The consequences of online information dissemination on stock market liquidity and efficiency: Implications on African markets

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THE CONSEQUENCES OF ONLINE INFORMATION DISSEMINATION ON STOCK MARKET LIQUIDITY AND EFFICIENCY: IMPLICATIONS ON AFRICAN MARKETS[1]

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ABSTRACT

From the Efficient Market Hypothesis, a market is efficient if security prices fully and correctly reflect all available information that is relevant for the stock's pricing. This requires a medium of information dissemination and transaction ordering with both speed and accuracy. This paper chronologically presents arguments in favour of the internet as one such medium. The internet has also enabled the transmission and archiving of bulky information in a ready-to-use format. And abnormal returns are now quickly observed and arbitraged away to non-existence. Using correlation analysis, we find a positive relationship between the internet and some stock market development indicators.

INTRODUCTION

Market efficiency, as defined by Fama (1970), depends on the '*speed* 'and '*accuracy'* with which '*information'* is incorporated into prices. The speed requires the fastest medium of information dissemination that makes the information available in the market immediately and promptly to all stakeholders concerned. The past century has seen an eruption of such media with significant improvement in speed since the establishment of the first stock market in the 18th century. Before the advent of the internet, stocks prices on different markets would respond to information with lags of days' length.

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Now it is only a matter of minutes, if not seconds to get market information across the world. This has made it easier to observe when a stock's price deviates from its intrinsic value and thus arbitraging away any abnormal gains. As Professor Goetzmann of Yale School of Management put it:

"By *the 18th century, financial news travelled fast -- in Rothschild's case it may have travelled by carrier pigeon. Studies of the efficiency of stock prices in this era indicate that when prices moved on the Amsterdam Stock Exchange on Monday, by Thursday they would move on the London Stock Exchange -- this is about the time it took for a fast messenger to travel the distance from city to city crossing the English Channel*." [Online quote][2]

In the early development of stock markets, traders were local enterprises and individuals, meaning that investors were confined to their locality. Slowly with the improvements in communications, starting with the telegraph and telephone, these markets transferred from being local markets to national markets. With further developments of the international telegraphic communications from the mid-19th century onwards, the obstacle in the investment arena between nations slowly dissipated, and most stock markets worldwide have become increasingly integrated with the advent of the Internet. The competence of the Internet as a communication and information transport medium, and the ease with which information can now be accessed allow investors to globalise their investments by extending into offshore markets. The market for each stock exchange has expanded from confinement to local investors to a huge world market.

Today, the response of stock prices world-wide tends to promptly occur irrespective of the geographical locations and national boundaries separating the stock exchanges. It is not questionable that the internet, which came with the electronic information revolution, has played a very significant role in this development. Sirigidi (1996) stated that this has been enabled by the rapid advancement of computer and telecom technologies and its close ties to effective information management techniques. He highlighted that the combination of computing technology and information power has influenced changes in the global industrial scenario and expert forecasts have improved. The Internet is now rife with market timing newsletters purporting to find long-term patterns in stock markets. The internet has greatly increased the liquidity and efficiency of stock markets around the world with the globalisation of the investment community.

1. INFORMATION DEFINED

Market efficiency is all about 'information' and is therefore also known as informational efficiency. But what is information? Freiden et al (1998) discussed information as a product whose nature can be in different forms such as words, numbers, pictures, software, sounds, videos and so forth. The information content may be in the form of news intelligence, facts and ideas that are acquired and passed on as knowledge. As Yuen et al (2001) observed, the most frequently requested by investors are corporate filings, news articles, trading data and information about listed companies. According to Freiden et al (1998), the initial thrust in the information industries has been creating new forms of information and technologies that are used to compile and disseminate it.

[2] http://viking.som.yale.edu/will/web_pages/will/finman540/classnotes/class8.html

Clarke and Rollo (2001) contributed to the definition of information by providing a distinction between data, information and knowledge. They defined data as sets of discrete objective facts, presented without judgement or context. Data is said to become information when it is categorised, analysed, summarised and placed in context, becoming intelligible to the recipient or user. Information, on the other hand, is data endowed with relevance and purpose. Information develops into knowledge when it is used to make comparisons, assess consequences, establish connections and engage in dialogue. Knowledge can be seen as information that comes with insights, framed experience, intuition, judgement and values, and it becomes wisdom when put to best use.

In financial markets, news reports are either in data form, information, knowledge or any combination of the three. Data, in financial markets usually refers to statistics such as prices, volumes and number of trades and is usually bulky. Without proper analysis, it is not easily intelligible or useful in decision-making. Research and investment analysts' reports can be said to provide information under Clarke and Rollo's (2001) definition. With inclusion of stock valuations and recommendations to buy, hold or sell specific stocks, these reports can be passed on as knowledge.

Freiden et al (1998) highlighted qualities of information, which they described as 'FACT', that is, Form, Accuracy, Completeness, and Timeliness. *Form* relates to the mode or medium through which the information is made available. An online information service is of little use to potential customers who lack access to the Internet. *Accuracy* describes how well the information represents the phenomena it purports to describe. Information that is inaccurate is misinformation and can be misleading or harmful to information consumers. *Completeness* refers to how much of the target phenomenon is described by the information available. Incomplete information may be useless to consumers or may have only reduced value. *Timeliness* refers to how up-to-date or current the information is. Outdated information is obsolete and may be of little or no value. It may in fact be misinformation and may mislead users. The importance of these qualities are nowhere better placed than in financial markets.

2. ONLINE INFORMATION DISSEMINATION

There are basically four different types of participants in the information market, the producers of the information, the brokers, value-adders and consumers (Yuen et al, 2001). For a financial information market, investors are the major consumers. While information is neither used up nor changed through consumption, it can become outdated with time. One other unique feature of information is that it can be consumed at a distance from its production site and can be distributed through several channels such as word of mouth, an ordinary store or mail order, dedicated phone lines and appropriate hardware such as the Internet.

Though a large part of published business information is available in printed form, databases are becoming increasingly important (Siriginidi, 1996). In the current era of information technology, also known as the Digital Information Age, it is almost the norm that information is stored and disseminated electronically. Traditionally, financial information/data was disseminated through traditional media or channels. Yuen et al (2001) remarked that at one time in the USA, financial filings were only made available to the public via five nation-wide Securities Exchange Commission (SEC) - reading rooms.

In order to obtain the information they needed, investors had to travel to these locations, do a search and make photocopies. Private companies that also provided financial information via dedicated connections were charging extremely high prices. Although real-time financial information became readily available on a real-time basis, not every investor could afford it.

The age of information technology (IT) brought with it the fastest medium of information dissemination with the capacity to handle large volumes of information and this medium is the Internet. With IT, statistical data and most financial information have been digitised and are much easier to handle and disseminate through the Internet despite the large volumes. According to Kamel and Hussein (2001), the Internet and the formulation of information highways have led to the development of the global information society that is driven by information dissemination and knowledge acquisition and management. Freiden et al (1998) also argued that as the world enters the information age, all types of digital data have become more important to many aspects of business, and selling, transporting and manipulating information has become a huge business.

The bulk of financial data is disseminated through the Internet in the hope that it will be widely available and useful to users (Yuen et al, 2001). When information is disseminated online, there is very little lag in the time with which it arrives in the market. The only time lag will be the time difference with which investors log-on and surf on the Internet. Professional and institutional investors, however, usually stay connected for the whole time that the stock exchanges are open. These investors immediately act upon almost all the information that comes into the market. Most other small investors have their portfolios managed by Mutual Funds. The Fund Managers also keep track of the different shares and try to get first hand information, and in most cases they do this through the online information media. Without a speedy transmission of information, prices would not reflect the information immediately and markets would not be efficient.

3. ONLINE TRADING

Market efficiency is not just about the speed with which information comes into the market but also the speed with which it is incorporated into prices. Incorporation involves investors' trading activities and the Internet has greatly improved this. Investors now have access to the fastest medium that enables them not just to acquire the information but also to execute transactions promptly, efficiently and at their convenience. Unsal and Movassaghi (2001) argued that the Internet has essentially allowed the ordinary investor more autonomy and flexibility in participating and influencing the market.

The appeal of online investing, as noted by Unsal and Movassaghi (2001), is the reduced transaction costs, convenience, speed and ease of use, and sense of control of one's own decisions that the online investor enjoys. Online trading enables investors to place their orders even after normal stock market trading hours and thus offer unlimited trade time. The Internet has enabled investors to access more reports and charts from more than one broker. In addition, investors can now search for the best broker for their needs with lower costs and reliability of service without going from one broker's office to another.

The increased competition, low transaction costs and free information that comes with online trading promotes market efficiency. According to Unsal and Movassaghi (2001, p58) "the playing field has become more level than before between the small investor and the Wall Street pros" when it comes to investment research and analysis on the Web.

Before investors can efficiently trade online on any market, it is a prerequisite that the market has electronic trading and settlement systems in place. Electronic trading and settlement promote the efficient operation of the stock market and improve its efficiency and liquidity through automated matching of buyers and sellers. Kadapakkam (2000) found that the introduction of the electronic settlement system on the Hong Kong Stock Exchange resulted in lower costs for arbitrageurs by reducing their minimum holding period for trades around ex-dividend days. Kadapakkam also found that the consequent reduction in risk exposure lowered the costs faced by arbitrageurs and enabled them to actively exploit positive ex-day returns. The switch to electronic settlement on the Hong Kong Stock Exchange led to an immediate drop in ex-day abnormal returns due to increased arbitrageurs actively eliminating excess returns in high-dividend-yield stocks. The finding was that with electronic settlement, the market is never dry up of trading volume as before. Kadapakkam observed that there was actually an increase in volume both before and after the ex-day in comparison to the period of physical settlement.

4. PROS AND CONS OF THE ONLINE MEDIA IN FINANCIAL MARKETS

4.1 Pros

There are several qualities of the online media that have made it more relevant in financial markets compared to other communication and information media. Financial analysts deal with bulky qualitative and quantitative information in their daily trading activities and decision-making processes. The timeliness and reliability of the information provided is of the essence. The following is a brief illustration aimed at highlighting the desirable qualities of the Internet in the dissemination of financial information and transaction-ordering in comparison to the telephone media.

Providing timely relevant information to investors that enables them to make informed decisions is a challenge. Even though the telephone, when compared to the print media, is a fast communication tool, it is less desirable in comparison to the Internet when it comes to the dissemination of financial information. We highlight the weaknesses of the telephone as information dissemination medium and in the process reveal the strengths of the Internet. What then are the weaknesses of the telephone?

a) *It cannot be used for bulky information*, yet such are what characterise information in financial markets.

b) *It is not time and cost efficient*. One cannot simultaneously reach all the investors over the phone by a single call. To reach a million investors, one has to dial a million plus times.

c) *Not all investors will have accurate information at a particular point in time*. Some investors will get information through rumours as it *leaks* from those who already have it. The word "leak" means that such information will only be a certain percentage of the full information. This "leaked" information, upon which some investors will act, will not be full and accurate as required by market efficiency.

d) *It will result in overreaction and/or under-reaction*. Those who would have acted upon the rumours would tend to readjust their actions. At first they tend to overreact or under-react through speculation, causing irrational adjustments in prices, as rumours are likely to give incomplete and/or inaccurate information. The second reaction would occur when accurate information is received (that is, from a reliable source) at which time these investors correct their positions and in so doing influence the prices. Assuming that the only dissemination media are the telephone and print media, each investor will only have accurate information through either of the two. Even if investors would want to confirm the rumours with the source before they act, call congestion would result in many investors eventually giving up, out of frustration. Instead of waiting to confirm the rumours or to receive accurate information, most investors will act on the rumours as if it were information with the intention of readjusting if and when the rumours proved to be incomplete or inaccurate. Can the stock market be efficient in such an environment?

e) *It gives room for insider trading and monopoly over information*. The information disseminated over the phone comes into the market with a lag, that is, not all investors would have accurate information at the same point in time. The first person receiving accurate information (i.e. the first person to be called) will have monopoly over that information and will tend to act upon it before the whole market does. This monopoly will dissipate from one person to the next in the chronological order in which they get the information. The stock price will only fully reflect the information when the last market participant gets the full/accurate information, at which time the participant is assumed to act[3]. This gradual incorporation of information into prices is evidence against the strong form of market efficiency.

[3] This action might be a readjustment to an initial action based on rumours.

The overreaction, under reaction and lagged response described above can be illustrated diagrammatically as follows:

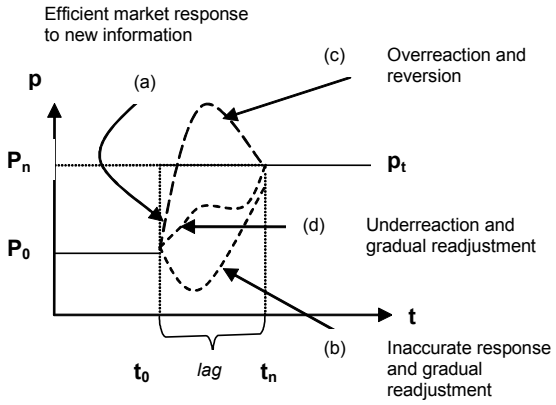

Figure 1: Market response to information

The diagram shows that before the new information, the stock was trading at price P_0. The information content of the news will cause the price to immediately jump to P_n if the market is efficient. However, in the absence of a medium that ensures that all investors receive the news as accurate and timely information, the price might not necessarily jump as indicated by (a) in the diagram. Inaccurate or incomplete information may result in responses such as (b) or (c) or a sluggish response such as (d). Response (d) may also be a reflection of the time lag with which investors get and respond to the information. The Internet, on the other hand, seems to provide information with 'FACT', that is, *form*, *accuracy*, *completeness* and *timeliness* much more than the other media.

4.2 Cons

The Internet has opened doors to rapid and abundant releases of information. According to Yuen et al (2001), huge amounts of financial data and information are generated daily and the number of websites providing such information on the Internet has increased very rapidly creating the problem of information overload. This overload of information on the Internet has been further exacerbated by the quality of such information. This has caused the Internet to be termed an 'information jungle' by some people. It, therefore, requires skill to sift through this jungle for the relevant information. The reduced quality of information has made it difficult for users, especially the inexperienced investors, to determine and interpret the relevance and reliability of the information. Searching, retrieving and utilising financial data has become a major challenge to both users and researchers.

In a survey by Yuen et al (2001) on the usage of financial information on the Internet, the respondents indicated that financial information on the Internet is time consuming to gather; volatile to "catch"; poorly distributed and fragmented in nature; bulky to store; too fast to collect; easily perishable; not unique; varying in content representation and format; and difficult to be processed by humans. Availability of information has now ceased to be the major problem but the ability of the market to interpret such information has become a major concern. Yuen et al (2001) indicated, however, that different countries have developed different electronic financial filing systems to make it more web-accessible to investors. An ideal electronic filing system is one that allows the submission of documents via the Internet to increase the speed of transmission as well as to lower transmission costs, among other things. Such an electronic financial filing system, according to Yuen et al (2001), would increase the transparency and efficiency of markets and would foster a sound environment for financial investment. Due to the information overload on the Internet, it has become extremely critical, especially for the individual investors to know who and how credible the information provider is (Unsal and Movassaghi, 2001). As observed by Unsal and Movassaghi (2001) some firms may promote certain stocks online to boost their prices without disclosing their relationships to the companies they are pushing. While market efficiency requires that the information is accurate and complete, induced boosting of prices is surely against market efficiency. Investors who lack knowledge about securities trading would be better off with full-service brick and mortar brokers. Investment and research reports on some online broker dealers' web sites can be mistaken by investors as recommendations to buy or sell certain stocks (Higgins, 2002).

It has also been questionable if traders get the best possible execution in terms of the best price from their online brokers. Some online brokers also do not provide all the necessary information on risks and returns of different products to investors to enable them to make informed decisions. For example, some of the complaints lodged with the SEC in the US are in connection with broker dealers not disclosing adequate information about when they would sell securities in a margin account, misuse of personal information and allowance of unauthorised access to trading accounts (Higgins, 2002).

Online investors also tend to trade more frequently than do the full-service clients and many tend to trade relying on human emotions. Online trading has thus encouraged short-term and noise trading in the form of what has become known as "online day rapid-fire trading" designed to capture tiny price differentials in stocks, instead of long-term profits from buying and holding securities (Unsal and Movassaghi, 2001). Supporters of short-term traders argue that these traders make a key contribution to the efficiency of financial markets by constantly scouring the markets for arbitrage opportunities, while the critics contend that these traders engage in speculation, leading to excessive and sapping volatility in market prices. Kadapakkam (2000), however, found evidence supporting the argument that removing constraints on short-term trading improves financial markets' pricing efficiency.

Online investing is also known to suffer from the problem of delays and outages. According to Unsal and Movassaghi (2001) and Higgins (2002), there was an outage in America in January and February of 1999. Many of the largest online brokerage firms in America are said to have failed to handle the torrent of trades unleashed by the heady stock market resulting in their systems breaking down (Unsal and Movassaghi, 2001). Online investors could not execute their trades resulting in the loss of financial opportunities.

5. THE INTERNET AND MARKET EFFICIENCY

An efficient market is one with the ability to efficiently process all relevant information. The Internet tends to reduce market frictions in terms of information availability and costs, thus promoting the market towards efficiency. According to Ross (2002)[4], randomness, in Samuelson's definition, is achieved through the active participation of many investors seeking greater wealth. These investors tend to pounce on even the smallest informational advantage at their disposal and in so doing, incorporate their information into market prices. In a world of frictionless markets and costless trading, this occurs instantaneously and thus the prices will always fully reflect all the available relevant information.

Over the past couple of years, the Internet, among other events, has spurred investors to reconsider the Efficient Market Hypothesis (West, 2002). This is because the flow of information has become faster with the Internet and surprises are factored in instantaneously (Hill, 2002). The Internet has promoted open-information economies, thereby increasing arbitrage activities and leading to more efficient prices. According to Kamel and Hussein (2001), today the Internet is a major driving force of change in the global market place. They argued that the world is becoming more and more aware of the opportunities enabled by the Internet as a vital source of information and knowledge at the individual and organisational level. The Internet has also enabled the internationalisation of economies leading to loss of local government control in many cases. New electronic-based services act as middlemen to locate, organise and present information to consumers.

Data and information is, however, valuable if the end-user is able to systematically convert, synthesise and create financial knowledge out of it. According to Yuen et al (2001), transparency and efficiency are two extremely important issues to users of financial information. With transparency, investors are able to know about the market's operations and its major activities while efficiency refers to the time and effort needed by users to search and retrieve the necessary information. Yuen et al (2001) remarked that in order to make high quality decisions and narrow the gap between private and institutional investors, both issues need to be solved. The activities of professional investors focussing on global markets require a medium such as the internet. These activities range from monitoring the latest price movements, analysing the trends and future performance of certain financial instruments and watching the latest news that may affect the prices. In addition, they need to study the background of the investment environment, complete and comply with some formally required investment procedures, manage portfolios and seek advice from other experts before making a decision (Yuen et al, 2001). The Internet, as a major information source and communication tool, has made it easier for investors to achieve all this by making information available that covers almost all the major financial markets and instruments in the world. A person with more complete market information is in a much better position to support investment decision-making than is someone whose information is insufficient.

[4] http://www.basicsoftrading.com/journal/2002-4/04-02/

5.1 Internet Accessibility to the African Investor[5]

Emerging markets, in particular, differ from their counterparts in developed nations in their information-related attributes and their institutional infrastructures (Kumar and Tsetsekos, 1999). The free flow of information to all participants is a necessary condition for market efficiency (Kumar and Tsetsekos, 1999) and this may not be the picture in emerging markets where information asymmetry is perceived to be an inherent characteristic. The Internet could be considered an important infrastructure in the efficient operations of stock markets today. The global Internet market is estimated to have around 150 million users and 44 million hosts in more than 130 countries. However, over 75% of computers linked to the Internet are in the USA (Unsal and Movassaghi, 2001) while emerging markets lag much further behind. Of the 816 million people living in Africa in 2001, 1 in every 160 or approximately 5 million people used the Internet (see Table 1).

Table1: Africa Communication and Regional Internet Statistics

Africa Communication Statistics 2001		
	Proportion of Population	Population (in millions)
Have a radio	1 in 4	205
Have a TV	1 in 13	62
Have a mobile phone	1 in 35	24
Have a fixed line phone	1 in 40	20
Have a PC	1 in 130	5.9
Use the Internet	1 in 160	5
Have Pay TV	1 in 400	2

Internet Users by region 2000	
Region	Proportion of Population
Africa	1 in 250-400
Latin America & the Caribbean	1 in 30
South Asia	1 in 250
East Asia	1 in 43
Arab States	1 in 166
North America and Europe	1 in 2
World average	1 in 15

Source: Compiled from AISI-Connect National ICT Profile on http/www3.sn.apc.org/africa/afstat.htm

As of mid 2002, the number of dial-up Internet subscribers was close to 1.7 million of which 1.2 million were from South Africa and North Africa and the remainder from the other 49 countries. In Africa, each computer with an Internet or email connection is said to support between 3 - 5 users. This puts the estimates of the total number of African Internet users at around 5 - 8 million with about 1.5 – 2.5 million outside of North and South Africa. While Africa still lags far behind in embracing this new technology it is estimated that an average North American resident has access to around 570 times more international bandwidth than the average African citizen.

The average cost of using a local dialup Internet account for 20 hours per month in Africa is about US$60/month, including fees and local telephone time. This is extraordinarily high as compared to US$22 in the USA, US$33 in Germany and US$39 across the EU in 2000, yet these countries have per capita incomes at least 10 times greater than the African average. Internet Service Provider (ISP) subscription charges vary greatly from US$10 to US$80 a month. Table 2 shows the internet statistics for African countries.

[5] Much of the information and statistics in this section was obtained from http/www3.sn.apc.org/africa/afstat.htm

Table 2: African Country Internet Status Summary - August 2001

Country	Dialup Internet Subscribers	International Bandwidth (Kbps Outgoing)	Internet Hubs (Number)	Number ISPs	Population (Millions) 2000	GDP/Capita (USD) 1999	Cities with POPs	Dialup Access Cost (USD)*
South Africa	750000	300000	5	80	44.31	2979	100	40
Algeria	45000	2048	1	4	30.08	1442	4	
Angola	4000	192	1	4	12.09	1684	5	
Benin	4000	1024	1	2	5.78	374	2	
Botswana	25000	14000	1	6	1.57	3252	4	
Burkina Faso	3000	256	1	3	11.31	199	1	42
Burundi	150	64	1	2	6.46	159	1	
Cameroon	2500	256	1	7	14.31	617	2	40
Cape Verde	1800	1024	1	1	0.41	876	1	
Central African Republic	200	64	1	1	3.48	276	1	
Chad	300	64	1	1	7.27	149	1	
Comoros	200	64	1	1	0.66	382	1	
Congo	200	128	1	1	2.79	833	2	
Cote D'ivoire	10000	5120	2	5	16.2	767	2	
D.R Congo	4500	2048	3	5	49.3	400	4	
Djibouti	300	64	1	1	0.62	846	1	
Egypt	80000	112500	3	100	65.98	1195	14	60
Equatorial Guinea	200	64	1	1	0.43	668	1	
Eritrea	1000	128	1	4	3.58	161	5	70
Ethiopia	2500	512	1	1	59.65	103	1	75
Gabon	2500	512	1	2	1.17	5121	2	
Gambia	3000	128	1	1	1.23	284	1	
Ghana	15000	4096	3	8	19.16	372	7	
Guinea	4000	128	3	2	7.71	677	3	
Guinea-Bissau	250	64	1	1	1.13	245	1	
Kenya	35000	6144	1	34	29.01	347	6	123
Lesotho	250	512	2	2	2.06	547	1	
Liberia	75	128	1		2.67	1000	1	
Libyan Arab Jamahiriya	4000	2048	1	1	5.98	6579	1	
Madagascar	8000	2556	2	7	16.36	224	4	
Malawi	2400	1024	3	2	10.75	242	2	
Mali	3000	128	1	5	10.69	230	1	130
Mauritania	550	384	1	5	2.53	455	2	
Mauritius	35000	4096	1	1	1.15	3661	1	
Morocco	80000	136000	1	250	27.87	1218	10	
Mozambique	6000	2048	3	5	18.88	86	4	31
Namibia	15000	3072	2	3	1.66	2051	13	40
Niger	350	192	1	1	10.08	161	1	
Nigeria	50000	9216	5	15	113.5	551	5	40
Reunion	500	576	1	2	0.68	9270	1	
Rwanda	1000	128	3	1	6.6	317	1	
Sao Tome & Principe	200	64	1	1	0.14	358	1	
Senegal	15000	48000	1	8	9	518	1	51
Seychelles	3000	4098	2	2	0.08	6995	1	
Sierra Leone	500	128	1	1	4.57	209	1	
Somalia	250	64	1	1	10.63	169	1	160
Sudan	2000	256	1	1	28.29	364	1	
Swaziland	1200	256	2	2	0.95	1388	2	
Tanzania	20000	4096	3	14	32.1	244	2	
Togo	1700	1536	2	12	4.4	324	1	
Tunisia	70000	41500	1	5	9.34	2144	7	30
Uganda	10000	2048	4	8	20.55	317	1	109
Zambia	6500	3072	3	3	8.78	463	3	
Zimbabwe	20000	5120	1	8	12.68	712	4	46

*Dialup internet access costs calculated for 20hours a month of local call time plus internet subscription fee
Source: AISI-Connect National ICT Profile on http://www3.sn.apc.org/africa/afrmain.htm

Though most emerging markets are still way behind in availing information electronically, some such as China (Drew, 1995), India (Siriginidi, 1996) and Egypt (Kamel and Hussein, 2001) have made greater strides in making information available to investors all over the world via the web. According to Kamel and Hussein (2001), Egypt made the Internet a priority for the government and the public sector as a tool for business and socio-economic development since 1994.

The availability of local African content on the Internet is, in particular, still a big challenge. While most African stock exchanges now have websites, the information on some of them is not regularly updated, rendering it useless to investors. In order to develop local content on the Internet, Egypt began implementing the Egyptian Information Highway project in 1995 with the objective of making the Internet more relevant and appealing to Egyptians (Kamel and Hussein, 2001). The greatest strides in making information available electronically have been in the area of investment opportunities, financial markets and services, infrastructural development and research studies. Other projects undertaken by Egypt includes the Capital Exchange Project, which addresses stock trading over the Internet and links the trading community of brokers with potential investors around the world, providing a better mechanism for trading in the Egyptian stock market, and the provision of online financial information related to money and capital markets (Kamel and Hussein, 2001).

5.2 The Internet and Market Efficiency: The African Perspective

While stock exchanges around the world have automated to varying degrees and some have eliminated floor trading altogether (Fish and Biekpe, 2002), some African stock markets are yet to adopt electronic trading and settlement. The relatively low trading volumes on African markets result from poor information flows about securities to both institutional and individual investors. Information regarding opportunities that exist on African markets has become more readily accessible online on those markets that have adopted electronic trading and have up-to-date websites. As the market becomes more efficient with electronic trading, investor confidence is heightened, as prices are perceived to reflect the stocks' intrinsic values and thus a reduction in the investors' risk exposure.

Fish and Biekpe, (2002) wrote that in May 2002 the Johannesburg Stock Exchange (JSE) converted its Johannesburg Electronic Trading (JET) system to the Stock Exchange Trading Systems (SETS) used on the London Stock Exchange (LSE). Other markets that adopted this trading system include Ghana and Namibia Stock Exchanges. SETS is a world-class, flexible and robust trading platform said to promise improved liquidity and more efficient functionality of the market through providing more in-depth price formation, improved efficiency and stronger trade. Transparency and liquidity encourages participation by traders while the new functionality stimulates trade in illiquid stocks, ensures equal access to information, minimises system complexity and facilitates the introduction of new instruments. According to Fish and Biekpe (2002), South African companies cited one of the main reasons for listing offshore to be the privilege to get into a global index, and thereby attracting the tracker funds that follow. SETS allow companies to get these offshore privileges without having to move offshore. The relationship between the JSE and the LSE through their uniform information dissemination component allows the publishing of each other's share price information and thus greater access to information.

The internet has made online trading, and thus the speedy making of transactions at reduced costs, possible. However, on many African stock markets, except for a few such as South Africa, Tunisia and Egypt, it is still not possible to place orders with stockbrokers online unlike in the United States where the number of on-line investors is said to have increased from 2.2 million in 1998 to about 5.2 million in 2000 (Unsal and Movassaghi, 2001). According to Unsal and Movassaghi (2001), in the US, stockbrokerage firms adopted the Internet technology more extensively than many other sectors in the financial services industry with the number of e-brokerage firms growing from only 12 in 1994 to 120 in 1999. They also noted that according to estimates one in every three equity trades made by retail investors in the US are now placed online and it is expected that over the next 3 to 5 years, nearly all investors will use the Internet to access their accounts.

5.3 Empirical Analysis

To empirically investigate if there is a (positive) relationship between stock market development (as measured by size, liquidity and efficiency) and the internet, a correlation analysis was performed. The assumption made is that the stock exchange is affected more by local residents in the country where it is located, which, though could be true for the restrictive African markets, may not be necessarily true for the open overseas markets. The analysis is done in two parts (a) using data from relatively developed overseas markets including South Africa, the results of which are presented in Table 3 and (b) using data from African countries, with results presented in Table 4.[6]

The results in Table 3 were obtained using internet statistics[7] for 46 countries for the period between January 1998 and December 2002 and the corresponding stock market data[8]. The internet statistics were measured over irregular intervals depending on availability (see source). In order to carry out our analysis, the stock market data had to be synchronised with the internet data. Since the internet data for each country could not give enough observations to make a meaningful analysis, data for all countries was combined to form a cross-sectional time series.

[6] We did a similar analysis using data from the World Development Indicators Fact book 2002, the results of which are presented in Appendix A1 and A2. In the Appendix more variables are included than is the case in Tables 3 and 4 and larger sample sizes are used. The results are, however, complimentary to those presented in Tables 3 and 4. Such a task was necessary since the credibility of sources and measurement methods for internet statistics is still wanting.
[7] Source: http://www.nua.com/surveys/how_many_online/index.html
[8] Source: http://www.world-exchanges.org/index.asp?resolutionX=800&resolutionY=600

Table 3: Correlation between internet accessibility and stock market indicators using cross-sectional time series data

	#Stocks	MC (US$'m)	Value (US$'m)	Turnover	Index	Internet Users	Users % Pop
#Stocks	**1**						
MC (US$)	**0.726****	**1**					
Value (US$)	**0.622****	**0.755****	**1**				
Turnover	**0.357****	**0.459****	**0.711****	**1**			
Index	**-0.170****	**0.054**	**0.057**	**-0.091**	**1**		
Internet Users	0.627**	0.518**	0.722**	0.376**	-0.012	**1**	
Users % Pop	0.215**	0.149**	0.413**	0.347**	-0.198**	**0.590****	**1**

** Implies significance at the 1% level (2-tailed)
Note: Correlation coefficients of interest in bold

The results in Table 3 show that there is a positive relationship between stock market development indicators (with the exception of stock market indexes) and internet access. These results are highlighted in bold in the matrix table. The lack of relationship between internet users and the Index cannot be readily explained. It could be a measurement problem due to the different methods of calculation by the different stock exchanges or the dependence of the index on pricing, which has more to do with the valuation of stocks than with the number of investors. The positive relationship between stock market size as measured by the number of stocks and market capitalisation, and internet access can be explained by the opportunities that the internet avails inspiring more and more companies to get listed. The greater the numbers of people with access to the internet the greater the continuous valuation of securities. This therefore improves liquidity and the discovery of patterns in stock prices that would be arbitraged away into non-existence, promoting market efficiency.

Table 4: Correlation between internet infrastructure and accessibility and stock market indicators using data from Africa

	Users	IntBand	%Users	Fixlines	Mobile	MCap	%MCap	Value	TRatio	Listed
Users	**1**									
IntBand	**0.904****	**1**								
%Users	**0.639***	**0.752****	**1**							
Fixline	**0.798****	**0.673****	**0.196**	**1**						
Mobile	**0.534***	**0.620***	**0.416**	**0.599***	**1**					
Mcap	0.827**	0.688**	0.314	0.934**	0.615*	**1**				
%MCap	0.739**	0.725**	0.749**	0.451	0.694**	**0.587***	**1**			
Value	0.853**	0.769**	0.612*	0.744**	0.766**	**0.815****	**0.857****	**1**		
TRatio	0.732**	0.728**	0.477	0.701**	0.500	**0.824****	**0.560***	**0.778****	**1**	
Listed	0.728**	0.509	0.090	0.868**	0.432	**0.921****	**0.486**	**0.705****	**0.692****	**1**

**** Implies significance at the 1% level (2-tailed)**
***** Implies significance at the 5% level (2-tailed)**
Note: Correlation coefficients of interest in bold
Users=*Dialup Internet Subscribers*; IntBand=*International Bandwidth (Kbps)*; %Users=*Dialup Internet Subscribers as percentage of population*; Fixline=*Fixed lines 1998 (thousands)*; Mobile=*Mobile Lines 1998 (thousands)*; MCap=*Market Capitalisation Jan 2000 (US$'m)*; %MCap=*Market Capitalisation as percentage of GDP*; Value=*Value traded*; TRatio=*Turnover Ratio*; Listed=*Listed companies*

Table 4 uses cross-sectional data from African stock markets. The correlation coefficients of interest are highlighted in bold. All of them are positive though some are not statistically significant. However, the correlation coefficients between the variable, 'Internet users', and the stock market indicators are not only positive, but also highly significant. While the markets used in Table 3 are mostly 100% open to foreign participation, the African markets used in Table 4 are relatively closed or partially open. For developed markets, it is not necessarily domestic investors that impact on the market since they are relatively/wholly open to foreign participation in comparison to their African counterparts. While most African markets are not fully open to foreign participation, local investors also have limited access to the internet. This, combined with the lack of local African content on the Web, sadly enough, result in African stock markets remaining illiquid and less efficient.

6. CONCLUSION

This paper attempted to highlight the role that the internet is playing in promoting stock market efficiency. An illustration has been made, showing that in the absence of the online media, and assuming the telephone to be the only fastest medium available for information dissemination and transactions ordering, stock markets will not be efficient, especially in the stronger forms. Stock markets around the world are making efforts to improve market efficiency by improving information dissemination, making stock price information accessible to a broader range of investors and introducing electronic or computer-based trading systems.

The Internet has saved technical analysts a lot of trouble and time in that they can now get all the bulky data (historical stock prices and volume traded) they need to study trends dating back several years for any particular stock exchange anywhere across the globe without physically going there to collect it. Data transmitted electronically and online, is usually in a ready-to-use format saving the analysts time and effort in uploading it onto their computer systems before they can do their analyses. Easy access to bulky data has also led to the production of software to aid in technical analyses that require large volumes of data such as the learning models, a good example of which is the artificial neural networks.

Investing on the stock market has become more interesting than it was before. Investors now make more informed decisions and not just act on hunches. With stockbrokers availing their research material online, access to these research documents has enabled investors to compare analysis reports from different stockbrokers and research firms. Market participants now have almost equal opportunities to accessing all relevant information. With the internet, trading has become more discrete as investors can now trade (buy and sell shares) from the comfort of their own homes (online trading) and therefore making it difficult to just follow other investors' actions.

With the positive correlation between most stock market development indicators and internet access, stock market liquidity and efficiency can be improved by availing information online and also promoting the infrastructure to improve internet accessibility. A home telephone and computer are often considered luxury items in some African countries, yet these are the key infrastructures to internet access. While foreign residents have greater internet access than African residents, they are restricted in their participation on African stock markets by regulations and lack of online up-to-date local information content from some African stock markets. Unless African governments address these issues, African stock markets will continue to lack in liquidity and efficiency.

Appendix: The Relationship between Internet infrastructure and accessibility, other information dissemination media and stock market development

A1: Non-African countries

Spearman's rho Correlations - Countries outside Africa

	EPI	INDEX	MCAP	MCAP%	STO-CKS	VAL%	T/O%	CELL	PC	INTEL	TEL US	TELOC	TELI NES	TEL CITY	TEL RAT	TEL REV	TEL IST	TEL-TIME	WWW	RA-DIO	TV
EPI	1.000																				
INDEX	.224**	1.000																			
MCAP	.768**	.256**	1.000																		
MCAP%	.504**	.332**	.811**	1.000																	
STOCK	.537**	-.031	.707**	.454**	1.000																
VAL%	.677**	.176*	.861**	.786**	.651**	1.000															
T/O%	.517**	.105	.619**	.385**	.621**	.802**	1.000														
CELL	**.235****	**.088**	**.546****	**.656****	**.183****	**.598****	**.340****	1.000													
PC	**.118**	**.143***	**.494****	**.621****	**.088**	**.553****	**.278****	.872**	1.000												
INTEL	**-.338****	**.111**	**.066**	**.445****	**-.306****	**.190****	**-.072**	.416**	.523**	1.000											
TELUS	**-.134**	**-.027**	**-.455****	**-.507****	**-.253****	**-.505****	**-.303****	-.719**	-.657**	-.315**	1.000										
TELOC	**.102**	**.120**	**.265****	**.154****	**.021**	**.199****	**.166****	.393**	.434**	.062	-.379**	1.000									
TELINE	**.399****	**.148***	**.574****	**.476****	**.290****	**.480****	**.325****	.645**	.555**	.034	-.515**	.349**	1.000								
TELCIT	**.169***	**.022**	**.282****	**.318****	**.124**	**.347****	**.363****	.693**	.748**	.109	-.524**	.279**	.621**	1.000							
TELRA	**.116***	**.152***	**.457****	**.581****	**.128****	**.530****	**.307****	.819**	.926**	.419**	-.619**	.408**	.601**	.861**	1.000						
TELREV	**.171****	**.199****	**.501****	**.622****	**.055**	**.469****	**.140****	.634**	.622**	.655**	-.465**	.321**	.347**	.196**	.484**	1.000					
TELIST	**.258****	**-.157**	**-.432****	**-.563****	**-.046**	**-.498****	**-.247****	-.735**	-.847**	-.618**	.554**	-.386**	-.485**	-.438**	-.763**	-.725**	1.000				
TELTIM	**-.303****	**-.219****	**-.631****	**-.658****	**-.223****	**-.625****	**-.364****	-.782**	-.836**	-.476**	.600**	-.418**	-.579**	-.508**	-.763**	-.714**	.893**	1.000			
WWW	***.628****	***.023***	***.815****	***.548****	***.680****	***.720****	***.607****	*.623***	*.495***	*-.098**	*-.607****	*.302***	*.619***	*.515***	*.494***	*.289***	*-.372****	*-.556****	*1.000*		
RADIO	**.025**	**.059**	**.351****	**.419****	**.106**	**.423****	**.275****	.645**	.704**	.209**	-.541**	.478**	.444**	.572**	.752**	.332**	-.634**	-.597**	.478**	1.00	
TV	**.170****	**.135**	**.423****	**.442****	**.128****	**.457****	**.299****	.707**	.789**	.270**	-.536**	.492**	.479**	.727**	.828**	.458**	-.660**	-.685**	.476**	.756**	1.000

**. Correlation is significant at the .01 level (2-tailed).

*. Correlation is significant at the .05 level (2-tailed).

A2: African countries

Spearman's rho Correlations _ African countries

	EPI	MCAP	MCAP%	STOCKS	VAL%	T/O%	CELL	PC	INTEL	TELOC	TELINES	TELCITY	TELRAT	TELREV	TELIST	TELTIME	WWW	RADIO	TV
EPI	1.000																		
MCAP	.585**	1.000																	
MCAP%	.587**	.661**	1.000																
STOCKS	.275	.897**	.541**	1.000															
VAL%	.596**	.706**	.765**	.624**	1.000														
T/O%	.528**	.592**	.438**	.561**	.704**	1.000													
CELL	**.384****	**.141**	**.444****	**.105**	**.337****	**.255***	1.000												
PC	**.176**	**.181**	**.491****	**.108**	**.584****	**.242**	.605**	1.000											
INTEL	**-.3***	**-.655****	**-.362****	**-.676****	**-.405****	**-.338****	.011	.049	1.000										
TELOC	**.344***	**-.140**	**-.064**	**-.279***	**-.234**	**.025**	-.082	-.245	.101	1.000									
TELINES	**.372****	**.381****	**.469****	**.189**	**.527****	**.309***	.583**	.671**	-.190	-.190	1.000								
TELCITY	**.300**	**.187**	**.503****	**.171**	**.533****	**.111**	.613**	.768**	.015	-.311*	.705**	1.000							
TELRAT	**.458****	**.293***	**.593****	**.174**	**.647****	**.233**	.594**	.856**	-.115	-.341**	.863**	.883**	1.000						
TELREV	**.021**	**-.183**	**-.271***	**-.162**	**-.407****	**-.194**	-.178	-.215	.312**	.618**	-.541**	-.543**	-.435**	1.000					
TELIST	**.039**	**.624****	**.315***	**.759****	**.443****	**.337***	-.193	-.211	-.696**	-.440**	.059	-.142	.062	-.403**	1.000				
TELTIME	**-.7****	**-.203**	**-.488****	**.063**	**-.310***	**-.063**	-.554**	-.583**	-.037	-.145	-.656**	-.622**	-.640**	.104	.335*	1.000			
WWW	***.249***	***.615****	***.346****	***.696****	***.489****	***.517****	*.504***	*.363***	*-.466***	*-.162*	*.375***	*.290**	*.304***	*-.128*	*.280**	*-.238*	*1.000*		
RADIO	**.312**	**.348***	**.405***	**.279**	**.349***	**.358***	.361*	-.026	-.302*	-.035	.133	.178	.046	-.263	.289	-.082	.275	1.000	
TV	**.567****	**.404****	**.382****	**.222**	**.381****	**.408****	.387**	.438**	-.267*	.029	.746**	.473**	.578**	-.356**	.002	-.334*	.331**	.209	1.000

**. Correlation is significant at the .01 level (2-tailed).

*. Correlation is significant at the .05 level (2-tailed).

Key to Appendix tables A1 and A2

CODE	DESCRIPTION	CODE	DESCRIPTION	CODE	DESCRIPTION
EPI	Portfolio investment, equity (DRS, current US$)	CELL	Mobile phones (per 1,000 people)	TELRAT	Telephone mainlines (per 1,000 people)
INDEX	S&P/IFC investable index (annual % change)	PC	Personal computers (per 1,000 people)	TELREV	Telephone revenue per mainline (current US$)
MCAP	Market capitalization of listed companies (current US$)	INTEL	International telecom, outgoing traffic (minutes per subscriber)	TELIST	Telephone mainlines, waiting list (thousands)
MCAP%	Market capitalization of listed companies (% of GDP)	TELUS	Telephone average cost of call to US (US$ per three minutes)	TELTIME	Telephone mainlines, waiting time (years)
STOCKS	Listed domestic companies, total	TELOC	Telephone average cost of local call (US$ per three minutes)	WWW	Internet users
VAL%	Stocks traded, total value (% of GDP)	TELINES	Telephone mainlines per employee	RADIO	Radios (per 1,000 people)
T/O%	Stocks traded, turnover ratio (%)	TELCITY	Telephone mainlines in largest city (per 1,000 people)	TV	Television sets (per 1,000 people)

Data used in the Analysis was obtained from the World Development Indicators Fact book 2002

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