TOPIX	16,485,000	9,708,180	59%	44,619	150
Toronto Stock Exchange	TSE60	37,646	17,910	48%	18,493	60

* denominated in local currency

Table 1 shows that the American Stock Exchange provides the greatest coverage of the market as almost 100% of the market is captured in this sample. The number of trades per day in each market is provided in part to appreciate the differences in liquidity levels of the securities within the sample (see fifth column from left). On this measure the NASDAQ market is the most liquid market.

Table 2 shows the statistics for the securities belonging in the first and tenth deciles of each market. Deciles in each market are determined by dividing the total number of securities in each market into 10 groups, based on their trading turnover.

Table 2: MARKET SUMMARY AND TRADING ACTIVITY FOR TOP AND BOTTOM DECILE SECURITIES DURING SEPTEMBER 1999

Market	Market Trading Value* ('000,000)	Sample Security Trading Value* ('000,000)	Sample Trading Value as a % of Market Trading Value	Average Number of Trades per day in group	Number of Securities identified in both deciles
American Stock Exchange	39,725	37,600	95%	7,455	201
Australian Stock Exchange	18,935	15,900	84%	22,861	261
Borsa Italia	45,446	32,277	71%	37,115	485
Cairo & Alexandria Exchanges+	2,826	2,535	90%	1,535	27
Copenhagen Stock Exchange	40,439	28,000	69%	3,586	62
Cyprus Stock Exchange+	171	143	83%	3166	28
Deustche Boerse-Xetra (electronic)	43,356	36,749	85%	19,395	767
Deustche Boerse -Frankfurt (floor)	10,745	5,930	55%	7,694	282
Euronext Paris	66,499	57,500	86%	78,466	244
Helsinki Stock Exchange	6,638	5,642	85%	1,770	35
Hong Kong Stock Exchange	175,060	81,100	46%	29,686	169
Istanbul Stock Exchanges+	2,099,110	1,339,887	64%	13,667	67
Jakarta Stock Exchange	1,086,460	810,000	75%	8,793	105
Kuala Lumpur Stock Exchange	9,346	7,030	75%	15,891	147
London Stock Exchange	106,117	71,460	67%	45,524	584
NASDAQ Stock Market	864,530	743,034	86%	890,028	678
New York Stock Exchange	652,125	495,571	76%	202,444	560
New Zealand Stock Exchange	1,295	897	69%	952	34
Oslo Børs	43,173	31,800	74%	3,277	46
Philippines Stock Exchange	53,341	30,800	58%	2,089	38
Singapore Stock Exchange	11,457	5,100	45%	6,640	93
Stockholmsbörsen+	271,803	228,002	84%	25,870	83
Taiwan Stock Exchange	2,143,000	1,531,000	71%	28,115	121
Tokyo Stock Exchange	16,485,000	11,064,589	67%	57,957	427
Toronto Stock Exchange	37,646	33,200	88%	43,934	471

*denominated in local currency
+ non-zero trading values for decile 10 securities

As one might expect the addition of the lower decile of securities adds little to the market coverage statistics. Once again the NASDAQ market is the most liquid market and the New Zealand Stock Exchange is the most illiquid market, averaging only 952 trades per day from its top and bottom 10% of securities

8. Results

Table 3 provides the average time weighted relative spreads for the three groups of securities, namely, index securities, decile 1 securities and decile 10 securities. The lower the spreads the higher the efficiency of the market. Although we have a ratio scale on which to rank each market, we have chosen to simply rank them 1 to 25 based on the lowest to highest spreads.

Table 3: Market Efficiency Rating based on the Size of the Average Time Weighted Relative Spreads

Market	Index Securities	Rank	Decile 1	Rank	Decile 10	Rank	Overall
New York Stock Exchange	0.09%	1	0.12%	1	2.41%	3	1
Euronext Paris	0.15%	2	0.19%	2	12.80%	20	5
Deustche Boerse- Xetra (electronic)	0.21%	3	0.62%	12	2.46%	4	4
Borsa Italia	0.23%	4	0.58%	11	39.49%	25	11
Toronto Stock Exchange	0.23%	5	0.68%	14	4.26%	7	6
Tokyo Stock Exchange	0.29%	6	0.30%	3	3.66%	6	2
Stockholmsbörsen	0.42%	7	0.41%	4	17.01%	22	8
London Stock Exchange	0.44%	8	1.14%	18	9.68%	14	12
Taiwan Stock Exchange	0.51%	9	0.48%	6	0.74%	1	3
Hong Kong Stock Exchange	0.53%	10	0.81%	16	2.86%	5	7
Helsinki Stock Exchange	0.59%	11	0.57%	10	9.50%	13	9
Copenhagen Stock Exchange	0.62%	12	0.62%	13	9.88%	15	13
Australian Stock Exchange	0.66%	13	0.48%	7	12.06%	19	10
Deustche Boerse -Frankfurt (floor)	0.67%	14	1.88%	24	7.94%	10	18
NASDAQ Stock Market	0.83%	15	1.41%	22	10.53%	17	22
New Zealand Stock Exchange	1.04%	16	0.52%	9	10.26%	16	14
Singapore Stock Exchange	1.06%	17	0.84%	17	14.94%	21	23
Kuala Lumpur Stock Exchange	1.07%	18	0.76%	15	9.12%	12	17
Istanbul Stock Exchange	1.54%	19	1.56%	23	7.52%	8	19
Oslo BØrs	1.59%	20	0.52%	8	17.31%	23	20
American Stock Exchange	1.64%	21	0.41%	5	10.88%	18	16
Cairo & Alexandria Exchanges	1.99%	22	1.19%	19	1.17%	2	15
Cyprus Stock Exchange	2.20%	23	1.28%	20	7.77%	9	21
Jakarta Stock Exchange	2.51%	24	2.07%	25	8.43%	11	24
Philippines Stock Exchange	3.41%	25	1.39%	21	18.14%	24	25

Figure 1

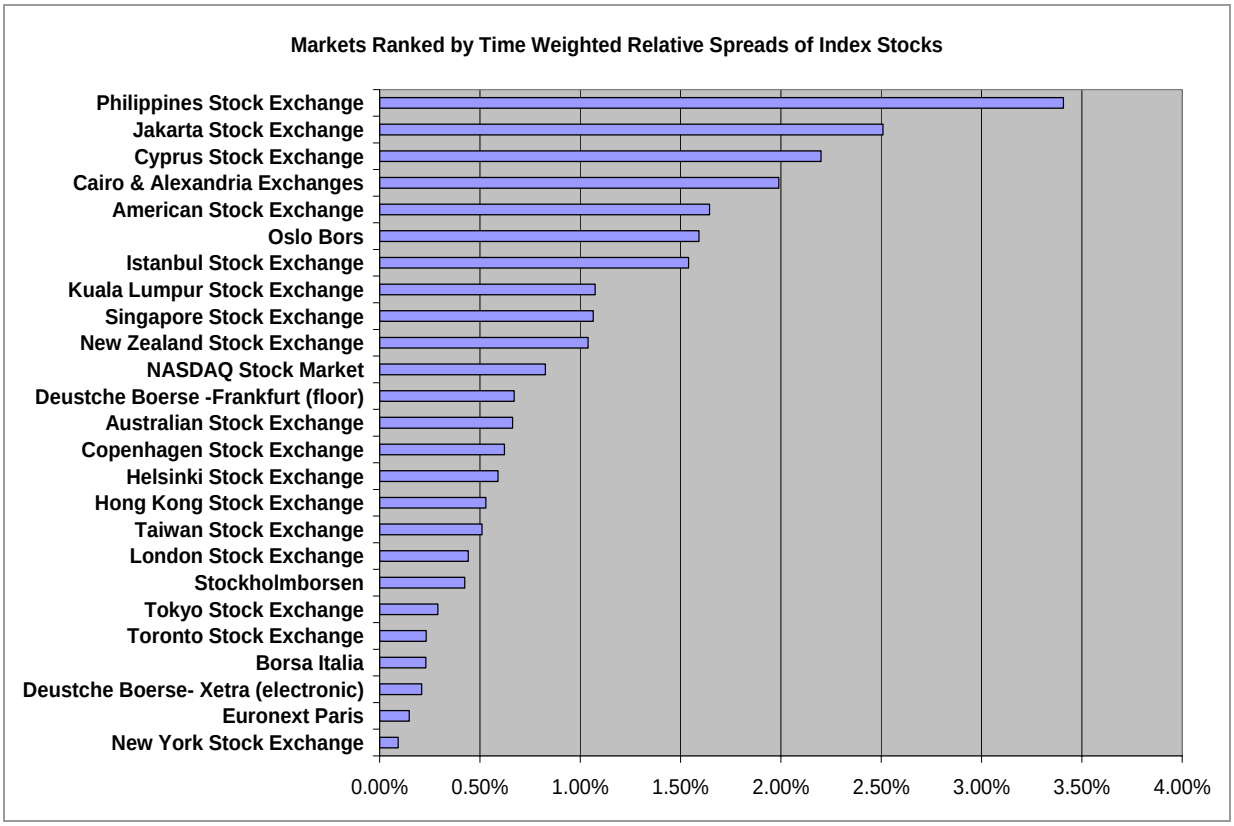


Figure 1 shows a representation of the average time-weighted relative spreads for indexed stocks in each market over the sample period of January 2002. The range of spreads varies from a low of 0.09% to a high of 3.41%. The mean spread is 0.95% which means that the average cost of trading on a dollar value worth of stock in any given market within this sample is 0.95 cents. The calculated median is 0.64%.

The overall rank (in the far right column of Table 3) comes from an effective equal weighting of each of the 3 individual scores. Note that decile 1 spreads are in some markets lower than the index securities. This arises because the numbers of securities in decile one are, for several markets, particularly the smaller ones, less than the number of securities in the index.

Though we have chosen to rank on index securities in Table 1, placing two North American, and three European markets in the top five, the results vary somewhat when the other deciles are included; although three of the top five remain in the top five. Paris, Italy, and Toronto with higher costs in the lower deciles swap positions with the Taiwan, Cairo and Hong Kong exchanges. The most interesting result is the very low costs for the smallest stocks in the Taiwan market. We have confirmed this result, however, at this stage we are not able to explain what makes trading in this market 3 times more efficient in the lower deciles than its closest competitor, New York, although clearly there are approximately 5 times more securities available for trading in the New York in this section of the market as there are in Taiwan.

Table 4 provides the number of potentially ramped securities (condition 1) among the three groups. We calculate both the number of ramping incidents and the average absolute price change across these ramped securities as a means of ranking markets on integrity. Further, we provide the incidence of non-month end window dressing in order to provide a basis for focusing on the last day of the month and quarters. On the face of it there does seem an obvious increase in the number of incidents of ramping at month rather than non-month end although it is possible that even the non-month ends results are driven by events such as triple witching dates[17] that we have not accounted for here. For the index stocks, we also present the incidence of price reversals on the next trading day for month-end cases (condition 3). Again we provide a simple ranking of 1 to 25 based on these respective measures.

[17] Triples witching days are when the contracts for stock index futures, stock index options and stock options all expire on the same day. Triple Witching Days happen four times a year: the 3rd Friday of March, June, September and December. It is sometimes referred to as "Freaky Friday".

Table 4: Securities ramped in the last 15 minutes of trading at month and non-month end for index securities, decile 1 securities and decile 10 securities ranked initially on the average number of index securities with month-end price reversals per month and then the average price change in last 15 minutes over a 30 month period.

	Index Securities						Decile 1 securities				Decile 10 securities			
	ave # mth-end cases reverting to level of pre-ramped VWAP * next day				Average Price Change in last 15 min		Average # cases		Average Price Change in last 15 min		Average # cases)		Average Price Change in last 15 min	
Market	# of cases	% fall from ramp to next day	Month-end	Ave non month-end	Month-end	Ave non-month-end	Month-end	Ave non month-end	Month-end	Ave non-month-end	Month-end	Ave non month-end	Month-end	Ave non-month-end
Deustche Boerse -Frankfurt (floor)	0	NA	0.20	0.15	0.27%	0.93%	2.00	1.00	1.98%	3.16%	0	0	0%	0%
Copenhagen Stock Exchange	0	NA	0.30	0.26	3.17%	2.26%	1.00	1.00	2.46%	2.46%	0	0	0%	0%
Cyprus Stock Exchange	0.03	0.08%	0.13	0.11	0.70%	3.21%	0.17	0.10	5.18%	3.17%	0	0	0%	0%
Philippines Stock Exchange	0.03	24.70%	0.40	0.22	4.79%	10.67%	0.43	0.48	3.38%	4.33%	0	0	0%	0%
Deustche Boerse- Xetra (electronic)	0.07	0.49%	0.63	0.54	0.60%	1.32%	6.00	4.00	3.94%	3.95%	0	0	0%	0%
Helsinki Stock Exchange	0.07	0.65%	1.00	1.00	1.02%	1.72%	0.33	0.35	0.78%	1.78%	0	0	0%	0%
Stockholmsbörsen	0.07	0.13%	2.00	1.00	1.03%	1.44%	2.00	2.00	1.19%	1.93%	0.03	0.03	9.40%	0.68%
Cairo & Alexandria Exchanges	0.10	0.56%	1.23	1.14	2.13%	2.78%	0.23	1.00	1.65%	2.14%	0.03	0.03	2.94%	3.33%
Oslo BØrs	0.10	0.34%	3.00	2.00	5.06%	2.86%	0.30	0.40	2.92%	2.48%	0	0	0%	0%
New Zealand Stock Exchange	0.20	1.33%	2.00	1.00	1.32%	1.62%	0.40	0.26	2.48%	2.19%	0	0	0%	0%
IBorsa Italia	0.20	0.76%	1.00	1.00	1.65%	1.60%	4.00	3.00	2.76%	2.86%	0	0	0%	0%
London Stock Exchange	0.20	1.24%	4.00	4.00	3.88%	3.67%	10.00	12.00	2.94%	3.68%	0	0	0%	0%
Hong Kong Stock Exchange	0.23	0.66%	2.00	1.00	1.75%	2.03%	0.37	1.00	1.51%	6.07%	0	0.10	0%	0.35%
Singapore Stock Exchange	0.23	0.85%	2.00	1.00	2.23%	2.26%	1.00	1.00	1.70%	2.73%	0	0	0%	0%
Toronto Stock Exchange	0.33	1.62%	3.00	2.00	1.31%	2.07%	8.00	5.00	3.90%	4.00%	0	0	0%	0%
New York Stock Exchange	0.50	0.68%	3.00	2.00	1.71%	1.43%	9.00	5.00	2.56%	2.10%	0.60	0.33	1.95	2.09%
Jakarta Stock Exchange	0.53	1.85%	5.00	4.00	3.98%	3.67%	2.00	2.00	6.74%	6.08%	0	0	0%	0%
Taiwan Stock Exchange	0.60	1.78%	8.00	6.00	1.80%	1.99%	2.00	2.00	1.84%	3.18%	0.96	0.86	2.27%	3.18%
Istanbul Stock Exchange	0.77	4.06%	7.90	5.78	2.58%	3.01%	4.00	3.00	14.11%	2.74%	0.17	0.10	3.17%	3.12%
Kuala Lumpur Stock Exchange	0.83	2.71%	10.00	6.00	2.745	2.35%	4.00	1.00	2.91%	2.61%	0.03	0.53	16.70%	2.34%
NASDAQ Stock Market	1.00	4.77%	6.00	3.00	1.74%	3.05%	14.00	9.00	4.64%	4.72%	0.40	0.10	0.38%	0.75%
Australian Stock Exchange	1.20	2.40%	10.00	5.00	1.94%	1.73%	5.00	2.00	2.48%	2.19%	0	0	0%	0%
Euronext Paris	1.40	1.62%	3.00	2.00	1.02%	1.16%	8.00	5.00	1.47%	1.73%	0	0	0%	0%
Tokyo Stock Exchange	1.50	6.56%	12.00	4.00	1.59%	1.76%	15.00	19.00	1.87%	2.09%	0	0	0%	0%
American Stock Exchange	2.40	6.65%	5.00	3.00	3.32%	2.13%	4.00	2.00	4.75%	4.88%	0.03	0.07	2.60%	0.05%

Table 5 : Market Integrity Rating based on average number of price reversals on index securities per month (from October 1999 to March 2002) relative to the number of securities in the index AND the average ramp movement

Market	ave # mth-end cases reverting to level of pre-ramped VWAP next day	% of index securities ramped and then reverting to pre-ramp VWAP levels per month	% price fall from ramp to next day	Ave # securities Ramped per month	# securities in Index	% of index securities ramped per month	Average Price change in the last 15minutes	Rank1	Rank2	Sum	Overall Rank
Deustche Boerse -Frankfurt (floor)	0	0.00%	NA	0.20	30	0.67%	0.27%	1	1	2	1
Cyprus Stock Exchange	0.03	0.15%	0.08%	1.2	20	6.00%	0.70%	4	3	7	2
Helsinki Stock Exchange	0.07	0.23%	0.65%	1	30	3.33%	1.02%	8	4	12	3
Deustche Boerse- Xetra (electronic)	0.09	0.30%	0.49%	0.63	30	2.10%	0.60%	10	2	12	4
Stockholmsbörsen	0.07	0.23%	0.13%	2	30	6.67%	1.03%	8	6	14	5
New Zealand Stock Exchange	0.20	0.50%	1.33%	2	40	5.00%	1.32%	12	8	20	6
Toronto Stock Exchange	0.33	0.55%	1.62%	3	60	5.00%	1.31%	14	7	21	7
Copenhagen Stock Exchange	0	0.00%	NA	0.30	20	1.50%	3.17%	1	20	21	8
Cairo & Alexandria Exchanges	0.10	0.20%	0.56%	1.23	50	2.46%	2.13%	6	16	22	9
New York Stock Exchange	0.50	0.50%	0.68%	3	100	3.00%	1.71%	12	11	23	10
Borsa Italia	0.20	0.67%	0.76%	1	30	3.33%	1.65%	16	10	26	11
Philippines Stock Exchange	0.03	0.09%	7.74%	0.40	33	1.21%	4.79%	3	24	27	12
Singapore Stock Exchange	0.23	0.42%	0.85%	2	55	3.64%	2.23%	11	17	28	13
London Stock Exchange	0.20	0.20%	1.24%	4	100	4.00%	3.88%	6	22	28	14
Tokyo Stock Exchange	1.50	1.00%	6.56%	12	150	8.00%	1.59%	20	9	29	15
Euronext Paris	1.40	3.50%	1.62%	3	40	7.50%	1.02%	25	4	29	16
Australian Stock Exchange	1.20	0.60%	2.40%	10	200	5.00%	1.94%	15	15	30	17
Hong Kong Stock Exchange	0.23	0.70%	0.66%	2	33	6.06%	1.75%	17	13	30	18
Oslo Børs	0.10	0.18%	0.34%	3	55	5.45%	5.06%	5	25	30	19
NASDAQ Stock Market	1.00	1.00%	4.77%	6	100	6.00%	1.74%	21	12	33	20
Istanbul Stock Exchange	0.77	0.77%	4.06%	7.9	100	7.90%	2.58%	18	18	36	21
Taiwan Stock Exchange	0.60	1.20%	1.78%	8	50	16.00%	1.80%	23	14	37	22
Kuala Lumpur Stock Exchange	0.83	0.83%	2.71%	10	100	10.00%	2.75%	19	19	38	23
Jakarta Stock Exchange	0.53	1.18%	1.85%	5	45	11.11%	3.98%	22	23	45	24
American Stock Exchange	2.40	2.40%	6.65%	5	100	5.00%	3.32%	24	21	45	25

Markets are tabulated in Table 5 by a double ranking system. First, we calculate the average number of month-end cases that were ramped at the end of the previous trading day which subsequently revert to pre-ramped benchmark levels as a percentage of the number of index stocks. We rank them low to high, the former being the better. Where this result provides equivalent results we then rank by the magnitude of the price reversal (see Rank 1). Second, we rank by the average price change in the last 15 minutes prior to the close of trading at the end of month for the affected securities (see Rank 2).

Table 5 reveals that over the 30-month period, the number of potential ramping incidents is approximately 6 on the Frankfurt floor. Initial attempts to explain the Frankfurt result suggest that it arises partly as a result of proprietary price stabilisation algorithms and partly from close regulatory scrutiny of major price variances through market making of floor traders at these times. To rank markets on integrity, we compared the number of incidents of price reversals to the numbers of securities in the respective indices (frequency) *and* the average ramp movement (magnitude). A summarised score of equal weights for the two rankings is computed for each market to produce an overall integrity score. The graph in Figure 2 shows the two-tiered integrity ranking system and lines up the markets faring the best to the worst from left to right.

Figure 2

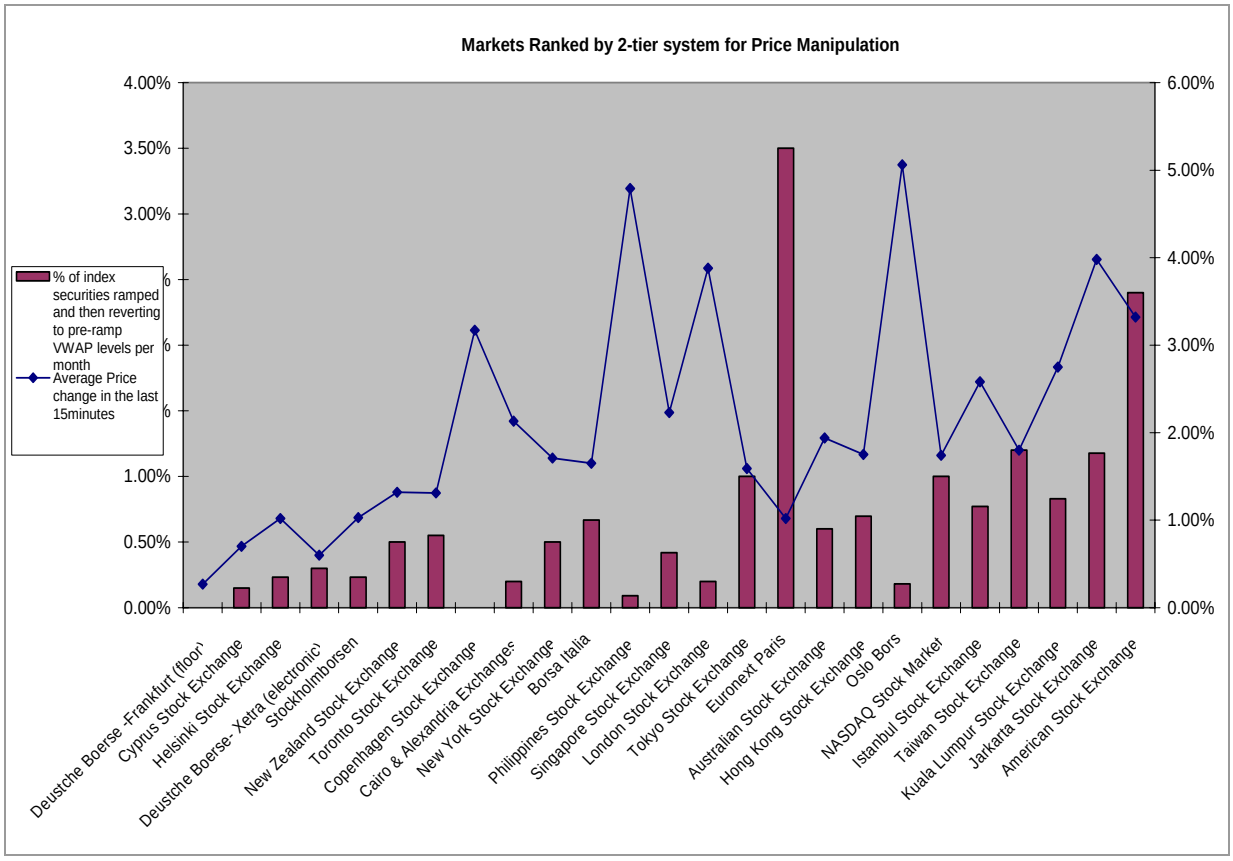


Table 6 provides an overall league ranking based on index securities alone. We assume equal weight to market integrity and efficiency and accordingly sum both ranks on efficiency and integrity to get an overall score for each market. The lower the score the better the market. (Where two markets have the same score, we favour the market with the least worst score in either of the two rankings, i.e. 5th in integrity and 8th in efficiency will beat 1st in integrity and 12th in efficiency, even though both sum to 13) Using this ranking procedure, XETRA (the Deustche Boerse's electronic market) is the clear winner ranking 3rd on efficiency and 4th on integrity. The New York Exchange follows closely behind being 1st on efficiency but faring a lower score of 10th for integrity. Both Stockholmborsen and the Toronto Exchange secure the third spot whilst five European markets including

Helsinki, Italy, Copenhagen and Paris hold the next positions. The top three Asia-Pacific exchanges, Tokyo, New Zealand and Hong Kong exchanges come in 10th, 12th and 14th overall. Note that New York is the highest ranking North American exchange on market integrity while the other North American markets some way behind.

In Europe, the Deutsche Boerse- Frankfurt has the highest integrity ranking, followed by Cyprus, Helsinki and XETRA (Deutsche Boerse's electronic market). In the Asia-Pacific region, the New Zealand exchange at 6th is followed by Philippines, and Singapore ranked 12th and 13th respectively. One possible reason for the New Zealand result may be the fact that this market does not have a developed funds management industry, one of the key reasons often cited for the likelihood of incentives to manipulate.

Table 6: Overall League Rankings on Market Efficiency and Market Integrity

Market	Efficiency Rank	Integrity Rank	Overall Score	Overall Rank
Deustche Boerse- Xetra (electronic)	3	4	7	**1**
New York Stock Exchange	1	10	11	**2**
Stockholmsbörsen	7	5	12	**3**
Toronto Stock Exchange	5	7	12	**3**
Helsinki Stock Exchange	11	3	14	**5**
Borsa Italia	4	11	15	**6**
Deustche Boerse -Frankfurt (floor)	14	1	15	**7**
Euronext Paris	2	16	18	**8**
Copenhagen Stock Exchange	12	8	20	**9**
Tokyo Stock Exchange	6	15	21	**10**
London Stock Exchange	8	14	22	**11**
New Zealand Stock Exchange	16	6	22	**12**
Cyprus Stock Exchange	23	2	25	**13**
Hong Kong Stock Exchange	10	18	28	**14**
Australian Stock Exchange	13	17	30	**15**
Singapore Stock Exchange	17	13	30	**15**
Cairo & Alexandria Exchanges	22	9	31	**17**
Taiwan Stock Exchange	9	22	31	**17**
NASDAQ Stock Market	15	20	35	**19**
Philippines Stock Exchange	25	12	37	**20**
Oslo Bors	20	19	39	**21**
Istanbul Stock Exchange	19	21	40	**22**
Kuala Lumpur Stock Exchange	18	23	41	**23**
American Stock Exchange	21	25	46	**24**
Jakarta Stock Exchange	24	24	48	**25**
Correlation	**0.2630769**			

Perhaps the most interesting result is the weakly positive correlation between efficiency and integrity. This suggests that there is no strong relationship between integrity and efficiency. This result is best exampled by Frankfurt, Cyprus and Helsinki, which scored high on integrity but lower on efficiency, and Paris, Italy and Tokyo which scored high on efficiency but lower on integrity. The Euronext Paris result is very stark. Ranked 2nd on efficiency but only 16th on integrity is a result that suggests that Euronext Paris may need to give more attention to systems to promote market integrity. An unexpected result is the low ranking of both the American Stock Exchange and the NASDAQ markets on both efficiency and integrity, particularly the latter which has reportedly spent significant sums on improving its regulatory division and its electronic surveillance systems. On the face of these results, this investment is yet to pay off. Future research is required to probe these results in order to understand how they arise.

Perhaps not so unexpected, though stark in its nature, is the frequent appearance of Asia/Pacific in the bottom half of the table. Tokyo is a case in point. As one of the world's largest markets, this result does not bode well for the reputation of the Tokyo market. Though ranked 6th on efficiency its rank of 15 out of 25 on market integrity suggest the need for urgent remedial action. Looking at these results in a more positive light, likely global alliances between markets in the future might be encouraged by the ability of one or other of the partners to contribute to greater market efficiency and/or integrity to the alliance.

We also perform a *spearman correlation test* which test for correlation between variables which are non-linearly related.

Spearman correlation coefficient:

$$r_s = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$$

r_s **= 0.2631** (< critical value of .336 at 5% level)

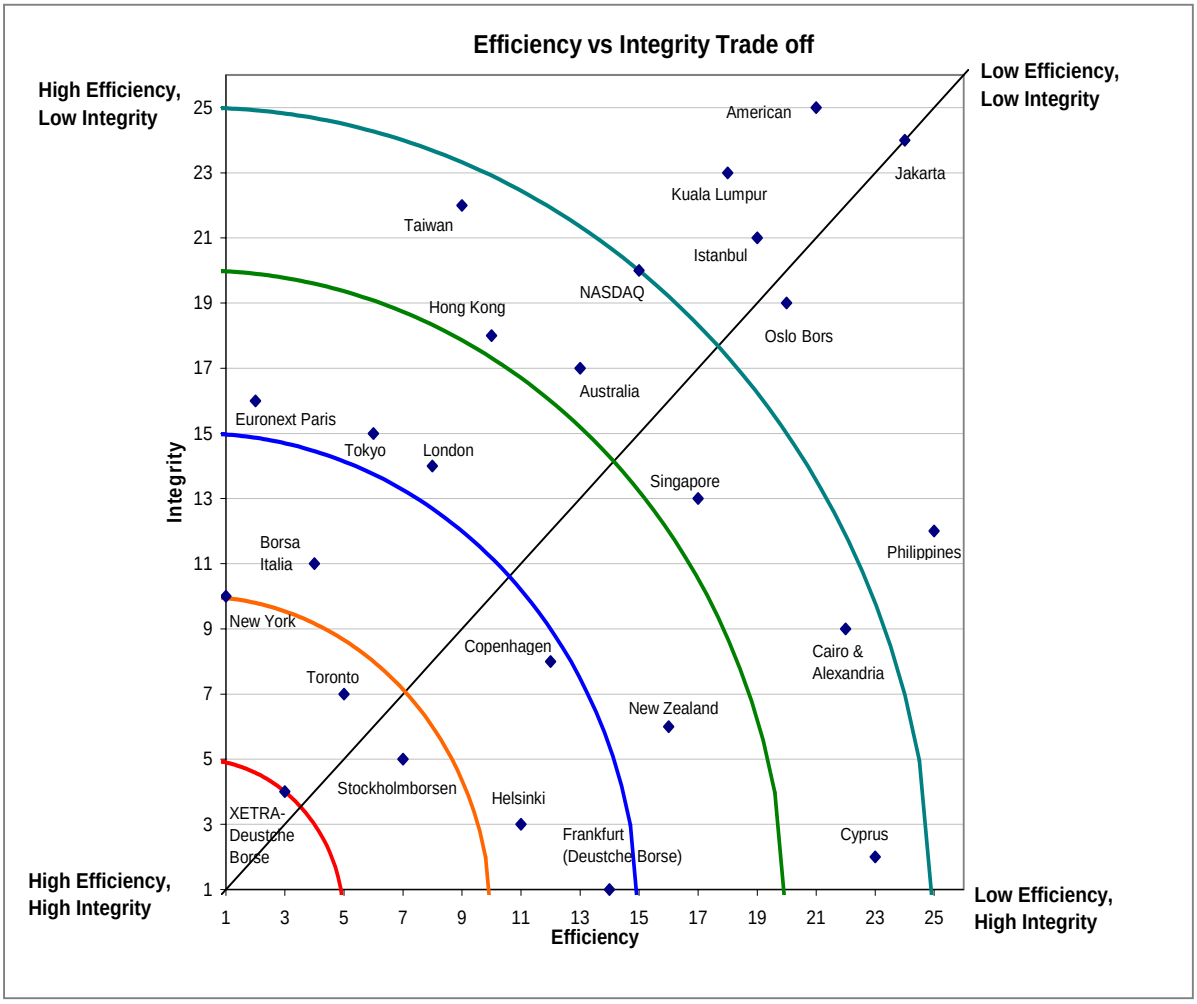
The coefficient is found to be statistically insignificant at the 95% confidence level. This suggests that from our first hypothesis, although markets, on the surface, seem to demonstrate their commitments to both goals of efficiency and integrity, we cannot statistically conclude that such a relationship is significant.

4.8.1 Finding the "Right" Balance

In this section, we attempt to represent the balance between the twin goals of efficiency and integrity the markets have demonstrated based on our results. The following Figure 3 is a scatter plot of the overall rankings for both efficiency and integrity across the markets. The 45 degree diagonal shows a direct one to one relationship between efficiency and integrity scores in the diagram space. The arcs form 'efficient frontiers' for different quadrant spaces within the sample (i.e. top 5, top 10 market space etc.)

If we were to assume that both efficiency and integrity are equally important , this would suggest that markets tending towards the 45 degree line are balancing their goals more 'right' than others. Further, markets that are closer to the origin (having top ranks in both categories) are also much 'better' markets.

Figure 3



The pattern from the scatter plot suggests that not only are the 'better' markets in the world (e.g. XETRA, Toronto, and Stockholm which are technologically and economically very advanced) highly ranked (close to the origin), they seem to balance their commitment towards efficiency and integrity more effectively (close to the diagonal).

From this, the scatter plot seems to support our second hypothesis which states that we expect better markets to be more committed to both goals, i.e. displaying better scores, due to their capabilities in advanced technology, research and economy.

We find a large concentration of European markets in the "top 10 to top 15" space (denoted by the blue and green boundaries) which seem to suggest that these developed nations have benefited technologically and economically from cross-border synergies arising from being in the European Union. We do not witness any Asia-Pacific market entering the "top 10" space, with only Tokyo and New Zealand bordering outside the frontier.

9. Sensitivity Analysis

In this section, we re-compute the efficiency and integrity scores to check whether the absolute rankings assigned to each market alter significantly when relative weights of each market are considered. We test whether one or some markets outweigh others by re-ranking them on their individual weighted scores obtained from the sum of all markets' scores in each category.

Table 7 shows the individual weighted raw scores which are calculated based on each market's spread as a proportion of the total sample's spreads. Thus, the higher the spread for the market as a proportion of the entire sample, the higher the weight applied to that market. The new overall rank (located in the far right column) show little deviation from the old method of ranking (effective equal weighting of each of the 3 individual scores) for the top ten markets. Notably, Borsa Italia fares much worse (dropping from an overall 11^{th} placing to 23^{rd}) under this method of classification as its spreads for decile 10 stocks fare one of the worst in the sample. Slight improvements are found in Copenhagen (from 13^{th} to 9^{th}) and Singapore (from 23^{rd} to 16^{th}) when uneven weights are placed on different groups of stocks under this ratio scale.

Table 7: Market Efficiency Rating based on the Size of the Average Time Weighted Relative Spreads II

Market	Index securities	Weighted Raw Score	Rank	Decile 1	Weighted Raw Score	Rank	Decile 10	Weighted Raw Score	Rank	New Sum	Old Overall	New Overall
New York Stock Exchange	0.09%	0.003766	1	0.12%	0.005623	1	2.41%	0.009248	3	0.01864	1	1
Euronext Paris	0.15%	0.005994	2	0.19%	0.009025	2	12.80%	0.049075	20	0.06409	5	6
Deustche Boerse- Xetra (electronic)	0.21%	0.008501	3	0.62%	0.029029	12	2.46%	0.009430	4	0.04696	4	4
Borsa Italia	0.23%	0.009378	4	0.58%	0.026980	11	39.49%	0.151402	25	0.18776	11	23
Toronto Stock Exchange	0.23%	0.009447	5	0.68%	0.031617	14	4.26%	0.016325	7	0.05739	6	5
Tokyo Stock Exchange	0.29%	0.011784	6	0.30%	0.014250	3	3.66%	0.014023	6	0.04006	2	2
Stockholmsbörsen	0.42%	0.017230	7	0.41%	0.019092	4	17.01%	0.065230	22	0.10155	8	11
London Stock Exchange	0.44%	0.017928	8	1.14%	0.053268	18	9.68%	0.037109	14	0.10830	12	13
Taiwan Stock Exchange	0.51%	0.020744	9	0.48%	0.022283	6	0.74%	0.002845	1	0.04587	3	3
Hong Kong Stock Exchange	0.53%	0.021511	10	0.81%	0.037680	16	2.86%	0.010977	5	0.07017	7	7
Helsinki Stock Exchange	0.59%	0.023970	11	0.57%	0.026709	10	9.50%	0.036442	13	0.08712	9	8
Copenhagen Stock Exchange	0.62%	0.025248	12	0.62%	0.029179	13	9.88%	0.037867	15	0.09229	13	9
Australian Stock Exchange	0.66%	0.026908	13	0.48%	0.022517	7	12.06%	0.046242	19	0.09567	10	10
Deustche Boerse -Frankfurt (floor)	0.67%	0.027208	14	1.88%	0.088178	24	7.94%	0.030429	10	0.14582	18	19
NASDAQ Stock Market	0.83%	0.033514	15	1.41%	0.065872	22	10.53%	0.040371	17	0.13976	22	17
New Zealand Stock Exchange	1.04%	0.042170	16	0.52%	0.024351	9	10.26%	0.039340	16	0.10586	14	12
Singapore Stock Exchange	1.06%	0.043197	17	0.84%	0.039205	17	14.94%	0.057286	21	0.13969	23	16
Kuala Lumpur Stock Exchange	1.07%	0.043602	18	0.76%	0.035743	15	9.12%	0.034974	12	0.11432	17	14
Istanbul Stock Exchange	1.54%	0.062492	19	1.56%	0.072983	23	7.52%	0.028834	8	0.16431	19	21
Oslo BØrs	1.59%	0.064594	20	0.52%	0.024267	8	17.31%	0.066354	23	0.15521	20	20
American Stock Exchange	1.64%	0.066729	21	0.41%	0.019092	5	10.88%	0.041712	18	0.12753	16	15
Cairo & Alexandria Exchanges	1.99%	0.080753	22	1.19%	0.055673	19	1.17%	0.004486	2	0.14091	15	18
Cyprus Stock Exchange	2.20%	0.089274	23	1.28%	0.059883	20	7.77%	0.029792	9	0.17895	21	22
Jakarta Stock Exchange	2.51%	0.101793	24	2.07%	0.096997	25	8.43%	0.032316	11	0.23111	24	24
Philippines Stock Exchange	3.41%	0.138294	25	1.39%	0.065086	21	18.14%	0.069608	24	0.27299	25	25

The integrity scores are also treated in the same manner and weights are assigned to each raw score obtained by the markets for the average price change in stocks for the last 15 minutes prior to the close and the percentage number of index securities that were ramped and subsequently reverted to pre-ramp volume weighted average price levels per month in our analysis period.

Table 8 sets out the weighted scores and the overall new rankings. As with efficiency ranks, the overall integrity ranking for the markets do not change significantly. The top ten markets still maintain their ranks with the exception of the Singapore, Tokyo and Paris markets, all which improved two notches to secure the 11th, 13th and 14th placings

respectively under the new ranking method. Notably, the Hong Kong Exchange, Philippines Exchange and Oslo Børs fared much worse. Hong Kong dropped four notches to secure a 22nd rating for integrity whilst the Philippines moved down by six places to a 19th placing. Oslo also moved six spots to join the bottom of the table. Such poor results are often driven by the magnitude of price changes in the last 15 minutes of trading prior to the close.

Table 8 : Market Integrity Rating based on average number of price reversals on index securities per month (from October 1999 to March 2002) relative to the number of securities in the index AND the average ramp movement II

Market	ave # mth-end cases reverting to level of pre-ramped VWAP next day	% of index securities ramped and then reverting to pre-ramp VWAP levels per month	# securities in Index	Raw Score for % of index securities ramped and reverting	Rank1	Average Price change in the last 15minutes	Raw Score for Average Price change in the last 15 minutes	Rank2	Old Sum	New Sum	Old Overall Rank	New Overall Rank
Deustche Boerse -Frankfurt (floor)	0	0.00%	30	0	1	0.27%	0.00506	1	2	0.00506	1	1
Cyprus Stock Exchange	0.03	0.15%	20	0.00862	4	0.70%	0.01312	3	7	0.02174	2	2
Helsinki Stock Exchange	0.07	0.23%	30	0.01341	8	1.02%	0.01912	4	12	0.03253	3	4
Deustche Boerse- Xetra (electronic)	0.09	0.30%	30	0.01724	10	0.60%	0.01125	2	12	0.02849	4	3
Stockholmsbörsen	0.07	0.23%	30	0.01341	8	1.03%	0.01931	6	14	0.03272	5	5
New Zealand Stock Exchange	0.20	0.50%	40	0.02874	12	1.32%	0.02475	8	20	0.05348	6	7
Toronto Stock Exchange	0.33	0.55%	60	0.03161	14	1.31%	0.02456	7	21	0.05617	7	8
Copenhagen Stock Exchange	0	0.00%	20	0	1	3.17%	0.05943	20	21	0.05943	8	9
Cairo & Alexandria Exchanges	0.10	0.20%	50	0.01149	6	2.13%	0.03993	16	22	0.05143	9	6
New York Stock Exchange	0.50	0.50%	100	0.02874	12	1.71%	0.03206	11	23	0.06080	10	10
Borsa Italia	0.20	0.67%	30	0.03832	16	1.65%	0.03093	10	26	0.06925	11	12
Philippines Stock Exchange	0.03	0.09%	33	0.00522	3	4.79%	0.08980	24	27	0.09503	12	19
Singapore Stock Exchange	0.23	0.42%	55	0.02403	11	2.23%	0.04181	17	28	0.06584	13	11
London Stock Exchange	0.20	0.20%	100	0.01149	6	3.88%	0.07274	22	28	0.08424	14	15
Tokyo Stock Exchange	1.50	1.00%	150	0.03448	20	1.59%	0.03637	9	29	0.08728	15	13
Euronext Paris	1.40	3.50%	40	0.01045	25	1.02%	0.09486	4	29	0.22028	16	14
Australian Stock Exchange	1.20	0.60%	200	0.20116	15	1.94%	0.01912	15	30	0.07086	17	16
Hong Kong Stock Exchange	0.23	0.70%	33	0.05747	17	1.75%	0.02981	13	30	0.07287	18	22
Oslo Børs	0.10	0.18%	55	0.04006	5	5.06%	0.03281	25	30	0.10531	19	25
NASDAQ Stock Market	1.00	1.00%	100	0.05747	21	1.74%	0.03262	12	33	0.09010	20	17
Istanbul Stock Exchange	0.77	0.77%	100	0.04426	18	2.58%	0.04837	18	36	0.09262	21	18
Taiwan Stock Exchange	0.60	1.20%	50	0.06897	23	1.80%	0.03375	14	37	0.10272	22	21
Kuala Lumpur Stock Exchange	0.83	0.83%	100	0.04770	19	2.75%	0.05156	19	38	0.09926	23	20
Jakarta Stock Exchange	0.53	1.18%	45	0.06769	22	3.98%	0.07462	23	45	0.14231	24	23
American Stock Exchange	2.40	2.40%	100	0.13794	24	3.32%	0.06224	21	45	0.20018	25	24

Next, we reconsider the new ranks based on weighted scores to re-produce the overall league rankings as shown in Table 9. Our results show that the overall rankings do not alter significantly. The top 10 markets remain within their class with the exception of Paris. Paris moves from an overall 8th placing to the 15th position. Once again, this is highly attributable to the fact that the market's percentage change in prices in the 15 minutes prior to the close was abnormally higher than the rest of the sample, rendering it a higher weight and thus a poorer integrity scoring. We witness slight improvements in terms of overall standing for most mid-tiered markets such as New Zealand, Hong Kong and Australia. Istanbul and Kuala Lumpur both registered the highest improvements by two places to move to 20th and 21st respectively. The new correlation coefficient which is slightly lower than the previous score is also found to be statistically insignificant.

Table 9: Overall League Rankings on Market Efficiency and Market Integrity with weights

Market	Efficiency II	Integrity II	Overall Score	Overall New Rank	Old Rank
Deustche Boerse- Xetra (electronic)	3	3	6	**1**	1
New York Stock Exchange	1	10	11	**2**	2
Stockholmsbörsen	7	5	12	**3**	3
Toronto Stock Exchange	5	8	13	**4**	3
Helsinki Stock Exchange	11	4	15	**5**	5
Deustche Boerse -Frankfurt (floor)	14	1	15	**6**	7
Borsa Italia	4	12	16	**7**	6
Copenhagen Stock Exchange	12	9	21	**8**	9
Tokyo Stock Exchange	6	16	22	**9**	10
London Stock Exchange	8	15	23	**10**	11
New Zealand Stock Exchange	16	7	23	**11**	12
Hong Kong Stock Exchange	10	14	24	**12**	14
Cyprus Stock Exchange	23	2	25	**13**	13
Australian Stock Exchange	13	13	26	**14**	15
Euronext Paris	2	25	27	**15**	8
Singapore Stock Exchange	17	11	28	**16**	15
Cairo & Alexandria Exchanges	22	6	28	**17**	17
Taiwan Stock Exchange	9	21	30	**18**	17
NASDAQ Stock Market	15	17	32	**19**	19
Istanbul Stock Exchange	19	18	37	**20**	22
Kuala Lumpur Stock Exchange	18	20	38	**21**	23
Oslo Børs	20	22	42	**22**	21
Philippines Stock Exchange	25	19	44	**23**	20
American Stock Exchange	21	24	45	**24**	24
Jakarta Stock Exchange	24	23	47	**25**	25
New Correlation			**0.1938462**		

10. Conclusions and Further Research

Our purpose in this research was to provide an indicative ranking on market efficiency and integrity for 25 world equity markets from the North American, European, Middle-eastern and Asia-Pacific time zones. Accepting the limitations of our design and data, the results suggest that the German XETRA (electronic) market and the New York Stock Exchange stand out among their international rivals as markets of high efficiency and integrity. Somewhat surprisingly however, the other North American markets (in particular NASDAQ and the American Stock Exchange) do not complement this image and overall European markets dominate eight of the top ten places. With some exceptions Asia-Pacific exchanges tend to lag their international competitors on both efficiency and integrity.

We found little correlation between efficiency and integrity leading us to speculate that in the interest of generating revenues, markets may have focused too much on the building of trading and settlement systems rather than surveillance and other regulatory systems in the past decade. Perhaps markets surveillance is being thought of as an adjunct to trading systems rather than a discipline in its own right requiring dedicated resources. It will be interesting, for example, as the subject of further research, to see whether other members of the Euronext alliance[18], have similar integrity rankings to Paris[19]. Should this be the case it might have implications for the amount of effort the alliance devotes to market surveillance as opposed to trading and settlement. Somewhat unexplained are the results for NASDAQ, a group that has dedicated significant resources to developing their regulatory and in-house electronic surveillance systems over the last decade. Future research might investigate the

[18] Euronext is the largest integrated, cross-border European market in the euro region that includes member organizations such as the Paris Bourse, Amsterdam and Brussels exchanges etc.

[19] We are currently undertaking similar analysis for Brussels and Amsterdam exchanges to test this theory. Interested readers are welcome to write to us for the results. Also, if you are associated with a market not covered by this study we expect to have more comprehensive market coverage to September 2004. We invite interested readers to register their interest in a particular market for subsequent communications.

effectiveness of this expenditure and/or whether there are natural lags between expenditure and results.

In an effort to cover as many markets as possible we restricted our analysis to one specific proxy for market efficiency and market integrity. We also performed a sensitivity analysis by re-weighting the factors we considered when ranking the markets. We found that it did not change the placing of the markets considerably. Future research might use a multi-factor approach, one objective of which might be to test whether these results stand up. Further research needs to test the robustness of these results to the assumptions made. That evidence which was provided in this vein, using different groups of securities based on size, suggests that while the results do vary, they did not change significantly.

Future research should also extend the analysis to the derivative markets and consider the impact of other periods (e.g. option expiry dates) to single out other market events that may have impacted our results. Finally, more detailed order book data (including volume weighted spreads) and the possibility of using longer time series might also allow us to determine whether there are perceptible changes in these ratings consistent with new regulatory and efficiency initiatives by particular markets. This involves gaining a deeper understanding of the structure of the respective markets and how this structure has changed through time. This might be achieved by an alliance of researchers from each of these markets.

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Appendix 1

Quotes from Various Lead Exchange Websites

New York Stock Exchange – www.nyse.com

"To help reassure investors and support customers, the Exchange further reduced trading costs and increased **operating efficiencies**, strengthened regulatory and governance standards, and introduced new ways for customers to access the market."

"Providing the highest possible market quality was our top priority, along with ensuring the **liquidity** and **transparency** that market participants have come to expect."

NASDAQ Market – www.nasdaq.com

"NASDAQ is among the world's most regulated stock markets, employing sophisticated surveillance systems…to protect investors and provide a **fair and competitive** trading environment."

"Offering growth and **liquidity**, fostering innovative technologies…NASDAQ continues to build the most **efficient** trading environment…to the benefit of all market participants and investors."

London Stock Exchange- www.londonstockexchange.com

"The FSA summarises its job as "To maintain **efficient, orderly and clean** financial markets and help retail investors achieve a **fair** deal…"

Euronext- www.euronext.com

"A business corporation that supervises listings on the exchange, ensures **efficient** trading, provides a guarantee of final settlement of transactions, disseminates market data in real time, and promotes securities markets in general."

"Euronext aims to provide a **fair and orderly** market with built-in safeguards for the quality of price formation. Euronext is of the opinion that market participants should have a **level playing field**."

Toronto Stock Exchange- http://www.tse.com/en/aboutUs/tse/index.html

"Toronto Stock Exchange provides an **efficient, liquid** market for senior equities".

"Market Regulation Services Inc. is a national, not-for-profit, self-regulatory organization. It seeks to foster investor confidence in the Canadian securities market and to safeguard investors by maintaining **fair and orderly** marketplaces. It is jointly owned by the TSX and the Investment Dealers Association of Canada**."**

Australian Stock Exchange- http://www.asx.com.au

"…the growing market capitalisation of the market have combined to increase **the depth and liquidity** of the market - two of the most crucial elements, along with **integrity** of a successful market;"

"The reputation of ASX's markets for **fairness and integrity** is very important to ASX. Maintaining this reputation involves constant and vigilant supervision."

Tokyo Stock Exchange- http://www.tse.or.jp

"The management aims are stipulated in the Tokyo Stock Exchange's constitution as, "In order to contribute towards the protection of the public interest and investors, the trading of securities must be carried out in a **fair and efficient** manner."

Hong Kong Sock Exchange- http://www.hkex.com.hk

"HKEx is committed to performing its public duty to ensure **orderly and fair markets** and that risks are managed prudently, consistent with the public interest and in particular, the interests of the investing public. "

"The powerful resources of its new integrated market structure will ensure that Hong Kong remains one of the most important centres for providing critical hedging and risk management facilities and for financing the development of China. At the same time, Hong Kong has the upward momentum to develop as a leading market with **maximum liquidity and minimum transaction costs.** "

Taiwan Stock Exchange- http://www.tse.com.tw/docs/eng_home.htm

Mission statements:- " To provide innovative, **efficient** and superior services."

" To maintain a **fair** open and safe trading market."