
# The impact of FDI on market efficiency

## A study about adaptive market efficiency in African frontier markets

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# Abstract

This paper examines the impact of Foreign Direct Investment (FDI) on the level of market efficiency over time in six African frontier stock markets. The countries examined are Botswana, Kenya, Mauritius, Morocco, Nigeria and Tunisia. The purpose of this study is to investigate what impact foreign investors' capital contributions have on the level of market efficiency in six major frontier stock markets in Africa. To be able to identify periods of market efficiency and inefficiency we will analyze the results in the light of the Adaptive Market Hypothesis.

To be able to answer the research question and fulfil the intended purpose three statistical tests will be conducted. Two Variance Ratio tests, namely the Chow Denning test (CD) and the multiple version of Wright's sign test (JS) have been conducted to obtain measures of time-varying market efficiency. These measures of time-varying market efficiency have then been used separately as the dependent variables in a set of 6 different multiple panel regression analyses. Based on previous research we chose a set of six macroeconomic factors that could have an impact on market efficiency. These were then used as independent variables in the panel regression analysis.

We found that FDI has no impact on the level of market efficiency when including all six countries in the regression model. However, re-performing the analysis on a reduced sample including only Kenya, Mauritius, Morocco and Tunisia we found that FDI is significant at the 5% level, i.e. higher FDI implies higher market efficiency. Considering this result, we strongly recommend African countries to relax FDI regulations.

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# 1. Introduction

*This chapter will introduce the development of the concept efficient market. This section will also provide an introduction of market efficiency theories in the context of Africa. Furthermore, the chapter will explain the reason and purpose behind this research as well as the research gap that makes this particular study unique. Later on, the chapter will present the limitations of the study and our chosen research question. The chapter will end with some definitions of relevant concepts.*

**Keywords:** Adaptive Market Hypothesis, Efficient Market Hypothesis, Behavioral Finance, Foreign Direct Investment, Frontier Market, Weak Form Market Efficiency, Random Walk Theory

## 1.1 Problem Background

Ten years ago, lots of attention was given to China and India as the new prosperous markets that would become the greatest economies in the world. Today, the African "lion economies" are starting to draw attention from all over the world. Total African Foreign Direct Investment (FDI) inflows, i.e. the net inflows of investment to procure a durable management interest in an enterprise operating in an economy other than that of the investor, increased by 480% from 2000 to 2007 and the rate of return on these foreign investments are higher than in any other developing region. Moreover, this substantial economic growth in Africa is creating considerable new business opportunities, opportunities that will be extremely important to fuel long-term growth (McKinsey & Company, 2010).

Previous studies suggest that FDI is a factor that contributes to economic growth (Moura & Forte, 2010, p. 1). When foreign capital is efficiently allocated, the economic theory suggests that FDI is a factor that boosts economic progression, mainly in two ways: First, FDI could be of use in a country that lacks domestic funds to advance the economic expansion. Second, the existence of foreign firms is associated with positive externalities (Mencinger, 2003, p. 491)

How much has FDI contributed to economic growth in developing countries? Utilizing data on FDI flows from developed countries to 69 emergent countries Borensztein (1995) found that FDI is a significant vehicle for the transmission of technology, contributing fairly more to growth than domestic capital. Further, Foreign Direct Investment contributes with improved know how, formation of human resources, global market integration, increased competition, and development and reorganization of firms (Moura & Forte, 2010, p. 1).

In fact, over the last decades we have seen a tremendous increase in business activities conducted in developing stock markets. Recently, extensive research has been conducted in the light of "frontier markets" and their economic potential (Chen et al. 2014; Berger et al., 2011; Speidell & Krohne, 2007; Speidell, 2008). These markets provide investors with long-term investment opportunities and facilitate the economic development within these regions, leading towards global integration for these countries (Chen et al., 2014, p. 85). The African stock markets have attracted many foreign investors during the last decades and Foreign Direct Investment (FDI) reached a record of $80 billion in 2014 (Wall street Journal, 2014).

The two most common forms of FDI are the acquisition of already existing assets in a foreign company and Green Field Investment, purchasing new assets and starting new projects. Another popular strategy is to perform a merger. The motives for these investments are to keep, unite and develop their positions by buying other companies that will enhance their competitiveness (Mwilima, 2003, p. 31). Mwilima argues further that one concern regarding FDI has been that the intentions of MNEs have been to shut down all the domestic players in order to achieve a monopoly, which might harm the attitudes toward FDI.

In 1998, half of the private capital flow to developing countries consisted of FDI. In the late 20th century there has been a shift in attitudes among policy makers in developing countries. The regulations have been tailored to favour attraction of FDI, to generate positive spill over effects (Alfaro et al., 2003, p. 1). The attitudes toward foreign capital contribution are keen, although, the countries have different motives, i.e. access to foreign markets, entrepreneurial skills and to improve the situation of shortage of foreign capital. Therefore, the overall perception among the African countries is that FDI brings positive effects to their economic development (Mwilima, 2003, p. 33).

In order for the African countries to successfully take advantage of the positive effects that FDI could generate, UN has established a new organization called (UNIDO United Nations industrial development organization). UNIDO has created a network called the AfrIPANet (the African Investment Promotion Agency Network). The countries within these networks have their own IPA (Investment promotion agency), as well as one UNIDO Investment and Technology Promotion Office (ITPO) and one advisory panel. This panel consists of CEOs in companies operating in the specific region and academic scholars focusing on the effects of FDI. Their goal is to make the countries of Africa designed in a way that favours FDI and development within the countries (UNIDO, 2015).

As a matter of fact, across the continent of Africa, the expansion of stock market activities seems to have played a significant role to strengthen the financial markets in the region. These activities have contributed to a positive economic growth in recent years (Afego, 2015, p. 243). Furthermore, Lagoarde-Segot and Lucy (2008) argue that the information available on the market will have an impact on the relationship between stock market activities and the economic growth within a country. Information availability is fundamental in an efficient market and critical in the investment process.

Thus, market efficiency is a fundamental right for investors; the same information should be available for all actors within a market (Nisar & Hanif, 2011, p. 441). Efficiency is therefore, an important factor in order to attract foreign investors. Nisar and Hanif (2011) argue further, that investing is a game of losers and winners, if there are actors with inside information that makes positive abnormal returns, some investors will lose because of this inside information, leading towards unwillingness to enter security markets. To conclude, if FDI could boost economic progress in

African markets, then there is a need for great market efficiency conditions, making foreign investors willing to operate within the African markets.

Subsequently, foreign investors entering a frontier market should be aware of the fact that asymmetric information may be an issue. One should remember that insiders and other established players, with better information at hand, have a more favorable position on the market. Strategic decisions have to be made and it is therefore reasonable to assume that many foreign investors choose not to enter new markets. However, with asymmetric information comes the possibility to make abnormal returns, or even exploit arbitrage opportunities. This pattern is typical of an inefficient market (Mobarek & Kasey, 2000, p. 4). From this angle, an inefficient market would reasonably attract new investors given that it is possible to make higher returns than normal. When this opportunity is exploited the market should, according to theory, return to being efficient. This reasoning leads to the question; does Foreign Direct Investment lead to a more efficient market?

There have been various explanations why foreign direct investments tend to flow from developed to underdeveloped markets. Acheampong and Wiafe (2013) mean that FDI tend to flow to undeveloped markets because these markets offer a higher expected return. If these markets are inefficient they will also offer investors opportunities to beat the market. Bekaert and Harvey (1994) highlight the fact that undeveloped markets that are less integrated with the rest of the world are exposed to different risks than more developed markets and therefore offer investors portfolio diversification benefits. Given these points, FDI could be assumed to trigger stock market development, which could mean that foreign investors' activities have a positive impact on the efficiency.

In order for foreign investors to succeed within frontier markets, they need to comply with domestic laws and regulations. Financial liberalization refers to government relaxation of restrictions in the market (Kunt & Detragiache, 1998, p. 4). Previous studies highlight the fact that financial liberalization will play an important role to increase the efficiency and boost the economic growth (Kim & Singal, 2000, p. 184). On the other hand, Maghyereh and Omet (2002) conducted a study on the Amman Stock Exchange and found that financial liberalization did not have any impact on the market efficiency. Demands from foreign investors will contribute to extensive transparency and rules of disclosure that will have a positive impact on efficiency allocation of capital (Kim & Singal, 2000, p. 184). On the contrary there is a discussion against free flow of capital. Mexico and East Asia faced a crisis at the end of the 20th century, which many academicians explained by the liberal regulations within these regions.

One issue associated with becoming more open towards the rest of the world is the expression "hot money" which means "International flow of funds that are allegedly highly sensitive to differences in interest rates, expectations of future economic growth, and expected returns from holding securities" (Kim & Singal, 2000, p. 184).

We can assume that if the frontier markets are inefficient, foreign investors could seize this opportunity to exploit arbitrage opportunities. However, if the frontier markets are efficient the market might offer diversification benefits. Whether the amount of FDI inflows have an effect on these frontier markets' level of efficiency or not is what this study aims to answer.

## 1.2 Theoretical Point of Departure

The idea behind an efficient market can be traced back to 1900 when Bacheliere discovered that the movement of stock prices might follow a Brownian motion, i.e. a random path. Approximately 50 years later the statistician Maurice G. Kendall (1953) picked up the idea and strengthened the idea of unpredictable future stock prices. Samuelson (1965) and Mandelbrot (1966) further tested the idea that is now known as the random walk theory (Yen & Lee, 2008, p. 308). However, it was Fama (1970) that popularized the idea of an efficient market and presented the Efficient Market Hypothesis (EMH) in his 1970 seminal review on stock market price behavior. In its very simplest form, a market is called efficient when prices fully reflect all available information (Fama, 1970, p. 383). Furthermore, Fama (1970) also presented three levels of market efficiency, namely, the weak form, the semi-strong form and the strong form.

In a study by Yen and Lee (2008) a review of empirical evidence on the EMH was presented. It became evident that the EMH no longer enjoys the solid support it did during the 1960s. Despite the central role, the EMH has in the academic world several empirical studies challenged the concept of an efficient market with findings inconsistent with the EMH, arguing that the EMH paradigm should be replaced by a behavioral finance approach (Yen & Lee, 2008, pp. 319-320). Other late findings have also proven that the market efficiency tends to evolve over time due to macroeconomic changes, changes in market regulations and information technologies (Lim & Brooks, 2011, p. 71). Self and Mathur (2006) write that a market can have the characteristics of an efficient market for one period and due to micro and macro factors depart from market efficiency the next.

To fill the gap between EMH and behavioral finance as well as explain the development of market efficiency Andrew W. Lo (2004) suggested a new version of the EMH, namely the Adaptive Market Hypothesis (AMH). The new framework lets the traditional models of financial economics coexist alongside models developed by the opposing school of behavioral finance. Lo (2005) argues that, based on evolutionary principles, the level of efficiency in a market depends on factors typically found in a market ecology, e.g. the number of competitors, profit opportunities available and the adaptability of market participants, factors that are not constant over time. Moreover, the AMH explains why periods of inefficiency do exist.

## 1.3 Research Gap

Numerous studies have been performed in order to test the market efficiency, especially in its weak form (Filis, 2006; Mobarek et al., 2008; Smith & Dyakova, 2014). The amount of studies on market efficiency conducted on the stock markets of Africa might be less than studies conducted on developed markets, however, in recent years more and more attention has been directed towards the continent of Africa (Smith & Dyakova, 2014; Nwosu et al., 2013; Kian-Ping Lim, 2009). Previous studies regarding Foreign Direct Investments' impact, have tried to explain the relationship between growth and wealth in Africa, if unemployment has been reduced and how relaxations of restrictions affect foreign investment behavior (Mecinger, 2003; Moura & Forte, 2010; Kim & Singal, 2000). However, few studies exist that try to measure market efficiency over time, and according to our knowledge no studies attempt to explain how market efficiency correlates with the level of foreign capital within the markets of Botswana, Kenya, Mauritius, Morocco, Nigeria and Tunisia.

## 1.4 Research Question

With the given problem background and the apparent research gap we have formulated the following research question that we, in this paper, will examine:

*Does Foreign Direct Investment have an impact on the level of market efficiency over time in African stock markets?*

## 1.5 Purpose

**Main Purpose**
Our main purpose intends to *investigate what impact foreign investors' capital contributions have on the level of market efficiency in six major frontier stock markets in Africa.* To be able to identify periods of efficiency and inefficiency we will analyze the results in the light of the Adaptive Market Hypothesis.

In order to satisfy our ambition to reach an answer to the research question we need to divide the main purpose into two parts, one main purpose and one subsidiary purpose. This division should also help the reader to get a first grip of the practical method, which we will apply to this study.

**Subsidiary Purpose**
To test whether inflow of foreign direct investment correlates with increased efficiency we are required to test for information efficiency on every stock market. Therefore, the subsidiary purpose *intends to investigate whether selected stock markets are weak form efficient or not over time.*

## 1.6 Theoretical and Practical Contributions

The theoretical contribution of our empirical study will mainly be to further increase the knowledge in the area of market efficiency, more specifically in the field of time varying efficiency. In accordance with our purpose we will extend the knowledge concerning factors that potentially affect market efficiency. We will especially test whether FDI can explain changes in the level of market efficiency.

With this empirical investigation we hope to gather practical information for investors conducting business on a global scale. Domestic investors can also benefit from this information to get a deeper understanding of the impact of increased Foreign Direct Investment in their markets. Furthermore, as Lo (2004) states, one of the most striking implications of the AMH is that arbitrage opportunities actually do arise from time to time. If our study proves that African stock markets are adaptive efficient, investors could exploit such inefficient periods and possibly make abnormal returns. If this study proves that increased FDI explains increased market efficiency the governments of the selected countries should really think about altering trade regulations to favor FDI.

## 1.7 Limitations

There are 29 stock markets in Africa (Financial Times, 2014). Our research will be limited to the six largest frontier markets in Africa, based on the amount of listed companies on every exchange, given that sufficient data is available. These markets need to be classified as frontier markets, following the criteria of MSCI, a leading provider of investment decision support tools. According to MSCI a frontier market has low or modest economic development, size and liquidity and market accessibility.

Data could not be found from the markets of Zimbabwe, Sudan, Uganda and the Ivory Coast. These countries have therefore been excluded from the sample. Due to limited time for this research we cannot investigate all of the sectors and countries within Africa. By narrowing the research to include only the six largest frontier stock markets we believe to obtain more adequate results from the markets investigated.

Furthermore, our time horizons of study will be set to seven and eight years, which should be sufficient enough in order to explore evolving efficiency and what causes evolving efficiency. The period chosen includes both economic downturns as well as years of economic prosperity. Over a seven-year period we hope to find interesting results that could contribute to existing research. The two VR tests are performed on moving sub-sample windows of two years, we therefore loose two years of observations.

There are several factors that could explain changing efficiency over time (Acheampong & Wiafe, 2013, p. 6). When investigating what possible factors that could explain evolving market efficiency we will use some of the most critical ones that affect the market on a macroeconomic level. Due to limited time we have based on previous research chosen six macroeconomic factors that we believe could have an impact on market efficiency.

Moreover, there are disagreements in the classification of the African markets in our sample. Some market analysts classify the selected markets as emerging while others claim that they should be classified as frontier markets. However, most of the analysts classify our selected markets as frontier markets. Thus, we have chosen to go along with MSCI's classification criteria of a frontier market, which is explained below. To avoid misunderstandings, we need to stress that other analysts classify some of the markets in our sample as emerging markets.

## 1.8 Definitions

**Arbitrage** - “Purchase of one security and simultaneous sale of another to give a risk-free profit” (Brealey et al. 2011, p. G)

**Abnormal Returns** - “Part of return that is not due to market wide price movements” (Brealey et al. 2011, p. G)

**Foreign Direct Investments** - “Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor” (The World Bank, 2015)

**Frontier Market** - According to MSCI’s market classification, a frontier market has low or modest: “economic development, size and liquidity and as well market accessibility” (MSCI, 2014)

# 2. Theoretical Methodology

*This study will be performed in a quantitative way, with a deductive approach. This implies that we will gather quantitative data from the chosen countries in Africa, looking at their indices on a seven-year horizon. When the data is collected, we will depart from fundamental theories within the concerned topic and examine previous studies that will help us establish and answer our hypotheses empirically. This will help us answer our research question; Does Foreign Direct Investment have an impact on the level of market efficiency over time in African stock markets?*

## 2.1 Previous Knowledge

We are both students at Umeå School of Business and Economics studying the International Business Programme. This study is our degree project and will complete four years of studies. We have both studied financial management on masters level, whereas, on undergraduate level our previous studies differ a little bit. We have both studied basic courses in business administration, economics, statistics, law and economic history. In contrast, on intermediate level, we studied financial economics and management separately. Our academic background will help us make educated choices of theories and concepts. It has also contributed with the ability to critically reflect on previous research and existing literature. Thus, for example, considering the fact that EMH is a fundamental theory in both business administration and economics we are both extensively familiar with that concept. This fact could, however, result in that our pre-understandings will influence this research and some level of subjectivity could occur. In the same way, readers of this thesis might have different academic backgrounds resulting in different interpretations of the results of this study.

## 2.2 Epistemology

The view of knowledge is often explained through epistemology, which type of knowledge that is perceived as acceptable in a particular field of study (Saunders et al., 2009, p. 112). There are two common approaches when looking upon knowledge, the interpretivist view and the positivistic view. The latter is aligned with natural science. In the positivistic view the reality is presented through objects, which have a separate existence from the researcher, referred to as the positivistic paradigm. Researchers conducting a positivistic study would argue that data collected is more objective and far less open to bias (Saunders et al., 2009, p. 112). On the other hand, the interpretivist approach is explained by Gorman and Clayton (2005) as "an approach that focuses on social constructs that are complex and always evolving, making them less amenable to precise measurement or numerical interpretation". The positivistic approach tries to create an understanding while the interpretivist tries to explain something (Bryman & Bell, 2012, pp. 28-29). Therefore, the positivistic approach is more suitable for a quantitative research while the interpretivist approach is better for a qualitative study.

This study will investigate whether Foreign Direct Investment has an impact on the level of market efficiency on frontier markets in Africa. Provided that, an interpretivist approach is not suitable for our research. The positivistic scientists should demonstrate how the social world should be looked upon with the same principles as natural science. Positivism affirms the importance of emulating the natural sciences (Bryman & Bell, 2012, p. 28). The positivistic researcher claims that the reality observed is independent of human actions and beliefs. This reasoning can also be referred to as realism (Collins & Hussey, 2009, pp. 56-57). Of course, our research has human actors within the markets investigated, and some might argue that these actors will affect our outcome, and that this study could be better off using a mixed research method. However, we will look upon the data as independent from human actions and beliefs. This paper will investigate the intended research question with a quantitative method, explaining our findings with existing theory. We do not emphasize a focus on the social realities impact on how our study is conducted, and how it possibly will affect the outcome. Collins and Hussey (2009, p. 56) mean that the "social reality is singular and objective and is not affected by the act of investigating it", i.e. the African stock markets exist independently of our investigation and interpretation.

The Adaptive Market Hypothesis is extensively explained and developed in Lo (2004, 2005, 2012), which provides us with knowledge about how the theory could be used in our research. The fact that the concept of adaptive efficiency has not yet been tested on many markets, and especially not on frontier markets, might complicate our research. Furthermore, difficulties exist of finding data on the exact amount of foreign direct investments in the African stock markets. Still, data on African stock market indices are available and the extensive and accurate theoretical framework linked with our findings will be supportive to reach a conclusion. The theories mentioned above will be the basis on which we will formulate various hypotheses to statistically test if there is a relationship between efficiency and foreign capital.

Our aim with this report is to make it unbiased from pre knowledge and be as objective as possible. We will perform this study separately from the social reality. Thus, this study will be performed with a positivistic approach.

## 2.3 Research Perspective

Ontological questioning is said to be how individuals perceive the reality. There are two fundamental perceptions to explain how the reality behaves, namely, objectivism and constructivism. The objectivistic approach claims that the real world exists independent and external from the human experience, often referred to as realism. The purpose of the human mind is to mirror the reality and learn from its behavior. Constructivism, on the other hand, explains the reality as a process within the human mind. The observer of the reality constructs the world, and from his/her apperceptions the observer interprets the real world (Jonassen, 1991, pp. 8-10).

This study will investigate whether the inflow of FDI can contribute to an increased level of efficiency over time. Therefore, our choice of approaching knowledge will be an objective view of reality, with a statistical test we want to obtain proof in order to explain the relationship between foreign capital and efficiency.

## 2.4 Scientific Approach

There are several ways to approach social science. The two most common methods are the deductive approach and the inductive approach. The deductive approach involves the advance of a theory that is exposed to a rigorous test (Saunders et al., 2009, p. 124). One of the features of the deductive approach is to build a theoretical framework and review the literature. The deductive researcher sees every theory as a variable and each of these will be related to the data collected, and out of this framework establish a hypothesis. The hypothesis works as an idea or proposition, which is tested against the empirical evidence that you bring together (Collin & Hussey, 2009 p. 188).

The other way to approach the research question is with an inductive approach. The inductive method intends to establish a new theory out of the data collected. The inductive researcher wants to get to the bottom with the problem and understand its nature. The researcher wants to link the theoretical variables with the social interpretation of the human mind, which is one of the strengths of this approach (Saunders et al., 2009, p. 126).

In this study we will approach knowledge as if the nature of the problem exists independently of the human interpretation. As mentioned earlier, the positivistic approach of knowledge will be used. Collin and Hussey (2009, p. 188) point out that, a positivistic approach is best suited along with a deductive approach. Therefore, in this study, the deductive approach will be used.

Our first step in the theoretical method approach was to get an overview of what previous studies have concluded about efficiency in frontier markets. Furthermore, we reviewed all the fundamental theories within efficiency to facilitate how our hypothesis should be formulated. Saunders et al. (2009, p. 125) mean that another important characteristic of deduction is that ideas and concepts need to be operationalized in such a way that facts can be measured quantitatively. After the formation of the hypothesis, data of African security indices as well as FDI (net inflows) have been gathered. All data have been retrieved from Reuters Datastream as well as from the World Bank Database. The data was then processed in Microsoft Excel to fit better in the statistical tests that was conducted later on. Finally, the outcome of this test will help us to accept or reject the hypothesis.

## 2.5 Research Strategy

There are two main methods to approach the scientific research question, the quantitative method and the qualitative method (Bryman & Bell, 2011, p. 26). The quantitative approach is mainly used when the researcher intends to collect or analyze numerical data. On the other hand, the qualitative approach is used when focus is on the generation of non-numerical data, i.e. words (Saunders et al., 2009, p. 151). This study will investigate whether FDI has an impact on the level of market efficiency over time in African frontier stock markets. To do that, vast amount of data has been collected in order to statistically test the possible relationship between FDI and market efficiency. For that reason, the quantitative method is the most suitable method for our research.

## 2.6 Literature search

The review of literature started in databases such as EBSCO, Google Scholar, the "Digitala Vetenskapliga Arkivet" (DiVA) and random searches through the web. Words that were used in the research process were, "Efficient Market Hypothesis", "Adaptive Market Hypothesis", "efficiency over time", "frontier market" and "Foreign Direct Investment". Thereafter, we changed our search preferences in order to observe studies conducted within Africa. We also typed: "efficiency over time, correlation with Foreign Direct Investment" just to make sure that similar studies had not been conducted before.

The review of literature showed that no previous studies had investigated what this study intends to investigate. However, several studies had been performed testing efficiency in frontier markets and the impact of Foreign Direct Investment on economic growth. Previous degree projects from Umeå University have also been helpful in order to structure the paper in a proper way. Those studies were collected from the DiVA database. All sources that were reviewed during this time in the research process have facilitated the progress of the work by giving us relevant and inspirational incentives to succeed with our degree project.

## 2.7 Evaluation of sources

Evaluating sources is a technique that combines skills, use of language and your attitude towards what is written. You should be able to question the text and be skeptical about it. This means that the researcher needs to be constantly reflecting, and justifying with clear arguments your own critical position (Saunders et al., 2009, p. 64). A critical analysis of the sources should identify and appraise what previous studies have contributed to the science and comment on weaknesses of what has been written by others. What the reviewer should focus on is credibility, validity and generalizability (Collis & Hussey, 2009, pp. 102-103).

This study will take a positivistic deductive approach. In order to obtain the most relevant theories for our theoretical framework, secondary data and scientific journals have been used. When referring from an article with secondary information we traced the information back to its primary source, whenever that was possible. We believe the articles gathered from databases like EBSCO and Google Scholar are trustworthy, since they have gone through a peer review. However, some articles have been collected from the web and might therefore be less reliable. Such articles demand more accurate review from the researcher. Nevertheless, information collected from these articles have been used to some extent due to the fact that we perceive the content relevant and interesting. To conclude, the majority of our sources have their origins from databases that have been reviewed, this should add credibility to our research and the data used.

Even though some of the reviewed studies demonstrate similar results one must be aware of the fact that the implications of the results might be different in different countries. It could for example be due to different laws and regulations. This needs to be considered when we analyze our final result.

The articles reviewed have been used to identify critical variables that could explain the relationship between market efficiency and foreign capital. Also, these articles have been important as they highlight other concerns of conducting business within the frontier markets of Africa. Without the information obtained from these articles regarding this topic, we might have missed information that could have affected our final outcome. The information has also been useful in order to establish our hypothesis and direct us towards interesting features within this field of research.

When selecting articles we did not consider when they were written or by whom or where. Though, most of the articles we have reviewed were published during the last ten years, which make them relevant today. In our theoretical framework there are some fundamental sources that were published during the $20^{th}$ century, e.g. Fama (1970). To conclude, all articles used are used for a reason, they all consist of relevant information despite when they were first published. Our report can therefore be seen as relevant and up to date.

# 3. Theoretical Framework

*This chapter will further elaborate and present in detail this study's theoretical point of departure. The chapter's main objective is to lay the ground for the adaptive market hypothesis. In order for the reader to get a grip of the AMH, the EMH and selected topics in Behavioral Finance will be presented in detail below.*

## 3.1 Why is market efficiency important?

As described in the first chapter, market efficiency is the market condition when prices fully reflect all available information, i.e. investors know that the price they are paying for an asset is a fair price (Fama, 1970, p. 383). This study is to a large extent concerned with market efficiency and in particular what it is that makes a market efficient. Thus, it is therefore relevant to reflect on and discuss the importance of market efficiency.

Brealey et al. (2011, pp. 329-333) presents "The Six Lessons of Market Efficiency" which are six features of market efficiency that one should bear in mind when operating on an efficient market. These six lessons also demonstrate the importance of market efficiency. We list and describe these lessons below:

**Lesson 1: Markets Have No Memory**
That markets have no memory basically tells you that in the weak form of market efficiency the past prices cannot help you to predict what will happen with the price of the asset in the future, i.e. an investor will not be able to look at historical price patterns to determine whether he should buy the security or not (Brealey et al., 2011, p. 329). This feature is important in a stock market to make sure that all actors have the same chance to succeed and that no one is able to make abnormal returns or exploit arbitrage opportunities.

**Lesson 2: Trust Market Prices**
All available information is impounded in the asset prices in an efficient market. This implies that most investors will not have the opportunity to earn positive abnormal returns unless they have superior information (Brealey et al., 2011, p. 330). It is important on a market that one can trust the prices otherwise it would be pointless for investors to invest.

**Lesson 3: Read the Entrails**
As demonstrated by the first two lessons, on an efficient market, the market prices are correct. It is therefore the investor's duty to estimate whether the prices will remain at the current price level or not. The investor could do this by, for example, reading the company's annual report (Brealey et al., 2011, p. 330). By doing this, an investor could find important information that helps him to estimate the future price of the security.

**Lesson 4: There are no Financial Illusions**
If the market is efficient there is no point for managers to conduct "creative accounting" because the market participants already know that the observed market price is the correct one (Brealey et al., 2011, pp. 331-332).

**Lesson 5: The Do-It-Yourself Alternative**
In an efficient market, investors will not pay others to do something they can do themselves. For example, why should two firms complete an expensive merger when an individual investor simply could buy both shares instead (Brealey et al., 2011, p. 332).

**Lesson 6: Seen One Stock, Seen Them All**
Brealey et al. (2011, p. 333) mean that investors buy stocks because of the possible return, in relation to its level of risk they could generate, i.e. not because of the stocks' unique features. In other words, stocks should be almost perfect substitutes to each other and the demand for a company's stocks should be highly elastic. If this holds, no one would buy a stock that offers less return than another less risky stock (Brealey et al., 2011, p. 333).

As explained above an efficient market is important for several reasons. Overall, the most important feature is probably the fact that you can trust the prices in an efficient market. This fact is important for several reasons. First, many companies use bonus programs for their employees and executives in the form of shares and options, i.e. employees are given shares or options as a sign of appreciation. It is important that the shares are fairly valued and are worth the actual market value. Second, for investors to trust the market, they need to be sure that prices are set at their fair value.

## 3.2 The Efficient Market Hypothesis (EMH)

Current accepted theories in academic finance are commonly known as traditional finance and builds on Harry Markowitz modern portfolio theory and the Efficient Market Hypothesis, which was popularized by Eugene Fama in 1970 (Ricciardi & Simon, 2000, p. 1). This chapter will thoroughly go through the latter, the pertinent efficient theories, in order to address our intended purpose. This part will elucidate the evolving research surrounded by market efficiency, which departures from Eugene Fama's Efficient Market Hypothesis. Furthermore, the evolution of the EMH will be addressed to arrive at the main theory intended for this study, namely, the Adaptive Market Hypothesis (AMH), which builds on the EMH as well as the school of behavioral finance.

The historical foundation of market efficiency can be traced back to 1900, when Louis Bachelier, mathematically, tested whether security prices were associated with a Brownian motion i.e. a random path. The empirical implications of his research was groundbreaking, generally he found that future stock price movements were impossible to foretell only by looking at historical prices (Yen & Lee 2008, p. 308). This Brownian movement of stock price behavior proved to be very complex to test empirically, therefore, it took 50 years to enlarge Bachelier's results. In 1953 Maurice G. Kendall was first to enlighten this behavior of stock prices, he stressed that the prices have a propensity to follow a random walk, this matter was later supported by

Samuelson (1965) and Mandelbrot (1966) (Yen & Lee, 2008, p. 308). Samuelson (1965), in his article “Proof that properly anticipated prices fluctuate randomly”, further widened these unpredictable patterns of prices and formed the “Random Walk Theory”.

The term “market efficiency” was developed by Fama (1970), as an outcome of Samuelson’s “Random Walk Theory” in 1965 (Lo, 2004). Bernstein (1999) argued that, before Fama’s formulation of the term market efficiency there were no explanations on why it was so difficult to beat the market. A joke that illustrates this phenomenon is described by Lo (2004), which is about an economist and his companion walking down the street and come upon a \$100 bill. The companion reaches down for the bill when the economist says: “Don’t bother, - if it were a genuine \$100 dollar bill, someone would have already picked it up.” Generally the Efficient Market Hypothesis asserts that the price of securities should fully reflect all available information. Thus, within an efficient market it should be impossible to beat the market and make returns above normal. To be more specific, there is no possibility to generate expected returns less or higher than the risk-adjusted opportunity cost of capital (Brealey et al., 2011, p. 321). Consequently, in a perfectly efficient market, no profits could be made with an information-based trading advantage; someone else would seize such opportunities immediately.

Fama (1970, p. 388) separates the market in three different forms of efficiency, the weak form, the semi-strong form and the strong form. The purpose of categorizing the market will allow the reader to pinpoint the level of information to observe where the diverse assumptions of the market forms break.

When the market is perceived in its weak sense: “prices efficiently reflect all the information compounded in the past series of stock prices” (Brealey et al., 2011, p. 335). This appearance of the market states that it should be impossible for investors to anticipate future prices, based on historical data of securities.

The semi-strong form asserts that prices reflect all public information available. Public information can be seen as financial reports by companies, previous stock prices and other information that could be seen as relevant to listed corporations. This hypothesis of the market states that it should be unachievable for actors on the stock market to consistently make abnormal returns by just by looking at the public information associated with the company (Fama, 1970, p. 383).

Finally, the strong form states that: “stock prices effectively impound all available information” (Brealey et al., 2010, p. 335). This form is extreme and barely holds in reality. “All available information” incorporates information available only to company insiders, thus, one could argue that these individuals have an advantage over other investors. This interferes with the strong form of market efficiency (Bodie et al., 2012, p. 348).

To conclude, Fama (1970) conducted three different tests on these market forms against the efficient market models (Yen & Lee, 2008 p. 309). Fama (1970) explains the efficient market models as “the hypothesis that security prices at any point in time “fully reflect” *all* available information” (Fama, 1970 p. 388). The weak form was tested against the efficient market models, the martingale test (sequences of random variables where the predicted value is equal to the present), for the semi-strong sense and ended up with strong tests of the efficient market models (Yen & Lee, 2008, p. 309). After the test was reviewed, Fama stressed:

> "*And we shall contend that there is no important evidence against the hypothesis in the weak and semi-strong form tests (i.e., prices seem to efficiently adjust to obviously publicly available information), and only limited evidence against the hypothesis in the strong form tests (i.e., monopolistic access to information about prices does not seem to be a prevalent phenomenon in the investment community)" (Fama, 1970, p. 388).*

## 3.3 Behavioral Finance

The EMH enjoyed several years without anyone questioning neither its validity nor its practical application in the real world. The support and empirical evidence were extremely strong among investors and in the academic world. In consequence, researchers started to challenge the model with evidence of market anomalies, i.e. evidence against an efficient market. As explained earlier, in an efficient market, prices reflect their fair value and it is therefore impossible to make abnormal returns. Thus, a market anomaly could for example be evidence of the contrary, i.e. that market participants have been able to generate returns above the normal level (Brealey et al., 2011, p. 321).

So, what causes prices to deviate from their fundamental values? The school of behavior finance believes the answers lie in behavioral psychology. Razek (2011, p. 7) means that financial and investment decisions are mysterious choices that will adjust with the changing of the environment and the prevailing surroundings. He concludes that this has to do with the fact that these decisions always incorporate the human aspect. Brealey et al. (2011, p. 326) explain that people are not 100% rational 100% of the time. This fact has created a gap between traditional finance and what is now commonly known as behavioral finance.

A simple overview of behavioral finance and what different schools it is made up of can be seen in figure 3.1 below. Traditional finance is still the centerpiece of behavioral finance; nevertheless, basic knowledge in psychology and sociology is essential in order to understand some of the elementary concepts within the field of behavioral finance (Ricciardi & Simon, 2000, p. 2). Thus, short definitions of psychology and sociology will be given below.

**Figure 3.1 – Behavioral Finance**


**Psychology** – *"Psychology is the basis for human desires, goals, and motivations, and it is also the basis for a wide variety of human errors that stem from perceptual illusions, overconfidence, over-reliance on rules of thumb, and emotions"* (Shefrin, 2002, p. ix).

**Sociology** – *"Is the systematic study of human social behaviour and groups. This field focuses primarily on the influence of social relationships on people's attitudes and behaviour"* (Ricciardi & Simon, 2000, p. 2).

The origins of behavioral finance can be traced back over 150 years when Charles MacKay published the article "Delusions and the Madness of Crowds", which shows how group behavior applies to financial markets as we know them today. The development continued in 1912 with George Charles Selden's book "Psychology of the stock market" which was the first book to apply psychology to the stock market. However, it was not until the 1990s the term behavioral finance started to pop up in academic journals and business publications (Ricciardi & Simon, 2000, p. 1).

Behavioral finance, today, attempts to map and increase the understandings of how investors reason and to what extent emotional processes affect the decision making process. Fundamentally, behavioral finance tries to explain the what, how and why of investing and finance, from a human perspective. For example, an explanation of market anomalies, e.g. speculative market bubbles, the January effect and crashes (Ricciardi & Simon, 2000, p. 2).

Furthermore, Ritter (2003) means that behavioral finance has two building blocks: cognitive psychology and the limits to arbitrage. On a market where there are limits to arbitrage rational investors fail to exploit obvious arbitrage opportunities (Brealey et al., 2011, p. 327). The cognitive psychology block refers to how people think, in this context, how investors think or not think on the financial market (Ritter, 2003, p. 429).

### 3.3.1 Behavioral Biases and Heuristics

According to Lo (2005), behavioral biases are simple heuristics taken out of context. Heuristics could be explained as rules of thumb, that make the decision making process easier. One could say that a heuristic is a shortcut, which is often helpful in the decision making process, but it could also lead to biases, particularly when circumstances change (Ritter, 2003, p. 431). However, Lo (2005) argues that even though the circumstances change, given enough time and sufficient competitive forces, any counterproductive heuristic will adapt to the current environment.

Tversky and Kahneman (1974) mean that people rely on a restricted number of heuristic principles and therefore, sometimes, make systemic errors. Herbert Simon found that people tend to satisfy rather than optimize, which leads to people taking shortcuts, i.e. heuristics to take on complex decisions, e.g. investment decisions (Razek, 2011, p. 9). Furthermore, Lo (2005, p. 21) argues that there are several behaviors that some classify as violations of rationality and therefore are inconsistent with market efficiency. Instead, these behaviors are, in fact, consistent with an evolutionary model of individuals trying to adapt to a changing atmosphere via simple heuristics.

So, why is it important to understand and identify certain behavioral biases? Pompian (2012, p. 45) means that, by simply be able to identify behavioral biases at the right time one could improve economic results and possibly save a company from a disaster. Furthermore, by recognizing the effects of behavioral biases on the investment process a company could more easily meet financial targets by modifying and or adapting to the irrational market behavior.

The behavioral biases (heuristics) stated by Lo (2004, p. 21), are described in detail below.

**Loss Aversion**

*"Winn as if you were used to it, lose as if you enjoyed it for a change" – Ralph Waldo Emerson* (Pompian, 2012, p. 191)

Tversky and Kahneman developed loss aversion in their 1979 study about the original prospect theory. They found that people tend to prefer avoiding losses rather than acquiring gains (Pompian, 2012, p. 191). Tversky and Kahneman (1985) explained that Loss Aversion explains peoples' reluctance to bet on a fair game. They did a test on undergraduates, which showed that most respondents refused to bet $10 on the toss of a coin if they stood to win less than $30. This simple example shows that people rather win nothing than loose $10, i.e. most people are subject to loss aversion.

**Overconfidence**

*"Too many people overvalue what they are not and undervalue what they are" – Malcolm S. Forbes* (Pompian, 2012, p. 199)

Overconfidence is an emotional type of bias and can be summarized as unjustified belief in one's instinctive reasoning, judgments, and cognitive capabilities. The concept of overconfidence has developed through psychological experiments in which subjects seem to overestimate their predictive abilities. As a consequence, this often leads to excessive risk taking simply because the subject in question overestimate her own abilities (Pompian, 2012, p. 199).

Pompian (2012, p. 202) describes 4 different overconfidence biases, i.e. behaviors that can cause investment mistakes. First, investors overestimate their ability to assess a potential investment and as a result become blind to important factors that could indicate a change in the actual value of the stock. Second, investors tend to trade disproportionately because of the belief that they possess superior information about the company. Third, investors seem to underestimate their downside risks. Fourth, overconfident investors, therefore, often hold undiversified portfolios.

**Overreaction**
De Bondt and Thaler published their study "Does the Stock Market Overreact?" in 1985, in which they measured how investors react to certain events and news, e.g. an earnings announcement. They argue that people, in revising their beliefs, tend to overweight recent information and underweight past data. Thus, reacting strongly to news without considering prior information (De Bondt and Thaler, 1985, p. 793).

**Mental Accounting**
People sometimes separate decisions that really should be combined for the best possible outcome. For example, households often have two separate budgets for food at home and food at restaurants. Families tend to eat cheap food like simple white fish at home, however, when they eat at restaurants they often order more expensive seafood like lobster or salmon. Instead, if people ate lobster at home and the simple white fish at the restaurant more money could be saved. This is another example of irrational behavior (Ritter, 2003, p. 431). In the same way, Statman (1999, p. 19) describes how people keep their money in separate mental "pockets". Some money is "fun money" some is retirement money and some money is devoted to your child's college education. People value these mental "pockets" differently which could mean that $1 dollar loss in the retirement account could be worse than a $1 loss in the college education account.

**Implications for an investor**
Entering a new and possibly unknown market, e.g. the African market would most likely imply taking on a higher risk. However, if the rewards are high enough one could gain from entering a new market even though people tend to avoid risks.

The four overconfidence biases could be of great help for an investor entering an inefficient market. An inefficient market implies the occurrence of information asymmetry, thus, an inefficient market offers arbitrage opportunities. Consequently, the information that an investor believes is superior may not be and instead lead to losses.

Additionally, investors might possess different portfolios consisting of stocks from different markets. Considering the mental accounting bias, investors might value these portfolios differently leading to irrational behavior. Furthermore, valuing portfolios differently might imply that an investor also reacts differently to market news from respective market, leading to the irrational behavior of overconfidence.

### 3.3.2 Critique Against Behavioral Finance

Although behavior finance is a relatively new field of study and praised by many prominent scholars, there are also some critics that argue that behavioral finance is not scientific because it does not have a dominant paradigm. In other words, they mean that behavioral finance draws from other disciplines in an ad hoc fashion, it is focused on short-lived and emergent phenomena (Olsen, 2001, p. 157). Olsen (2001) means that behavioral finance lacks the essentials of a science, i.e. statements or hypothesis must be hypothetically tested and falsifiable. Furthermore, other finance theorists claim that behavioral finance, unlike traditional finance with CAPM and EMH, lacks a "unified theory". These theorists argue that the need of having a unified theory stems from two observed needs. First, there must be a common framework to ensure logical consistency. Second, this common framework must guide the search for important unanswered questions (Olsen, 2001, p. 158).

### 3.3.3 Future Coexistence between EMH and Behavioral Finance

As stated before, the EMH does not enjoy the same strong support it did during the 1960s. There are some intuitions in behavioral finance that are very important for investors, Malkiel (2005, p. 134) argues, in a discussion with his fellow academicians Bruce Strangle and Sendhil Mullainathan. Malkiel (2005) further concludes that the EMH will last another generation in the academy, however, so will the behavioral insights do as well. Strangle argues that one should not really care whether EMH or behavioral finance applies, considering the fact that from an investing point of view, both schools tell you to do the same thing, "you can't beat the market, so buy an index fund".

Shiller (2003, p. 102), a proponent of the behavioral finance paradigm, claims that behavioral finance helps us understand market anomalies, i.e. evidence against the EMH. He writes that we need to start distance ourselves from the presumption that stock markets always work well. He contends that the challenge for economists is to incorporate this reality into their models.

Considering the future, Mullainathan means that neither EMH nor behavioral finance offers any real understandings of peoples' attitudes towards risk, return and the market as a whole. These areas are of great importance, because that is what is going to drive market innovation (Malkiel et al., 2005, p. 134). Indirectly, Mullainathan gives us a hint of the desire of a unifying model.

## 3.4 Adaptive Market Hypothesis

So far, the EMH and the school of behavioral finance have been presented. The EMH argues for a constant efficient market, whilst the behavioral finance paradigm explains market anomalies and the human aspect of market behavior i.e. behavioral biases and irrational behavior. Questions have been raised whether market efficiency evolve over time? The possibility that market efficiency change over time is explained by Self and Mathur (2006, p. 3154), who argue that the market sometimes behaves according to the definition of the EMH and sometimes, according to certain market forces, deviate from the typical pattern of an efficient market. To accommodate the changing nature of market efficiency Lo (2004) suggests a new version of the EMH, derived from evolutionary principles, which he calls the Adaptive Market Hypothesis (AMH). Moreover, he proposes a new paradigm in which EMH and behavioral finance can coexist. He develops his ideas further in his subsequent papers on the subject (Lo, 2005, 2012).

“If Adam Smith had a mind meld with Charles Darwin, Andrew Lo might result”, Time Magazine wrote. Andrew W. Lo is a professor at the Sloan School of Management and known for his peculiar ways of better understanding the market. His work is influenced by neuroscience and sociobiology. He is probably best known for his important work on the AMH (Foroohar, 2012). The work with the AMH began in 1999 with Farmer and Lo’s article “Frontiers of Finance: Evolution and Efficient Markets” and continued with Farmer’s “Market Force, Ecology and Evolution” (2002), Lo’s “Bubble, Rubble, finance in trouble?” (2002), which led to Lo’s 2004 article “The Adaptive Market Hypothesis: Market Efficiency from an Evolutionary Perspective” in which Lo established the AMH (Lo, 2005, p. 30). The AMH is based on several different bodies of literature including bounded rationality in economics, complex systems, evolutionary biology, evolutionary psychology and behavioural ecology. The revolutionary implications of the AMH includes not only the fact that it allows EMH and behavioural finance to coexist but also, concrete implications to the practice of investment management (Lim & Brooks, 2011, p. 72).

Applying evolutionary ideas to economic behaviour is not a new concept. Wilson (1975) was one of the first to systemically apply the principles of competition, reproduction, and natural selection to social interactions, which resulted in new exiting explanations of human behaviour, including mate selection, religion, ethics etc. (Lo, 2005, p. 29). Wilson (1975) named this field “Sociobiology” and released a book with the same name which ideas are formed around the animal life; however, the ideas could easily be applied on human behaviour and market ecologies. Which they have been, Niederhoffer (1998, p. 357) compares financial markets with an ecosystem with dealers as herbivores, speculators as carnivores, and floor traders and distressed investors as decomposers.

As explained above Lo (2004) describes the AMH as a new version of the EMH derived from evolutionary principles. He lists six primary components of the AMH to make the hypothesis easier to understand (Lo, 2005, p. 31):

(A1) – Individuals act in their own self-interest
(A2) – Individuals make mistakes
(A3) – Individuals learn and adapt
(A4) – Competition drives adaptation and innovation
(A5) – Natural Selection shapes market ecology
(A6) – Evolution determines market dynamics

A1 is true under both EMH and AMH, however, A2 and A3 do not hold under the EMH. In an efficient market individuals do not make mistakes nor learn and adapt. On the contrary, in the AMH framework, individuals do make mistakes but they are also capable of learning from those mistakes and adapting their behaviour appropriately (Lo, 2005, p. 31). Furthermore, A4 is straightforward and A5 implies that the current market environment is the result of the interactions among various market participants and these interactions are governed by natural selection i.e. in this context, the survival of the richest. A6 aims to sum up the other five components, A1 to A5 is what we perceive as market dynamics (Lo, 2005, p. 31).

Lo (2004, 2005, 2012) often describes the market as an ecology, just like Niederhoffer (1998) likened the financial market with an ecosystem. By species, Lo (2005, p. 31) means different market participants behaving in a common manner, such as pension funds, retail investors and hedge fund managers. If several species, in the same market, are competing for scarce resources, that market is likely to be highly efficient. The same goes for the opposite conditions, i.e. few species competing on a large market would imply low market efficiency. Consequently, as the market environment changes, which it frequently does, the market efficiency and the market behaviour will change accordingly, and the efficiency cycle will start all over again (Lo, 2005, p. 32). This explains the nature of an adaptive market, which is the essence of the AMH.

Perhaps the greatest reason why the AMH has been given so much attention, and is regarded as a revolution in the research around efficient markets, is the fact that it gives practical implications for investors, portfolio managers and policymakers (Lo, 2012, p. 24). Lo (2012) argues for at least five practical implications of the AMH:

1. Given that the market environment changes over time the trade-off between risk and reward will not remain stable. For example, when the market is in dislocation, investors will turn to safer investments, which will reduce the returns on risky assets and increase the returns on safer ones. This reasoning is completely opposite to the traditional reasoning around risk and return (Lo, 2012, pp. 24-25).

2. Market efficiency is not an absolute condition but rather a continuum. Market efficiency depends on the relative proportion of participants in the market. Lo (2012) means that the degree of market efficiency should be measured and that the more the market participants have adapted to the market environment the higher the degree of efficiency. Therefore, this should imply that a new market should be less efficient than a more rooted market that has been around for decades. However, even the latter case could have periods of market inefficiency due to changes in the environment or population (Lo, 2012, pp. 25-26).

3. As market conditions and investor-populations change, investment policies must be formulated with these changes in mind and they should adapt accordingly.

4. Under the EMH, alpha, i.e. the "return earned on a portfolio in excess of that predicted by the capital asset pricing model" (Hull, 2012, p. 595), should always be zero. Under the AMH, alpha has a changing nature because of the adaptive nature of competition, innovation and natural selection in financial markets (Lo, 2012, p. 26).

5. Under the AMH risk premiums and volatilities vary over time in response to apparent market conditions. Thus, an adaptive investment strategy may be the best possible option, i.e. mix different financial instruments to form a suitable portfolio

instead of using static predetermined portfolio weights (Lo, 2012, p. 27).

## 3.5 What makes a market efficient?

So far, we have explained why market efficiency is important. Now, on to the next important feature, what makes a market efficient? To arrive at a market where the price of an asset fully reflects all available information, Fama (1970, p. 387) discusses a few ideal market conditions. First, there should be no transaction costs. Second, all market participants should be able to access all available information for free. Third, “all agree on the implications of current information for the current price and distributions of future prices of each security”.

As explained above, Lo (2004, 2005, 2012) means that market efficiency change constantly in response to changes in the market environment. Lim and Brooks (2011, pp. 81-85) list a number of such market changes and argue that it is more important to investigate the underlying factors that lead a market to become efficient, just in line with this study. Some of these factors and empirical evidence will be presented and discussed below.

**The Opening of Domestic Stock Market to Foreign Investors**
Perhaps the most interesting factor for this study is whether the opening of stock markets to foreign investors affects the market efficiency, which indirectly will increase the inflow of foreign capital. Kim and Singal (2000) investigated whether stock markets became more efficient after policymakers in 20 developing countries opened up their markets to foreign investors. They found that the markets in general became more efficient. Füss (2005) reached similar conclusions with evidence from seven emerging stock markets in Asia. One could assume that the amount of participants increases when foreign investors are allowed on the market. These results are in line with what Lo (2012, p. 25) states about market efficiency; “market efficiency is not an all-or-nothing condition but a continuum, one that depends on the relative proportion of market participants who are making investment decisions…” i.e. market efficiency increases when the number of participants increase.

**The Adoption of an Electronic Trading System**
In recent decades, stock markets around the world have replaced their physical trading floors with computerized trading systems (Lim & Brooks, 2011, p. 82). How has this change affected market efficiency? Naidu and Rozeff (1995) found that the adoption of an electronic trading system on the Singapore Stock Exchange led to a decrease of the autocorrelations of returns. However, a study by Freund and Pagano (2000) proved that the introduction of electronic trading systems on the New York Stock Exchange did not change the efficiency significantly.

**The Changes in Regulatory Framework**
Using daily data on the Istanbul Stock Exchange Composite Index Antoniou et al. (1997) examined what impact changes in the regulatory environment would have on market efficiency. These regulatory changes encouraged market participation, removed institutional restrictions on trading and ensured high quality and reliable information to be easier available to investors. Their most significant finding was that

regulatory changes from 1989 led to market efficiency on the Istanbul Stock Exchange from 1991 and onward.

# 4. Previous Research

*This chapter presents some previous research, which we, the researchers, believe are important to present in order to motivate our field of research. It is divided into three parts. First, previous research concerning frontier stock market integration will be presented. Second, FDI related studies are presented. Finally, we will present some previous studies concerning efficiency in frontier markets.*

The table below is a summary of all the studies. They are presented in the table in the same order as they are presented in the subsequent three sections (4.1, 4.2, 4.3).

**Table 4.1 – List of previous studies**

| Authors | Period | Market | Conclusions |
|---|---|---|---|
| **Bekaert & Harvey (1995)** | 1969-1975 | Developed, Emerging | Emerging, not integrated with developed markets |
| **Speidell (2008)** | 2007-2008 | Frontier | Frontier, integrated due to foreign debt |
| **Berger et al. (2011)** | 1989-2005 | Developed, Emerging, Frontier | Periods of integration exist |
| **Chent et al. (2014)** | 2008 | Developed, Frontier | For integration, policy makers should focus on certain variables |
| **Borensztein et al. (1998)** | 1970-1989 | Emerging | FDI, positive impact on growth, if certain conditions are met |
| **Kim & Singal (2000)** | 1980-1990 | Emerging | Make the market more open and transparent towards FDI |
| **Mecinger (2003)** | 1994-2001 | Frontier | Form of FDI, depend if it contribute with growth |
| **Moura & Forte (2010)** | 1959-2009 | Developed, Emerging, Frontier | FDI positive impact on growth, if certain conditions are met |
| **Acheampong & Wiafe (2013)** | 1990-2010 | Frontier | Modernize stock market, improve regulation, attract FDI |
| **Jefferis et al. (2002)** | 1990-1998 | Emerging, Frontier | Most of the African market do not behave in the weak form |
| **Füss (2006)** | 1980-1996 | Emerging | Asian market, more efficient after increased financial liberalization |
| **Self & Mathur (2006)** | 1992-2003 | Developed | Periods of predictability exist, on G7 countries markets. |
| **Lagoarde-Segot & Lucey (2008)** | 1998-2004 | Emerging, Frontier | Market size and liquidity has an impact on the weak form of the market |
| **Nwosu et al. (2013)** | 1998-2008 | Developed, Emerging, Frontier | African markets are not consistent with the weak form of the market |
| **Smith & Dyakova (2014)** | 1998-2011 | Emerging, Frontier | Efficiency is predictable from time to time, AMH better than EMH |

## 4.1 Frontier Stock Market Integration

**Bekaert and Harvey (1995)** examined returns on frontier markets, so called "segmented markets" separated from the global market, and established a measure to identify how well these markets are integrated with the global capital market (p. 403). The authors' findings revealed that only four out of twelve countries were integrated with the rest of the world (p. 437).

**Speidell (2008)** investigated how 28 different frontier markets performed during the 2008 financial crisis. Speidell (2008) found that Eastern Europe was hit hard while Africa and the Middle East thrived (p. 7). What the author observed was that most of the frontier markets offered investors a diversification benefit since these markets were not dependent on global capital, which was the case for Eastern Europe, which explains their bad performance (p. 9). Further, Speidell found that these markets were most occupied by local investors that were more concerned with operations on a local level. The author mentioned Ghana as an example. During the pre-period of the crisis the market of Ghana rose by 30% and the author argued that this was due to the few foreign investors active within the market (p. 10). To sum up, Speidell's findings showed that the Eastern European markets were integrated with the rest of the world due to their foreign debt, while the rise in African markets and in the Middle Eastern markets pointed to evidence that they not yet were integrated with the more developed economies.

**Berger et al. (2011)** further elaborated on Speidell's (2008) discussion about to what extent frontier markets are integrated with the developed markets, by examining the diversification benefits of investing within less developed markets. The outcome of this paper supported Speidell's (2008) results, and again, the evidence supported the fact that frontier markets are not integrated with the rest of the world (p. 227). However, the authors found that periods of higher degree of integration exist, making the assumption that integration is time varying. Berger et al. (2011) also found evidence of diversification benefits of investing in frontier markets, provided that the portfolio consists of stocks in developed markets as well (p. 241).

**Chen et al. (2014)** examined, just like Speidell (2008) and Berger et al. (2011), how well integrated the frontier markets are with the more developed markets. Just like Speidell (2008), Chen et al. (2014) used the global crisis period of 2008 as a time horizon and how the frontier markets were affected (pp. 84-84). The authors also brought up the concern regarding the narrow empirical research on frontier markets. Lack of information, opinions of excessive risk or lurking variables affecting investments are unwanted features that discourage investors to act on these undeveloped markets. Acheampong and Wiafe (2013), Lagoarde-Segot and Lucey (2008), Mecinger (2003) and Smith and Dyakova (2014) all support Chen et al. (2014), arguing that regulations need improvement and or alteration in order to attract foreigners and their capital to the markets. Furthermore, the authors pointed out that frontier markets are not fully integrated with the developed markets. Finally, Chen et al. (2014) stressed that, policy makers of frontier markets need to focus on industry value, real interest rate, gross savings, tax rates and tariffs in order to integrate with the leading economies (p. 99).

### 4.1.1 Implications for our research

According to previous research frontier stock markets of Africa are not fully integrated with the rest of the world. Berger et al. (2011) stressed that frontier stock markets of Africa are integrated from time to time. Chen et al. (2014) found that frontier stock markets were not affected by the financial crisis of 2008. Furthermore, Speidell's findings (2008) revealed that Eastern Europe, which was dependent on foreign capital, was affected by the financial crisis while the frontier stock markets of Africa were not. However, that does not mean that we can ignore neither the financial crisis nor the integration aspect when analysing the efficiency development in the re-examined markets.

## 4.2 Foreign Direct Investment

**Borensztein et al. (1998)** tested the effect of inflow of FDI from developed countries to 69 emerging markets and how this foreign capital affected the economic growth. The authors found that the main achievement that FDI could bring to developing countries was the transfer of knowledge and information (p. 155). Borensztein et al. (1998) also stressed the importance of human capital and the overall level of education as the most critical factors in order for FDI to succeed to generate positive economic growth in the less developed markets. However, domestic investments did not have any explanatory power, which the authors claimed could be due to the differences in technology between FDI and domestic investments. As a final point, the authors suggested that future researchers could examine whether the increase in economic growth is due to increased efficiency or the amount of foreign capital within a market (pp. 133-134).

**Kim and Singal (2000)** studied the role of free flow of capital into emerging markets. The authors mentioned that previous studies are pessimistic about uncontrolled capital, and that this type of capital is risky and destabilizing. On the other hand, some studies point to the fact that free capital contributes to economic progress and better allocation of resources. With this paper, Kim and Singal tried to bring more evidence to this relationship. Further, the authors investigated the impact of free flow of capital on various factors, namely, stock returns, efficiency, inflation and exchange rates. The authors found that eased regulations, allowing foreign capital into their market, decreased the inflation due to improved production efficiency. However, the authors did not find any evidence that the exchange rate was affected, i.e. an appreciated currency. Regarding the question of level of efficiency due to increased flow of free capital the authors found an increased randomness, in returns that could support that efficiency increased with more free capital within the market. To conclude, the authors stressed that the benefits of free capital into the market is out weighted with the potential risk associated with the free capital. There are needs for policy makers to make the markets more open and transparent towards foreign capital.

**Mecinger (2003)** examined whether FDI always boosts economic growth. Mecinger started his discussion with previous arguments for FDI as a mechanism of economic growth, that contribution of international capital nurture efficient distribution of resources, which by itself should stimulate economic development. The study consists of eight countries from Eastern Europe that candidate for the European Union and he wanted to see if foreign capital always is good for an emerging market (pp. 491-492).

Further, Mecinger argued that, the link between FDI and the current account should be explored. Mecinger found that foreign debt increased due to increased FDI, since the trade deficit increased. All of the candidate countries had a negative impact of FDI on economic development in the pre-period of entering the union. Mecinger explained that this has to do with the form of FDI that is presented in these regions. He argued that Acquisitions, one of the most common form of FDI does not involve investing in real assets, the sales from such acquisitions were spent on consumption and imports, contributing to a trade deficit on the current account, which advanced into foreign debt (pp. 500-502). Moreover, Mecinger addressed the importance for local firms to be able to invest in foreign technologies and learn from them in order to generate positive spill over effects (p. 503). To conclude, Mecinger found that FDI plays an important role in order to enhance the economic growth.

**Moura and Forte (2010)** examined and discussed the most critical characteristics needed from the host country in order to generate economic growth through increased levels of FDI. The authors went through previous empirical studies on FDI's impact, and found arguments supporting Borensztein et al. (1998), that FDI generates positive outcomes, but also arguments supporting Mecinger (2003), which showed evidence that FDI not necessarily brings positive effects in a host country (p. 1). The authors claimed that there is doubt that FDI has an effect on growth in the host country. The different outcomes from previous work, according to them, depend on the different variables used when these relationships are tested, or that the analysis of the host country is too narrow. What Moura and Forte (2010) found as the most important for the host country to be able to benefit from FDI, were the political, cultural, social and economic situation within the country. Local authorities need to consider these factors in order to get the desired outcomes out of FDI. Finally, the authors pointed out that, these authorities should participate in projects that can meet the country's needs, also making the policies suitable to comply with the existing conditions within the country. Then FDI can contribute with desirable impacts on the economic growth within a country (pp. 25-26).

**Acheampong and Wiafe (2013)**, just like Borensztein et al. (1998), investigated the effect of FDI. Specifically they investigated FDI's effect on stock market development, where they focused on the security market of Ghana. The authors studied which other possible variables that could have a positive impact on the evolution of stock markets. The result showed that FDI positively affects stock market development. They also found that exchange rate and inflation support an increased development in security markets (p. 3). The authors stressed that governments should form policies to improve laws in order to create an attractive investment environment that will attract foreign investors to their markets. The authors argued that the surpluses that FDI generates should be re-invested in order to increase the economic growth and development of stock markets. Acheampong and Wiafe concluded that the Government of Ghana should modernize the country's stock market, and reinforce both the institutional and regulatory framework that facilitates the inflow of FDI (p. 14).

### 4.2.1 Implications for our research

The previous studies regarding FDI will be useful for us in our research process in order to understand the reasons behind foreign capitals potential impact on efficiency.

Moura and Forte (2013) explained that there are other variables that affect FDI, which in turn will have an impact on our final results. Thus, this needs to be considered in our regression model. Even if we find a relationship between FDI and market efficiency there could be other lurking variables that should have been included. Acheampong and Wiafe (2013) found that the exchange rate and the level of inflation have a positive impact on stock market development. We can therefore assume that both these variables will have an impact on the degree of trading within a market thus, an impact on the level of market efficiency. These variables could therefore have been included in our model. However, we decided to include similar but different variables in this study, namely the deposit interest rate and the GDP per capita. The underlying motives behind these choices will be explained further in section 5.1.4.

## 4.3 Efficiency In Frontier Markets

**Jefferis et al. (2002)** examined some of the major stock markets of Africa to check whether they were consistent with the weak form efficiency and found that the African markets behaved inconsistently with the behaviour of the weak form of the market. The only stock market that was aligned with the weak form was the Johannesburg Stock Exchange (JSE) of South Africa (p. 274).

**Füss (2006)** tested the weak form efficiency in emerging markets in Asia before and after the increase of financial liberalization. The author found that before the financial liberalization, Asian markets did not comply with the weak form of market efficiency. What he observed was that efficiency increased in the post liberalization period. Thus, the Asian markets became more efficient with increased financial liberalization (p. 60).

**Self and Mathur (2006)** further investigated whether the EMH always is right, i.e. that the market is in an equilibrium that makes it impossible to earn abnormal returns. They continued the discussion with the fact that investors do not use all information available in their investment decisions. Instead, they use the information needed in line with their preferences and constraints. Self and Mathur (2006) argued that there are periods in time when the EMH does not hold. The problem, that this paper was trying to solve, was that researchers systematically found market anomalies that deviated from the EMH, and tried to identify the underlying economic factors that could explain this behaviour (pp. 3153-3154). By using data on indices of G7 countries, the authors tried to find predictable patterns that could explain the underlying economic mechanism that makes the market depart from the EMH. Self and Mathur (2006) found that each of the markets investigated had periods when it was possible to predict the market.

**Lagoarde-Segot and Lucey (2008)** explored informational efficiency in a set of seven emerging markets in the Middle-Eastern North African Region (MENA) security markets. The authors approached this by performing an aggregated random walk test and a technical trade analysis, creating an efficiency index. Then, the authors investigated if the market progress, corporate control and economic liberalization had an impact on the weak form of market efficiency (p. 94). By using their established efficiency index, they found that the market size and how liquid the market is had an impact on the weak form of market efficiency. This could explain why the South African market is considered one of the most efficient stock markets in Africa (Jefferis et al., 2002). Furthermore, financial liberalization had no explanatory power. The authors explained that a country that wants to generate positive economic spill over effects, generated from stock market activities, needs to focus on factors that can make the market bigger in terms of size and liquidity and at the same time structure regulations properly for this purpose. These regulations should focus on managerial liabilities and shareholder protection in order to reach a more efficient market (p. 104).

**Nwosu et al. (2013)** investigated the weak form efficiency within four of the major stock markets in Africa, and in one developed market (The US) over the time period 1998-2002. From the specific markets chosen, the weekly market index return from the four indices from Africa and S&P 500 were used to determine whether the stock market returns in Africa went against the random walk hypothesis (p. 485). The authors found that the emerging markets in Africa did not behave in a way characteristically of the weak sense of market efficiency. Nwosu et al. (2013) observed a contrast between African equity markets and the US market. They found that African markets offer a higher average rate of return and that these markets are more volatile compared to the US market. However, one interesting observation from the authors was that the developed market seemed to also be weak form inefficient, but not to the same extent as the frontier markets in Africa. The authors argued further that this could explain the exceptional growth in the US market between the periods of 2004-2007 (p. 495). Finally, the authors rejected their null hypothesis, that the African market is weak form efficient. They concluded that assets within Africa are attractively valued and can play an important part for worldwide portfolio diversification, which is consistent with the results of Berger et al. (2011). Nwosu et al. (2013) argued that this could be one of the explanations for the tremendous increase of foreign investors within Africa along with offering investors potential high returns (p. 496).

**Smith and Dyakova (2014)** investigated whether African security markets were consistent with the weak form of market efficiency. The authors examined changes in predictability and ranked them according to their relative predictability (p. 258). The authors criticised the old theories due to their simplicity and that they either sets the market to be efficient or not. The authors examined previous studies that concluded that the market could evolve in different stances of efficiency from time to time. This is captured in their report by looking at the results in the light of the Adaptive Market Hypothesis (AMH). The authors stressed that efficiency is time varying, due to changes in environmental settings and variations in the population of market participants (p. 259). The outcome from their test was that these African markets were consistent with AMH; periods of predictability were followed up by unpredictable periods. The most predictable markets were Kenya and Zambia. Not surprisingly, the more developed markets of Egypt, South Africa and Tunisia were less predictable. Further, the authors discussed that illiquid and small markets were more predictable, supporting the findings of Lagoarde-Segot and Lucey (2008). The authors highlighted the importance for investors to be aware of these periods of predictability in order to adjust their future plans for their portfolio strategies. Finally, this research suggested that efficiency is predictable from time to time and deviates from the EMH, which implies that AMH explains market efficiency in Africa in a better way.

### 4.3.1 Implications for our research

By reviewing the previous literature on market efficiency in frontier stock markets, we can see that markets have developed over time from being inefficient to facing more frequent periods efficiency. Lagoarde-Segot and Lucey (2008) created an efficiency index in order to track the predictable periods of market efficiency. We will not use the same test, however, we will create a similar index of market efficiency using test statistics from two different Variance Ratio tests, which will clearly present how the market efficiency has evolved over time in the re-examined markets of Africa. Furthermore, Lagoarde-Segot and Lucey (2008) found that market size and liquidity have positive impacts on the weak form of market efficiency. Therefore, we will use three different proxies for size and liquidity, namely, market capitalization as a percentage of the GDP, population and the total value of stocks traded as a percentage of GDP. We will justify and explain these variables further in chapter five.

# 5. Practical Methodology

*This chapter intends to clarify the practicalities around conducting this research. The statistical tests will be clarified and the different variables used will be justified and defined. The data collection procedure will also be presented as well as data shortfall.*

## 5.1 Data

In order to conduct this quantitative study, the quality of the collected data is critical in order to succeed. Our data come from two sources, Thomson Reuters Datastream and from the World Bank Database. It is important for this research to have reliable data, which are provided from these well-recognized databases. The selection of data sources is not hard to motivate. Thomson Reuters Datastream and the World Bank Database are well-recognized sources of financial data and micro- and macro economic information. Therefore, the gathered data will be useful in order to conduct this research.

### 5.1.1 Collection and processing of data

The data are collected from the stock markets of Botswana, Kenya, Mauritius, Morocco, Nigeria and Tunisia. The indices used are the NGSEINDX (all share, Nigeria), SEMDEX (all share, Mauritius), KNSMIDX (price weight index, 20 firms, Kenya), MOSENEW (all share, Morocco), TUSISE (all share, Tunisia), BGSMDC (all domestic companies, Botswana) (Bloomberg Business, 2015). The data collected are daily price indices, collected from Thomson Reuters Datastream. The chosen indices cover the period from 31st of December 2004 to the 1st of January 2015. The empirical analysis of this report uses the daily closing prices, translated into natural logarithmic returns for the six stock exchanges, all in local currency. The motive of using returns instead of stock prices comes with the fact that investors are more interested in returns rather than prices. Therefore, returns from the chosen indices are used in this study in order to measure the weak form efficiency. For a better understanding of the analysis and processing of the data collected a four-step procedure will be given later in this chapter.

### 5.1.2 Data shortfall

When we first approached the task of collecting data we hoped to find price indices for the ten largest frontier stock markets of Africa. We realized quite fast that data for some indices were lacking. For example, we could not find data from the stock market of Ivory Coast. Furthermore, the data for some of the variables used in the panel regression analysis are not complete, e.g. we could not find the deposit interest rate of Tunisia between the years 2007-2013. The shortfall of data is not favourable for this study considering the fact that, with less data, it will be harder to analyse the results. The shortfall of data has led to the exclusion of some macroeconomic variables that would have been of interest for this study, e.g. level of education in the countries. For those countries that only have data from 2007-2012 the 2013 value in the panel data has been replaced by the latest observed value, i.e. the value for 2012. This correction made the panel regression analysis statistically strongly balanced.

Table 5.1 below is a summary of the selected markets and presents the Thomson Reuters Datastream code as well as the index name to enable future researchers to easier replicate this study. The two VR tests are performed on moving sub-sample windows of two years, we therefore loose two years of observations.

**Table 5.1 – Stock markets and indices**

| Market | Stock Exchange | Founded | Index Name | Datastream Code |
|---|---|---|---|---|
| **Botswana** | Botswana Stock Exchange | 1989 | BGSMDC | BOTDCII |
| **Kenya** | Nairobi Securities Exchange | 1954 | KNSMIDX | NSEINDX |
| **Mauritius** | Stock Exchange of Mauritius | 1988 | SEMDEX | ISEMDEX |
| **Morocco** | Casablanca Stock Exchange | 1929 | MOSENEW | MASIIDX |
| **Nigeria** | Nigerian Stock Exchange | 1960 | NGSEINDX | NIGALSH |
| **Tunisia** | Bourse de Tunis | 1969 | TUSISE | TUTUNIN |

### 5.1.3 Data analysis procedure

After the collection of data, conducting a quantitative study involves several steps. For this particular study the steps are:

1. Calculating logarithmic returns
2. Performing Variance Ratio tests
3. Performing panel regression analyses
4. Answering the research question by rejecting or accepting the null hypothesis

The steps are defined and argued for below.

**1. Calculating logarithmic returns**

To investigate whether the selected stock markets are weak form efficient or not, i.e. are following a random walk, the first step is to calculate the daily logarithmic returns on each stock market index.

The daily logarithmic returns are calculated as follows:

$$\mathrm{R_t} = \ln(\mathrm{p_t}) - \ln(\mathrm{p_{t-1}})$$

Where:
$R_t$ = Logarithmic return at time t
$p_t$ = Price at time t
$p_{t-1}$ = Price at time t-1

Calculating this on every stock market gives us six separate return series, which we will use in the variance ratio tests. The yearly log returns are displayed in Appendix 1.

**2. Performing Variance Ratio tests**

Serial correlation tests and spectral analysis were used in the past to test the weak form of market efficiency, also called the Random Walk 3 model (Lim & Brooks, 2011, p. 73). Lo and MacKinley presented their seminal work in 1988 in which they proved that stock market prices do not follow random walks. They used a, by the time, slightly different test to measure if past prices were correlated or not. They used the Variance Ratio (VR) test, which has since then emerged as the primary tool for testing if stock returns series are serially uncorrelated or not, i.e. if the market is weak form efficient or not (Lim & Brooks, 2011, p. 74). Furthermore, the VR test is established around the statistical characteristic that if the stock price (in our case the index price) follows a random walk, "the variance of the *k*-period return is equal to *k* times the variance of the one-period return. Hence, the VR, defined as the ratio of the variance of the k-period return to k times the variance of the one-period, should be equal to one for any holding period k" (Lim & Brooks, 2011, p. 74). Assuming $\mathrm{r_t}$ to be the, t = 1,…, T, asset return the VR statistic can be written as:

$$\mathrm{VR(r;k)} = \frac{\frac{1}{\mathrm{Tk}}\sum_{\mathrm{t=k}}^{\mathrm{T}}(\mathrm{r_t} + \mathrm{r_{t-1}} + \cdots + \mathrm{r_{t-k+1}} - \mathrm{k}\hat{\mu})^2}{\frac{1}{\mathrm{T}}\sum_{\mathrm{t=1}}^{\mathrm{T}}(\mathrm{r_t} - \hat{\mu})^2}$$

Where $\mu = \mathrm{T}^{-1}\sum_{\mathrm{t=1}}^{\mathrm{T}}\mathrm{r_t}$.

To measure whether the markets are efficient or not over time we have decided to use two different tests, the Chow and Denning test (1993) and the multiple version of Wright's sign test (2000). Both tests build on the conventional VR test. Previous work by Kim and Shamsuddin (2008) proved that the conventional Variance Ratio test performed by Lo and MacKinley (1988) could deviate from the asymptotic distribution in small samples, resulting in errors in the statistical interpretation. Furthermore, the selected Variance Ratio tests are better suited to accommodate the dynamic nature of African stock markets (Kim & Shamsuddin, 2008, p. 519).

To obtain time-varying measures of return predictability the two VR tests, the Chow and Denning test and the multiple version of Wright's sign test, are performed on moving sub-sample windows of two years (500 days), moving the window forward one week at a time (5 days). The software GAUSS will be used to perform the two Variance Ratio tests, which is a matrix programming language used for mathematics and statistics (Aptech, 2015).

**Chow and Denning test (CD)**

In order to measure whether the relative stock return in African stock markets are predictable or not over time, an extension of Lo and McKinley's (1988) multiple VR-test is used called the Chow and Denning test (CD) (1993). The Chow and Denning (1993) multiple variance ratio test suggests a joint null hypothesis $V_{(Ki)}$ = 1, for i = 1,…..*l* against the alternative hypothesis that $V_{(Ki)} \neq 1$ for some holding period k*i.* The test statistic for the Chow and Denning VR test is given by:

$$CD = \max_{1 \le i \le l} |M(r;k_i)|$$

Where $M(r;k_i)$ is given by:

$$M(r;k) = \frac{VR(r;k) - 1}{\left(\sum_{j=i}^{k-1}\left[\frac{2(k-j)}{k}\right]^2 \delta_j\right)^{1/2}},$$

There might be some complications with the Chow and Denning test due to its sensitivity against outlying observations (Hellström et al., 2013, p. 6). Therefore, as mentioned above, the multiple version of Wright's sign test will also be considered.

**Multiple Version of Wright's Sign Test (JS)**

The joint sign based test of Wright (JS) (2000), was modified by Kim and Shamsuddin (2008) with influences from Chow and Denning's (1993) VR test (Hellström et al., 2013, p. 6). Kim and Shamsuddin (2008) proposed a multiple joint test of $V(k_i) = 1$ for $i = 1,\ldots, l$, against the alternative hypothesis that $V(k_i) \neq 1$ for some $i$. The test statistic for the multiple version of the Wright's sign test is given by:

$$JS = \max_{1 \leq i \leq l} |S_1(k_i)|.$$

Where $S_1(k_i)$ is given by:

$$S_1(k) = \left( \frac{(Tk)^{-1} \sum_{t=k}^{T} (s_t + s_{t-1} + \ldots + s_{t-k+1})^2}{T^{-1} \sum_{t=1}^{T} s_t^2} - 1 \right) \left( \frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2}$$

Both tests have critical values of 2.569 at the 5% significance level and 2.311 at the 10% significance level. If the test statistic is higher than those numbers we reject the null hypothesis that the market is efficient for that specific period. In line with, for example, Lagoarde-Segot and Lucey (2008) we interpret the CD and JS test values as proxies for the level of market efficiency. In general, the lower the value is, the higher is the level of efficiency. Similarly, the higher the value is, the lower is the level of efficiency.

The tests performed give us efficiency measures for eight periods of which we have calculated a mean value for the years 2007-2014. Six markets and two different variance ratio tests give us a total of 96 observations. However, considering we only have data on macroeconomic variables until 2013 the efficiency measure for 2014 will not be used in the regression analysis.

**3. Performing panel regression analysis**

The methodology conducted for this paper's empirical analysis will involve a multiple linear regression analysis of panel data, which is a statistical method that concerns two-dimensional panel data. Panel data are formed when cross-sectional and time series data sets are merged to create a single data set (Studenmund, 2014, pp. 364-365). We use panel data to be able to provide an insight into our research question, which would not have been possible using time-series or cross-sectional data alone (Studenmund, 2014, p. 365). The data are collected over time and a regression is run over the two dimensions. We will run the panel regression analysis in the statistical software STATA.

A Hausman Specification test was conducted in STATA, which is a test conducted in order to reach a conclusion whether you should run your panel regression analysis using random effect or fixed effect. The output revealed that our chi value was negative and that the data did not hold the asymptotic assumption under the Hasuman test. Due to this failed test statistic and that our sample is relatively small the results from the Hausman test could be misleading (Bole & Rebec, 2012, p. 650). Therefore, we will run the panel regression analysis using random effect because we have reasons to believe that differences across entities have some influence on our dependent variable, the time varying market efficiency. Furthermore, using random effect is more suitable because we think that there are several time invariant macroeconomic factors (e.g. political situation, international agreements) that could affect the final results in our panel regression analysis.

Moreover, running a panel regression analysis is also beneficial since it allows you to include variables, which cannot be observed, such as specific regulations, cultural differences or international agreements, which we think might have an impact on our results (Princeton, 2007). The two dimensions in our case are the time (year) and the country, which define the panels. The panel regression analysis allows us to test for several variables at the same time over two dimensions (year and country). The panel data is presented in Appendix 2. For clarification, in the column called "Country" we define 1 = Botswana, 2 = Kenya, 3 = Mauritius, 4 = Morocco, 5 = Nigeria, 6 = Tunisia. In the column called "Year", 1-7 = year 2007-2013.

Considering the fact that our panel data consist of relatively few observations we will also perform a pooled regression analysis, in addition to the main panel regression analysis, to make sure that we obtain statistically correct results. The p-value for the pooled regression will be marked p* in the tables presenting the STATA output. Furthermore, to present a regression analysis that is more suitable for the reader to analyse and interpret we have to scale down some of the numbers in the panel data before running the regression analysis. On all tests, FDI and population will be scaled down, divided by 1 million. On the two tests with all countries included in the regression model the variable GDP per Capita was scaled down as well. Again, this will not affect the results, only the presentation of it.

We will perform regression analyses using both the Chow and Denning efficiency measure and the Joint Sign Test efficiency measure as the dependent variable. The other variables, especially the FDI variable, will be used in the regression model as independent variables as they possibly explain a changing degree of market efficiency. Those other variables are total population, the deposit interest rate, market capitalization as a percentage of GDP, total value of stocks traded as a percentage of GDP and GDP Per Capita. A description and motivation to the included explanatory variables are given in a later section.

The regression formula is formulated below:

$$\mathrm{E_{it}} = \alpha + \beta_1(\mathrm{FDI_{it}}) + \beta_2(\mathrm{GDP_{it}}) + \beta_3(\mathrm{MC_{it}}) + \beta_4(\mathrm{POP_{it}}) + \beta_5(\mathrm{DIR_{it}}) + \beta_6(\mathrm{ST_{it}}) + \varepsilon_{\mathrm{it}}$$

Where:
$\mathrm{E_t}$= Efficiency at time t (the VR test values)

$FDI_t$ = Foreign Direct Investment, net inflows at time t
$GDP_t$ = GDP per capita at time t
$MC_t$ = market capitalization (% of GDP) at time t
$POP_t$ = total population at time t
$DIR_t$ = deposit interest rate at time t
$ST_t$ = stocks traded, total value of GDP at time t
$\varepsilon_t$ = Error term at time t
i = Country 1, 2…6

The parameters in the equation to be estimated are given by $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$, and $\beta_6$.

Testing for all the variables and countries at the same time might not result in significant outcomes due to the fact that one variable could significantly affect another variable. In the same way, a country could significantly affect the total outcome. Therefore, we will perform panel regression analyses on subgroups of countries to see if there are specific countries where FDI explains a changing degree of market efficiency. This will result in a more robust and thorough analysis as well as a more comprehensive study.

**Significance test and Hypothesis Formulation**
In order to reject or accept the null hypothesis a decision rule has to be created and applied to the regression analysis. We apply a significance level of 10%, which corresponds to a confidence level of 90%. The confidence level indicates that one with a 90% level of confidence can reject the null hypothesis (Studenmund, 2014, p. 140).

The null hypothesis will be rejected if the p-value is equal or lower than 0,1, which represents a significance level of 10%.

**Hypotheses formulation**
To analyse the main result, whether FDI has an impact on market efficiency or not, we will test the following hypotheses running several panel regression analyses:

**Hypothesis 1a**, running a panel regression analysis with all six countries using the JS statistics as the dependent variable
$H_0$: FDI does not have an impact on market efficiency
$H_A$: FDI has an impact on market efficiency

**Hypothesis 1b**, running a panel regression analysis with all six countries using the CD statistics as the dependent variable
$H_0$: FDI does not have an impact on market efficiency
$H_A$: FDI has an impact on market efficiency

As explained above a significance level of 10% will be applied, which implies that the null hypothesis will be rejected if the p-value is equal or lower than 0,1.

**4. Answering the Research Question**
Does FDI have an impact on Market efficiency? Do the other variables have an impact on market efficiency? In chapter six we will present the results from the two different variance ratio tests as well as the results from the regression analyses performed. We will in the same chapter analyse the results. In chapter seven we will reach a conclusion and answer the research question.

### 5.1.4 Justification of variables

To investigate what factors that possibly could explain changing market efficiency, either increased efficiency or decreased efficiency, we have chosen a set of six macroeconomic variables based on previous research that we believe could possibly give us answers about the nature of changing market efficiency.

This section below argues for the different variables used in our correlation-test, and why they are of interest. This paper's intended purpose is to investigate what impact Foreign Direct Investment has on market efficiency. Therefore, FDI is the main variable that will be analysed. All variables used will be tested against the outcome in the variance ratio test to see their impact on market efficiency. The results will thereafter be analysed to get an overview of how well FDI possibly could explain a changed level of market efficiency, compared to the other variables tested. Data on these variables are collected from the World Bank Database. The considered variables motivated from previous research are:

**Foreign Direct Investment, Net Inflows (Current US$)**
The World Bank definition of FDI is when an investor acquires more than ten percent of voting power in a company based in an economy different from the investor (The World Bank, 2015). The net inflows show the inflow of foreign capital less the outflow of foreign capital (The World Bank, 2015). Previous research has proved that FDI has an impact on a countries economy. Borensztein et al. (1998) argued that FDI could transfer information and knowledge. Acheampong and Wiafe (2013) argued further that FDI has a positive impact on stock market development. Considering this study's intended purpose, the FDI variable will be of greatest interest in the analysis later in this paper. In the tables below, we denote this variable as "FDI, Net Inflows (M)".

**Population (Total)**
Population refers to the total amount of people living within a country (The World Bank, 2015). Lo (2004, 2005, 2012) argued that the changing nature of a market's ecology has an impact on market efficiency, therefore, the underlying motivation for this variable is that a larger population possibly means more actors trading on the stock market. More buyers and sellers increase the activity, liquidity and the size of the market. In the tables below, we denote this variable as "Population (M)".

**GDP Per Capita (Current US$)**
This variable refers to the Gross Domestic Product divided by midyear population. Gross domestic product is the amount of value added by all domestic trading in a country's economy (The World Bank, 2015). GDP per capita could be assumed to tell us something about the overall status of a country. If people have more money in their pockets, they potentially will have more incentives to invest their money in various

forms, e.g. in the securities market. As previous stated by Lagoarde-Segot and Lucey (2008) and Smith and Dyakova (2014), if the market becomes more liquid and bigger in terms of size, desirable outcomes on the efficiency could be achieved. In the tables below, we denote this variable as "GDP Per Capita ($)"

**Market Capitalization of Listed Companies (% of GDP)**
This term could also be referred to as the total market value. This is the amount of total shares outstanding times the share prices (The World Bank, 2015). The data used in this report is the market capitalization as a percentage of GDP. This could be seen as a proxy for stock market development and as the size of the stock market relative to the economy as a whole. According to previous research, e.g. Smith and Dyakova (2014), markets that are big in terms of size and liquidity behave more consistent with the weak form of efficiency. Therefore, market capitalization needs to be considered as a potential variable affecting market efficiency. In the tables below, we denote this variable as "M. Cap (% of GDP)".

**Deposit Interest Rate (%)**
Deposit interest rate is defined as the rate paid by commercial or similar banks for time, demand, or saving deposits (The World Bank, 2015). The underlying assumption behind this variable is that, investors in countries with lower deposit interest rates are possibly more eager to invest their money in the security market instead of depositing money at the bank, thus, increasing the stock market activity. As Lagoarde-Segot and Lucey (2008) claimed, the more liquid and bigger the market gets, the more efficient the market becomes. Therefore, an increased trading activity with more capital in the market could explain increased efficiency. In the tables below, we denote this variable as "Dep. Int. rate. (%)".

**Stocks Traded, Total Value (% of GDP)**
Stocks traded denote the total value of shares traded over a given period. This is a good indicator to show if trading matches the market size (The World Bank, 2015). This variable could explain why a high level of activity and liquidity within a market increase the degree of efficiency. Stock markets referred to as developed are often large both in market capitalization and in number of shares listed and tend to behave consistent with the weak form of market efficiency. Therefore, the impact of the level of stock market activity needs to be tested against the level of efficiency. In the tables below, we denote this variable as "Trading (% of GDP)".

All data of the variables are presented for each country in the tables below. "(M)" behind some of the variables stands for Million.

**Table 5.2 – Variables, Botswana**

| Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|
| FDI Net Inflows (M) | 494.7 | 520.9 | 128.8 | 136.1 | 1,092.8 | 147.1 | 188.6 |
| Population (M) | 1.92 | 1.93 | 1.95 | 1.97 | 1.99 | 2.00 | 2.02 |
| GPD Per Capita ($) | 5,711 | 5,747 | 5,178 | 6,980 | 7,734 | 7,255 | 7,315 |
| M. Cap (% of GDP) | 53.8 | 32.0 | 42.3 | 29.7 | 26.7 | 31.6 | N/A |
| Dep. Int. rate. (%) | 8.6 | 8.7 | 7.5 | 5.6 | 5.1 | 3.6 | 3.1 |
| Trading (% of GDP) | 1.0 | 1.3 | 1.0 | 1.0 | 0.9 | 0.8 | N/A |

**Table 5.3 – Variables, Kenya**

| Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|
| FDI Net Inflows (M) | 729 | 95.6 | 116.3 | 178.1 | 335.2 | 258.6 | 514.4 |
| Population (M) | 37.75 | 38.78 | 39.82 | 40.91 | 42.03 | 43.18 | 44.35 |
| GDP per Capita ($) | 847 | 926 | 930 | 978 | 998 | 1,166 | 1,246 |
| M. Cap (% of GDP) | 41.9 | 30.4 | 29.1 | 36.2 | 24.3 | 29.4 | N/A |
| Dep. Int. rate. (%) | 5.2 | 5.3 | 6.0 | 4.6 | 5.6 | 11.6 | 8.6 |
| Trading (% of GDP) | 4.1 | 4.0 | 1.3 | 2.7 | 2.1 | 2.0 | N/A |

**Table 5.4 – Variables, Mauritius**

| Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|
| FDI Net Inflows (M) | 340.8 | 377.7 | 256.7 | 430 | 433.4 | 589 | 258.6 |
| Population (M) | 1.24 | 1.24 | 1.25 | 1.25 | 1.25 | 1.26 | 1.26 |
| GPD Per Capita ($) | 6,286 | 7,749 | 7,082 | 7,772 | 8,985 | 9,111 | 9,478 |
| M. Cap (% of GDP) | 72.7 | 35.7 | 53.6 | 76.6 | 68.1 | 62.0 | N/A |
| Dep. Int. rate. (%) | 11.8 | 10.1 | 8.4 | 8.4 | 7.1 | 6.2 | 8.8 |
| Trading (% of GDP) | 4.7 | 4.2 | 3.7 | 3.7 | 4.6 | 2.6 | N/A |

**Table 5.5 – Variables, Morocco**

| Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|
| FDI Net Inflows (M) | 2,826 | 2,466 | 1,970 | 1,241 | 2,521 | 3,361 | 2,842 |
| Population (M) | 30.67 | 30.96 | 31.28 | 31.64 | 32.06 | 32.52 | 33.01 |
| GPD Per Capita ($) | 2,416 | 2,827 | 2,861 | 2,823 | 3,044 | 2,900 | 3,093 |
| M. Cap (% of GDP) | 100.4 | 74.0 | 69.2 | 76.2 | 60.6 | 54.9 | N/A |
| Dep. Int. rate. (%) | 3.7 | 3.9 | 3.8 | 3.7 | 3.8 | 3.8 | 3.9 |
| Trading (% of GDP) | 34.9 | 24.7 | 32.4 | 11.8 | 6.4 | 3.7 | N/A |

**Table 5.6 – Variables, Nigeria**

| Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|
| FDI Net Inflows (M) | 6,035 | 8,197 | 8,555 | 6,049 | 8,842 | 7,101 | 5,609 |
| Population (M) | 147.2 | 151.2 | 155.4 | 159.7 | 164.2 | 168.8 | 173.6 |
| GPD Per Capita ($) | 1,131 | 1,376 | 1,091 | 2,311 | 2,508 | 2,742 | 3,006 |
| M. Cap (% of GDP) | 51.9 | 23.9 | 19.7 | 13.8 | 9.5 | 12.2 | N/A |
| Dep. Int. rate. (%) | 10.3 | 12.0 | 13.3 | 6.5 | 5.7 | 8.4 | 8.0 |
| Trading (% of GDP) | 10.1 | 9.6 | 2.7 | 1.4 | 1.0 | 0.9 | N/A |

**Table 5.7 – Variables, Tunisia**

| Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|
| FDI Net Inflows (M) | 1,515 | 2,601 | 1,525 | 1,334 | 432.7 | 1,554 | 1,059 |
| Population (M) | 10.23 | 10.33 | 10.44 | 10.55 | 10.67 | 10.78 | 10.89 |
| GPD Per Capita ($) | 3,806 | 3,343 | 4,163 | 4,211 | 4,305 | 4,198 | 4,317 |
| M. Cap (% of GDP) | 13.8 | 14.2 | 21.0 | 24.0 | 21.0 | 19.6 | N/A |
| Dep. Int. rate. (%) | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Trading (% of GDP) | 1.7 | 3.3 | 2.9 | 3.8 | 2.4 | 2.8 | N/A |

Looking at tables 5.2 to 5.7 we observe some interesting values. The population of all countries has increased steadily between 2007 and 2013 implying that the number of participants in the market ecology has increased. The market capitalization of all countries, except for Tunisia, dropped quite drastically in 2008. We believe this has to do with the global financial crisis that hit the world economy in 2008. Furthermore, as explained above, in part 5.1.2, we could not find the deposit interest rate of Tunisia between the years 2007-2013. We can also conclude that Nigeria, which has an extremely large population, has a relatively low market capitalization. The market capitalization of Nigeria has also decreased quite substantially since 2007, which is the case for the market capitalization of Morocco as well. The highest amount of FDI Net Inflows is found in Nigeria. Nigeria's FDI Net Inflows peaked in 2011 at $8,842 million.

# 6. Results and Analysis

*This chapter will present the results from the variance ratio tests as well as the results from the panel regression analysis. The results will also be analysed in this chapter in order for the reader to easier connect the results with the analysis. Furthermore, the hypotheses will be rejected or accepted. After the presentation of the test results we will provide the reader with an analysis as well as a discussion. We separate the analysis and the discussion because we do not want the analysis to be affected by our own perceptions, thoughts and beliefs.*

In this chapter, the outcome from our regression model will be analysed. The test results from the variance ratio tests will be used as the dependent variable against the independent variables explained in section 5.1.4. The test results from this regression model will then be presented in the form of statistical output. Regression analyses have been conducted to test whether FDI has an impact on market efficiency. We analysed all countries as one group as well as using subgroups of countries to get a deeper understanding of the effects. Finally, the discussion will go deeper and examine whether other macroeconomic variables have explanatory power regarding increased market efficiency.

## 6.1 Results – Efficiency Over Time

Before heading to our main purpose to analyse the impact of FDI on market efficiency over time, test results from the CD-test and the JS-test will be reported. The results from the Variance Ratio tests are presented in tables 6.1-6.6 below where the dark grey curve represents the results from the CD-test and the light grey curve corresponds to the JS-test. The dark grey dashed line represents the trend curve for the CD-test and the light grey dashed line represents the trend curve for the JS-test. The two horizontal lines represent the two critical levels, which are the same for both tests. The black horizontal line represents the 5% significance level and the grey horizontal line represents the 10% significance level. The x-axis shows the measurement period in weeks, reaching over an eight-year period. The y-axis shows the efficiency value, i.e. the test statistics from the CD-test and the JS-test. When the test results appear below the critical values the market is statistically regarded as efficient on a 5% significance level or a 10% significance level.

**Chart 6.1 – Market efficiency over time, Botswana**

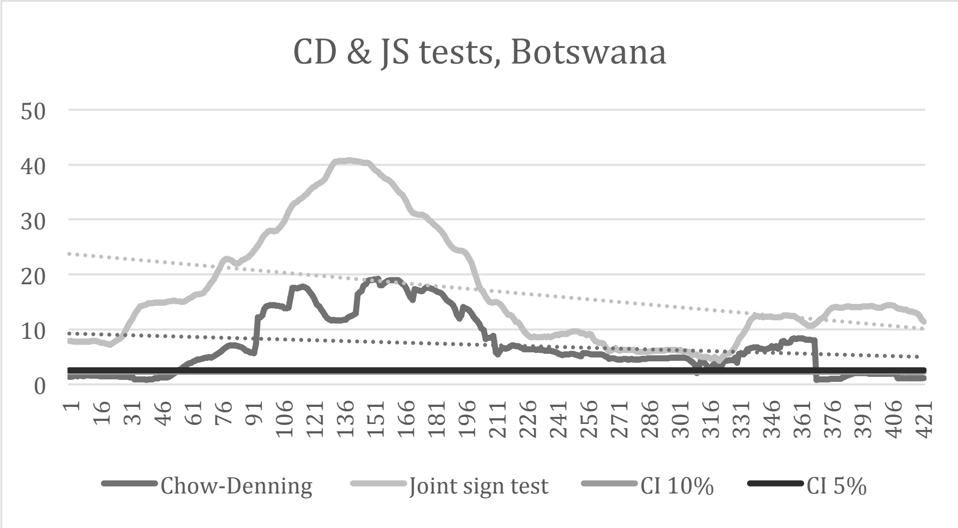



**Chart 6.2 – Market efficiency over time, Kenya**

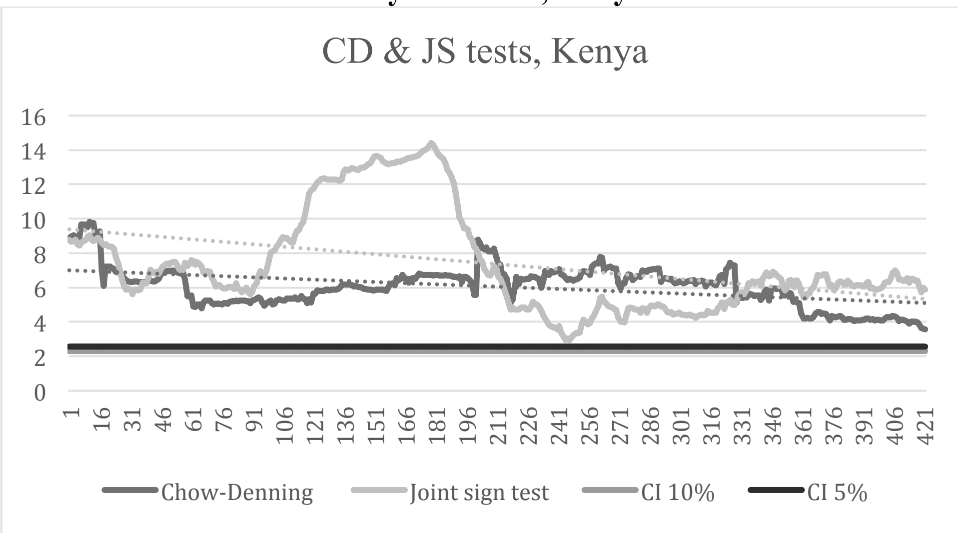



**Chart 6.3 – Market efficiency over time, Mauritius**

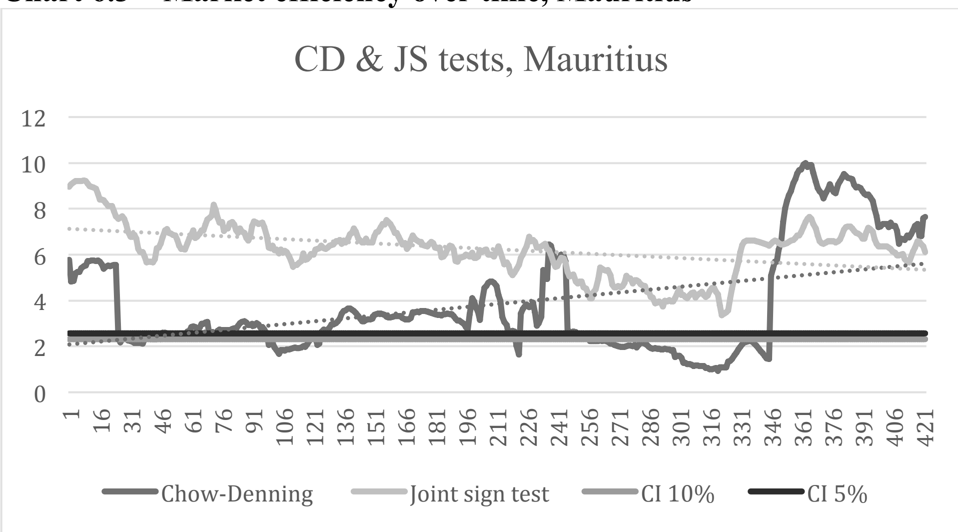


**Chart 6.4 – Market efficiency over time, Morocco**

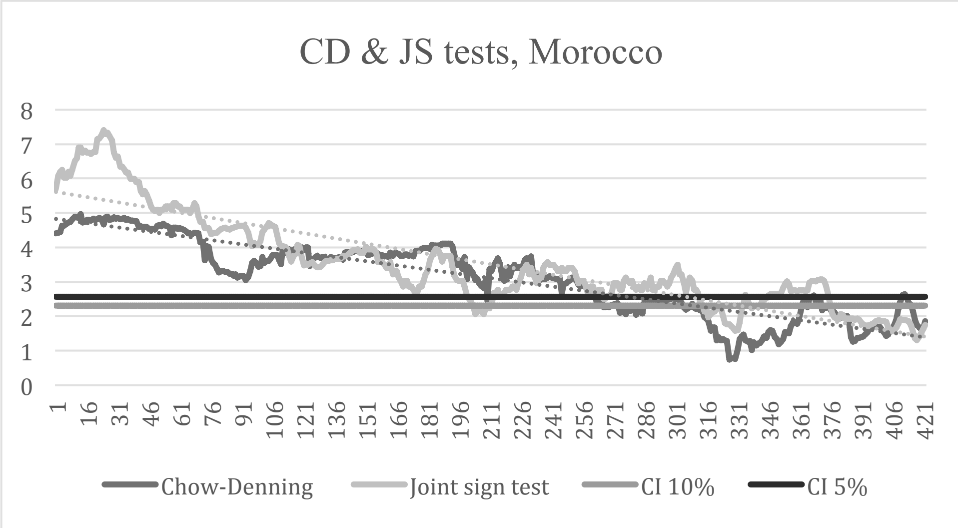



**Chart 6.5 – Market efficiency over time, Nigeria**

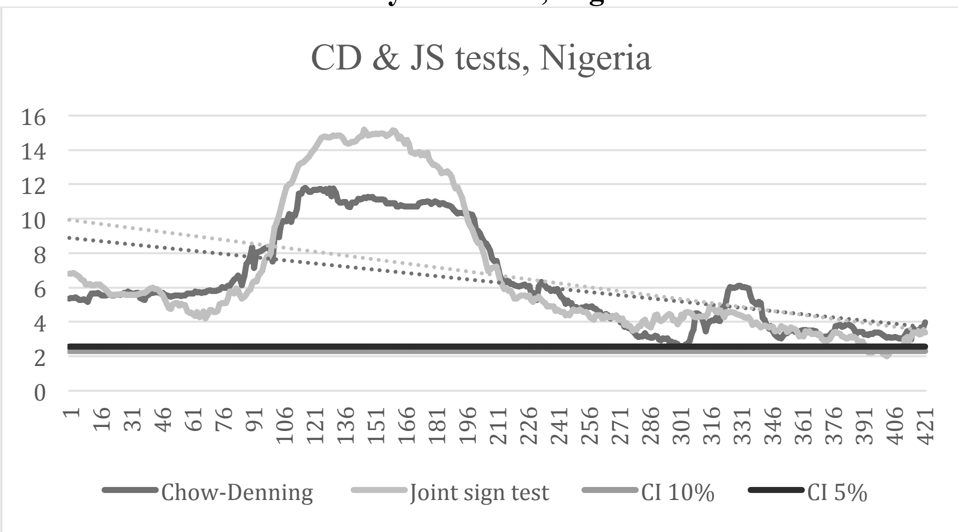
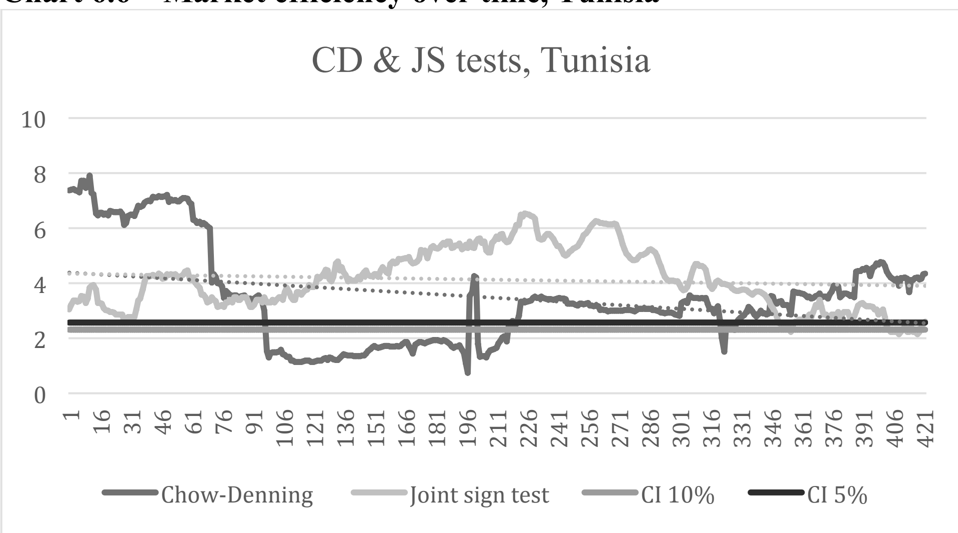



**Chart 6.6 – Market efficiency over time, Tunisia**



To track the development of market efficiency for the six African stock markets in our sample, two tests have been performed, namely the CD-test and the JS-test. In the figures above, two lines for each test are presented over a time period of 422 weeks (due to the chart format, the charts are only displaying 421 weeks), between 1st of December 2006 to 26th of December 2014. Similar for both test results are, the higher the number, the more inefficient the market tend to be. The critical values for both the test are shown in the two horizontal lines in each figure. The corresponding critical value for a confidence level of 10% is estimated to be 2,311, and for a 5% confidence level the critical value is estimated to be 2,5687. When the test result is below these values the market tend to behave consistent with the weak form of market efficiency, i.e. following a random walk.

### 6.1.1 Analysis – Efficiency Over Time

By examining figures 6.1-6.6 the JS-test, overall, shows higher values compared to the CD-test, i.e. lower efficiency. The JS-test indicates more observations that deviate from market efficiency in comparison with the CD-test. The curves from the CD-tests have more observations below the critical values. Looking at figures 6.1, 6.2, 6.3 and 6.6 we can see that the two test scores have different developments in regard to market efficiency. Conversely, in figures 6.4 and 6.5 the test results are more similar. There is evidence that all markets have improved their efficiency over this time period, except the CD-test for Mauritius. The negative trend of market efficiency for Mauritius could potentially be due to the fact that the CD-test is more sensitive towards outliers. By investigating figure 6.3 we see that Mauritius in the beginning of the examined period tended to be an efficient market. However, a big shift towards market inefficiency was observed in the end. The JS-test suggests that the efficiency has been improved in Mauritius as well.

In almost all markets investigated, periods of market efficiency exist as well as periods where the markets are not efficient. The only market that has been inefficient during the whole investigated time period is Kenya. These results are consistent with the Adaptive Market Hypothesis, which says that periods of efficiency tends to be followed by periods of inefficiency, i.e. market efficiency fluctuates over time due to the changing nature of various macroeconomic factors such as FDI.

Even though all markets are trending towards becoming more efficient, periods exist where the markets are inefficient. As Lo (2012) pointed out when arguing for the AMH, market efficiency is not an absolute condition but rather a continuum. Market efficiency depends on the relative proportion of participants in the market. Lo (2012) means that the degree of market efficiency should be measured and that the more the market participants have adapted to the market environment the higher the degree of efficiency. Therefore, this should imply that a new market should be less efficient than a more rooted market that has been around for decades. However, even the latter case could have periods of market inefficiency due to changes in the environment or population (Lo, 2012, pp. 25-26). This further implies that market efficiency in theory should trend towards a higher degree of market efficiency given that more market participants adapt to macroeconomic changes.

By investigating how many weeks the markets tended to be efficient, Mauritius reached the highest number for the CD-test with around 38% of the observed time being below the critical values, i.e. being efficient (see appendix 2 for panel data). Interesting is that the JS-test suggests that the Mauritius stock exchange never reached an efficient state, even though the JS-test is trending towards improved efficiency. According to the JS-test, Morocco proved to be efficient around 22% of the time. Subsequently, both of these results support the Adaptive Market Hypothesis. The African markets are statistically efficient in periods but are not following a random walk throughout the whole investigated period. The Random Walk Hypothesis is consistent with the Efficient Market Hypothesis that suggests that the market should be perfectly efficient hundred percent all the time, which is not the case for these African markets.

### 6.1.2 Discussion – Efficiency Over Time

According to our results, the frontier stock markets examined in the study do not seem to be efficient. The results reveal facts that the markets observed are facing longer periods of inefficiency rather than periods of efficiency. These markets seem to be more consistent with the Adaptive Market Hypothesis since periods of efficiency exist in all of the markets except Kenya. However, all of the markets have positive trends towards becoming efficient more frequently. Our results suggest that the market will behave more similar to developed markets, which, according to previous studies are facing more frequent periods of the weak form of market efficiency (Self & Mathur, 2006; Nwosu et al., 2013). We therefore have reasons to believe that the stock market activities in Africa have increased in magnitude. Again, a stock market that increases in magnitude should also, in line with previous studies, become more efficient.

These positive trends might be explained by an increased integration between African markets and the rest of the world. By comparing earlier empirical studies regarding market efficiency and frontier stock market integration, we can see that these results might have a connection. When reviewing the literature regarding frontier stock market integration in section 4.1, we can see that the discussion evolves from markets being not integrated to markets becoming time varying integrated. The same goes for the literature concerning market efficiency. The earlier studies reviewed suggest that the frontier markets of Africa are not efficient while the later studies suggest that periods exist when they are efficient. Therefore, there could be a link between an increased integration and improved market efficiency. For instance, Speidell (2008) mentioned that these markets, due to lack of integration, offer diversification benefits and that these benefits have been disposed over time, leading towards an increased market efficiency.

The fact that most stock markets of Africa are not consistent with the weak form of market efficiency is not a new phenomenon. Both studies from Jefferis et al. (2002) and Nwosu et al. (2013) found empirical evidence pointing towards inefficient African markets that were not consistent with the weak form of market efficiency. That periods of weak form efficiency exist are not something new either. Smith and Dyakova (2014) addressed the fact that efficiency in African stock markets tended to be time varying, that the adaptive market hypothesis explains efficiency more appropriate than the Efficient Market Hypothesis. However, our findings suggest that all markets investigated in this study have a positive trend towards becoming more efficient. Our evidence suggests that African stock markets have improved and tend to behave more similar with developed stock markets.

Furthermore, the trend curves suggest that business conditions within these regions have been improved. Lo (2004, 2005, 2012) talked about the changing nature of the market ecology as a factor for changing market efficiency. We can assume that, with maturity comes an increased overall knowledge about stock market activities, which in turn should lead to a lower level of information asymmetry, i.e. increased market efficiency.

## 6.2 Results, Panel Regression Analysis (All Countries)

Two multiple panel data regression analyses, including all countries, were performed in STATA. The output is presented in tables 6.1 and 6.2. The results are interpreted below the tables. The complete set of STATA output is presented in Appendix 3.

**Table 6.1 – STATA JS-Test Output (All Countries)**

| Efficiency JS | Coef. | Std. Err. | P>\|z\| | p* |
|---|---|---|---|---|
| FDI Net Inflows ($) | 0,000649 | 0,0012864 | 0,614 | 0,618 |
| Population (M) | -0,0932934 | 0,07266 | 0,199 | 0,21 |
| GDP Per Capita ($) | -6,339029 | 609,8061 | 0,992 | 0,992 |
| M. Cap (% of GDP) | -0,1799286 | 0,0975598 | 0,065 | 0,076 |
| Dep. Int. Rate (%) | 0,5218478 | 0,4829831 | 0,28 | 0,289 |
| Trading (% of GDP) | 0,0925774 | 0,2366991 | 0,696 | 0,699 |
| Constant | 15,28378 | 5,882798 | 0,009 | 0,015 |

**R-Squared = 0,2149**

**Table 6.2 – STATA CD-Test Output (All Countries)**

| Efficiency CD | Coef. | Std. Err. | P>\|z\| | p* |
|---|---|---|---|---|
| FDI Net Inflows ($) | 0,0000762 | 0,0005818 | 0,896 | 0,897 |
| Population (M) | -0,0202879 | 0,032862 | 0,537 | 0,542 |
| GDP per capita ($) | -137,8773 | 275,7978 | 0,617 | 0,621 |
| M. Cap (% of GDP) | -0,0981551 | 0,0441235 | 0,026 | 0,034 |
| Dep. Int. Rate (%) | 0,1704504 | 0,2184394 | 0,435 | 0,442 |
| Trading (% of GDP) | 0,0880391 | 0,1070522 | 0,411 | 0,418 |
| Constant | 9,512527 | 2,660621 | 0,000 | 0,001 |

**R-Squared = 0,231**

By performing a panel regression analysis including all countries and variables as shown above in tables 6.1 and 6.2 we can conclude that there is no significant evidence, at the 10% level, that FDI explains a changing degree of market efficiency. With a p-value of 0,614 using the JS statistics as the dependent variable we see that FDI is far from significant. The same goes for the regression analysis using the CD-test as dependent variable. In this test the p-value for FDI is even higher at 0,896. The R-Squared of 0,231% is fairly low and is read as the percentage of variance explained by the model.

As presented in the table above there are only two variables, Market Capitalization (M. Cap – JS) and Market Capitalization (M. Cap – CD), which are statistically significant with p-values of 0,065 (JS) and 0,026 (CD). This implies that Market

Capitalization has explanatory power regarding market efficiency. When Market Capitalization increases, the VR test scores decreases, which in turn implies increased market efficiency. The p* column represents the p-value for a pooled test using a multiple linear regression. This is to check whether a test without random effect gives the same result. Even in this test there is no evidence arguing for that FDI should have any impact on efficiency. We can therefore not reject the null hypotheses for the full sample.

### 6.2.1 Analysis, Panel Regression Analysis (All Countries)

When all countries are included in our panel regression analysis there is nothing, statistically, that indicates that FDI should have any impact on market efficiency. However, we can see that market capitalization is significant on the 10% level for the JS-test and significant on the 5% level for the CD-test. When observing our data, we see that the market of Nigeria have very low market capitalization compared to the amount of FDI and population. Previous research by Lagoarde-Segot and Lucey (2006) suggests that illiquid, small markets fail to benefit from the positive spill over effects that FDI could generate. The efficiency curve for Botswana looks similar to the curve of Nigeria, facing a period of extreme inefficiency compared to the other countries in our sample (See tables 6.1 and 6.5). This is the period 2009-2010, right after the financial crisis in 2008. Later in this chapter we will go deeper in to the situation of Nigeria and Botswana to see if their respective market situations could reveal some facts that could possibly have affected this test.

### 6.2.2 Discussion, Panel Regression Analysis (All Countries)

The drop in market efficiency in 2009-2010 could possibly be explained by some extraordinary events that happened in the wake of the crisis that could have affected the overall results of our model. Another possible reason regarding the insignificant results could be due to an under analysed model. There might be too few observations corresponding to a fairly short time horizon. Moura and Forte (2010) stressed the fact that there is doubt whether FDI could increase growth and that the outcome is dependent on the variables used to test the relationship, which could also be the case in our study. Suggestions for variables included could be financial liberalization, or some proxy for the financial crisis. However, there could be several lurking variables that affect the outcome of this regression analysis. There could be regional differences that affect the results when all countries are put together, there could also be religious and cultural differences that affect the results. To conclude, we cannot see that FDI should have an impact on the level of efficiency for all the countries. Therefore, as stated above, the null hypothesis is accepted for both Hypothesis 1a and Hypothesis 1b, FDI does not have any impact on the level of efficiency when conducting a panel regression analysis including all six countries.

## 6.3 Results, Panel Regression Analysis – Reduced Sample

Two multiple panel data regression analyses, including only Kenya, Mauritius, Morocco and Tunisia, were performed in STATA. The output is presented in tables 6.1 and 6.2. The results are interpreted below the tables.

**Table 6.3 – STATA JS-Test (Country 2,3,4,6)**

| Efficiency JS | Coef. | Std. Err. | P>\|z\| | p* |
|---|---|---|---|---|
| FDI Net Inflows ($) | -0,0016595 | 0,0006491 | 0,011 | 0,023 |
| Population (M) | -0,2241598 | 0,1295412 | 0,084 | 0,106 |
| GDP Per Capita ($) | -0,0013142 | 0,000658 | 0,046 | 0,066 |
| M. Cap (% of GDP) | -0,0082223 | 0,0467244 | 0,86 | 0,863 |
| Dep. Int. Rate (%) | -0,268942 | 0,2564209 | 0,294 | 0,312 |
| Trading (% of GDP) | 0,012844 | 0,0748971 | 0,864 | 0,866 |
| Constant | 20,36027 | 7,298022 | 0,005 | 0,014 |

**R-Squared = 0,5427**

**Table 6.4 – STATA CD-Test (Country 2,3,4,6)**

| Efficiency CD | Coef. | Std. Err. | P>\|z\| | p* |
|---|---|---|---|---|
| FDI Net Inflows ($) | -0,0012903 | 0,0002975 | 0,000 | 0,001 |
| Population (M) | 0,06772711 | 0,05937 | 0,257 | 0,276 |
| GDP Per Capita ($) | -0,0001441 | 0,0003016 | 0,633 | 0,64 |
| M. Cap (% of GDP) | 0,0219008 | 0,0214142 | 0,306 | 0,324 |
| Dep. Int. Rate (%) | 0,0440584 | 0,1175202 | 0,708 | 0,713 |
| Trading (% of GDP) | 0,0175791 | 0,0343261 | 0,609 | 0,617 |
| Constant | 2,948836 | 3,344754 | 0,378 | 0,393 |

**R-Squared = 0,7984**

The results when all countries were included in the regression model showed that FDI was not significant. Therefore, we started to test the countries in subgroups and came up with an interesting result when Botswana and Nigeria were excluded. One reason for excluding these countries was that their efficiency indices deviated far from their critical values, making these markets extremely inefficient for certain periods. Again, these deviations will be further examined later in this chapter. By conducting a panel regression analysis including Kenya, Mauritius, Morocco and Tunisia, excluding Botswana and Nigeria shown in table 6.9 and 6.10 we got different results compared to the previous tests, with all countries included. From these tests we can conclude that FDI is significant on the 5% level, with a p-value of 0,011 for the JS-test and 0,000 for the CD-test.

Looking at table 6.3, which shows the results using the JS-test as the dependent variable, we can conclude by looking at the negative coefficients that higher FDI implicates a lower JS-test score, which in turn implies higher efficiency. The same goes for GDP Per Capita, when GDP Per Capita increases, market efficiency increases. Population, which is significant at the 10% level, also has explanatory powers regarding market efficiency. When the population increases, the level of market efficiency increases.

By instead looking at table 6.4, which shows the results using the CD-test as the dependent variable, we can conclude that higher FDI implies higher market efficiency.

To make sure that the random effect has no major influence on our result, a pooled multiple regression analysis was also conducted. Again, the p* value suggests that FDI has a major influence on market efficiency. According to our test, the p-value of

0,046 (JS) for the variable GDP Per Capita implies that it is significant at the 5% level and therefore, with 95% certainty, explains a changing degree of market efficiency. The corresponding R-squared, which explains how well the variation is explained by the model is about 50% for the JS-test and 80% for the CD-test. From these regression models, we can draw the conclusion that FDI in both tests is the most significant variable, explaining a changed efficiency for these four countries.

### 6.3.1 Analysis, Panel Regression Analysis – Reduced Sample

Our results from the subgroup panel regression analysis suggest that FDI has explanatory power regarding the impact of market efficiency. Of course there could be several explanations for the influence of FDI on market efficiency. We know from looking at previous studies that FDI could have an impact on the economic growth by transferring knowledge and technology (Borensztein et al., 1997). Furthermore, Moura and Forte (2010) explain that FDI could help improve know how, the formation of human recourses, the level of competition and the development and reorganization of firms. These are important macroeconomic factors, which in turn could increase the level of FDI even more considering the improved economical situation. Moreover, the positive externalities that FDI brings could possibly be important for increased market efficiency.

Efficiency is about the level of information in a stock market and if the local actors get aware of the risks with inside information and learn how to read the entrails, fewer mistakes would be made, leading towards increased market efficiency. We also know from Acheampong and Wiafe (2013), that FDI has a positive impact on the stock market development.

The positive efficiency trend curve for all examined frontier markets could be thanks to the work of AfrIPANet (UNIDO). They have established suitable conditions within these markets in order for FDI to generate positive spill over effects. As Moura and Forte (2010) pointed out, there is a need for certain conditions to be met in order for FDI to bring positive effects. The political, cultural, social and economic situations within the host country are critical for the country to benefit from FDI. UNIDO's work the past years have definitely helped establishing a promising environment that facilitate for positive outcomes from FDI.

We realize that our results might be under analysed consisting of too few variables and a relatively short time horizon. For instance, Chen et al. (2014) stressed the importance for policy makers to make a safe and sound investment environment that will attract foreign investors. Kim and Singal (2000) found that eased regulations decreased the inflation and increased the production efficiency. Therefore, this study could have included variables such as financial liberalization, taxation, tariffs, gross savings and industry value to mention a few.

To conclude, if FDI favors economic growth and, as our study shows, affect market efficiency, African countries should really consider relaxing their FDI regulations.

### 6.3.2 Discussion, excluding Botswana and Nigeria

There is a need to highlight the two countries excluded from the subgroup regression model. What are the reasons for a significant relationship between FDI and market efficiency when data from Botswana and Nigeria are not accounted for? This section will provide the reader with a brief discussion where we try to identify possible lurking problems within these two countries.

**Botswana**

First, Botswana is a small country with around 2 million people (see table 5.2), making the domestic market relatively small. Second, 75 per cent of their GDP comes from the mining industry, mainly exporting diamonds. Third, the diamond industry is critical for Botswana's economic wellbeing. Historically, the diamond industry took Botswana from being a poor country to a middle-income country (howwemadeitinafrica.com, 2013). During the financial crisis there was a big drop in diamond prices, which hit the economy of Botswana hard due to their dependency on minerals (KPMG, 2013, p. 2). We can assume that many projects where put aside such as developing the infrastructure and that the government acted more defensively in accepting new projects. The financial crisis was observable in our data, the FDI level dropped in 2009 where we can assume that the drop in the prices of diamonds was the underlying cause. The world economy was hit hard by the recession and the demand for diamonds decreased, diamonds became a more risky asset than in the past. Lo (2012) explained that when the market environment changes over time the trade-off between risk and return will not remain stable. Thus, when the market of Botswana was hit by the financial crises we can assume that investors turned to safer investments, which further decreased the financial situation of Botswana.

Another problem that Botswana is facing is the low level of competition in the market. Many of the firms are dependent on sales to the government (worldbank.org). Also, the efficiency indices in tables 6.1 to 6.6 reveal the fact that the market faced a period of being highly inefficient. This period of inefficiency, compared to the other countries' more stable degree of market efficiency during the same period could be one of the reasons why having them included did affect the significance of the impact of FDI on market efficiency in our regression model.

Furthermore, another aspect of the problem could be their large dependency on other countries. The diamond industry has attracted a lot of foreign investors, which might have enhanced their integration with the rest of the world. We draw this assumption due to the fact that the financial crisis hit them relatively hard and that their GDP is dependent of the demand for diamonds. We know from previous empirical research that FDI is not always beneficial for the host country. As Speidell (2008) found in the case of Eastern Europe, foreign debt made them integrated with the rest of the world, which in turn affected them during the financial crisis. Linking this to our study, the case could be that the diamond market and Botswana's dependency on foreign demand of diamonds have made Botswana relatively more integrated with the rest of the world. Therefore, including Botswana in the panel regression analysis affects our result in an unfavourable way.

**Nigeria**

Nigeria is much bigger compared to Botswana with a population of 173.6 million inhabitants (see table 5.6). Despite the size of the country there are relative few listed companies on the Nigerian Stock Exchange. Nigeria is the biggest economy in Africa and similar to Botswana a big part of the population live in poverty and funds are unequally distributed (The World Bank, 2015). Nigeria also ended up far down the “supply of electricity” list (The Economist, 2014). Considering these conditions in Nigeria it might discourage foreign investors to operate within the country. Similar to Botswana we can see the same market efficiency pattern over time during the financial crisis. Since Nigeria is one of the largest oil exporters in the world, the country’s overall economy relies upon it. They depend on the oil industry in the same way as Botswana depends on the diamond industry. However, there is nothing that indicates in our Nigerian FDI data that FDI became lower during the crisis. We decided to exclude Nigeria due to the facts that the market capitalization in relation to the population is very low. When we ran the regression for both tests, we saw that market capitalization plays a significant role to boost efficiency when all countries were included.

Data show that 62% of the people are living below $1,25 dollar per day (2010) with a corresponding GDP per capita of 3,006 billion dollars (The World Bank, 2015). With that in mind we can draw the conclusion that there are relatively few actors on the Nigerian Stock Exchange. We connect this with Lagoarde-Segot and Lucey (2006) who claimed that market size and liquidity affect market efficiency. Mobarek and Kasey (2000) discussed that there could be problems with asymmetric information in Nigeria due to the large population compared to its market capitalization. Moreover, out of the information in this study we can assume that the few actors involved have inside information, which allows for arbitrage opportunities, i.e. not in line with the weak form of market efficiency. Finally, even though Nigeria has the highest net inflow of FDI of the countries observed in this study it does not seem to be efficient. The trend points towards that even Nigeria will face more periods of efficiency. But over the given time period in this study the Nigerian market conditions fail to seize the positive spill over effects that FDI could generate. Therefore, our opinion is that the Nigerian efficiency index gives a misleading result that affects our panel regression model, which led to the exclusion of Nigeria in the second panel regression model consisting of only Kenya, Mauritius, Morocco and Tunisia.

# 7. Conclusion

*In this chapter the research questions will be answered and the purpose of the study will be addressed. A clarification of the Hypotheses will be presented. The chapter will end with suggestions for future research.*

This study has reviewed the market efficiency in six African security markets using the Chow and Denning test and the multiple version of Wright's sign test to track the market efficiency over the time. The weak form of market efficiency was re-examined for six African stock markets including Botswana, Kenya, Mauritius, Morocco, Nigeria and Tunisia using weekly log returns for 422 weeks. All the markets investigated except Kenya behaved in line with the Adaptive Market Hypothesis, which says that market efficiency varies over time. This pattern of market efficiency was important to identify in order for us to achieve the main purpose of this study, to investigate whether FDI has an impact on market efficiency or not. Our findings suggest that market efficiency has been strengthened in the examined markets. In order to identify if FDI could be the underlying reason for this increased efficiency a panel regression analysis was conducted. The results were not significant when testing for all countries at the same time. However, when Botswana and Nigeria were excluded there were a strong correlation between market efficiency and FDI.

## 7.1 Research Question, the impact of FDI on market efficiency

The research question of this study: *Does Foreign Direct Investment have an impact on the level of market efficiency over time in African stock markets?*

Based on our results we can conclude that FDI has no impact on the level of efficiency when the test was conducted on all the countries together. However, when Botswana and Nigeria were excluded from the panel data regression analysis we saw a strong linkage between market efficiency and FDI. Our result suggests that FDI has an influence on the level of market efficiency in some of the re-examined countries.

Furthermore, our result indicates that market capitalization have explanatory power in order to explain changing market efficiency. When the subgroup panel regression analysis was conducted GDP Per Capita appeared to be significant in order to explain changing market efficiency in Kenya, Mauritius, Morocco and Tunisia.

The main purpose of the study; *investigate what impact foreign investors' capital contributions have on the level of efficiency in six major frontier stock markets in Africa,* has thereby been fulfilled.

### 7.1.1 Subsidiary Purpose, Market efficiency in African frontier stock markets

The subsidiary purpose intended to *investigate whether selected stock markets are weak form efficient or not over time.* Our results show that the African frontier stock markets are not constantly consistent with the weak form of market efficiency.

Our results reveal that all of the markets, except Kenya, show that periods of efficiency are followed by periods of inefficiency. Looking at our findings we can draw the conclusion that the frontier stock markets of Africa goes in line with the

Adaptive Market Hypothesis, since efficiency has been time-varying over the examined time period. To conclude, we found that the efficiency trend for all countries suggests that all markets examined will face more frequent periods of market behavior consistent with the weak form of market efficiency.

## 7.2 Summary of Hypotheses

**Hypothesis 1a**, running a panel regression analysis with all six countries using the JS statistics as the dependent variable
$H_0$: FDI does not have an impact on market efficiency
$H_A$: FDI has an impact on market efficiency

**Accept** the null hypothesis; FDI does not have an impact on market efficiency

**Hypothesis 1b**, running a panel regression analysis with all six countries using the CD statistics as the dependent variable
$H_0$: FDI does not have an impact on market efficiency
$H_A$: FDI has an impact on market efficiency

**Accept** the null hypothesis; FDI does not have an impact on market efficiency

However, re-performing the analysis on a reduced sample including only Kenya, Mauritius, Morocco and Tunisia we found that FDI is significant at the 5% level, i.e. higher FDI implies higher market efficiency. Considering this result, from a stock market point of view, we strongly recommend African countries to relax FDI regulations.

## 7.3 Theoretical and Practical Contributions

The theoretical contributions of our empirical findings have mainly been to increase the knowledge in the area of market efficiency, more specifically, adaptive market efficiency. We believe that this study can lay ground for future research within these markets. Finally, this study might have given incentives to other researchers to investigate the effects of other macroeconomic variables on market efficiency.

With this empirical investigation we hope that both domestic and foreign investors have achieved a deeper understanding of these markets. We hope that this study have given actors within the host country a deeper understanding of what FDI could bring to their markets. To conclude, this study suggests that the frontier stock markets of Africa are consistent with the Adaptive Market Hypothesis, information that investors could use to exploit arbitrage opportunities.

## 7.4 Suggested further research

If conducting a similar study one could include more variables in the regression model in order to further explain what could cause a shift in market efficiency.

Examples of other variables that could possibly explain market efficiency could be literacy rate, how technological advanced a country is and/or import and exports.

Another suggestion could be to replicate our study but on other markets, e.g. on the "Next 11" countries. Goldman Sachs identified in 2007, 11 countries that could possibly become the new BRICs and over time rival the G-7 countries. The countries are: Korea, Mexico, Iran, Indonesia, Turkey, Egypt, Pakistan, the Philippines, Nigeria, Vietnam and Bangladesh. It would be interesting to see if these "up and coming" nations are affected by FDI in the same way as the African frontier markets in our sample.

Another suggestion for future research could be to see whether foreign investors tend to decrease their investments if the market becomes more efficient and integrated with the rest of the world. When an earlier non-integrated market becomes more linked with the global market and no longer offers diversification benefits, such as different risks compared to the world market, it might discourage foreign investors to enter these markets. To take this even further one could investigate the sources of the diversification benefits in the markets of Africa, and especially in the frontier markets.

Upcoming research could focus on the negotiation process between MNEs' managers and the local, domestic managers, with a focus on the latter. What are the biggest concerns regarding letting foreign investors into their company? Which risks are associated with letting foreign players into their country? In the negotiation process, which type of demands comes from the local managers? We can assume that there will be cultural differences between a manager of a MNE and a domestic manager. How should values and missions be treated to fit both the foreign investor and the domestic management?

# 8. Criteria of Truth

*When conducting a quantitative study it is important that we, the authors, scientifically relate to the problem we want to study. This study investigates the relationship between market efficiency and FDI in frontier markets of Africa. Statistical tests will be conducted in order to reach a result. Our own thoughts and believes will not affect the result and conclusion of this study. In this section we provide the reader with the validity and reliability of this study.*

## 8.1 Validity

The concept of validity is the extent to which the outcomes of the research reflect the problem under study (Saunders et al., 2009, p. 157). The validity shows how well the authors succeed to measure the intended problem. Validity regarding the content of the study can be achieved by selecting an adequate number of variables for measurement. Therefore, the selected variables need to be carefully chosen in order to possess validity to the content (Sreejesh et al., 2014, pp. 116-117). It is important that the authors make sure that there are no research errors. These errors could be mistakes in the research process, such as bad samples and inaccurate or misleading measurements that could weaken the validity (Collis & Hussey, 2009, pp. 64-65).

We are aware of the fact that the CD-test is sensitive against outliers and that this could affect the outcome of our study when efficiency over time is measured (Hellström et al., 2013, p. 10). In fact, there are some extreme values observed in our data and the CD-test could therefore be misleading. In order to handle this potential biased outcome the JS-test complements the CD test, which is less sensitive against outlying observations.

Furthermore, we are also aware of the fact that the world hit a severe financial crisis during our time period. We can assume that investors might be extra defensive and a drop in the overall stock trading could be assumed. However, our data do not present any special or extreme observations during this time period. Previous studies suggest that the frontier stock markets of Africa are not fully integrated with the rest of the world. Therefore, we do not think that the crisis will affect the outcome remarkably, even though the reader should be aware of this crisis when judging the validity of our data.

## 8.2 Reliability

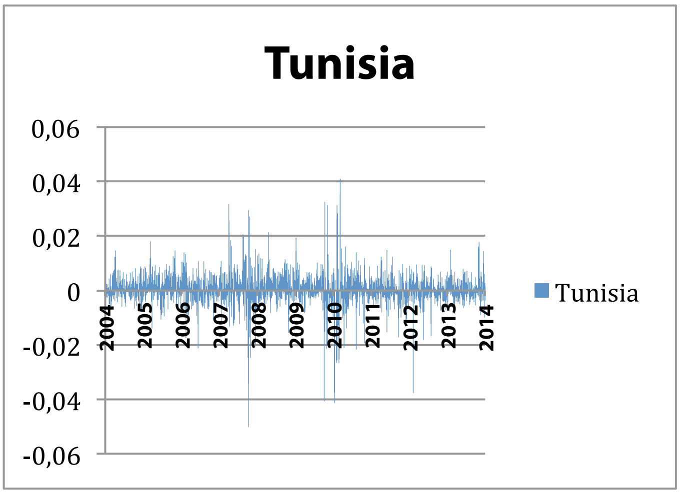
Reliability refers to the results of the research and is one of the criteria for measuring the credibility of the findings. Therefore, if the study gets replicated it should be possible to achieve the same results (Collis & Hussey, 2009 p. 64). Human mistakes are something that could hurt the reliability of this study. Our data are gathered from Thomson Reuters Datastream and the World Bank Database, this data will be the same for other researchers. However, even if the data is the same to all users there could be adjustments made by us that could affect the final outcome.

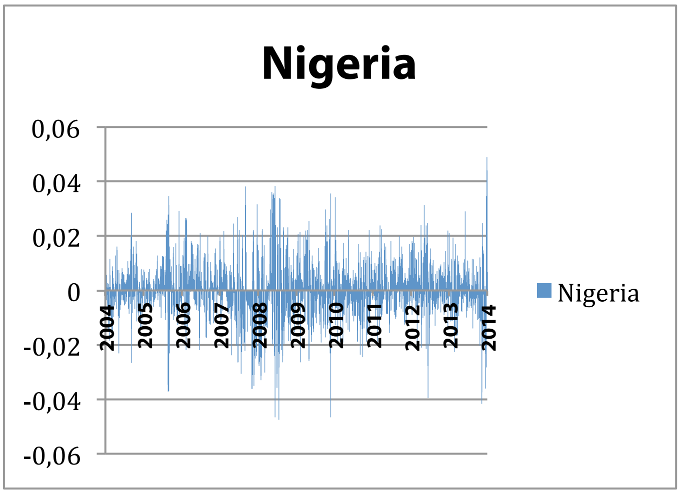
## 8.3 Ethical Issues

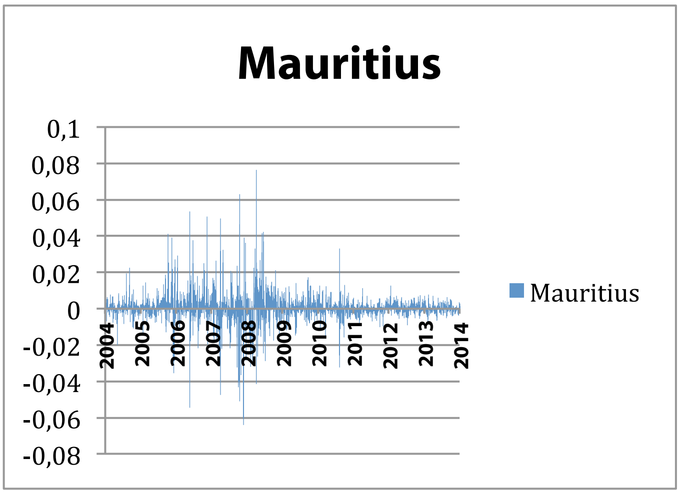
In the light of research, ethics is "the appropriateness of your behaviour in relation to the rights of those who become the subject of your work, or are affected by it" (Saunders et al., 2009, pp. 183-184). Furthermore, Saunders et al. (2009) stress that ethics in the context of research is driven by our norms or standards in our behaviour and how we make moral choices to others. Research ethics therefore refer to how the topics in the study are formulated and clarified. The research process and how the data is collected should therefore be conducted in a responsible and morale way.

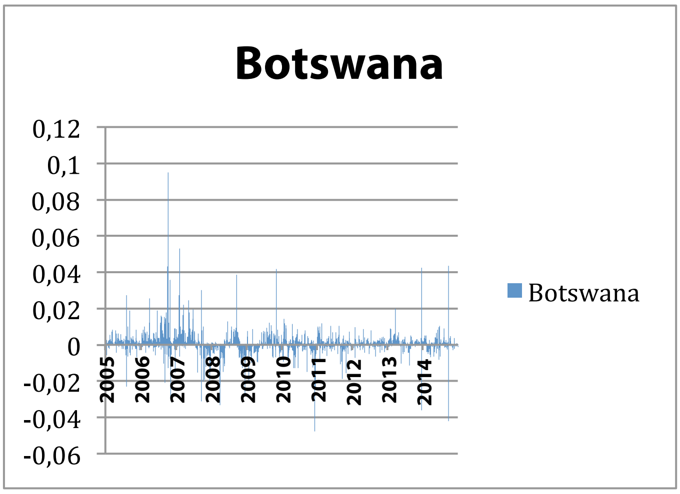
Our study has followed the Umeå university code of ethics. This work has been conducted independently and if phrases or quotes have been used we have referred to the author behind the work. This study has been performed without conducting any interviews, the data in our study are collected from databases and therefore the data used have been independent from our norms and standards. To conclude, neither our results nor the data collected have been manipulated.

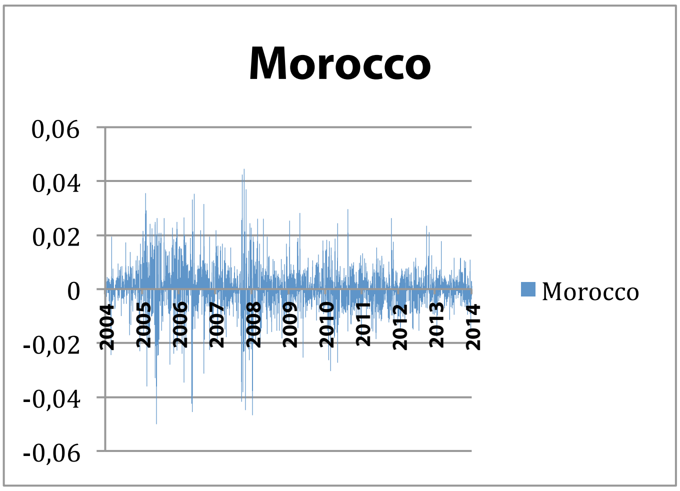
# Appendix 1 – Yearly log returns

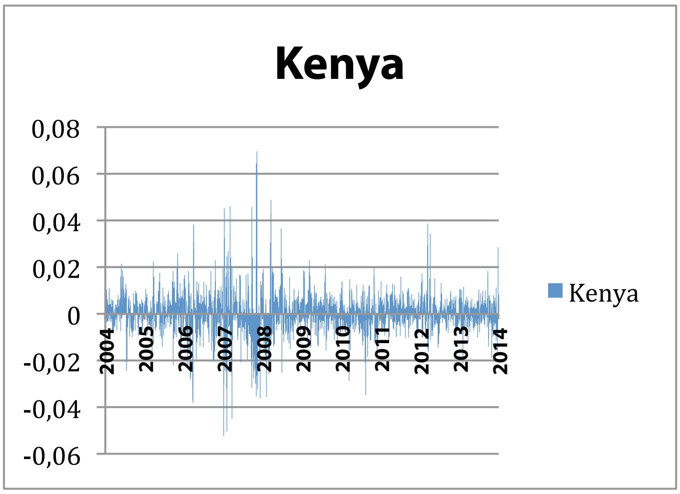


## Appendix 2 – Panel Data

| Country | Year | Efficiency (CD) | Efficiency (JS) | FDI Net Inflows | Population (M) | GDP Per Capita | M. Cap | Dep. Int. Rate | Trading % of GDP |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1,36 | 10,76 | 494681695,03 | 1915187,00 | 5711,73 | 53,82 | 8,62 | 1,01 |
| 1 | 2 | 7,29 | 21,43 | 520918029,49 | 1933719,00 | 5746,98 | 32,00 | 8,67 | 1,30 |
| 1 | 3 | 15,44 | 37,38 | 128840735,93 | 1951715,00 | 5178,44 | 42,33 | 7,47 | 1,02 |
| 1 | 4 | 15,01 | 26,93 | 136063064,94 | 1969341,00 | 6980,36 | 29,65 | 5,60 | 1,02 |
| 1 | 5 | 6,06 | 10,06 | 1092802290,54 | 1986701,00 | 7734,03 | 26,73 | 5,15 | 0,95 |
| 1 | 6 | 4,60 | 6,11 | 147058312,87 | 2003910,00 | 7254,56 | 31,56 | 3,61 | 0,78 |
| 1 | 7 | 6,03 | 9,65 | 188606245,73 | 2021144,00 | 7315,02 | 31,56 | 3,11 | 0,78 |
| 2 | 1 | 7,46 | 7,53 | 729044146,04 | 37752304,00 | 846,52 | 41,89 | 5,16 | 4,12 |
| 2 | 2 | 5,36 | 6,83 | 95585680,23 | 38773277,00 | 925,77 | 30,41 | 5,30 | 4,01 |
| 2 | 3 | 5,75 | 11,88 | 116257608,99 | 39824734,00 | 929,61 | 29,05 | 5,97 | 1,34 |
| 2 | 4 | 6,83 | 11,60 | 178064606,75 | 40909194,00 | 977,78 | 36,15 | 4,56 | 2,71 |
| 2 | 5 | 6,71 | 4,48 | 335249880,28 | 42027891,00 | 998,27 | 24,32 | 5,63 | 2,09 |
| 2 | 6 | 6,66 | 4,64 | 258607630,29 | 43178141,00 | 1165,74 | 29,38 | 11,57 | 2,00 |
| 2 | 7 | 5,71 | 5,78 | 514387425,41 | 44353691,00 | 1245,51 | 29,38 | 8,64 | 2,00 |
| 3 | 1 | 3,76 | 7,58 | 340763853,70 | 1239630,00 | 6285,80 | 72,71 | 11,77 | 4,74 |
| 3 | 2 | 2,65 | 6,96 | 377724738,06 | 1244121,00 | 7749,31 | 35,71 | 10,11 | 4,18 |
| 3 | 3 | 2,80 | 6,43 | 256680711,80 | 1247429,00 | 7082,30 | 53,65 | 8,45 | 3,73 |
| 3 | 4 | 3,52 | 6,31 | 429958030,69 | 1250400,00 | 7772,10 | 76,57 | 8,35 | 3,68 |
| 3 | 5 | 3,59 | 5,57 | 433358879,68 | 1252404,00 | 8984,65 | 68,13 | 7,11 | 4,64 |
| 3 | 6 | 1,80 | 4,48 | 589018302,83 | 1255882,00 | 9110,81 | 61,99 | 6,23 | 2,59 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 7 | 4,20 | 5,92 | 258587556,27 | 1258653,00 | 9477,79 | 61,99 | 6,81 | 2,59 |
| 4 | 1 | 4,73 | 6,25 | 2825801376,44 | 30667086,00 | 2416,26 | 100,36 | 3,67 | 34,93 |
| 4 | 2 | 3,82 | 4,71 | 2466288357,37 | 30955151,00 | 2827,29 | 73,97 | 3,91 | 24,67 |
| 4 | 3 | 3,80 | 3,80 | 1970323920,01 | 31276564,00 | 2861,03 | 69,20 | 3,81 | 32,36 |
| 4 | 4 | 3,69 | 3,08 | 1240626688,00 | 31642360,00 | 2822,73 | 76,18 | 3,69 | 11,85 |
| 4 | 5 | 3,16 | 3,05 | 2521362080,66 | 32059424,00 | 3044,11 | 60,57 | 3,76 | 6,37 |
| 4 | 6 | 2,32 | 2,88 | 3360909924,36 | 32521143,00 | 2899,97 | 54,88 | 3,83 | 3,65 |
| 4 | 7 | 1,50 | 2,38 | 2841954371,38 | 33008150,00 | 3092,61 | 54,88 | 3,91 | 3,65 |
| 5 | 1 | 5,55 | 5,85 | 6034971231,03 | 147187353,00 | 1130,88 | 51,88 | 10,29 | 10,08 |
| 5 | 2 | 6,75 | 5,95 | 8196606673,15 | 151208080,00 | 1376,02 | 23,94 | 11,97 | 9,59 |
| 5 | 3 | 11,11 | 14,14 | 8554840768,97 | 155381020,00 | 1090,75 | 19,66 | 13,30 | 2,70 |
| 5 | 4 | 10,30 | 12,01 | 6048560266,39 | 159707780,00 | 2310,86 | 13,79 | 6,52 | 1,43 |
| 5 | 5 | 5,70 | 5,14 | 8841952775,28 | 164192925,00 | 2507,68 | 9,54 | 5,70 | 1,01 |
| 5 | 6 | 3,49 | 4,15 | 7101031884,45 | 168833776,00 | 2742,22 | 12,18 | 8,41 | 0,91 |
| 5 | 7 | 4,35 | 3,98 | 5609000000,00 | 173615345,00 | 3005,51 | 12,18 | 7,95 | 0,91 |
| 6 | 1 | 6,92 | 3,52 | 1515345044,00 | 10225100,00 | 3806,34 | 13,76 | | 1,68 |
| 6 | 2 | 4,25 | 3,56 | 2600674976,50 | 10328900,00 | 4342,82 | 14,21 | | 3,33 |
| 6 | 3 | 1,35 | 4,12 | 1525244857,53 | 10439600,00 | 4162,51 | 20,99 | | 2,89 |
| 6 | 4 | 1,86 | 5,17 | 1334497694,56 | 10547100,00 | 4212,15 | 24,04 | | 3,83 |
| 6 | 5 | 3,05 | 5,77 | 432666011,58 | 10673800,00 | 4305,01 | 21,03 | | 2,43 |
| 6 | 6 | 3,10 | 4,91 | 1554269128,78 | 10777500,00 | 4197,51 | 19,64 | | 2,77 |
| 6 | 7 | 3,04 | 3,36 | 1058622582,18 | 10886500,00 | 4316,69 | 19,64 | | 2,77 |

# Appendix 3 – STATA Output

**Panel regression analysis, STATA ouptut Joint Sign Variance Ratio test, all countries (1-6).**

```
Random-effects GLS regression                   Number of obs      =        35
Group variable: Country                         Number of groups   =         5

R-sq:  within  = 0.0031                         Obs per group: min =         7
       between = 0.6993                                        avg =       7.0
       overall = 0.2149                                        max =         7

                                                Wald chi2(6)       =      7.66
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.2638
```

| EfficiencyJS | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| FDINetInflows_S | .000649 | .0012864 | 0.50 | 0.614 | -.0018724 | .0031704 |
| PopulationM_S | -.0932934 | .07266 | -1.28 | 0.199 | -.2357044 | .0491177 |
| GDPPerCapita_S | -6.339029 | 609.8061 | -0.01 | 0.992 | -1201.537 | 1188.859 |
| MCap | -.1799286 | .0975598 | -1.84 | 0.065 | -.3711424 | .0112852 |
| DepIntRate | .5218478 | .4829831 | 1.08 | 0.280 | -.4247818 | 1.468477 |
| TradingofGDP | .0925774 | .2366991 | 0.39 | 0.696 | -.3713443 | .5564992 |
| _cons | 15.28378 | 5.882798 | 2.60 | 0.009 | 3.753713 | 26.81386 |
| sigma_u | 0 | | | | | |
| sigma_e | 5.5364934 | | | | | |
| rho | 0 | (fraction of variance due to u_i) | | | | |

**Panel regression analysis, STATA ouptut Chow and Denning Variance Ratio test, all countries (1-6)**

```
Random-effects GLS regression                   Number of obs      =        35
Group variable: Country                         Number of groups   =         5

R-sq:  within  = 0.0096                         Obs per group: min =         7
       between = 0.8251                                        avg =       7.0
       overall = 0.2310                                        max =         7

                                                Wald chi2(6)       =      8.41
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.2096
```

| EfficiencyCD | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| FDINetInflows_S | .0000762 | .0005818 | 0.13 | 0.896 | -.0010642 | .0012165 |
| PopulationM_S | -.0202879 | .032862 | -0.62 | 0.537 | -.0846963 | .0441205 |
| GDPPerCapita | -.0001379 | .0002758 | -0.50 | 0.617 | -.0006784 | .0004027 |
| MCap | -.0981551 | .0441235 | -2.22 | 0.026 | -.1846357 | -.0116746 |
| DepIntRate | .1704504 | .2184394 | 0.78 | 0.435 | -.257683 | .5985839 |
| TradingofGDP | .0880391 | .1070522 | 0.82 | 0.411 | -.1217794 | .2978576 |
| _cons | 9.512527 | 2.660621 | 3.58 | 0.000 | 4.297806 | 14.72725 |
| sigma_u | 0 | | | | | |
| sigma_e | 2.9511101 | | | | | |
| rho | 0 | (fraction of variance due to u_i) | | | | |

**Panel regression analysis, STATA output Joint Sign Variance Ratio test: Kenya, Mauritius, Morocco and Tunisia (2,3,4,6)**

```
Random-effects GLS regression                   Number of obs      =        21
Group variable: Country                         Number of groups   =         3

R-sq:  within  = 0.2520                         Obs per group: min =         7
       between = 1.0000                                        avg =       7.0
       overall = 0.5427                                        max =         7

                                                Wald chi2(6)       =     16.62
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0108

------------------------------------------------------------------------------
EfficiencyJS |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
FDINetInflows_S |  -.0016595   .0006491    -2.56   0.011    -.0029317   -.0003872
PopulationM_S |  -.2241598   .1295412    -1.73   0.084     -.478056    .0297364
 GDPPerCapita |  -.0013142    .000658    -2.00   0.046    -.0026038   -.0000246
         MCap |  -.0082223   .0467244    -0.18   0.860    -.0998004    .0833559
   DepIntRate |   -.268942   .2564209    -1.05   0.294    -.7715177    .2336338
 TradingofGDP |    .012844   .0748971     0.17   0.864    -.1339516    .1596396
        _cons |   20.36027   7.298022     2.79   0.005     6.056409    34.66413
-------------+----------------------------------------------------------------
      sigma_u |          0
      sigma_e |  1.9741906
          rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

**Panel regression analysis, STATA output Chow and Denning Variance Ratio test: Kenya, Mauritius, Morocco and Tunisia (2,3,4,6)**

```
Random-effects GLS regression                   Number of obs      =        21
Group variable: Country                         Number of groups   =         3

R-sq:  within  = 0.2753                         Obs per group: min =         7
       between = 0.9947                                        avg =       7.0
       overall = 0.7984                                        max =         7

                                                Wald chi2(6)       =     55.46
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
EfficiencyCD |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
FDINetInflows_S |  -.0012903   .0002975    -4.34   0.000    -.0018733   -.0007072
PopulationM_S |   .0672711     .05937     1.13   0.257    -.0490919    .1836342
 GDPPerCapita |  -.0001441   .0003016    -0.48   0.633    -.0007352    .0004469
         MCap |   .0219008   .0214142     1.02   0.306    -.0200703     .063872
   DepIntRate |   .0440584   .1175202     0.37   0.708    -.1862769    .2743937
 TradingofGDP |   .0175791   .0343261     0.51   0.609    -.0496987     .084857
        _cons |   2.948836   3.344754     0.88   0.378    -3.606762    9.504434
-------------+----------------------------------------------------------------
      sigma_u |          0
      sigma_e |  .73790978
          rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

**Pooled regression analysis, STATA output Joint Sign Variance Ratio test, all countries (1-6)**

| Source | SS | df | MS |
|---|---|---|---|
| Model | 374.044825 | 6 | 62.3408041 |
| Residual | 1366.54067 | 28 | 48.8050241 |
| Total | 1740.5855 | 34 | 51.1936912 |

| | |
|---|---|
| Number of obs | = 35 |
| F( 6, 28) | = 1.28 |
| Prob > F | = 0.2994 |
| R-squared | = 0.2149 |
| Adj R-squared | = 0.0467 |
| Root MSE | = 6.9861 |

| EfficiencyJS | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| FDINetInflows_S | .000649 | .0012864 | 0.50 | 0.618 | -.0019861 | .0032841 |
| PopulationM_S | -.0932934 | .07266 | -1.28 | 0.210 | -.2421307 | .0555439 |
| GDPPerCapita_S | -6.339029 | 609.8061 | -0.01 | 0.992 | -1255.47 | 1242.792 |
| MCap | -.1799286 | .0975598 | -1.84 | 0.076 | -.3797709 | .0199137 |
| DepIntRate | .5218478 | .4829831 | 1.08 | 0.289 | -.4674983 | 1.511194 |
| TradingofGDP | .0925774 | .2366991 | 0.39 | 0.699 | -.3922787 | .5774336 |
| _cons | 15.28378 | 5.882798 | 2.60 | 0.015 | 3.23342 | 27.33415 |

**Pooled regression analysis, STATA ouput, Chow and Denning Variance Ratio test, all countries (1-6)**

| Source | SS | df | MS |
|---|---|---|---|
| Model | 83.9479911 | 6 | 13.9913319 |
| Residual | 279.525027 | 28 | 9.98303668 |
| Total | 363.473018 | 34 | 10.6903829 |

| | |
|---|---|
| Number of obs | = 35 |
| F( 6, 28) | = 1.40 |
| Prob > F | = 0.2489 |
| R-squared | = 0.2310 |
| Adj R-squared | = 0.0662 |
| Root MSE | = 3.1596 |

| EfficiencyCD | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| FDINetInflows_S | .0000762 | .0005818 | 0.13 | 0.897 | -.0011156 | .001268 |
| PopulationM_S | -.0202879 | .032862 | -0.62 | 0.542 | -.0876028 | .0470269 |
| GDPPerCapita_S | -137.8773 | 275.7978 | -0.50 | 0.621 | -702.8235 | 427.0689 |
| MCap | -.0981551 | .0441235 | -2.22 | 0.034 | -.1885381 | -.0077722 |
| DepIntRate | .1704504 | .2184394 | 0.78 | 0.442 | -.2770025 | .6179033 |
| TradingofGDP | .0880391 | .1070522 | 0.82 | 0.418 | -.1312474 | .3073257 |
| _cons | 9.512527 | 2.660621 | 3.58 | 0.001 | 4.062492 | 14.96256 |

**Pooled regression analysis, STATA output Joint Sign Variance Ratio test, Kenya, Mauritius, Morocco, Tunisia (2,3,4,6)**

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| Model | 67.9918865 | 6 | 11.3319811 | Number of obs = | 21 |
| Residual | 57.2814138 | 14 | 4.09152955 | F( 6, 14) = | 2.77 |
| Total | 125.2733 | 20 | 6.26366501 | Prob > F = | 0.0545 |
| | | | | R-squared = | 0.5427 |
| | | | | Adj R-squared = | 0.3468 |
| | | | | Root MSE = | 2.0228 |

| EfficiencyJS | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| FDINetInflows_S | -.0016595 | .0006491 | -2.56 | 0.023 | -.0030517 | -.0002673 |
| PopulationM_S | -.2241598 | .1295412 | -1.73 | 0.106 | -.5019981 | .0536785 |
| GDPPerCapita | -.0013142 | .000658 | -2.00 | 0.066 | -.0027254 | .000097 |
| MCap | -.0082223 | .0467244 | -0.18 | 0.863 | -.1084361 | .0919916 |
| DepIntRate | -.268942 | .2564209 | -1.05 | 0.312 | -.8189101 | .2810262 |
| TradingofGDP | .012844 | .0748971 | 0.17 | 0.866 | -.1477943 | .1734823 |
| _cons | 20.36027 | 7.298022 | 2.79 | 0.014 | 4.707569 | 36.01297 |

**Pooled regression analysis, STATA ouput Chow and Denning Variance Ratio test, Kenya, Mauritius, Morocco, Tunisia (2,3,4,6)**

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| Model | 47.6625375 | 6 | 7.94375625 | Number of obs = | 21 |
| Residual | 12.0318339 | 14 | .859416704 | F( 6, 14) = | 9.24 |
| Total | 59.6943714 | 20 | 2.98471857 | Prob > F = | 0.0003 |
| | | | | R-squared = | 0.7984 |
| | | | | Adj R-squared = | 0.7121 |
| | | | | Root MSE = | .92705 |

| EfficiencyCD | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| FDINetInflows_S | -.0012903 | .0002975 | -4.34 | 0.001 | -.0019283 | -.0006522 |
| PopulationM_S | .0672711 | .05937 | 1.13 | 0.276 | -.0600649 | .1946071 |
| GDPPerCapita | -.0001441 | .0003016 | -0.48 | 0.640 | -.0007909 | .0005027 |
| MCap | .0219008 | .0214142 | 1.02 | 0.324 | -.0240282 | .0678298 |
| DepIntRate | .0440584 | .1175202 | 0.37 | 0.713 | -.2079973 | .2961141 |
| TradingofGDP | .0175791 | .0343261 | 0.51 | 0.617 | -.056043 | .0912012 |
| _cons | 2.948836 | 3.344754 | 0.88 | 0.393 | -4.224948 | 10.12262 |

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