Computational Methods in Social Sciences

Vol. IV, Issue 1/2016

Computational Methods in Social Sciences

Applying big data technologies in the financial sector – using sentiment analysis to identify correlations in the stock market

Eszter Katalin Bognár*

Business Informatics M.Sc., Budapest University of Technology and Economics, Hungary

Abstract

The aim of this article is to introduce a system that is capable of collecting and analyzing different types of financial data to support traders in their decision-making. Oracle's Big Data platform Oracle Advanced Analytics was utilized, which extends the Oracle Database with Oracle R, thus providing the opportunity to run embedded R scripts on the database server to speed up data processing. The extract, transform and load (ETL) process was combined with a dictionary-based sentiment analysis module to examine cross-correlation and causality between numerical and textual financial data for a 10 week period. A notable correlation (0.42) was found between daily news sentiment scores and daily stock returns. By applying cross-correlation analysis and Granger causality testing, the results show that the news' impact is incorporated into stock prices rapidly, having the highest correlation on the first day, while the returns' impact on market sentiment is seen only after a few days.

Keywords: *Big Data, finance, Oracle Advanced Analytics, sentiment analysis, R programming.*

1. Introduction

"To make the most of big data, enterprises must evolve their IT infrastructures to handle these new high-volume, high-velocity, high-variety sources of data and integrate them with the pre-existing enterprise data to be analyzed."[1] Financial markets can be viewed as complex, dynamic systems that evolve continuously and interact with the news as well as the economic and political environment. As a side effect, they generate enormous amounts of data and challenge the utilization of the latest Big Data technologies.

This article consists of two main parts. The first is a technical overview of the latest Oracle Big Data technology which was used to create a data analysis system for processing financial market data. In the second part, a sentiment analysis study will be introduced to discover the connection between market sentiment and stock returns.

2. Technology overview

In the following section, the Oracle Big Data options' [2] [3] [4] applicability in designing a financial data processing system will be reviewed.

2.1. Oracle Advanced Analytics

Oracle Advanced Analytics (OAA) is an option to the Oracle Database Enterprise Edition and offers in database analytics. The main advantage of this option is that it brings the algorithms close to the data. In contrast to traditional data analysis platforms where it is required to transfer the data from the database to separate analytical and statistical engines, using Oracle Advanced Analytics enables to use the algorithms where the data are stored thus eliminating the overhead of moving the data back and forth. This gives a better, simpler, more scalable architecture for delivering better decisions and deeper insights using predictive analytics. This platform is ideal for processing and forecasting financial time series data and news, where real-time processing is a requirement. It also lowers the total cost of ownership, as it eliminates the need for separate analytical servers.

The Oracle Advanced Analytics option comprises both the Oracle Data Mining (ODM) and Oracle R Enterprise (ORE) components. It offers a wide range of data mining and statistical algorithms. With Oracle Advanced Analytics, it is easy to discover hidden patterns in massive volumes of data, helping users to reach new insights, form predictions and quickly apply results. The native SQL analytics and model building, as well as the embedded R execution, are made parallel so that the processing of high volume data is much faster than

---

* corresponding author email: bgeszti@gmail.com

with traditional architectures. OAA also offers powerful visualization tools, as the results of the analysis can be accessed via different kinds of UIs like Oracle Business Intelligence Enterprise Edition[1] or web database applications created using Oracle Application Express (Apex)[2].

Oracle Advanced Analytics can be accessed through a graphical interface, like that contained in Oracle Data Mining, or via SQL, PL/SQL and R APIs. Database applications have direct access to the OAA database tables, enabling the user to easily visualize results and create dashboards for ad hoc analysis.

2.2. Oracle R

For complex analyses of large datasets, which are usually stored in an Oracle database, it is much faster and easier to do this from "inside" the database, rather than exporting the data into another specialized external format.

Oracle R Enterprise, a component of the Oracle Advanced Analytics option, makes the open source R statistical programming language[3] and environment available for in-database Big Data processing. R has become very famous in recent years; it boasts a global, highly active community of approximately two million users, with new packages being developed daily.

2.3. In-database analytics using Embedded R execution

Oracle R Enterprise lets users run R scripts in the database using embedded R execution. Server-side execution can be done via R or SQL interfaces. The R interface is most often used to test R scripts before utilizing them in database applications. The SQL interface can be used in database applications.

By utilizing server-side resources, server-side execution of scripts helps to eliminate the memory constraints of the R client while also providing the benefits of parallel execution.

3. Sentiment analysis

In recent years, sentiment analysis has become a hot topic among researchers attempting to automatically extract and quantify the opinions and sentiments embedded in news headlines, financial microblogs and Twitter tweets.

Sentiment analysis is itself is a data mining technique, the primary goal being to automatically extract the news' attitude towards the subject of analysis without having to manually read content. The first step of analysis is cleaning up the text in question. News on webpages is generally in HTML format, so HTML tags and irrelevant items must be removed. After converting the text into a clean format, different pre-processing techniques are applied. One of the early-stage techniques is to identify the "units" of the text; these may be words, sentences, phrases or n-grams. Lemmatization or stemming are also used to reduce the number of words by simplifying them to their common root. Additional techniques include removing capital letters, identifying the language of the text, removing stop-words, etc.

The most basic form of sentiment analysis is performed by counting the positive and negative words in the text, then using the resulting proportion to arrive at a sentiment score.

After the selection and preliminary processing of the text units, it is imperative to choose the right dictionary for the sentiment analysis. A given word can express a positive attitude in the field of finance but a negative attitude in some other field. For example, if we look at the sentiment of the word "rise" in the financial sector, it usually means a positive thing: rise of prices. If we examine the same word in the context of healthcare, it may have negative connotation, such as rise of blood pressure. For this reason, it is imperative to select the sentiment dictionary that best fits the domain of the analysis.

Besides the application of sentiment dictionaries, statistical methods that identify the sentiment of a given article can be employed. The most popular statistics-based solutions incorporate the naïve Bayes or Maximum Entropy classifiers or Support Vector Machines, but neural networks can also be used for this task. The

---

[1] https://www.oracle.com/solutions/business-analytics/business-intelligence/index.html
[2] https://apex.oracle.com/en/
[3] https://www.r-project.org/

implementation can be done by using either supervised or unsupervised learning methods. For the supervised learning, a training set consisting of articles and their sentiment is required. Most of the time, the training set is created manually with the contributions of experts in the researched field. The shortcomings of this method are the amount of time needed to classify the news in the training set and the subjective nature of sentiment; different people may express a variety of opinions regarding the same article. In unsupervised learning, the stock prices are usually used to train the classifier. If stock prices go up, the articles for the day should express positive sentiment, and vice versa if stock prices fall.

4. Previous studies

One influential person in the early years of sentiment analysis is the Hungarian researcher, Győző Gidófalvi. His work [5] formed the basis of many later studies in the field. Gidófalvi applied a naïve Bayesian text classifier to 5500 financial news articles covering 12 stocks. The change in stock price and the β-value (used to measure the volatility of stock) were fed into this classifier, which then grouped the articles into three categories. Although the prediction power of the classifier was low, Gidófalvi recognized a strong correlation between the news articles and the stock price movements.

A framework called AZFin Text (Arizona Financial Text System) was designed by Robert P. Schumaker and Hsinchun Chen [6][6]. In their research, the prediction power of daily news was tested using three textual methods: Bag of Words, None Phrase and Named Entities. They examined 9,211 financial news articles and 10,259,042 stock quotes during a five week period and tried to predict the stock price 20 minutes after the news articles were released. They achieved 57.1% accuracy in predicting the direction of future stock price movement using the stock price at the time of an article's release.

The work of Anurag Nagar and Michael Hahsler [7] is also notable. They used the open source R language for the analysis; more specifically, a dictionary-based sentiment analysis approach including words from the MPQL dictionary, combined with words built into the tm.plugin.webmining R package that is widely used for sentiment analysis. Although their paper omits the detailed, number-based evaluation of the results, visualization of their analysis shows a strong correlation between news sentiment and stock prices.

Koppel and Shtrimberg [8] investigated 12,000 articles about stocks in the S&P500 index between year 2000 and 2002. They employed support vector machines and naïve Bayes classifiers to predict the change in daily stock prices. The authors selected for all words that appeared at least sixty times in the corpus and eliminated common stop words. They also introduced two complex labelling methods for the financial news based on the date of the article publication and the gap between the daily opening and closing prices. They concluded that negative price movements are more easily predicted than positive ones.

Nuno Oliveira, Paulo Cortez and Nelson Areal [9][9] analyzed data from StockTwits, a microblogging website dedicated entirely to the stock market. This platform is similar to Twitter, in that the length of messages are limited to 140 characters. The team investigated five companies and the S&P500 index with three measurements: stock return, volatility and trading volume. They used a robust regression model to predict stock prices and the RSME and MAPE indicators to measure error. Their analysis was also performed using the R programming language. In contrast with previous studies, they found that there is no strong correlation between stock returns and sentiment indicators or between posting volume and volatility.

Nearly all of the aforementioned studies propose that there is a correlation between sentiment in different textual sources and stock price movements. As the amount of textual information become larger and larger, there is growing need to interpret and incorporate it into stock price predictions.

5. Sentiment dictionaries

The dictionary-based approach is the easiest method for extracting sentiment from text documents. The basic premise is to look at the text of articles as a "bag of words." Meaning, the order and grammatical structure of the words does not matter. From this collection of words, a document-term vector can be constructed that represents each word along with its frequency. Next, the words are matched to entries in the selected dictionary where words and their sentiments are stored. The potential shortcomings of this method are in the selection of the right

dictionary and in the methods used to weigh different words. In our analysis, the Harvard Inquirer[4] and The Bing Liu dictionaries[5] were chosen.

The General Inquirer (GI) uses words from the Harvard IV-4 dictionaries or the DICTION dictionary developed by Roderick Hart.

The GI lexicon contains approximately 12,000 words grouped in 184 sentiment categories such as negative, positive, strong, weak, power, pain, etc. Thus, this dictionary not only contains the basic positive and negative sentiments, but a variety of other associations.

The Bing Liu Lexicon contains approximately 6,800 English words categorized as either negative or positive. It also contains mistyped and slang words to extend the applicability of the lexicon.

6. System design

6.1. Data sources

My experiment was conducted using financial data for Apple (AAPL) covering a 10 week period from 28/09/2015 to 04/12/2015. Only the New York Stock Exchange trading days were considered, thus weekends and 26/11/2015 (market holiday due Thanksgiving Day) are excluded from the dataset. The data were stored in Oracle Database tables.

Daily adjusted closing prices were downloaded from Yahoo Finance, and financial news scraped from Google News RSS Feeds with an average of 34 postings per day. Regarding the daily news, only those articles published between 7:30 AM and 16:30 PM were considered, which covers the stock market trading hours plus two additional hours before the market opens. This time window was selected to exclude news which could not affect daily stock prices, on account of its after-hours publication.

6.2. Pre-processing of financial news

The following pre-processing steps were performed on the financial news in the database using the *XML, RCurl, boilerpipeR, tm.plugin.webmining, NLP* and *openNLP* R packages:

- **Filtering content**: Article content can vary. Some articles focus only on the examined company, in this case Apple, while others contain superfluous information regarding other companies. To avoid irrelevant content, each article was broken into its composite sentences and only those containing the words "appl" or "apple" were extracted.

- **Converting the text to lowercase**: Text typical of a news article contains both upper and lower case characters, which can prove cumbersome when searching for words. Prior to the analysis, all text was converted to lowercase, making a given word identical in appearance wherever it occurs.

- **Removing numbers, punctuations**: Numbers, punctuation and special characters were removed.

- **Removing stopwords**: In every text, there are a lot of common but uninteresting words (a, and, also, the, etc.). Stopwords are frequent by nature, and will confound the analysis if they remain in the text. To avoid this, common English stopwords were removed from the articles.

- **Creating a document term matrix**: A core step of text analysis is the creation of the document term matrix. This is an n*m matrix, where n refers to the number of documents and m refers to the number of terms. Each value in the matrix is a frequency number that shows how many times the term appears in the document. This matrix can be very sparse. The terms were sorted based on their frequencies in decreasing order, and only those with frequencies above a given minimum threshold were kept.

---

[4] http://www.wjh.harvard.edu/~inquirer/3JMoreInfo.html
[5] https://www.cs.uic.edu/~liub/FBS/sentiment-analysis.html#lexicon

6.3. News sentiment scoring using sentiment dictionaries

After pre-processing, the documents were scored according to sentiment. The scoring technique was based on the method of Johannes Tines[6].

Each of the documents was broken into sentences, and filtered for company-specific content. For each of the remaining sentences, a document term matrix was created, and the positive and negative terms counted. For locating the positive and negative terms within the sentences, two different sentiment dictionaries were used (Harvard General Inquirer and the Bing Liu opinion lexicon). For each sentences in the document, the sentence score was calculated by subtracting the negative term count from the positive term count (1) below.

$$sentenceScore = count(posTerms) - count(negTerms) \tag{1}$$

After obtaining these sentiment scores, each sentence was marked as 1, -1 and zero (positive, negative and neutral), by taking the sign of the sentence score (2).

$$sentenceSign = sign(sentenceScore) \tag{2}$$

Finally, the document score for a given article was calculated from the sentence signs by taking the proportion of the positive and the sum of the positive and negative sentence signs (3).

$$documentScore = \frac{sum(sentenceSign==1)}{sum(sentenceSign \, !=0)} \tag{3}$$

Using this scoring technique, each documents received a sentiment value between 0 and 1.

Since many documents are published within a single day, an overall daily sentiment score can also be calculated from the daily document scores, by taking the sum of document scores greater than 0.5 divided by the sum of document scores greater than 0 (4).

$$dailySentScore = \frac{sum(documentScore>0.5)}{sum(documentScore \, !=0)} \tag{4}$$

Using the above technique, news sentiments could be quantified and serve as the basis for comparisons with numerical financial data. To perform the analysis, the data were stored in an Oracle Database, with the sentiment calculation and further analysis conducted by Oracle in-database analytics with Oracle embedded R execution.

Fig. 1 shows the design of the financial data processing system.

---

[6] https://www.linkedin.com/pulse/20141109035942-34768479-r-sentiment-scoring-hsbc-w-harvard-general-inquirer
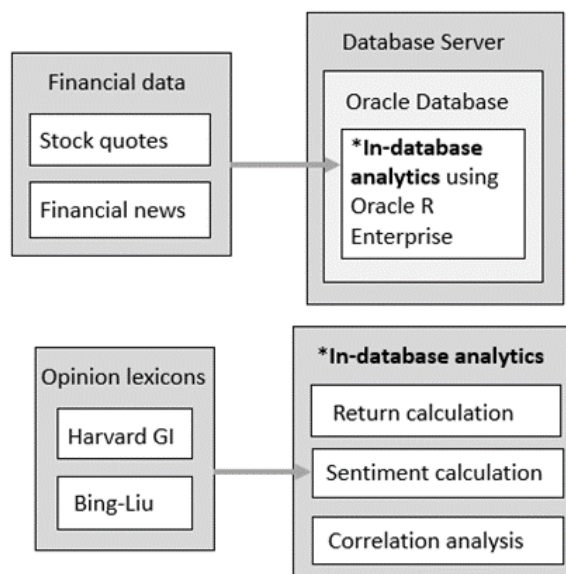
Fig. 1. System design

7. Results

The combined application of the General Inquirer and Bing Liu dictionary can lead to a better correlation between returns and sentiment scores. To identify the best weighing method, I cycled through all of the possible combinations of weights with 0.1 steps. The resulting table (**Table** 1) shows the best correlation in the case of 0.6 and 0.4 weights for the General Inquirer and Bing Liu lexicons, with a 0.423 correlation coefficient.

Table 1. Correlation with Different Dictionary Weights

GI score	Bing-Liu score	Combined score	GI weight	Bing-Liu weight
0.340	0.311	0.331	0.1	0.9
0.340	0.311	0.353	0.2	0.8
0.340	0.311	0.376	0.3	0.7
0.340	0.311	0.397	0.4	0.6
0.340	0.311	0.414	0.5	0.5
0.340	0.311	0.423	0.6	0.4
0.340	0.311	0.419	0.7	0.3
0.340	0.311	0.402	0.8	0.2
0.340	0.311	0.375	0.9	0.1
0.340	0.311	0.331	0.1	0.9

A visual comparison of the sentiment score and daily return plots (**Fig. 2**) reveals a possible correlation. The general up and down course of the two time series are quite similar. It is also remarkable that some lags can be identified. A significant decrease in the returns of Apple on 26/10/2015 was followed with a negative market sentiment on the next day.
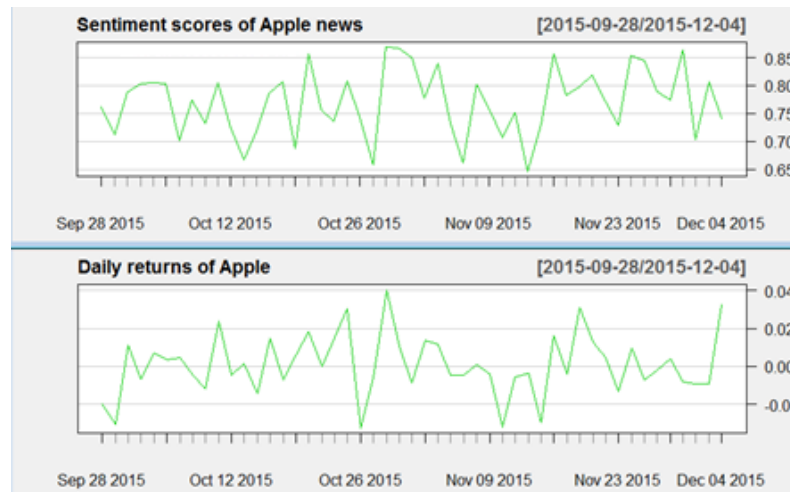
Fig. 2. Daily stock returns and sentiment scores

In some time intervals, the direction of time lag is reversed; that is, the changes in daily returns appear to follow the changes in market sentiment. To clarify this, a cross correlation analysis was taken on the two time series to identify the possible lags between the data. **Fig. 3** shows the cross-correlation between the returns and sentiment scores.
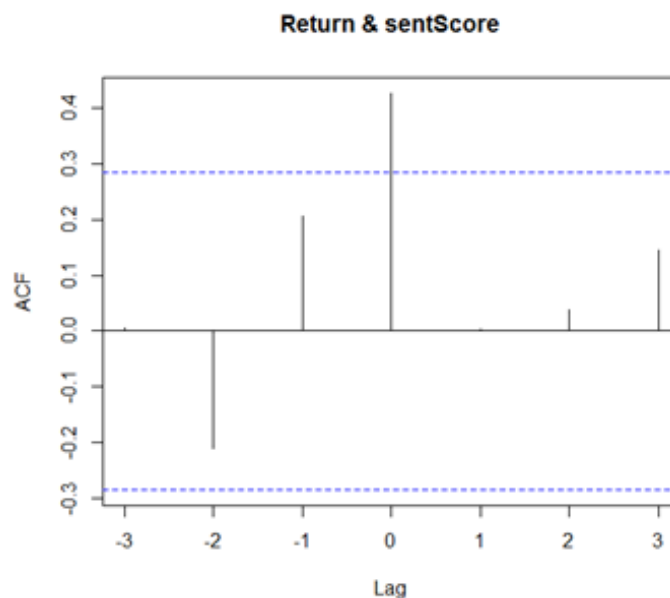
Fig. 3. Cross-correlation

Examining this correlation plot, it can clearly be seen that the highest correlation between the returns and sentiment scores is on the first day, meaning that the news' influence works quickly on stock prices. It is interesting that a weaker but still notable correlation can be seen on lag -1 and -2, indicating that returns may affect sentiment score values a few day later. Therefore, the market sentiment is a reaction to market prices, and does not have predictive power for future stock returns.

Another way to identify the relationship between the two time series is the usage of the Granger causality test. The main question is whether the future values of a time series are predictable using prior values of another time series. This is tested by using the lags of one series to model changes in a second series.

Based on the results of the cross correlation analysis, I suggest that the return values at time *T-1* can predict the sentiment scores at time *T*. **Fig. 4** shows the result of the Granger test that indicates that returns are granger cause sentiment scores with a significant (0.01357) p value.

```
> grangertest(Score ~ Return, order=1)
Granger causality test

Model 1: Score ~ Lags(Score, 1:1) + Lags(Return, 1:1)
Model 2: Score ~ Lags(Score, 1:1)
  Res.Df Df     F  Pr(>F)
1     44
2     45 -1 6.615 0.01357 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*'
```

Fig. 4. Granger causality

8. Conclusions

Although the predictive power of the sentiment scores cannot be proven, it is apparent that the sentiment of the financial news is correlated with returns. The selection of sentiment scoring method and data sources are important for obtaining statistically meaningful results. Both the General Inquirer and the Bing Liu lexicons were appropriate for identifying stock market direction, with the best performance achieved using their weighted combination. Both the cross correlation and Granger tests demonstrated that the effect of the news on returns is fast-acting, even appearing on the same day. On the other hand, the news is influenced by stock returns only after a few days lag.

The analysis could be improved by incorporating more sophisticated semantic analysis of the textual data and by using more domain-specific sentiment dictionaries.

With the detailed review and appropriate selection of the latest Oracle Big Data technologies, the data processing system outlined in this article can form the basis of further real time analysis of structured and unstructured financial data in a fast, efficient and cost-effective manner. This article hopes to introduce and encourage the use of these new technologies in the financial sector.

References

[1] Oracle: "*Big Data for the Enterprise*", Oracle White Paper, June 2013, [Online]. Available: http://www.oracle.com/us/products/database/big-data-for-enterprise-519135.pdf [Accessed March 29, 2016].

[2] Charlie Berger: "Big Data Analytics with Oracle Advanced Analytics In-Database Option", 2012, [Online]. Available: http://www.oracle.com/technetwork/database/options/advanced-analytics/oaa12cpreso-1964644.pdf [Accessed March 29, 2016].

[3] Bryan Pottle: "*Introducing Oracle R Enterprise 1.4*", 2014, [Online]. Available: http://www.oracle.com/webfolder/technetwork/tutorials/tutorial/db/ore1.4/part1/presentation_content/external_files/Introducing_Oracle_R_Enterprise_1_4.pdf [Accessed March 29, 2016].

[4] Bryan Pottle: "*Embedded R execution: R Interface*", 2014, [Online]. Available: http://www.oracle.com/webfolder/technetwork/tutorials/tutorial/db/ore1.4/part6/presentation_content/external_files/Embedded_R_Execution.pdf [Accessed March 29, 2016].

[5] Gidofalvi, Győző: "*Using News Articles to Predict Stock Price Movements*", Department of Computer Science and Engineering. University of California, San Diego, 2001, [Online], Available: http://cseweb.ucsd.edu/~elkan/254spring01/gidofalvirep.pdf [Accessed March 29, 2016].

[6] R. P. Schumaker, H. Chen: "*Textual analysis of stock market prediction using breaking financial news: The AZFin Text system*", ACM Transactions on Information Systems (TOIS), Volume 27, Issue 2, Article No. 12., February, 2009.

[7] Anurag Nagar and Michael Hahsler: *"Using Text and Data Mining Techniques to extract Stock Market Sentiment from Live News Streams"* in International Conference on Computer Technology and Science (ICCTS 2012), IACSIT Press, Singapore, 2012.

[8] M. Koppel and I. Shtrimberg: "**Good News or Bad News? Let the Market Decide**" in **AAAI Spring Symposium on Exploring Attitude and Affect in Text**, The AAAI Press, Palo Alto CA, pp. 86-88., 2004.

[9] Nuno Oliveira, Paulo Cortez, Nelson Areal: "*On the Predictability of Stock Market Behavior Using StockTwits Sentiment and Posting Volume*" in 16th Portuguese Conference on Artificial Intelligence, EPIA 2013, Angra do Heroísmo, Azores, Portugal, pp. 355-365., 2013.

The Likert scale analysis using parametric based Structural Equation Modeling (SEM)

Zainudin Awang[*1], Asyraf Afthanorhan[2], Mustafa Mamat[3]

[1,2,3] Faculty of Economics and Management Sciences, Universiti Sultan Zainal Abidin, Kampus Gong Badak, 21300 Kuala Terengganu, Malaysia.

Abstract

The Likert scale is commonly used in survey research using primary and secondary data to measure the respondent attitude by asking insofar to which they agree or disagree with a particular questions. In generals, Likert scale would be preferred in the questionnaire development stage to ascertain the researchers conducting their research needed. However, the researchers nowadays are abuse to understand the nature of measurement scale in data analysis and thus causes the finding obtained are meaningless. This article is aimed to compare the performance of two categories of measurement scales which are 5 point and 10 points of Likert scales using the same sample size and research subject that would pave the way to understand the real different between both of these ranges using Structural Equation Modeling (SEM). Moreover, this study also interested to clarify briefly between two types of measurement scale namely ordinal and interval data. The findings reveal that 10 points of Likert scale is more efficient than 5 points of Likert scale in operating of measurement model.

Keywords: *Likert Scale, Structural Equation Modeling (SEM), Ordinal, Interval, Parametric*

1. Introduction

The Likert scale is commonly used in survey research especially from social science, management, marketing, education, tourism, healthcare and other disciplines to measure the respondents attitude by asking insofar to which they agree or disagree with a particular question or statement presented. A typical scale that frequently apply by majority of researchers might be "strongly agree, somewhat agree, not sure/undecided, somewhat disagree, and strongly disagree. At the outset, survey data using Likert scale may seem easy to analyze or to identify the factors involve in the study, but there are another important issues that should be addressed for a data analyst to consider it. This is because the implementation of the Likert scale in analysis has become one of the main interested technique for each researchers and scholars lately.

However, most of the researchers from various field abuse the true nature of the Likert scale in the questionnaire development stage. Therefore, their findings would be troublesome or probability to derive the true value is risky due to the requirement of the scale needed is limited. Thus, the main problem of this research is to let the scholars understand the real strength of Likert scale using structural equation modeling on 5 points and 10 points of Likert scale using the same quantity of data sets and model. Generally, the researchers prefer to choose the short ones than the long scales as they believe the result obtained would not be affected. Consequently, the 5 points of Likert scale was frequently implemented if it is related with the survey research. Additionally, most of the researchers believe the label for each measurement scale is required in developing the questionnaire. In fact, their aim of the study was more prone towards the parametric technique as it is only being rationale for interval and ratio scale. Therefore labeling term for each scale was exactly as ranking order, but then, it is being ignored by applied researchers as they thought it can help the respondents to make a choice for each questions presented. By doing so, the researchers keep analyze the data obtained using parametric technique without concern the sensitivity of the statistical assumptions.

Lately, Structural Equation Modeling (SEM) has become one of the prominent statistical method as it is take into account of the multiple variables simultaneously and being free from the measurement error that associated with every variable. In SEM, the achievement of fitness of measurement model must be ensured during the Confirmatory Factor Analysis (CFA; Zainudin, 2015). The fitness of measurement model was very sensitive to the characteristics or pattern of the data sets. Therefore, the good fitness of

---

[*] corresponding author email: drzainudin888@gmail.com

measurement model was actually represents the data obtained was compatible with the theories conveyed (Henseler, Hubona, & Ray, 2016). In order to obtain the good fitness of measurement model, the researchers must concern with their data sets that is the data was collected based on respondents perception. In the questionnaire, the Likert scale was considered as the measurement scale to assess the degree of the respondents' opinion. If the measurement scale presented more choices, then, it will accelerate the researchers to decide their choice.

In the questionnaire development stage, Likert scale might be coding for 5 point, 7 points and 10 points to represent of how much higher of respondent to agree of the particular question. The original idea for the Likert scale is found in Rensis Likerts 1932 articles in Archive of Psychology titled "A Technique for the Measurement Attitudes". In his research, he expand the present knowledge of the procedures namely Likert scale developed by Thurstone (Edmondson, 2005). In scale of measurement, the 5 points typically been employed to determine the respondents agree or disagree on questions contemplated. However, the scale used with 5 points is inadequate at determining of characters of respondents intention especially when the researchers decide to attempt parametric test in statistical inference. Because 5 points of Likert scales was represents of 5 choices undermine the strength of parametric techniques.

Consequently, this study interest to make a comparison between 5 point and 10 points of Likert scale using SEM approach. The outcome of each factors would portray the real different for each strength of scale of measurement. However, majority of researchers less sensitive on the scale used, instead more likely concentrate on the analysis adapted. In fact, the probability to attain the true value is closely related on the scale used in determining of the parameter estimate and hypothesis testing for inference testing. In addition, the fitness of measurement model and reliability of construct also affected.

The structure of paper is as follows. First, relevant issues on scale of measurement and sampling technique are discussed. This is followed by methodology and generation of scale items used. Once the data analysis is focused on CFA approach, path analysis is discussed. Then after psychometric properties of the scales, results, theoretical, practically, and implication of scale are presented. The paper also concludes the recommendation, future research and scope of limitations.

2. Likert Scale in the form of rank order

Mostly, the researchers today would using the primary data as a main source for them to carry on the particular research required. Therefore, they would design their questionnaire based on their previous literature to support their decision to ask respondents. However, the way they design the questionnaire can harm the result at the data analysis stage. This is because most of them are still confused to distinguish between ordinal and interval scale in data analysis. In fact, the wrong identification data can causes misinterpretation finding.

Ranking procedure require the respondents to order stimuli with respect to some designated property of interest. For instances, the researchers would classify for each 5 point scales in their questionnaire design as presented below:

Very Interested	Somewhat Interested	Neutral	Not Very Interested	Not at All Interested
5	4	3	2	1

Very Much	Somewhat	Undecided	Not Really	Not at All
5	4	3	2	1

Very Much Like Me	Somewhat Like Me	Neutral	Not Much Like Me	Not at All Like Me
5	4	3	2	1

Very Happy	Somewhat Happy	Neutral	Not Very Happy	Not at All Happy
5	4	3	2	1

Almost Always	Sometimes	Every Once In a While	Rarely	Never
5	4	3	2	1

Figure 1: Likert Scale of Ordinal order

This scale of measurement applied is inappropriate to be applied since the researcher rename of each scale listed. This step would be recognized as ordinal data due to the rank of each scale. In parametric test, the researchers usually intend to analyze on how much of attitude of respondent instead to ask rank of their opinion. Parametric test can be conducted for interval and ratio data, thus, nominal and ordinal is not eligible to be test as parametric analysis.

Figure 1 is the sample of ordinal scale that classify of each scale. This scale is only useful for the non-parametric test such as descriptive frequency, mean, Mann Whitney test, Kruskal Wallis and so forth. So, the major problem here is induced the researchers are inconsiderate to learn the statistical methodology that is prior in empirical research.

In statistics discipline, there are four scale of measurement that should be understand by researchers and scholars so that they would know on how to differentiate of all scale provided. Indeed, all scale can be analyzed using method required to complement their analysis. Nevertheless, many infamous researchers claim that interval data is more powerful in determining of the attitude of respondent on each issues faced (Velleman & Wilkinson, 1993; knapp, 1990; korotayev, 2004). Therefore the interval order often gain attraction of researchers to conduct the parametric analysis as presented Figure 2.

Scale of measurement

Basically, data can be divided into numerical and categorical data. Numerical data contains numbers that we can manipulate using ordinary arithmetic operations, in a while, categorical data can be sorted into categories. (Lau, Phang & Zainudin, 2012). Usually, data is classified as nominal, ordinal, interval or ratio as explained below:

Nominal	•Known as categorical data •The lowest measurement scale •No order or structure •Non-parametric test used: Mode and cross tabulation (Chi-square test) •Eg: Gender, Race, Yes/No
Ordinal	•Known as ranking scale •The second lowest measurement scale •Order structure •Non-parametric test used: Median and Mode, Rank order correlation, kruskal wallis test, mann whitney test •E.g: Level of education
Interval	•Known as rating scale •More powerful compare than nominal and ordinal data •Have equidistance points between each of the scale elements •Parametric test used: Mean and standard deviation, Correlation, Regression, Analysis of Variance, Factor Analysis •E.g: Customer satisfaction, Motivation, job performance
Ratio	•Known as ratio scale •The top level of measurement but not available in social research •Parametric test used •Same as interval data •E.g: Temperature

Source: Lau, Phang & Zainudin (2012), Statistics Edition three

2.1. Treating ordinal scales as interval scales

Today, the use of scale of ordinal scale has become a common practice in statistical analysis. Most of the researchers do not really understand of requirement for each scale measurement. For instances, researchers today postulates ordinal scale can be used in parametric test as well such as ANOVA, t-test, regression analysis, and so forth. In fact, those approach can be well functioned with interval or ratio scale only. Other than that, those estimation provided for inference testing are vague.

To add, this issue has been continuing controversy since Harvard psychologist S.S. Stevens (1946) advances his ideas concerning the connection between measurement scales and statistical analysis regarding of traditional descriptive and inferential statistics. Marcus-Roberts and Roberts (1987) put forth that it is always appropriate to calculate means for ordinal scales but inappropriate to make certain statements about such means. This statement justify that the inferential statistics dependent on ordinal is not comprehensive to reflect the actual research that involving of large sample size.

Knapp (1990) remarked that if the researcher convince that their data applied are ordinal, they should be able to carry on their research using traditional statistics that leads to fruitful result. This statement also be agreed by Marcus-Roberts & Roberts, (1987) that if the scale used is ordinal, nonparametric test should be employed in the inference stage, only because of the distribution-free nature of such test but because they tend to be more appropriate for hypotheses that are meaningful for ordinal scale.

The appropriate method will provide a meaningful hypothesis as explain by (Marcus-Roberts & Roberts, 1987).Therefore, treating of ordinal scales as interval scales in inferential stage is improper to be applied since this scales is limited to the nonparametric test. Plus, the meaningless hypothesis would not contribute significant impact on the social research. Thus, the researchers have to construct their questionnaire as interval scales if

interested to apply the parametric test. In SEM, the researchers permanently using maximum likelihood estimator that is one of normality theory. Using this, maximum likelihood is admissible with interval scales. However, Muthens (1998) offered a new estimator as Weighted Least Square Maximum Variance (WLSMV) in the integration of SEM was rationale as well with ordinal scale. Such finding enable the researchers to excel their analysis with SEM. In order to make sure the readers understand distinguish between parametric and non-parametric approach, we listed several approaches at the Table 1 and different abilities between them at Table 2 as follows:

Table 1: Comparison Parametric and Non-Parametric Approach

Parametric Approach (Means)	Non-Parametric Approach (Medians)
Paired t-test	McNemar test
1-sample t-test	Median test, Wilcoxon sign test
2-independent sample t-test	Mann-Whitney test
Pearson Correlation	Spearman Correlation, Tau Equivalent, Rank Correlation, Ordinal Correlation
Analysis of Variance (ANOVA)	Kruskal-Wallis test, Mood's median test
Factorial DOE with one factor and one blocking variable	Friedman test
Multivariate ANOVA (MANOVA)	Permutation MANOVA
Binary Logistic	Cochran test
Regression Analysis	Robust Regression Analysis, Quantile Regression Analysis, Ordinal Regression

Table 2: Comparison abilities between Parametric and Non-Parametric Test

Parametric test	Non-Parametric test
There are numerous statistical assumption or stringent assumption about the parameter means	There is no stringent assumption or they relaxes the statistical assumptions
Parametric center on the mean differences and differences between medians	Non-Parametric center on order or ranking. The data are changes from exact scores to rank and different signs
The population must have the same variance (homoscedasticity)	No same variance (heteroscedasticity)
High statistical power and efficiency	Low statistical power and efficiency
High sensitive to detect the large sample size	Less sensitive to detect the large sample (preferred for small samples)

2.2. Forced Measure (interval scale should be identical and independent)

By using Structural Equation Modeling (SEM) as a main method in this study, the authors would analyze two type of ranges which is for 5 points and 10 points to obtain the result. Usually, the researchers are interested to apply 5 points of measurement scale, instead to apply 10 points of Likert scale. Most of them believe the result cannot be affected even adapt short scale. In fact, the long scale (e.g: 10 points) is better than short scale (e.g: 5 points) in determining of how much agree or disagree of respondent on particular questions.

For instance, if the enumerator ask the respondents to evaluate of the question consists of 5 points, the respondent would rate the particular question in the range of 0% to 100%. If they decide to agree of that questions is 90%, the enumerator would be claim that 90% was exactly represents of 5 points of the Likert scale which is the highest point in scale of measurement in the questionnaire designed. This situation is contrary to the questionnaire that posits of 10 points for each items in which the enumerator would rate the question as 9 point that represents of 90% in scale of measurement. Thereby, it can be inferred that the equidistance is not occurred in measurement scale when correlate with short scale.

In fact, the scale of measurement is supposedly reflect the actual intention of respondent towards the question submitted. If the 5 points is sustain in scale of measurement, the analysis provided will be not reliable even the standard error produced is much lower than of 10 points. The short scale of measurement inhibit the actual scale of

respondent intention and thus pushing them to rate the question based on scale presented. Thus, this situation might create a force measure in inferential statistics that provide a meaningless outcome induced there is no freedom for respondents to make a choice of their intended.

In this respect, the expected value for mean and variance of IID random variables should be identical and independent specifically as X_1, X_2,…, X_n . Means that, the scale used should be independent and identical for constructing the linear formula as stipulated in z-test and t-test in order to prevent occurrence of force measure. Moreover, the common method variance that tendency to harm the construct validity, measurement error and covariance among latent variables resolved.

2.3. Sampling Technique

Sampling is the process of selecting a sample from a population. Since the information obtained from the sample is used to generalize or to make a conclusion about the population, the sample must be selected in such a way that it will accurately represent its population (Lau, Phang, & Zainudin, 2012).

Sampling technique can be classified broadly into two categories namely non-probability sampling technique and the probability sampling technique. The non-probability sampling techniques encompasses of convenience sampling, judgmental sampling, snowball sampling, and quota sampling. In a while, probability sampling encompasses of simple random sampling, systematic sampling, stratified sampling, cluster sampling and multi-stage sampling. Both of these sampling carry the different character of methodology in inferential statistics. In generals, non-probability sampling is appropriate for nonparametric test whereas probability sampling is useful for parametric test.

However, the researchers fail to meet the requirement of parametric test especially during the data collection stage that is associated with the sampling technique. At this stage, they collect the data or distribute the questionnaire based on non-probability sampling and supposedly nonparametric test should be conducted in empirical research. Against on that, they constantly attempt parametric analysis since the evidence clear that parametric analysis is better than non-parametric analysis. Therefore, the finding produced is against their theoretical concept. In order to compare between 5 point and 10 points as suggested in this paper, the data was generated into two different of measurement scale that consist same quantity of data sets. Both of these data sets will be tested at the same confirmatory model such that to examine which kind of measurement scale was preferable for those model. In this stage, CB-SEM was ideal represents of second generation modeling that is able to operate multiple construct measurement (refers Figure 2).

3. Finding
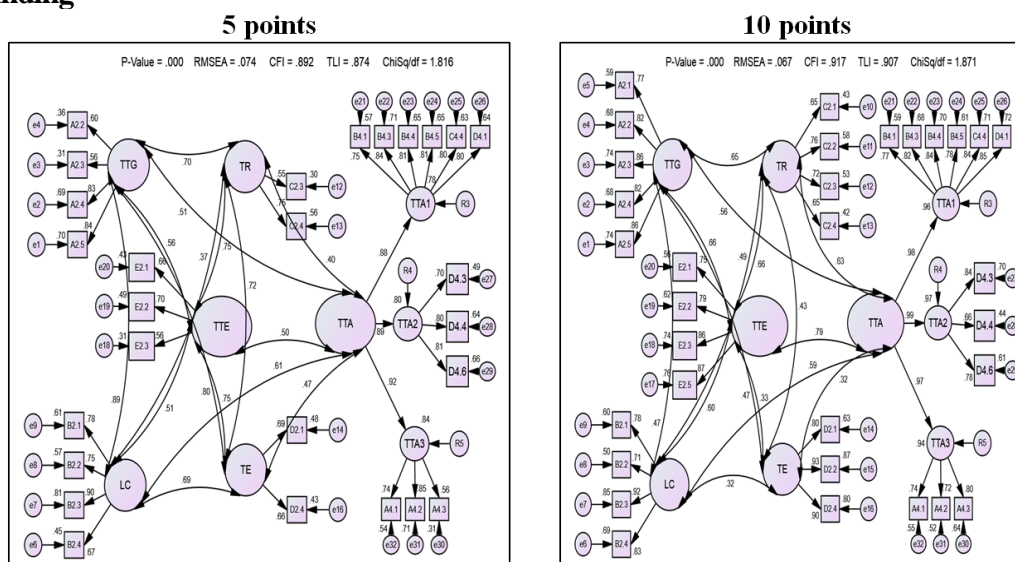
Figure 2: Comparison model between 5 points and 10 points

Figure 2 shows the result of construct measurement that consist of different measurement scales. Based on that, the items retained in the model among them was not equivalent although the technical procedure to specify the construct measurement was identical. Followed by those factor loadings, the next assessment such as Composite Reliability (CR), Average Variance Extracted (AVE) and discriminant validity was performed.

3.1. The 5 points of measurement scales

Table 3: Factor loading of 5 points of measurement scale

Construct	TTA	TTA1	TTA2	TTA3	TR	TTG	LC	TTE	TE
TTA1	.88								
TTA2	.89								
TTA3	.92								
B4.1		.75							
B4.3		.84							
B4.4		.81							
B4.5		.81							
C4.4		.80							
D4.1		.80							
D4.3			.70						
D4.4			.80						
D4.6			.81						
A4.1				.74					
A4.2				.85					
A4.3				.58					
C2.3					.55				
C2.4					.75				
A2.2						.60			
A2.3						.58			
A2.4						.83			
A2.5						.84			
B2.1							.78		
B2.2							.75		
B2.3							.90		
B2.4							.67		
E2.1								.66	
E2.2								.70	
E2.3								.56	
D2.1									.69
D2.4									.66
CR	.925	.915	.815	.772	.598	.810	.860	.677	.626
AVE	.804	.643	.595	.536	.433	.523	.607	.413	.456

Table 4: Discriminant Validity

	TTA	TR	TTG	LC	TTE	TE
TTA	.896					
TR	.48	.658				
TTG	.51	.70	.723			
LC	.61	.37	.89	.779		
TTE	.50	.75	.56	.51	.642	
TE	.47	.72	.80	.69	.75	.543

3.2. The 10 points of measurement scales

Table 5: Factor loadings of 10 points of measurement scales

Construct	TTA	TTA1	TTA2	TTA3	TR	TTG	LC	TTE	TE
TTA1	.98								
TTA2	.99								
TTA3	.97								
B4.1		.77							
B4.3		.82							
B4.4		.84							
B4.5		.78							
C4.4		.84							
D4.1		.85							
D4.3			.84						
D4.4			.66						
D4.6			.78						
A4.1				.74					
A4.2				.72					
A4.3				.80					
C2.1					.65				
C2.2					.76				
C2.3					.72				
C2.4					.65				
A2.1						.77			
A2.2						.82			
A2.3						.86			
A2.4						.82			
A2.5						.86			
B2.1							.78		
B2.2							.71		
B2.3							.92		
B2.4							.83		
E2.1								.75	
E2.2								.79	
E2.3								.86	
E2.5								.87	
D2.1									.80
D2.2									.93
D2.4									.90
CR	.986	.923	.806	.798	.754	.915	.886	.890	.910
AVE	.960	.668	.583	.569	.506	.683	.662	.671	.772

Table 6: Discriminant validity

	TTA	TR	TTG	LC	TTE	TE
TTA	.997					
TR	.63	.711				
TTG	.56	.65	.826			
LC	.59	.49	.47	.813		
TTE	.79	.66	.66	.60	.819	
TE	.32	.43	.47	.32	.33	.878

Based on the results revealed, the construct measurement that consist of 10 points of measurement scales was seemed more relevant under the confirmatory approach. Because the factor loadings appear in the model was higher than 0.60 (Zainudin, 2015), value of CR was greater than 0.70 (Nunally & Bernstein, 1994; Afthanorhan, Ahmad, & Mamat, 2014), value of AVE higher than 0.50 (Hair et al., 2009) and discriminant validity that associated with latent variable correlation was satisfied (correlation must be less than the square root of AVE; Fornell & Larcker, 1981). Therefore, the construct measurement of 10 points (refer Table 5 and Table 6) is able to proceed to the next stage that is the relationships between latent variables can be confirmed. In contrast, the results of construct measurement with 5 points of Likert scale (refer Table 3 and Table 4) was seemed fail to satisfy the SEM requirement as this approach can be admissible when the construct measurement was satisfied in terms of its reliability and validity. Other than that, the path analysis for estimating the relationships among latent variables cannot be executed.

In SEM, the first priority is to ensure the construct involve in the model was reliable and valid. Thereby, this method is frequently viewed as confirmatory tool (Bollen, 2014) that is the model must be have a strong theory. The necessity of strong theory should be compatible with the data available to avoid more items deleted from the

model. In this case, we confirm that the 5 points of Likert scale was not meet with such requirement of parametric based SEM.

4. Conclusion

The plethora of discussion and debate around measurement scale called for a fresh look at this scale as the use of Likert scale become a common practice in social science and management research. As important aspect endeavor, we provide an answer the question "What point of scale is preferable?" This answer is 10 points of Likert scale as justified by our recent findings. It is particularly helpful for researchers who have educated in measurement scale in the past, and who interest to add knowledge or understanding of the measurement scale. With this, they know how to distinguish which one is called ordinal or interval and further they more convince to choose the best scale for their research.

Finally, recent research confirms that 10 points of Likert scale serves a promising scale under parametric based SEM. Both measurement and structural models can be assessed with 10 points of Likert scale that is expected more success in determining the construct validity. We anticipate that once social science and management's researchers' interest in developing questionnaire based of Likert scale becomes more pronounced, 10 points of Likert scale will face an additional substantial gain popularity and surely the danger of common method variance in the model can be evaded.

5. References

[1]   Afthanorhan, W. M. A. B. W., Ahmad, S., & Mamat, I. (2014). Pooled Confirmatory Factor Analysis (PCFA) using structural equation modeling on volunteerism program: A step by step approach. International Journal of Asian Social Science, 4(5), 642-653.
[2]   Bollen, K. A. (2014). Structural equations with latent variables. John Wiley & Sons.
[3]   Edmondson, R.D. (2005), "Likert Scales: A History", University Florida, USA, 127-133.
[4]   Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics.Journal of marketing research, 382-388.
[5]   Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2009). Análise multivariada de dados. Bookman Editora.
[6]   Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: updated guidelines. Industrial Management & Data Systems, 116(1), 2-20.
[7]   Knapp, T. R. (1990). Treating ordinal scales as interval scales: an attempt to resolve the controversy. Nursing research, 39(2), 121-123.
[8]   Korotayev, A. (2004). World religions and social evolution of the old world Oikumene civilizations: A cross-cultural perspective. E. Mellen Press.
[9]   Kya, L. T., Ngor, P. Y., & Awang, Z. (2012). Statistics for UiTM.
[10]   Likert, R. (1932). A technique for the measurement of attitudes. Archives of psychology.
[11]   Marcus-Roberts, H. M., & Roberts, F. S. (1987). Meaningless statistics.Journal of Educational and Behavioral Statistics, 12(4), 383-394.
[12]   Muthén, B. O. (1998). Mplus technical appendices. Los Angeles, CA: Muthén & Muthén, 2004.
[13]   Nunally, J. C., & Bernstein, I. H. (1994). Psychonometric theory. New York.
[14]   Velleman, P. F., & Wilkinson, L. (1993). Nominal, ordinal, interval, and ratio typologies are misleading. The American Statistician, 47(1), 65-72.
[15]   Zainudin Awang. (2015). A Handbook on SEM. MPWS Publisher.

Performance analysis of aodv, dsdv and aomdv using wimax in NS-2

Madhusrhee B*

Department Computer Science, L.J Institute of Technology, Ahmedabad, India

Abstract

WiMAX (IEEE 802.16) technology empowers ubiquitous delivery of wireless broadband facility for fixed and mobile users. WiMAX standard describes numerous physical and MAC layer characteristics. Here, an attempt is made to implement some of these physical and MAC layer structures including the mobility extension 802.16e. NS2 (Network Simulator-2) is chosen as the simulator to implement these features as NS2 provides suitable library to simulate network scenario. The performance of the simulated module is analyzed by running AODV, DSDV and AOMDV routing protocols on a wired-cum-wireless WiMAX scenario. The throughput for each routing protocol is calculated for varying number of mobile nodes or subscriber stations.

Keywords: *Worldwide Interoperability for Microwave Access (WiMAX), AODV, DSDV and AOMDV routing protocols*

1. Introduction

Worldwide Interoperability for Microwave Access (WiMAX), is wireless broadband standard that has promised high bandwidth over long-range transmission. The standard identifies the air interface, including the medium access control (MAC) and physical (PHY) layers, of Broadband Wireless Access.

WiMAX technology enables ubiquitous delivery of wireless broadband service for fixed and/or mobile users, and came into existence in 2006 by Korea Telecom, when it started the deployment of a 2.3 GHz type of mobile WiMAX service called WiBRO in the Seoul metropolitan area to provide great performance for data and video. WiMAX is a standard-based wireless technology that delivers high throughput broadband connections over lengthy distance. WiMAX can be deployed for a number of applications, comprising "last mile" broadband connections, hotspots and high-speed internet access for network users. It delivers wireless metropolitan area network (MAN) connectivity at speeds up to 70 Mbps and the WiMAX base station typically can cover 5 to 10 km.

The supple bandwidth allocation and multiple built-in types of Quality-of-Service (QoS) support in the WiMAX technology let the facility of high-speed Internet access Voice over IP (VoIP) and video calls, multimedia chats and mobile show business. Also, the WiMAX connection can be used to transport data to multimedia devices such as the iPod.

The significant growth in the Physical layer comprises orthogonal frequency- division multiplexing (OFDM), in which multiple access is accomplished by allocating a subset of subcarriers to each individual user. This looks like code-division multiple access (CDMA) spread spectrum in that it can offer diverse quality of service (QoS) for individual consumer; users attain different data rates by assigning different code spreading factors or different numbers of spreading codes [1].

NS2 is the simulator used here. It has two languages because simulator has two different kinds of things it needs to do. On one hand, a detailed simulation of protocols requires a systems programming language which can efficiently manipulate bytes, packet headers, and implement algorithms that run over large data sets. For these tasks run-time speed is important and turn-around time (run simulation, find bug, fix bug, recompile, re-run) is less important. On the other hand, a large part of network research involves slightly varying parameters or configurations, or quickly exploring a number of scenarios. In these cases, iteration time (change the model and re-run) is more important. Since configuration runs once (at the beginning of the simulation), run-time of this part of the task is less important. *NS* meets both of these needs with two languages, C++ and OTcl. C++ is fast to run but slower to change, making it suitable for detailed protocol implementation. OTcl runs much slower but

---

* corresponding author email: bmadhushree@yahoo.com

can be changed very quickly (and interactively), making it ideal for simulation configuration. *NS* (via tclcl) provides glue to make objects and variables appear on both languages [2].

2. Literature Review

2.1. AODV (Ad hoc On-demand Distance Vector)

AODV is a distance vector routing algorithm which discovers route whenever it is needed via a route discovery process. It adopts a routing algorithm based on one entry per destination i.e., it records the address of the node which forwards the route request message. AODV possesses a significant feature that once the algorithm computes and establishes the route between source and destination, it does not require any overhead information with the data packets during routing. Moreover the route discovery process is initiated only when there is a free/available route to the destination. Route maintenance is also carried out to remove stale/unused routes. The algorithm has the ability to provide services to unicast, multicast and broadcast communication. AODV routing algorithm has two phases.

2.1.1. Route discovery phase

When a node wants to send some packets to the desired node or destination, it tries to look into the routing table for its next hop. Then the source sends RREQ message to the neighbors or next hop, which is then retransmitted by the intermediate node until the RREQ reaches the destination. To avoid the route request packets from congesting the network, the algorithm uses expanding-ring strategy. In this technique, the node which tries to send the packets sets the initial value of the TTL (time-to-live) to search the destination. If the RREQ reaches the next hop, TTL is decremented. If not reached/no reply is received, the value is incremented till it reaches the threshold value.

When an intermediate node receives the RREQ, it stores the address of the adjacent node from which it receives the first packet of the route request message, so that the node will be capable of establishing a reverse path. When route request RREQ message reaches the destination node, a unicast route reply RREP message is sent along the reverse path. As the RREP traverse along the reverse path, forward path entries to the destination are recorded. Hence the route from source to destination is established when route reply message is received at the source.

2.1.2. Route maintenance phase

The route established between the source and destination is maintained as long as the route is needed by the source to transmit packets. Source can reinitiate route discovery phase to establish new route when it moves during routing of packets. In other case, if the destination/intermediate node breaks from the routing chain, route error RERR message is sent to the nodes in the route till it reaches the source. Upon receiving the route error message, the source stops the data transmission and reinitiates route discovery process [5]

AODV (Reactive type routing protocol) AODV is a modification version of destination sequence distance vector (DSDV) protocol used in wireless mobile networks. This property solves the disadvantages of DSDV by implementing a sequence number. Not like DSR [9] which carries the whole route from source to destination in the packet, the nodes in AODV carry out the next hop information corresponding to each data flow. Reactive protocol route is discovered as when needed and maintained as long as they required. Hybrid protocols have well combination form of both reactive and proactive routing protocols methods [3]

2.2. DSDV

DSDV is a pro-active, table-driven protocol based on the distributed version of the classical. Each mobile node stores a routing table that contains information about all the possible destinations in the network. Each entry in the routing table is marked with a sequence number assigned by the destination node and contains information like the number of hops required to reach the destination and the next hop on the path to the destination. The route labelled with the latest sequence number is always used to avoid stale routes. If two updates have the same sequence number, the route with the minimum number of hops to reach the destination is used. Routing table updates are propagated periodically across all nodes to maintain table consistency. Thus, in spite of the high

communication overhead, a node always learns of the shortest hop route to the destination. DSDV fits under the minimum-weight path routing category.

Destination-Sequenced Distance Vector routing protocol (DSDV) is a typical routing protocol for MANETs, which is adapted from the conventional Routing Information Protocol (RIP) to ad hoc networks routing. One key advantage of DSDV over traditional vector protocols is that it guarantees loopfreedom. Each DSDV node maintains a routing table for the next hop to reach a destination node. DSDV tags each route with a sequence number which is originated by the destination, indicating how old the route is. Each node manages its own sequence number by assigning it two greater than the old one (call an even sequence number) every time. When a route update with a higher sequence number is received, the old route is replaced [4]

2.3. AOMDV

AOMDV is based on AODV and obtains multiple loop-free link-disjoint paths using the following property observable in flooding: Let S be a node that floods a packet m to the network. At any node I (_S), the set of copies of m received via different neighbours of S constitute a set of node disjoint paths (and hence the link-disjoint paths) from I to S.

Loop freedom is guaranteed using the notion of "advertised hop count" for a given destination sequence number (or RREQ packet) at each node in the network. The "advertised hop count" of a node I is basically the hop count incurred by t1he first RREQ packet for a given destination sequence number from the source S to node I. When a node has no route to the destination, it forwards only the first arriving RREQ packet. When a node has a valid route to the destination and receives a duplicate RREQ packet, it checks whether the RREQ packet arrived on a new node-disjoint path using the above flooding property. If so, the node checks whether the hop count incurred by this RREQ is less than that of the primary path. As the primary path is selected similar to the procedure used in AODV, it is most likely to be a minimum delay path, while the alternate paths have hop counts shorter or equal to the primary path. Thus, AOMDV could fit into the category of routing protocols based on minimum-weight path routing. Since, AOMDV selects only link-disjoint or node-disjoint paths, the multiple paths are likely to have infrequent route discoveries at low mobility compared to single-path AODV.

3. Implementation

The prototype implemented is based on the IEEE 802.16 standard (802.16-2004) and the mobility extension 80216e-2005. The wireless simulation supports multi-hop ad-hoc networks or wireless LANs. But there is a need to simulate a topology of multiple LANs connected over wired nodes, or in other words necessity is to create a wired-cum-wireless topology. The wired-cum-wireless network scenario of the WiMAX networks is being created using Tool Command Language (TCl). TCL is the front-end language in NS2.

3.1. Topology

For the mixed scenario, we are going to have 1 wired node called Sink, connected to our wireless domain consisting of 5 mobile nodes and 10 mobile nodes in the second scenario via a base-station node, BS. Base station nodes are similar to gateways between wired and wireless spheres and permit packets to be exchanged between the two kinds of nodes.

3.2. TCL Script

The Adhoc routing protocol used are DSDV, AODV and AOMDV. Also, TCP and CBR links are defined between the wired and wireless nodes in the script.

For mixed simulations it is required to use hierarchical routing in order to route packets between wireless and wired domains. In NS-2, the routing statistics for wired nodes are centered on connectivity of the topology that is how nodes are connected to one another using Links. This connectivity information is conditioned to populate the forwarding tables in every wired node. However wireless nodes have no perception of "links". Packets are routed in a wireless topology by means of their adhoc routing protocols which construct forwarding tables by trading routing queries among its neighbors. Consequently so as to exchange packets among these wired and wireless nodes, base-stations are used, which work as gateways between the two domains. Separation of wired

and wireless nodes is done by employing them in different domains. Domains and sub-domains (or clusters) are defined using hierarchical topology structure

The throughput of the WiMAX network is analyzed by implementing three routing algorithms, DSDV, AODV and AOMDV. The comparison of the throughput of WiMAX network in scenarios for different number of nodes is shown in following sections.

4. Performance analysis

The graphs are plotted by considering number of packets and the throughput. The graphs show the behavior of routing protocols with varied number of nodes. The graphs change when different protocols of Transport layer are used. So the each routing algorithm is analysed with both TCP and UDP separately.

Figure 1 and Figure 2 show the performance of the network with DSDV as routing protocol. The throughput of the WiMAX network varies as the number of nodes is increased. It fails when the number of nodes increases to 35 with only one destination node.
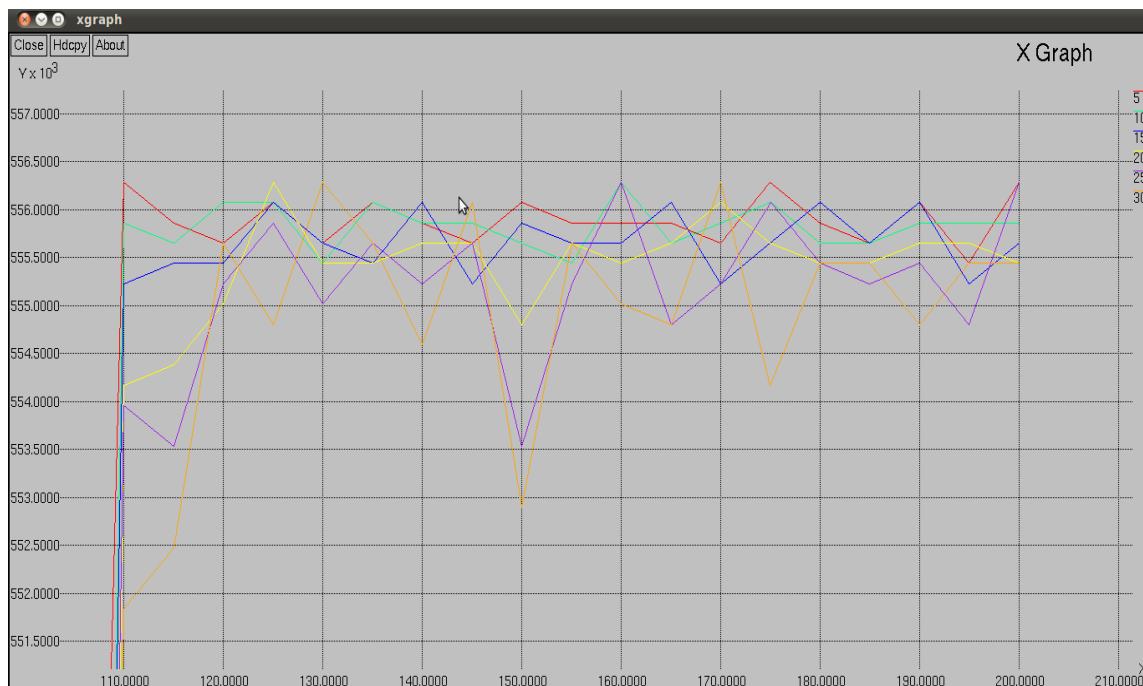
Figure1: DSDV performance analysis using TCP

Figure 3 and Figure 4 show the performance of the network with AODV with TCP and UDP. Figure 5 and Figure 6 show the performance of the network with AOMDV as routing protocol with TCP and UDP.
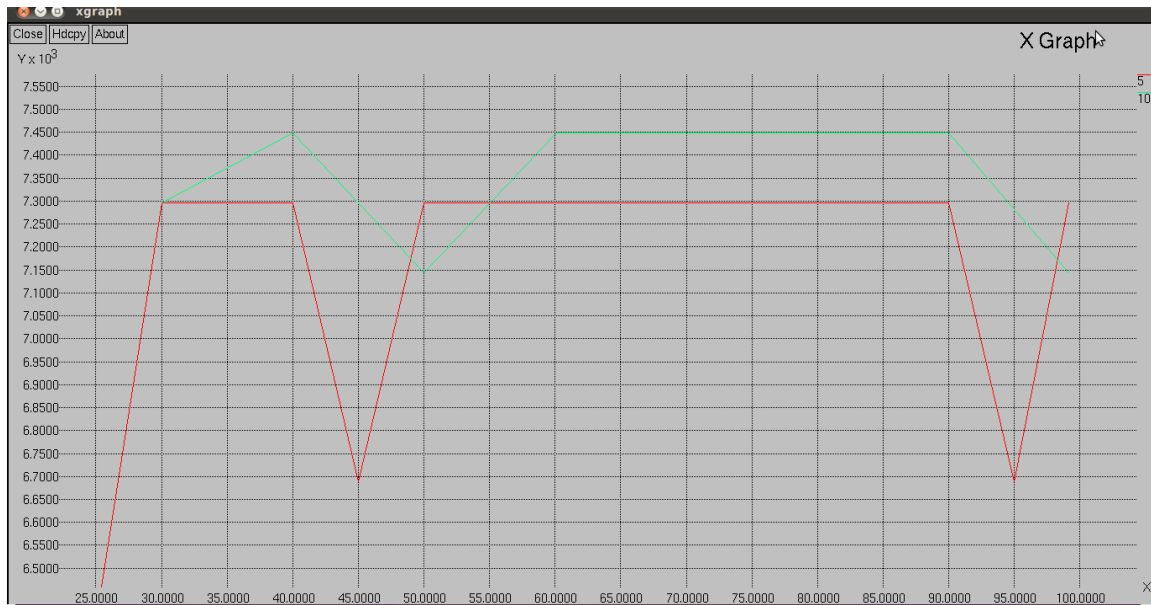
Figure2: DSDV performance analysis using UDP
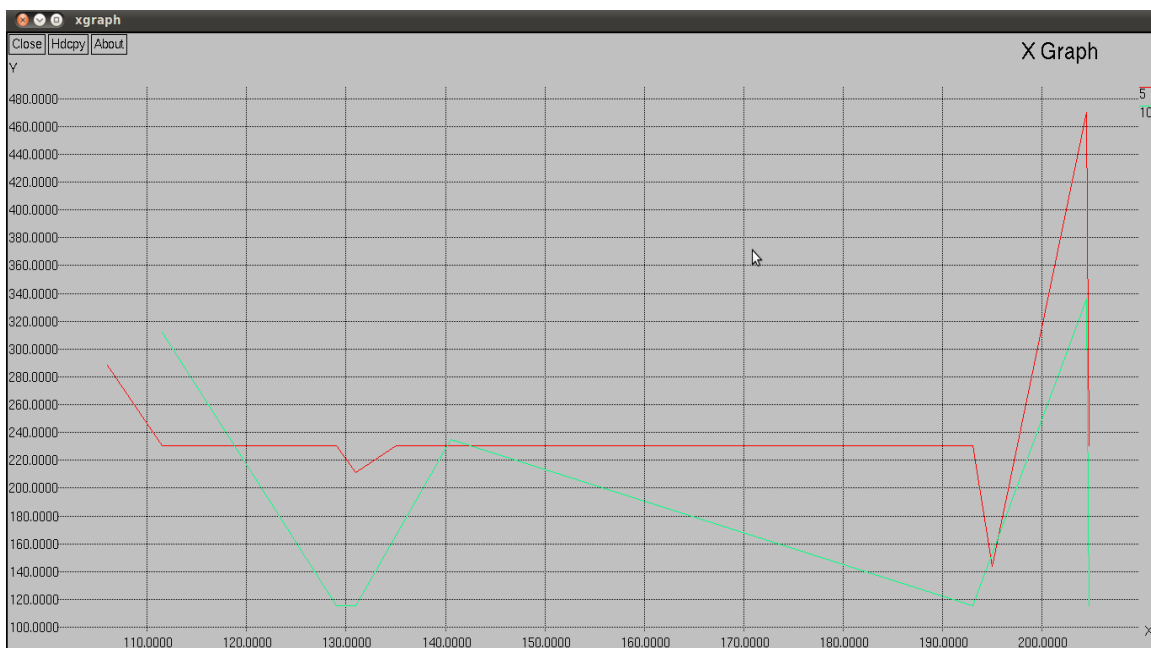
Figure 3: AODV performance analysis using TCP

Figure 4: AODV performance analysis using UDP
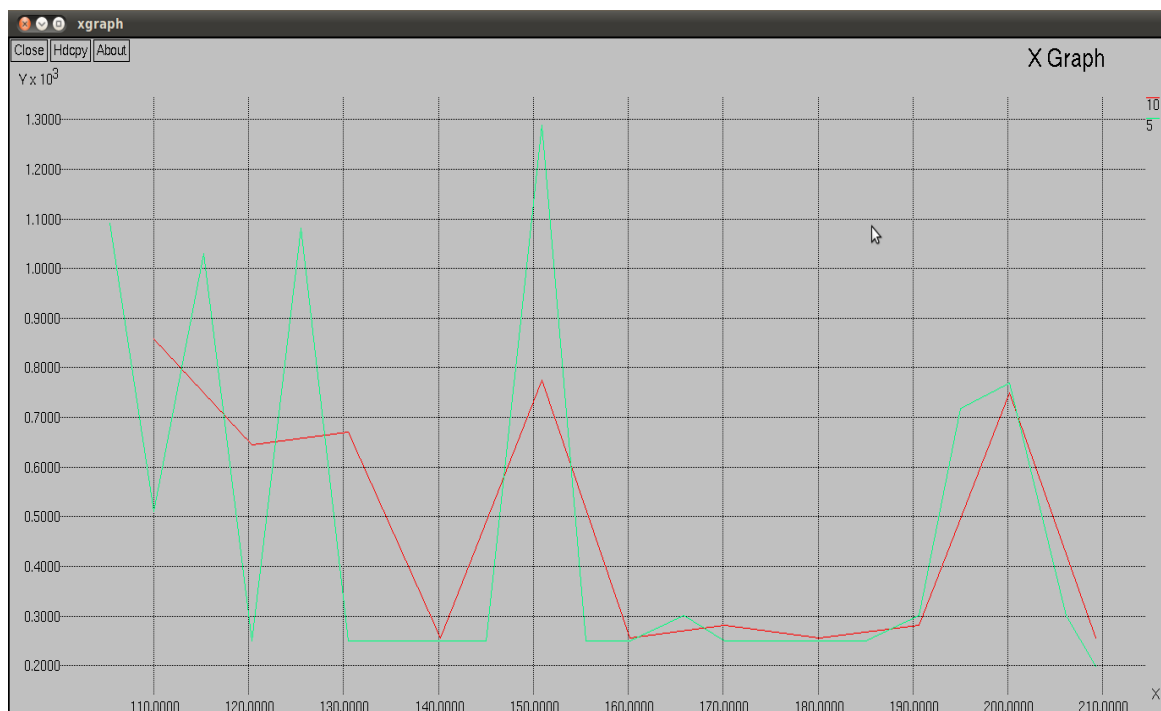
Figure 5: AOMDV performance analysis using TCP

Figure 6: AOMDV performance analysis using UDP

5. Conclusion

Various modules for IEEE 802.16 WiMAX network were implemented using NS-2. To measure the performance of the implemented modules various routing algorithms like AODV, AOMDV and DSDV are run and graphs are plot for measuring throughput of these algorithms by varying the number of subscriber stations. It is being observed that the throughput increases initially and as the simulation is carried out the throughput varies over a range. It decreases as the number of subscriber stations communicating with the wired sink node via base station, increases. It is also noticed that, the throughput of the system is the highest for DSDV protocol and the lowest for AOMDV protocol. As most of the physical and MAC layer features are implemented, the WiMAX package can further be enhanced by implementing new wireless routing algorithms and measuring the performance of various parameters for those routing algorithms.

References

[1]   Sanida Omerovic, "WiMAX Overview", White Paper and MCI Perspective.
[2]   Kevin Fall, Kannan Varadhan, "The NS Manual", the VINT project, March 14 2008.
[3]   Pandya, Morli, and Ashish Kr. Shrivastava. "Improvising Performance With Security Of AODV Routing Protocol For Manets". International Journal of Computer Applications 78.11 (2013): 30-36.
[4]   C.E. Perkins and P. Bhagwat, "Highly dynamic destination-sequenced distance vector routing (DSDV) for mobile computers," in Proc. ACM SIGCOMM 94, London, UK, Oct. 1994, pp. 234-244.
[5]   Nagarajan N et.al.," Adaptive Routing algorithm to support Distributed Services in WiMAX", International Journal of Digital Content Technology and its Applications, Volume 3, Number 2, June 2009.

What does FDI inflow mean for emerging african economies? Measuring the regional effects of FDI in Africa

Paul I. Ojeaga[1]*, Emmanuel O. George[2], Oluwatoyin Mathew[3], Adetunji Adekola[4]
[1] Senior Research Fellow Economics Federal University of Agriculture Abeokuta Nigeria
[2] Ph. D. Olabisi Onobanjo University Agi Iwoye Ogun State Nigeria
[3] Ph. D. Covenant University Ota Nigeria
[4] Igbinedion University Okada Nigeria

Abstract

Can foreign direct investment (FDI) promote growth in Africa? What does the inflow of investment hold for African emerging economies? Are the determinants of FDI different for different regional blocs in Africa? This study reviews the implication of FDI for different regional blocs in Africa. FDI was found to have a significant effect on growth in North Africa but had no significant effect in East, Southern and West Africa. FDI was also found not to be driving growth in the whole of Africa in a significant manner. The implications of the findings are that even though trade openness seems to be a major factor driving FDI. Poor domestic markets were still preventing many African economies from taking full advantage of the gains from foreign direct investment. The study results could be useful to scholars who study the dynamics surrounding FDI disbursement and strategies on how FDI can drive growth in developing countries.

Keywords: *Africa, Political Economy, FDI, Regional Policy and Markets.*

JEL Classification: C23, C70, E61, E62, F42, G25, H5, L16, O11, O23

1. Introduction

Not many studies have tried to study the differences in the implications of FDI inflow specifically for countries across different regional blocs in Africa, implying that this study could fill this gap by contributing to the body of knowledge in this area. FDI is also likely to be more beneficial for growth in some regions than in others, and there will also be some differences in the implication of FDI for growth due to regional specific characteristics attributable to differences in trade, infrastructural and macroeconomic policy capabilities in countries. Also the outcome of FDI can be affected by natural resource presence, relative low cost of production and country specific strategic investment in infrastructure, which could make investors want to invest in many developing economies. Past studies have also listed specific regional conditions that can affect investor's perception these include the riskiness of the business environment for trade, ease of credit access to private sector businesses, transaction cost of carrying out business activities, infrastructural challenges, macroeconomic policy etc. see George, Odejimi, Matthews, and Ojeaga (2014).

GDP trends across the Africa continent show that many African countries are enjoying economic growth despite the global economic decline of the late 2000s, (the 2007 financial crisis to be specific) UN Statistics 2012. Differences in regional specific attractiveness for trade also mean that the true picture of what FDI implications will be across regions in Africa are also largely unknown. While there have been lots of insinuations that FDI can drive growth in countries, this has not been true for many developing countries particularly those in Eastern Europe and Africa, George, Odejimi Matthews, and Ojeaga (2014) since there have been little or no empirical evidence to support this.

This study investigates the effect of FDI on growth in ten countries (Egypt, Algeria, Nigeria, Ghana, Cameroon, Angola, Kenya, Uganda, South Africa and Botswana), two each from the five regional blocs in Africa which include North, East, West, Central and Southern Africa using panel data for a period of 53 years (1960 to 2012) . The method of estimation is the general method of moment GMM although the results of the Ordinary least squares, linear mixed effects, two stage least squares (fixed and random effects) are also presented in the study. The rest of the paper is divided into the scope and objectives of study, stylized facts on FDI, growth, and macroeconomic variables in Africa, review of literature, theory and methodology, empirical analysis and results and finally the concluding section.

---

* corresponding author email:drpaulojeaga@gmail.com

2. Scope and Objective of Study

The study investigates the implications of FDI for growth across regions in Africa. It also presents empirical arguments as to what factors are responsible for FDI inflow across regions. The objectives of the study include: i) To what extent can foreign direct investment (FDI) promote growth in Africa? ii) What does the inflow of investment hold for African emerging economies? iii) Are the determinants of FDI different for different regional blocs in Africa?

3. Stylized Facts on FDI, Growth and Other Macroeconomic Variables in Africa.

Trade openness appears to be on the decline in many African countries with only noticeable minimal increases in Eastern Africa. Depicting strong government involvement in business and a protectionist policy to protect domestic enterprises from hostile foreign firms in many African countries see Fig. 1 below.

Fig. 1
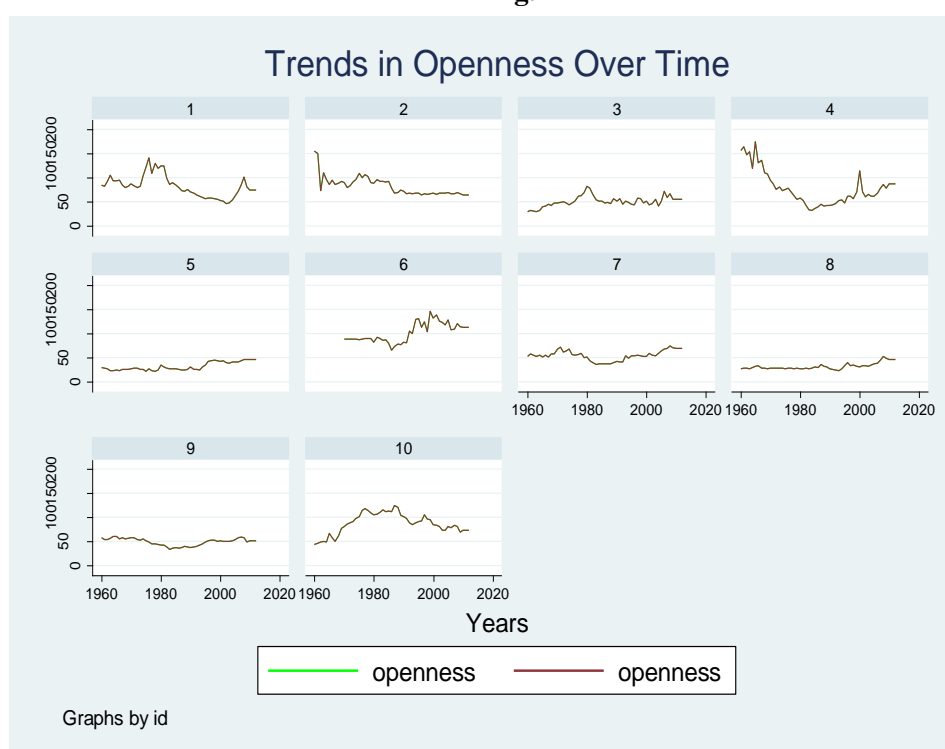
Note: The above trends depict openness for the ten African countries in our sample Egypt, Algeria, Nigeria, Ghana, Cameroon, Angola, Uganda, Kenya, South Africa and Botswana. Openness is the ratio of exports to imports in the ten countries.

There also appears to be increases in government spending across regions although there are slight decline for Nigeria. This depicts that many African countries were probably increasing spending with relative increases in GDP across countries se Fig. 2 below. Increased government spending if spent on capital expenditure could improve infrastructural quality in manner African countries.

Infrastructural decadence is still prevalent in many parts of Africa due to high level of corruption and institutional weaknesses. Transparency in policy implementation is likely to improve infrastructural and the quality of governance in many parts of Africa.

Fig. 2

Trends in Government Expenditure Over Time

Note: The above trends depict government expenditure spending for the ten African countries in our sample Egypt, Algeria, Nigeria, Ghana, Cameroon, Angola, Uganda, Kenya, South Africa and Botswana. Government expenditure spending is the aggregate expenditure of government in years in constant USD.

There are also slight decreases in inflation in many African countries see Fig. 3; however inflation remains quite high across all regions, with North and West Africa experiencing the highest inflation rate of well over 4% on the average (World Bank Statistics 2013). Poor monetary policy is also a contributory factor to high inflation and the inability of the apex bank to proffer solutions to the poor rate credit acquisition in many African countries, this also mean that few private firms can access capital and this can hurt aggregate production in countries making many African countries to rely on imports.

Fig.3

Inflation Over Time

Note: The above trends depict inflation for the ten African countries in our sample Egypt, Algeria, Nigeria, Ghana, Cameroon, Angola, Uganda, Kenya, South Africa and Botswana. Inflation is the increment in average prices over time in percentage.

Direct credit to the private sector i.e. corporate businesses (the measure for privatization) is also on the increase across all regions except North Africa. This is attributable to the relative level of instability in the region due to the global financial crisis and the Arab Spring see Fig. 4.

Fig.4

Note: The above trends depict privatization for the ten African countries in our sample Egypt, Algeria, Nigeria, Ghana, Cameroon, Angola, Uganda, Kenya, South Africa and Botswana. Direct credit to the private sector is all credit granted to the private sector in constant USD.

GDP is also on the increases in most African countries, depicting that high prices in global commodities were probably driving growth in across all regions in Africa see Fig. 5. The period of mild prosperity has however not been very effective in ushering in growth, making many African countries to be experiencing "jobless growth".

Many African countries are also mineral resource dependent, while production of industrial manufacturables are primarily for domestic consumption since these products do not compete favorably with other manufactured goods in the global markets.
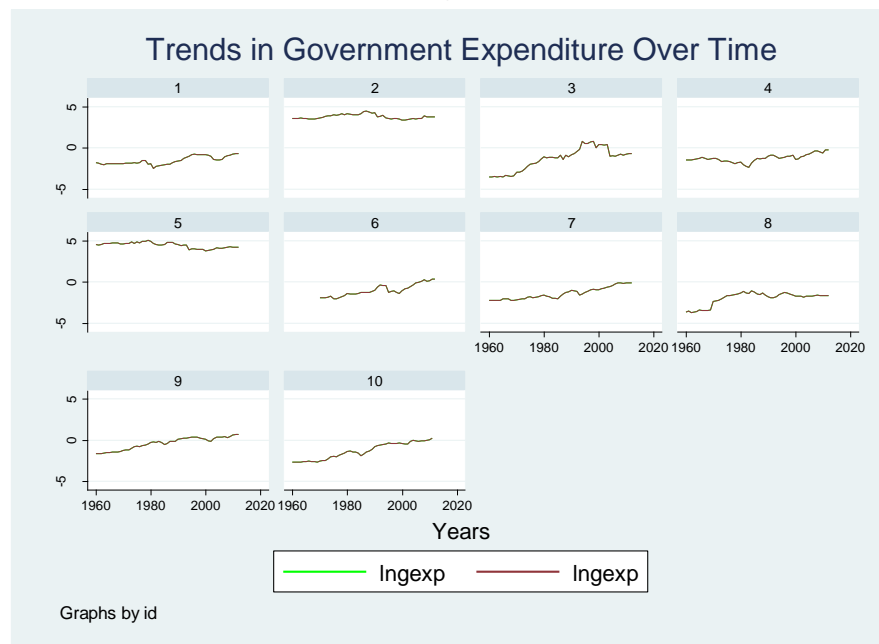
Fig. 5

Trends in GDP Over Time

Note: The above trends depict GDP for the ten African countries in our sample Egypt, Algeria, Nigeria, Ghana, Cameroon, Angola, Uganda, Kenya, South Africa and Botswana. GDP is the total goods and services produced in countries in constant USD.

FDI was also high, showing that Africa was still a choice destination for investors despite the riskiness of the business environment see Fig. 6. Other factors that are likely to attract foreign investment include relative cheap labor, closeness to destination markets for investors and availability and closeness to cheap raw material for production. Lots of factors still affect investors perception negatively these include political instability, inconsistency in macroeconomic policies, poor infrastructure, epileptic power supply, cost of training manpower etc.

Fig.6

Net FDI Inflow Over Time

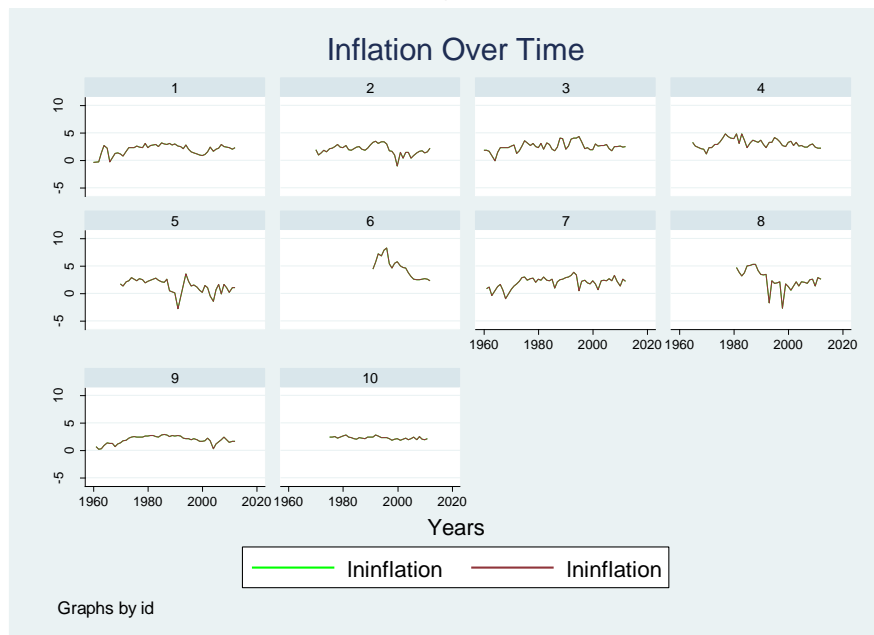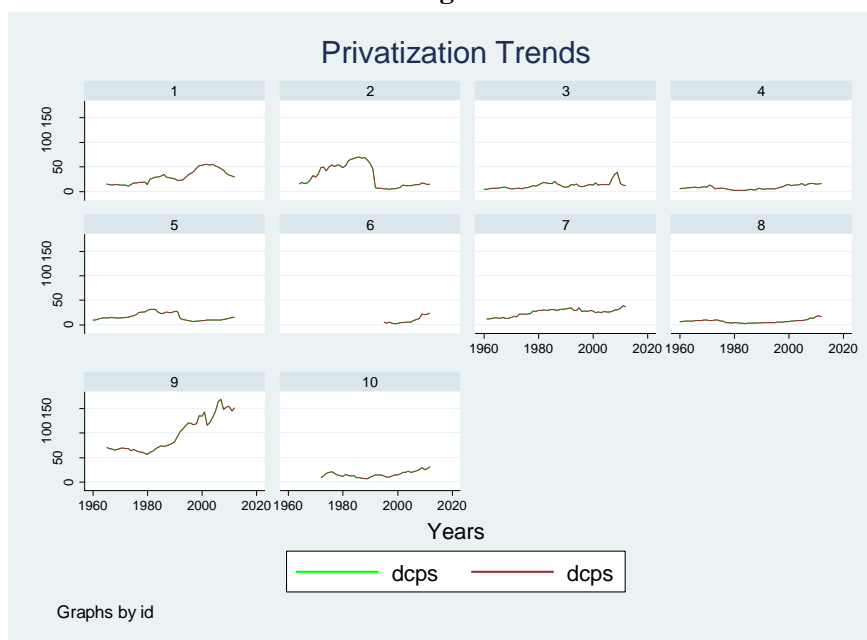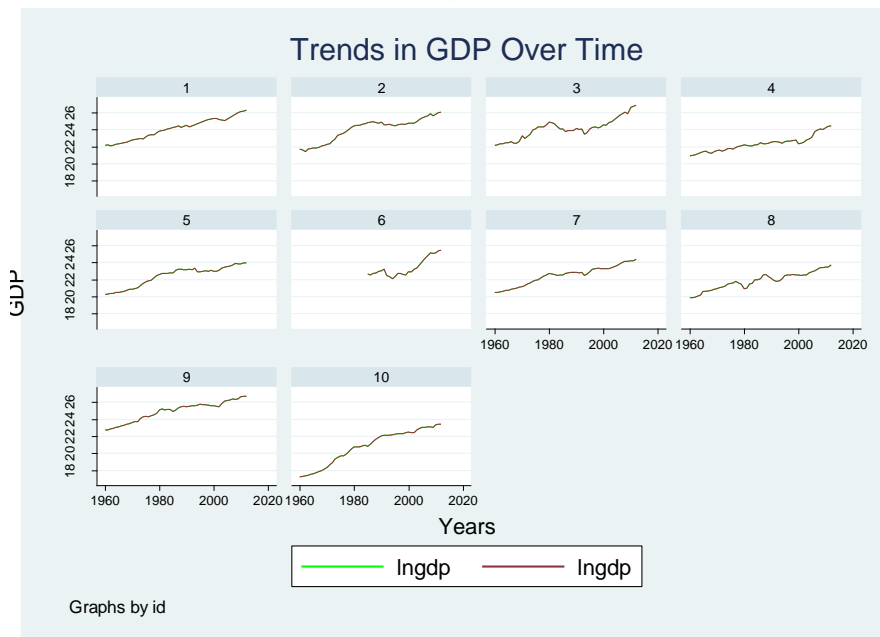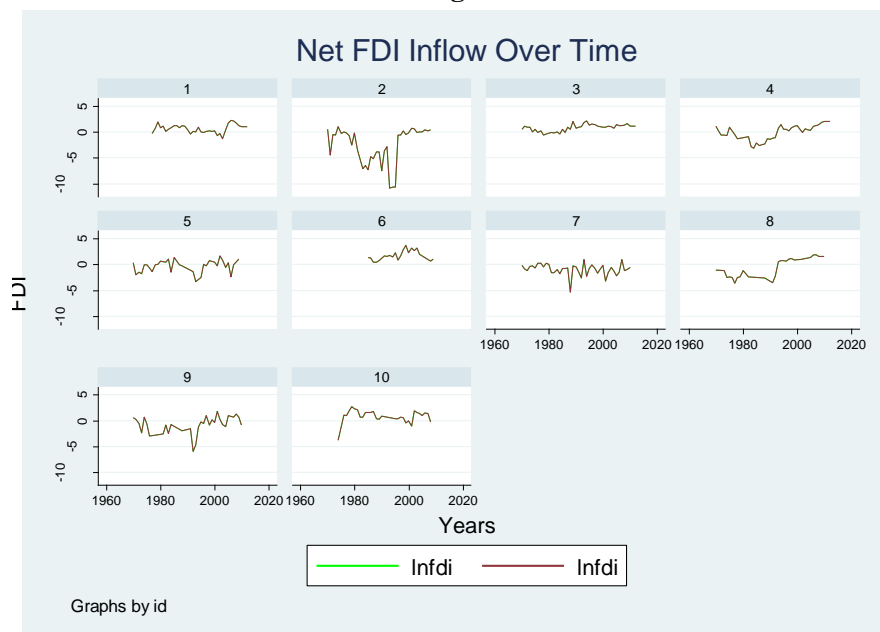**Note:** The above trends depict FDI for the ten African countries in our sample Egypt, Algeria, Nigeria, Ghana, Cameroon, Angola, Uganda, Kenya, South Africa and Botswana. FDI is the aggregate foreign direct investment inflow in constant USD.

3. Review of Literature

In this section we review past and current literature, on the topic under discussion. The paper by Brunetti, Kisunko, and Weder (1997) argue that political instability has the capability to make countries less attractive for foreign direct investment. Henisz 2000 also states that institutions and policy changes can also affect investment inflow to countries. Other studies such as, Feng (2001) and Jensen (2003, 2006) argue that regime changes and country specific democratic status can affect investment inflow. Ojeaga (2012), also state that FDI has strong capability to improve living conditions in Africa using a panel sample of 10 selected African countries and controlling for endogeneity of the institutional variable using two stage least (2SLS) estimation technique.

Bornschier and Chase-Dunn 1985 also state that autocratic governments also have the capability to attract multinational companies (MNC) due to their ability to suppress labor cost and the reduced level of policy uncertainty associated with political elections. Studies also show that after taking control of foreign markets investors often fail to bring along all their revenues with them Graham and Krugman (1991), Kindleberger (1969), and Lipsey (2003).

Laura Alfaro, Areendam Chanda, Sebnem Kalemli-Ozcan, and Selin Sayek (2006) also state that firms undertake foreign investments because certain assets are worth more under foreign control than domestic control. Borensztein, De Gregorio, and Lee(1998) and Xu (2000) state that FDI could stimulate transfer of technology in countries with minimum threshold of stock of capital.

Aghion, Comin, and Howitt (2005) developed a model that show that domestic firms can attract FDI if they are innovative and perform well enough to drive growth. This study investigates the implications of FDI on growth in Africa. And contributes to the body of knowledge, by considering the implicational differences across regions. The regions considered include North, West and east/ South Africa. For a review of the FDI literature see Laura Alfaro, Areendam Chanda, Sebnem Kalemli-Ozcan, and Selin Sayek (2006).

4. Theory and Methodology

4.1. Theory

In this section we present the theory and methodology utilized in the study. Useful and non-predatory foreign direct investment can have positive effects on growth in many developing countries wishing to drive growth through investment in their domestic economies.

A host of factors can attract investors to many developing countries; they include cheap cost of labor which has the capacity to drive up cost of production, ease of access to capital which can influence the attractiveness of investing in a country, country specific institutional structure which can affect issues of property rights and private assets protection, country specific domestic market potential which can influence consumption and demand for produced products, investment destination fiscal policy such as government spending patterns, country specific monetary policy which can depict the riskiness of the immediate business environment, trade policy which can affect cost of starting new business and awards of business permits and the cost of transportation to local markets as well as ports for exporting which will reflect the transaction cost of business.

There also exist past theories of FDI, which suggest factors that affect FDI and conditions under which FDI can drive growth, some include e.g. Vernon (1966) who suggests the product life cycle theory which he asserts the level of economic development directs the direction of investment. He states that new products are initially produced in the North due to its Research and Development and other Human Resources endowment and that as the product become improved and popular they are transferred to the less developed and gradually industrializing Southern economies. This he used to describe the flow of FDI from the developed North to other less developed economies in the South.

The Japanese FDI theory see in-depth analysis in Kojima, Kiyoshi and Terutomo *Ozawa* (1984), also analyzed FDI, competitiveness and economic development dividing it into three stages or phases of growth which include: i.) The first phase being where the country is under developed and becomes the focus of foreign investors who identify the advantageous potentials of the developing country. ii) The second phase being a case where the country is on the ladder of development and has developed internal markets and living standards and outgoing FDI is motivated by increasing labour cost. iii) The third phase where economic growth is based on

competitiveness of the country and FDI is attracted and flows out based on innovation and country specific technological advances.

Dunning J. (1977) also state that a five stage FDI theory where in the first stage a country receives low FDI but foreign firms are beginning to see FDI benefits and there is no outgoing FDI since local firms see no specific advantage in investing overseas. In the second stage there begins to exist a growing incoming FDI due to low labour cost in the country and the standard of living is rising drawing more people to the country. However there is still low outgoing FDI. The third stage where there exist high levels of incoming FDI but the nature is changing owing to a rise in wages and outgoing FDI are beginning to take off due to growth of domestic firms which are getting stronger and becoming more domestic firms becoming competitive internationally. The fourth stage where there is a high outflow with domestic firms seeking investment opportunities internationally. And the fifth stage where investment decisions are largely affected by Multinational Corporations (MNC) strategies and the inflow and outflow of FDI come to equilibrium.

Past methodologies such as that of Bengoa M. and Sanchez-Robles B. (2003) using a sample of 18 Latin American countries for 1970-99 also suggest that panel studies are suitable for studying the relationship between FDI and growth, showing that there exist a correlation between growth and FDI in Latin America. Borensztein E. J., Gregorio J. D. and Lee J. L. (1998) also state that a minimum threshold of human capital was needed for FDI to have a significant effect on growth using a panel data of 69 countries from 1970-1989.Roy and Van den Berg (2006) utilizing a time series data and adopting a simultaneous equation model (SEM) and considering the bidirectional relationship, between FDI and growth for the US, reveal that FDI has a significant and positive impact on growth. There are also mixed outcome for the spill over benefit of FDI for countries for instance Yudayeva et al. (2000), Castellani and Zanfei (2001), and Haskel et al. (2002) find positive evidence for the existence of spillover benefits from FDI while on the other hand Aitken and Harrison (1999) for firms in Venezuelan and Djankov and Hoekman (2000) for firms in Czech Republic find and report negative and insignificant spillovers effects of FDI, respectively.

Blonigen and Wang (2005), also argue for the importance of absorptive capacity for countries to benefit from FDI, and state that FDI generates benefits to its host country only if the business climate is conducive defining conducive as the presence of adequate human capital, public infrastructure, financial institutions, legal environment necessary for private firm growth.

4.2. Methodology

In this study principal agency problem under the assumption that the investment process now becomes contract that is written in a World of asymmetric information, uncertainty and risk is adopted, utilizing 2 player (Investors and government) simple normal form game in the figures (i.e. Table 1 to 3), below. Investors can decide to invest or not to invest catering to their expectations and intended returns from investing in a country. Secondly investors could also see future potentials for growth in developing countries making them to invest subject to country specific economic circumstances and economic climate. This will results in different payoffs for the country and investors concerned.

We consider the five different states of development FDI inflow as stated by Dunning J. (1977) and the implicative effects for investors and countries with resulting payoffs. This will therefore lead to the following propositions for Africa:

- Proposition 1.0) → Poor living standard could deter the inflow of FDI to countries.
- Proposition 2.0) → Rising wages and improved living conditions could affect the inflow of FDI to countries.
- Proposition 3.0) → Improved domestic innovation is likely to have an effect in attracting FDI and promoting growth in Africa.
- Proposition 4.0) → Development of the domestic market that will lead to stronger Competition among local firms will attract FDI and improve growth in Africa.
- Proposition 5.0) → Improved markets, wages and sound macroeconomic policies will lead to optimum returns on investment for investors and maximize the growth potentials for countries. Resulting in a Nash-Equilibrium for investors and governments.

In the study we also consider different model specifications the first in which we study the effect of a host of factors on FDI, the second where the effect of FDI on growth is considered and the third where the implicative effects of FDI in the presence of macroeconomic policy on growth is considered. In the first case in Table 1 below,

Table 1. FDI Flow Normal Form Game

Strategy	State 1 Poor Wages	State 2 Rising Wages	State 3 Rising Technology	State 4 Competitive Domestic Firms	State 5 Strong Presence of MNC
Condition A Investors do not Invest	(0,0) No FDI Attracted (Equilibrium of no Development)	(0,1) No FDI Attracted	(0,2) No FDI Attracted Growth	(0,3) No FDI Attracted	(0,4) No FDI Attracted
Condition B Investors Invest	(1,0) Little or No FDI Attracted	(2,1) FDI Attracted	(3,2) Significant FDI Attracted	(4,3) Very Significant FDI Inflow	(5,4) FDI Inflow Peaks

Note: The above depicts the normal form game for FDI inflow to a country depicting the different stages in the countries development.

where we study the implicative effects of a host of factors on FDI we assert that countries in their development state are divided into five categories and that investors, will take these states into cognizance when making their investment decisions. In each state the investor can decide whether to invest (Condition A) or not to invest (Condition B) based on country specific economic conditions such as the standard of living (State 1), quality of labor (State 2), the level of domestic innovation (State 3), the state of development of the domestic market for trade (State 4) and finally the presence of Multinational Corporations (State 5). Here even though FDI inflow will peak in state 5 with strong presence of MNCs the FDI inflow will not be at optimum level since investors will be skeptical of the quality of many African countries economic policy. The same normal form game is also depicted to explain the implicative effects of FDI for economic growth in Table 2. This shows once again that FDI inflow results to little or no growth in State 1 Condition B, FDI inflow results to FDI driven growth of little significance in State 2 Condition B, FDI.

Table 2. Normal Form Game Depicting Strategies for Driving Growth Using FDI without Economic Policy

Strategy	State 1 Poor Wages	State 2 Rising Wages	State 3 Rising Technology	State 4 Competitive Domestic Firms	State 5 Strong Presence of MNC
Condition A Investors do not Invest	(0,0) No FDI Driven Growth	(0,1) No FDI Driven Growth	(0,2) No FDI Driven Growth	(0,3) No FDI Driven Growth	(0,4) No FDI Driven Growth
Condition B Investors Invests	(1,0) FDI Inflow With Little or No Growth	(2,1) FDI Inflow Driven Growth of little significance	(3,2) FDI Inflow With Significant Growth	(4,3) FDI Inflow With Very Significant Growth	(5,4) FDI Inflow and FDI Driven Growth Peaks (Optimal Growth Condition Not Achievable)

Note: The above shows the strategies for driving growth in countries in different stages of development, it explains that growth might peak in countries with strong multinational corporation presence, but that growth is not likely to be the optimal growth.

results in significant growth in State 3 Condition B, FDI results in very significant growth in State 4 Condition B and in state 5 Condition B. In this case growth does peaks but not at the optimum level owing to probably poor attention to macroeconomic policy, implementation. In Table 3 with the implementation of sound macroeconomic policy growth is assumed to peak at optimum level for countries with strong Multinational Corporation Presence. With poor wages and living standards, FDI will do little to improve growth allowing us to state that FDI can only be beneficial for growth in the presence of good economic climate; further supportive arguments can also be found in Blonigen and Wang (2005).

Table 3. Normal Form Game Depicting Strategies for Driving Growth Using FDI with Economic Policy

Strategy	State 1 Poor Wages	State 2 Rising Wages	State 3 Rising Technology	State 4 Competitive Domestic Firms	State 5 Strong Presence of MNC
Condition A Investors do not Invest	(0,1) No FDI Driven Growth	(0,2) No FDI Driven Growth	(0,3) No FDI Driven Growth	(0,4) No FDI Driven Growth	(0,5) No FDI Driven Growth
Condition B Investors Invests	(1,1) FDI Inflow With Little or No Growth	(2,2) Inflow With Little Growth	(3,3) FDI Inflow With Significant Growth	(4,4) FDI Inflow With Very Significant Growth	(5,5) FDI Inflow and Growth Peaks at Optimum (Optimum Growth Achievable) (Nash Equilibrium)

Note: The above depicts the strategies for driving growth in countries in different stages of development; it also explains that growth might peak in countries with strong multinational corporation presence, and that this growth is likely to reach the optimum level with the implementation of specific macroeconomic policies.

The model adopted for the study now becomes one in which in the first specification, FDI will be a function of Market Potential, and all explanatory variables are lagged to resolve issues of multi-co linearity and serial correlation although this was done for only one period. The variable year is included to control for year effects and for robustness in the econometric estimation process. Three different specifications are written for the FDI Model using OLS and Linear mixed effects in equation 1, two stage least square in equation 2 and generalized methods of moment in equation 3 respectively. The problems of endogeneity are not resolved the first equation estimated using OLS and linear mixed effect regression. However they are taken care of in equations 2 and 3 with problems of good instrument affecting the results of equations 2. The preferred model is equation 3, estimated using the GMM estimation technique.

1. $FDI_{i,t} = \alpha_0 + \alpha_1 MARKPT_{i,t} + \alpha_2 X_{i,t} + u_{i,t}$

(2a). $INST_{i,t} = \alpha_0 + \alpha_1 POL_{i,t} + \alpha_2 X_{i,t} + u_{i,t}$

(2b). $FDI_{i,t} = \alpha_0 + \alpha_1 MARKPT_{i,t} + \alpha_2 X_{i,t} + u_{i,t}$

(3). $FDI_{i,t} = (\alpha_o - 1)FDI_{t-1} + \alpha_1 MARKPT_{i,t} + \alpha_2 X_{i,t} + \epsilon_{i,t}$

While three different model specifications are written for the growth model, here growth is assumed to be a function of a set of explanatory variables $X_{i,t}$ and market potential. The first model is estimated using the OLS, linear mixed effects, the second using the two stage least squares estimation technique and the third the generalized methods of moment's estimation techniques respectively in this case the institutional variable is assumed to be endogenous both for the growth and FDI model specification for the two stage least squares estimation. While the country dummy results are not reported even though they are

(4). $Growth_{it} = \alpha_0 + \alpha_1 MARKPT_{i,t} + \alpha_2 X_{i,t} + u_{i,t}$

(5a). $INST_{i,t} = \alpha_0 + \alpha_1 POL_{i,t} + \alpha_2 X_{i,t} + u_{i,t}$

(5b). $Growth_{it} = \alpha_0 + \alpha_1 INST_{i,t} + \alpha_2 X_{i,t} + u_{i,t}$

(6.) $Growth_{it} = (\alpha_o - 1)Growth_{t-1} + \alpha_1 FDI_{i,t} + \alpha_2 X_{i,t} + \epsilon_{i,t}$

(7.) $Growth_{it} = (\alpha_o - 1)Growth_{t-1} + \alpha_1 FDI_{i,t} + \alpha_1 (FDI \ X \ Policy)_{i,t} + \alpha_2 X_{i,t} + \epsilon_{i,t}$

included in the regression. The control for the endogeneity of the institutional variable is based on past literature which suggests that institutions are endogenous Przewoski A. (2004). The use of GMM in addition to control for multiple endogenous variables, deals with issues of panel bias and fixed effects since the disturbance term $\epsilon_{i,t}$ consist of the fixed effects $\mu_{i,t}$ and the idiosyncratic shocks $v_{i,t}$ see Arrellano Bond (1998), Bond (1998), Doormik, Arellano, Bond (2002) and Roodman (2009). Some other obvious advantages of the GMM estimation are that it controls for long run effects and the estimates are robust even in the presence of

heteroscedastic errors. The lag of the dependent variable $(\alpha_o - 1)$ is also added as an explanatory variable and the system GMM includes all explanatory variable and their lag values as instruments allowing us to overcome the problem of searching for a suitable instrument see Roodman (2009) for extensive explanation of the GMM estimator.

5. Data, Empirical Analysis and Results

5.1. Data

In this section we describe all data used in the study and their sources and present the results of the regression models estimated for the study. The data used for the study is

Table 4. Descriptive Statistics Used in the Study

Variable	Observations	Mean	Std. Dev.	Min	Max
Direct Credit to the Private Sector	462	25.69	29.53	1.54	167.54
Log of GDP per capita	505	0.31000	0.600000	0.160000	0.00003
Foreign Direct Investment (FDI)	155	8861	4464	26	16960
Institutions (Paved Road Network)	386	1091653	2106332	4700	12000000
Exports in Constant USD	459	28.37	14.72	3.34	89.62
Transportation Cost	530	38.09	25.94	9.34	99.71
Market Potential	530	27900000	29100000	524173	1700000000
Openness	520	64.16	29.31	22.30	174.70
Exchange Rate	514	108.34	315.93	0.000000025	2147.5
Inflation	436	39.01	249.72	-8.42	4145.11
Government Expenditure Spending	519	14.16	30.74	0.03	154.21
Index of Economic Policy	436	3980000000	4860000000	-21600000000	4145

Note: Descriptive statistics is derived from author's dataset obtained from data market of Iceland and WDI data of the World Bank.

drawn from previous work by George, Odejimi, Mathews and Ojeaga (2014). All data are obtained from the data market of Iceland unless otherwise stated. A panel of ten African countries is used in the study two from each of the five major regional blocs (i.e.

Table 5. List of Variables and Description

Variables	Sources	Abbreviations	Description
Direct Credit to the Private Sector	Data Market of Iceland	DCPS	Credit granted to the private sector in constant USD.
Foreign Direct Investment	Data Market of Iceland	FDI	Aggregate inflow of investment over years in constant USD.
Gross Domestic Product	Data Market of Iceland	GDP/capita	Total goods and services produced in countries in constant USD
Institutions	Data Market of Iceland	INST	The measure for institution was the length of paved roads in kilometers
Openness	Data Market of Iceland	OPEN	This is the ration of exports to imports
Inflation	Data Market of Iceland	INF	This is the percentage changes in prices of community overtime.
Exchange Rate	Data Market of Iceland	EXC	This is the average local currency dollar exchange rate overtime.
Market Potential	Data Market of Iceland	MARPT	Domestic attractiveness of the local market for both foreign and local producers measured using population density.
Transportation Cost	Data Market of Iceland	TRCOST	Cost of crude oil overtime was used to capture the cost of transportation which represents the transaction cost of trade.
Exports	Data Market of Iceland	EXP	Aggregate goods and services exported overseas in constant USD.

| Government Expenditure | Data Market of Iceland | GOVEXP | Government expenditure spending is the aggregate spending on consumption and infrastructure over time. |
| Index of Economic Policy | Authors Compilation | POL | Economic policy index constructed from the residual of inflation and openness on GDP (see Burnside and Dollar (2004)) |

Note: All data are obtained from Data Market of otherwise stated. The economic policy index is developed by authors.

Algeria, Egypt, Nigeria, Ghana, Cameroon, Angola, Kenya, Uganda, Botswana and South Africa) for a period of 53 years (i.e. 1960 to 2012), Direct credit to the private sector the measure for privatization is the flow, of private credit to private sector business in constant US dollars, GDP per capita our measure of growth and foreign direct investment foreign direct investment (FDI) are used as dependent variables interchangeably. Other list of explanatory variables include Institutions (INST) which is the length of paved road in Kilometers, exports which is total goods and services exported in constant USD, transaction cost of doing business is captured using average crude oil price which is a function of transportation cost, market potential depicts the domestic market attractiveness as a destination for finished products was captured using population density and four macroeconomic variables namely openness which is the ratio of exports to imports, government expenditure spending which captures country specific fiscal spending, inflation which depict the riskiness of the immediate business environment and reflects the quality of a country's monetary policy and average local currency to dollar exchange rate. The table of descriptive statistics is presented above in Table 4. The variable description and sources are also explained in Table 5 above. See George, Odejimi, Mathews and Ojeaga (2014) MPRA REPEC for full details.

5.2. Empirical Analysis and Results

In this subsection we present the intuition for the study and argue that FDI is not likely to have strong implications for developing countries in Africa with poor living standards, since investors will be less willing to invest and even in cases where wages and economic reforms are ongoing it will have little or no significant effect as depicted by past FDI theories and represented in the Normal form games presented in the methodological sections of the study.

Table 6. FDI Regressions for Africa

VARIABLES	(1) OLS FDI	(2) LME FDI	(3) 2SLS RE FDI	(4) 2SLS FE FDI	(5) GMM FDI
MARKPT	-0.02	-0.02	0.86***	-22.30*	-26.03***
	(0.43)	(0.43)	(0.30)	(12.50)	(6.79)
CREDITACC	-0.0177**	-0.02**	0.01	-0.0341*	-0.00557
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
INST	8.60	8.60	-7.17	4.96	-2.62
	(1.31)	(1.31)	(5.19)	(7.39)	(2.10)
INF	-0.001	-0.001	-0.0004	-0.002**	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
OPEN	0.03**	0.03***	0.04***	0.10***	0.08***
	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)
GEXP	-0.01	-0.01	-0.01	0.03	0.02
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
EXP	0.09***	0.09***	0.09***	0.02	-0.02
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
TRCOST	0.01	0.01	0.01	-0.02	0.01
	(0.04)	(0.04)	(0.03)	(0.02)	(0.03)
Year dummy	No	No	Yes	No	Yes
Observations	306	306	306	306	285
R-squared	0.315	0.32	0.23	0.23	
Number of id			10	10	10

Note: Standard errors in parentheses*** $p<0.01$, ** $p<0.05$, * $p<0.1$.The above results depicts the variable controlled for and asserted to be responsible for FDI inflow in Africa. Economic policy has stong effects on FDI inflow depicting that investors pay close attention to country specific economic policy that can influence the business environment.

FDI will however have modest results under conditions where domestic markets, living standards and macroeconomic policies have been improved to a significant level. Therefore the justification for FDI to affect growth will be one in which the recipient country positions itself for the long term benefits of foreign investments. The results for the FDI model specification regression using OLS, linear mixed effects, two stage least squares and GMM for the African countries in the sample are presented in the Table 6 below however interpretation is based on our preferred model, the GMM estimation technique(see Table 6 Column 5). It depicts that FDI inflow can increase with less trade restriction and improved international trade since trade openness had a positive significant effect (contributing 8 percentage points to FDI increases in the countries in the sample) on foreign investment inflow into the continent. The results of the two-stage least square fixed effect and the GMM estimation appear close. This depicted that controlling for endogeneity of the institutional variable and unobservable effects in countries across regions were necessary. The Arrelano-Bond test for serially correlation and the Hansen over-identification test for instrumental validity were conducted and it was concluded that auto-correlation were minimized and the instrument were valid although these are not reported for brevity.

The results for countries in regions are also presented in tables 7 to 9 respectively The results show that different factors were responsible for FDI inflow to regions. For North Africa it was found that the level of past economic development, the potential of the domeestic markets and the riskiness of the business environment captured using inflation across countries had a strong and positive significant effect on investment inflow in general, but poor insitutions were found to weaken investors perception and lead to negative inflow of FDI to these countries.

Table 7. FDI Regression for North Africa

VARIABLES	(1) OLS FDI	(2) LME FDI	(3) 2SLS FE FDI	(4) GMM FDI
GDP/CAP	2.01***	2.01***	2.50***	8.71***
	(6.74)	(6.74)	(39.49)	(2.55)
MARKPT	23.44***	23.44***	2.121	216.9***
	(6.51)	(6.51)	(61.19)	(81.66)
DCPS	0.03	0.03	-0.01	0.05
	(0.04)	(0.04)	(2.78)	(0.04)
INST	-8.20**	-8.20**	7.93	-1.83***
	(3.61)	(3.61)	(3.40)	(5.03)
INF	0.17***	0.17***	0.08	0.13**
	(0.05)	(0.05)	(1.58)	(0.05)
OPEN	0.08***	0.08***	0.10	0.06
	(0.02)	(0.02)	(1.40)	(0.05)
GEXP	0.06	0.06	0.03	-0.01
	(0.04)	(0.04)	(0.79)	(0.05)
EXP	0.04	0.04	0.18	-0.04
	(0.08)	(0.08)	(3.58)	(0.10)
TRCOST	-0.08**	-0.08***	0.12	0.07
	(0.03)	(0.03)	(130.2)	(0.06)
L1.FDI				-0.21
				(0.27)
L2.FDI				-0.45**
				(0.20)
YEAR EFFECT	No	No	No	Yes
OBSERVATIONS	67	67	67	62
R-SQUARED	0.89			
NUMBER OF ID			2	2

Note: Standard errors in parentheses*** $p<0.01$, ** $p<0.05$, * $p<0.1$. FDI inflow for North Africa is affected significantly by market potential, which depicts the domeestic market attractiveness for consumption and production such as availability of cheap labor. Institutions remain strong concerns that should be addressed in a critical manner since it has strong negative effects on investment inflow to North Africa.

Table 8. FDI Regressions for West Africa

VARIABLES	(1) OLS FDI	(2) LME FDI	(3) 2SLS RE FDI	(4) 2SLS FE FDI	(5) GMM FDI
GDP/CAP	2.14	2.14		15.39	3.44
	(4.20)	(4.20)		(56.01)	(4.90)
MARKPT	2.69	2.69	1.26	-102.2	-6.44
	(2.90)	(2.90)	(1.34)	(368.2)	(11.13)
DCPS	-0.07	-0.07	-0.08	0.23	-0.07
	(0.07)	(0.07)	(0.07)	(0.64)	(0.08)
INST	-1.34	-1.34	2.54*	0.06	-1.58
	(1.81)	(1.81)	(1.46)	(0.173)	(2.08)
INF	0.02*	0.02**	0.01	0.03	0.03**
	(0.01)	(0.01)	(0.01)	(0.14)	(0.01)
OPEN	0.05*	0.05**	0.06**	-4.33	0.07**
	(0.02)	(0.03)	(0.03)	(15.34)	(0.03)
GEXP	0.06	0.061	1.06	0.18	0.24
	(0.64)	(0.64)	(0.66)	(0.49)	(0.74)
EXP	0.051	0.05	0.06*	-0.18	0.08
	(0.03)	(0.03)	(0.04)	(0.62)	(0.05)
TRCOST	0.02	0.02	-0.002	2.60	0.166
	(0.05)	(0.05)	(0.03)	(9.17)	(0.14)
L1.FDI					-0.30
					(0.24)
L2.FDI					-0.07
					(0.21)
YEAR EFFECT	No	No	No	No	Yes
OBSERVATIONS	67	67	67	69	63
R-SQUARED	0.916				
NUMBER OF ID			2	2	2

Note: Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1.The results of the preferred GMM model above depict that monetary (inflation) policy and trade policy (openness) has strong effects on FDI in West Africa. See Column 5 in the above table.

For West Africa the results are presented in table 8. The preferred model the GMM results in Column 5 Table 8 show that the economic climate (INF) and trade openness had positive significant effect on FDI inflow contributing 3 and 7 percentage

Table 9. FDI Regression for East and Southern Africa

VARIABLES	(1) OLS FDI	(2) LME FDI	(3) 2SLS RE FDI	(4) 2SLS FE FDI	(5) GMM FDI
GDP/CAP	-795.29**	-795.29**	0.01	-5.39	-5.39
	(340.0)	(340.0)	(0.03)	(429.23)	(429.23)
MARKPT	-2.40	-2.40	-44.81**	-27.65**	-27.65**
	(1.82)	(1.82)	(18.44)	(12.56)	(12.56)
DCPS	-0.02	-0.02	0.03	0.02	0.02
	(0.03)	(0.03)	(0.09)	(0.06)	(0.06)
INST	6.31	6.31	-5.91	-1.22	-1.22
	(7.55)	(7.55)	(5.13)	(1.38)	(1.38)
INF	-0.001	-0.001	-0.002	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
OPEN	0.22***	0.22***	0.244***	0.17***	0.17***
	(0.06)	(0.06)	(0.09)	(0.06)	(0.06)
GEXP	0.02	0.02	0.08*	0.02	0.02
	(0.01)	(0.01)	(0.04)	(0.03)	(0.03)
EXP	-0.16*	-0.16*	-0.07	-0.09	-0.09
	(0.08)	(0.08)	(0.12)	(0.09)	(0.09)
TRCOST	-0.08	-0.08	-0.10	-0.03	-0.03
	(0.12)	(0.12)	(0.12)	(0.11)	(0.11)
YEAR EFFECT	0.02	0.02	1.09	0.35	0.35
	(1.10)	(1.11)	(1.22)	(1.04)	(1.04)
L1.FDI				0.25***	0.25***
				(0.08)	(0.08)
L2.FDI				0.05	0.05
				(0.09)	(0.09)
OBSERVATIONS	172	172	172	160	160
R-SQUARED	0.434				
NUMBER OF ID			6	6	6

Note: Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. The preferred GMM model (see Column 5) show that less restrictive trade policies have strong capabilities to attract FDI for countries in our sample for this region and that FDI also depended on past FDI inflow to the region. Poor markets also had negative effect on FDI inflow to this region (market potential had a negative significant effect on FDI inflow).

points to FDI increases in West Africa. This depicted once again that, investors pay strong attention to trade restrictions and the riskiness of the business environment when deciding to invest or not to invest. The results for East and Southern Africa are presented in Table 9 and the results of the preferred GMM model show that less restrictive trade policies have strong capabilities to attract FDI for countries in our sample for this region and FDI was also found to depend on past FDI inflow to the region. Poor markets also had negative effect on FDI inflow to this region (market potential had a negative significant effect on FDI inflow). The results of the growth regressions are also presented below in Tables 10 to 13. It depicted that FDI had no significant effect on growth in Africa.

Table 10. Effect of FDI on Growth in Africa

	(1)	(2)	(3)	(4)	(5)
	OLS	LME	2SLS RE	2SLS FE	GMM
VARIABLES	GDP	GDP	GDP	GDP	GDP
FDI	-6.01	-6.01	1.77	6.02	8.01
	(3.77)	(3.77)	(4.50)	(9.29)	(5.76)
MARKPT	-3.62***	-3.62***	-4.67*	-0.02	-3.89
	(1.33)	(1.33)	(2.59)	(0.02)	(7.00)
DCPS	-4.68	-4.68	2.68	1.81	0.02
	(4.94)	(4.94)	(7.82)	(5.44)	(1.91)
INST	0.01***	0.02***	0.01	0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
INF	-1.89***	-1.89***	-1.21	0.20	0.23
	(5.52)	(5.52)	(2.40)	(3.22)	(0.71)
OPEN	9.97	9.97	-4.16	1.86**	-2.67
	(7.00)	(7.00)	(1.30)	(9.00)	(2.24)
GEXP	-2.37***	-2.37***	-2.10	-1.44**	-0.02
	(4.23)	(4.23)	(1.48)	(6.92)	(1.95)
EXP	5.72***	5.72e-08***	-8.99	1.42	1.30
	(1.25)	(1.25)	(3.59)	(1.12)	(2.90)
TRCOST	2.67	2.67	1.84	1.60	-2.78
	(2.36)	(2.36)	(6.71)	(1.20)	(3.22)
L1.GDP/CAP					1.34***
					(0.06)
L2.GDP/CAP					-0.37***
					(0.05)
YEAR EFFECT	No	No	Yes	Yes	No
OBSERVATIONS	306	306	306	306	292
R-SQUARED	0.844				
NUMBER OF ID			10	10	10

Note: Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1 The results presented above

depict that FDI has no effect on growth in Africa. It also depicts that growth were found to be influenced significant from growth from past periods.

The results for regions had a significant effect on growth although the results were mixed for regions except North Africa. also show the same for the implicative effect of FDI on growth. However Trade openness

Table 11. Growth Regressions for North Africa

	(1)	(2)	(3)	(4)	(5)
	OLS	LME	2SLS RE	2SLS FE	GMM
VARIABLES	GDP	GDP	GDP	GDP	GDP
FDI	1.35***	1.35***	1.35***	-3.12	-3.16
	(4.51)	(4.51)	(4.51)	(5.04)	(7.05)
MARKPT	-9.47***	-9.47***	-9.47***	-1.24***	-2.90
	(7.94)	(7.94)	(7.94)	(3.97)	(1.88)
DCPS	1.57*	1.57*	1.57*	-2.18***	-8.58
	(8.70)	(8.70)	(8.70)	(4.66)	(1.11)
INST	0.02*	0.02**	0.01**	0.01***	-0.03*
	(0.02)	(0.02)	(0.01)	(0.03)	(0.03)
INF	-2.01	-2.01	-2.01	-1.07***	3.85**
	(1.45)	(1.45)	(1.45)	(9.31)	(1.86)
OPEN	-1.65**	-1.65**	-1.65**	-4.86***	-0.04

VARIABLES					
	(6.81)	(6.81)	(6.81)	(3.82)	(1.06)
GEXP	-2.52**	-2.52**	-2.52**	-2.84***	3.75***
	(1.01)	(1.01)	(1.01)	(3.97)	(1.36)
EXP	5.45	5.45	5.45	-3.07***	2.10
	(2.12)	(2.12)	(2.12)	(8.87)	(2.60)
TRCOST	5.95	5.95	5.95	3.98***	-2.55**
	(9.09)	(9.09)	(9.09)	(4.51)	(1.10)
L1.GDP/CAP					0.58***
					(0.19)
L2.GDP/CAP					0.34*
					(0.19)
YEAR EFFECT	No	No	No	Yes	Yes
OBSERVATIONS	67	67	67	67	64
R-SQUARED	0.99			1.00	
NUMBER OF ID					2

Note: Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. The results for regions also show the same for the implicative effect of FDI on growth. However Trade openness had a significant effect on growth although the results were mixed for regions except North Africa.

Table 12. Growth Regressions for West Africa

VARIABLES	(1) OLS GDP	(2) LME GDP	(3) 2SLS RE GDP	(4) 2SLS FE GDP	(5) GMM GDP
FDI	6.60	6.60	1.79	1.79	1.79
	(1.15)	(1.15)	(1.12)	(1.12)	(1.12)
MARKPT	-6.92***	-6.92***	-8.41***	3.17	3.17
	(3.02)	(3.02)	(6.07)	(2.56)	(2.56)
DCPS	-8.67**	-8.67***	2.24	2.81	2.81
	(3.13)	(3.13)	(4.82)	(3.56)	(3.56)
INST	0.02***	0.02***	0.03***	0.02	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
INF	9.33	9.33*	-2.03	0.01	0.21
	(5.59)	(5.59)	(1.19)	(6.92)	(6.92)
OPEN	-4.19***	-4.19***	-9.49***	-5.77***	-5.77***
	(1.12)	(1.12)	(2.17)	(1.32)	(1.32)
GEXP	8.84***	8.84***	5.79**	2.50	2.50
	(2.70)	(2.70)	(2.56)	(3.16)	(3.16)
EXP	-2.40	-2.40	-7.80***	0.33	0.33
	(1.75)	(1.75)	(2.49)	(1.87)	(1.87)
TRCOST	-5.73***	-5.73***	-6.68	-5.77	-5.77
	(1.45)	(1.45)	(2.24)	(2.44)	(2.44)
L1.GDP/CAP				0.82***	0.82***
				(0.16)	(0.16)
L2.GDP/CAP				0.11	0.11
				(0.16)	(0.16)
YEAR EFFECT	No	No	No	Yes	Yes
OBSERVATIONS	67	67	67	65	65
R-SQUARED	0.99		0.99		
NUMBER OF ID				2	2

Note: Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. The results for regions also show the same for the implicative effect of FDI on growth. However Trade openness had a significant effect on growth although the results were mixed for regions except North Africa.

Table 13. Growth Regressions for East and Southern Africa

VARIABLES	(1) OLS GDP	(2) LME GDP	(3) 2SLS RE GDP	(4) 2SLS FE GDP	(5) GMM GDP
FDI	-5.08**	-5.08**	-1.24	-3.59**	1.33
	(2.17)	(2.17)	(7.68)	(1.52)	(8.48)
MARKPT	-5.09***	-5.09***	-3.04	0.01	-7.69
	(1.22)	(1.22)	(1.32)	(0.03)	(1.28)
DCPS	1.31*	1.31*	-2.52	2.53*	-1.84
	(7.52)	(7.52)	(2.50)	(1.44)	(5.61)
INST	0.02**	0.02**	0.21	0.23	0.21
	(0.03)	(0.01)	(0.03)	(0.13)	(0.11)
INF	1.77	1.77	-6.29	-7.32	0.14
	(3.02)	(3.02)	(5.39)	(5.06)	(0.03)
OPEN	1.10***	1.10***	2.70	1.54***	-1.34**
	(1.13)	(1.13)	(1.04)	(2.66)	(6.67)
GEXP	-1.08***	-1.08***	2.29	-8.21	-0.93

	(3.21)	(3.21)	(2.18)	(1.22)	(3.35)
EXP	-1.64***	-1.64***	-1.97	-1.04***	1.74*
	(1.57)	(1.57)	(2.29)	(3.36)	(8.92)
TRCOST	-2.21	-2.21	-9.47	-5.86	-1.24
	(2.95)	(2.95)	(6.07)	(4.67)	(1.05)
L1.GDP/CAP					1.31***
					(0.08)
L2.GDP/CAP					-0.34***
					(0.08)
YEAR EFFECT	No	No	No	No	No
OBSERVATIONS	172	172	172	172	163
R-SQUARED	0.98				
NUMBER OF ID			6	6	6

Note: Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. The results for regions also show the same for the implicative effect of FDI on growth. However Trade openness had a significant effect on growth although the results were mixed for regions except North Africa.

The fourth Growth model specification where FDI was interacted with country specific economic trade policy was also considered and estimated the results are presented in Table 14. It showed strong significant effect for growth, depicting that FDI inflow into countries with sound and consistent macroeconomic policy particularly as it relates to trade could make the seeming non-growth increasing FDI begin to have useful implications for growth.

Table 14. Growth Regressions Africa Using Interactive Variable Openness for Policy

	(1) OLS	(2) LME	(3) 2SLS RE	(4) 2SLS FE	(5) GMM
VARIABLES	GDP	GDP	GDP	GDP	GDP
FDI*POL	0.01	0.17	1.77	6.02	0.03***
	(0.26)	(0.27)	(4.50)	(9.29)	(6.34)
MARKPT	0.39***	0.38***	-4.67*	-0.02	-0.52***
	(0.11)	(1.21)	(2.59)	(0.02)	(0.68)
DCPS	0.36	-1.08**	2.68	1.81	-9.25
	(0.48)	(0.47)	(0.78)	(0.54)	(0.17)
INST	0.03***	0.01***	0.01	0.01	0.02**
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
INF	0.10**	0.10**	1.21	0.20	0.02
	(0.45)	(0.47)	(2.40)	(3.22)	(0.03)
GEXP	-2.83***	-2.85***	-4.16	1.86**	-2.20
	(0.41)	(0.41)	(1.30)	(9.00)	(1.60)
TRCOST	0.54**	0.15***	0.21	0.14**	0.23
	(0.24)	(0.52)	(1.48)	(6.92)	(0.66)
L1.GDP/CAP			-8.99	1.42	1.56***
			(3.59)	(1.12)	-0.03
L2.GDP/CAP			1.84	1.60	-0.58***
			(0.67)	(0.12)	-0.03
YEAR EFFECT			Yes	Yes	
OBSERVATIONS	329	329	306	306	329
NUMBER OF GROUPS	320	280			
NUMBER OF ID			10	10	10

Note: Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1. FDI in the presence of sound macroeconomic policy appears to have a positive significant effect on economic growth making sound macroeconomic policy to be a useful factor in making FDI help improve Growth on the Continent.

6. Discussion, Conclusion and Recommendations.

In this study we investigated the factors responsible for FDI inflow into some selected African countries and the implicative effect of FDI for growth in some selected countries in Africa and across regions in Africa (these regions included, North, West, Southern and East Africa, the last which were combined as a result of their inter-relatedness). The objectives of the study were to determine: i) To what extent can foreign direct investment (FDI) promote growth in Africa? ii) To examine what the inflow of foreign direct investment hold for African emerging economies? iii) Are finally examine the differences in the determinants of FDI for different regional blocs in Africa?

It was found that FDI does not have significant effect on growth in the selected African countries in our sample and in the selected countries in regions. It was also discovered that FDI could have strong implicative effects on growth if sound and consistent macroeconomic policies are implemented particularly less trade restrictive policies.

There were also observed differences in the factors responsible for FDI inflow across the selected countries in regions. It was found that past economic performances, country specific market potential and the riskiness of the business climate had positive significant effects on FDI inflow into North Africa. However institutional factors were found to remain an impediment as this affected investors perception of the region strongly (see Table 7 Column 5).

For West Africa it was noticed that less restrictive trade policies and the less risky the business climate is had strong influences on investor's perception and FDI inflow to the West African Sub-Region (see Table 8 Column 5). For Southern and East Africa it was found that less restrictive trade policies had strong capabilities to drive FDI inflow into the Sub- Region, the major impediment to FDI inflow to this region was found to poorly developed domestic markets which meant that investors and producers where probably faced with the challenge of exporting finished goods to the international market making investors perception about available domestic market for finished goods to affect FDI inflow in a negative manner(see Table 9 Column 5).

Using the Normal form games based on the past theories of FDI it was asserted the sound and consistent macroeconomic policies were probably likely to make FDI have useful effects for economic growth and that countries could achieve optimum growth from foreign investment if macroeconomic policy particularly as they effect trade are put in place. In concluding the study, it is recommended that countries across regions should pay strong attention to macroeconomic policies particularly as it affects trade.

It is also clear that domestic market development is necessary, since this has strong capabilities to insulate countries in times of global shocks and boost investors' confidence in the strength of the investment destination country in times of uncertainty. Improvement of institutions is also recommended for transparency and ease of obtaining business permits; other factors such as legal framework as it concerns trade have to also be put in place boost investors' confidence in the judiciary and shore up their confidence in obtaining redress in cases where there are breaches of contracts etc.

The implication of the results of the study are that FDI is not currently promoting growth in a significant manner in Africa, and that if policy makers pay strong attention to the development of domestic markets as well as improving the business environment for trade through less restrictive trade policies, FDI is likely to have strong implicative effects for growth. It is recommended that institutions and infrastructural concerns be addressed as this could reduce the transaction cost of trade as well as the ease of obtaining business permits in general.

References

[1]   Aghion, P., P. Howitt, and D. Mayer-Foulkes, (2005). "The Effect of Financial Development on Convergence: Theory and Evidence," Quarterly Journal of Economics 120, 173-222.

[2]   Aitken, B. J. and A. Harrison, (1999). "Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela," American Economic Review 89, 605-618.

[3]   Bengoa M., Blanca Sanchez-Robles (2003) "Foreign direct investment, economic freedom and growth: new evidence from Latin America" European Journal of Political Economy Vol. 18 Available on http://ciberoamericana.com/documentos/BengoaySanchez-Robles%5B2003%5D.pdf

[4]   Blonigen, Bruce; Wang, Miao.(2005) "Inappropriate Pooling of Wealthy and Poor Countries in Empirical FDI Studies," in Does Foreign Direct Investment Promote Development? Theodore Moran, Edward Graham, Magnus Blomstrom, (eds.), Washington, DC: Institute for International Economics, 2005, pp. 221–44.

[5]   Borensztein, E., J. De Gregorio, and J-W. Lee, (1998). "How Does Foreign Direct Investment Affect Economic Growth?" Journal of International Economics 45, 115-135.

[6]   Bornschier, Volker, and Christopher Chase-Dunn. (1985). Transnational Corporations and Underdevelopment. New York: Praeger.

[7]   Brunetti, Kisunko and Weder (1997) "Credibility of Rules and Economic Growth Evidence from a Worldwide Survey of the Private Sector1" Background paper for the World Development Report 1997. The World Bank, Washington D.C.

[8]   *Castellani and Zanfei (2001) "Attracting foreign investments or promoting domestic multinationals? Evidence from productivity spillovers in Italy"* Available on http://www.econ.uniurb.it/zanfei/convegno/papers/castellani_zanfei.pdf

[9]   Djankov, Simeon and Bernard Hoekman. (2000). "Foreign Investment and Productivity Growth in Czech Enterprises," World Bank Economic Review, 14(1): 49-64.

[10]   Dunning, J. H., (1981). International Production and the Multinational Enterprise. London: George Allen and Unwin.

[11]   Feng, Yi. (2001) "Political Freedom, Political Instability, and Policy Uncertainty." International Studies Quarterly 45 (2): 271-94.

[12]   George E.O., **Ojeaga** P., Odejimi D.O. and Matthews O. (2014): "Is Privatization Related With Macroeconomic Management? Evidence From Some Selected African Countries" European*.* Available on www.mpra.ub.uni-muenchen.de

[13]   Graham, E.M. and P. Krugman. (1991). Foreign Direct Investment in the United States: Institute of International Economics. International Review of Social Sciences. Vol. 44, Issue 3, pp. 476–478, August *1991.*

[14]   Haskel, J. E., S. C. Pereira, and M. J. Slaughter, (2002). "Does Inward Foreign Direct Investment Boost the Productivity of Local Firms?" NBER Working Paper 8433.

[15]   Henisz (2000) "The Institutional Environment for Multinational Investment"Journal of Law and Economics Vol.16 No 2. Aavailable on file:///C:/Users/paul/Downloads/The_Inst_Environemnt_Multinational.pdf

[16]   Jensen, Nathan M. (2003). "Democratic Governance and Multinational Corporations: Political Regimes and Inflows of Foreign Direct Investment." International Organization 57 (3): 587-616.

[17]   ———. (2006). Nation States and the Multinational Corporation: A Political Economy of Foreign Direct Investment. Princeton: Princeton University Press.

[18]   Kindleberger C.P. (1969): "American Business Abroad", The International Executive 11, p.11–12.

[19]   KijimaKiyoshi, and Terutomo Ozawa (1984) "Micro and Macro – Economic Models of Direct Foreign Investment; Towards a Synthesis" Hitotsubashi Journal of Economics Vol. 24 No 1. June.

[20]   Laura Alfaro, Areendam Chanda, Sebnem Kalemli-Ozcan, and Selin Sayek (2006) How Does Foreign Direct Investment Promote Economic Growth? Exploring the Effects of Financial Markets on Linkages. NBER Paper Series Available on http://www.nber.org/papers/w12522.pdf.

[21]   Lipsey, Robert E. (2003), "Foreign Direct Investment, Growth, and Competitiveness in Developing Countries," in Peter K. Cornelius, Editor, The Global Competitiveness Report, 2002-2003, New York, Oxford University Press, pp. 295-305.

[22]   Ojeaga (2012) "Economic policy, does It help life expectancy? An African Evidence of the Role of Eonomic Policy on Longevity." Available on https://mpra.ub.uni-muenchen.de/secure/40199/1/MPRA_paper_40199.pdf

[23]   Roy. A and Van den Berg. H.V (2006), "Foreign Direct Investment and Economic Growth: A TimeSeries Approach" Global Economy Journal, Volume 6, Issue 1.

[24]   UN Statistics 2012 "The Millennium Goals Report" Available on http://www.un.org/millenniumgoals/pdf/MDG%20Report%202012.pdf

[25]   Vernon R. (1966) "International Investment and International Trade in the Product Cycle", Quarterly Journal of Economics, 80, 190-207

[26]   World   Bank   Statistics   2012   "African   Pulse"   April   2013   Vol.   7.   Available   on http://www.worldbank.org/content/dam/Worldbank/document/Africa/Report/Africas-Pulse-brochure_Vol7.pdf

[27]   Xu, B., (2000). "Multinational Enterprises, Technology Diffusion, and Host Country Productivity Growth," Journal of Development Economics 62, 477-493.

[28]   Yudaeva, K., K. Kozlov, N. Malentieva and N. Ponomareva (2003), "Does Foreign Ownership Matter? The Russian Experience", Economics of Transition, 11(3), pp. 383- 409.

Importance of human values of personnel in the contemporary organization

Şerb Diana[1*], Cicioc Nicoleta[2]

[1] University Valahia Târgovişte, Nr. 190, Gheboieni, Dambovita, Romania

[2] University Valahia Târgovişte, Nr 23, Valulul lui Traian Baia Mare, Maramures, Romania

Abstract

With the theme of importance of human values in contemporary organizations staff this article has two parts: the theoretical and practical part. The first part presented the concept of human values knowledge. In part two of the article we made of an office research based on the analysis of secondary sources. An analysis approached from two perspectives: at the European level and at national level. The assumption behind this article is that human values are essential in the workplace.. Data was retrieved and processed in Excel, and SPSS. In order to test research hypotheses correlation was used. To support the argument we used a series of tables and representative images. The conclusions of this analysis show that the Romanian and European respondents consider important the following human values: creativity and freedom of decision.

Keywords: *human values, personnel, organization*

Jel: A13

1. Theoretical Approach

Personal values have an impact on knowledge sharing in the workplace and personal values, they play a role in the formation of attitudes toward organizational change (N Koivula, 2008). At the managerial level we should propose modifying the employee's values to support the organization's objectives.

Value according to another definition is an important component of one's self and personality, distinct attitudes, beliefs, norms and traits. Values are motivator critics of behavior and attitudes (S Schwartz, 2012).Human values were important factors for scientists in their empirical studies of social, psychological, economic and political nature. There is a diversity of views on the classification of human values. According to many specialists in human values (Cheng et all, 2010):

1. competence (creativity, independence, physical ability, logic, imagination) Vs. security (family security, peace)
2. morality (forgiveness, honesty, courage) Vs. success (social recognition, power, comfortable life)
3. social reliability (responsibility, courtesy, self-control, obedience) to beauty (beauty world)
4. political harmony (equality, world peace, social justice) vs sociability (being cheerful, cleaning, being loving).

There are twelve items of value in PVS (personal values scale) (Shou A, 2010): (1) intellectualism, (2) kindness, (3) social skills (4) loyalty (5) academic (6) the physical growth (7) state, (8) honesty (9) religion, (10), self-control, (11) creativity, and (12) independence.

The structure of these values is considering relationships of conflict and congruence between values. Values are structured in similar ways. This suggests that there is a universal organization of human motivations. Although the nature of values and their structure may be universal, individuals and groups are different.

2. Human Values of Contemporary organization's staff

Research methodology

Objectives:

- Knowledge of any differences of perception between Europeans and Romanians about human values,

---

[*] corresponding author email: dianaserb10@yahoo.com

- Observing what percentage of research participants were happy.

Hypotheses:
1. Europeans and Romanians mostly declare themselves happy,
2. Equality is perceived as important,
3. European respondents gender influences the perception of the importance of creativity,
4. The ability of Europeans to make their own decision affects their level of happiness.
   Research organization

The method of gathering the information for the present research was the analysis of secondary sources. The data was taken from two websites specializing in analysis of conditions of life and work of individuals (European Social Survey, analyzing human values of Europeans and World Values Survey-analyzing the human values of Romanians). The sample for the study that was conducted at the European level consists of 28 221 people.

The sample size for this research in our country consists of 1500 people.

Duration of the survey - 2012 (for the World Values Survey) and 2014 (European Social Survey).

The results obtained
Analysis takes place on two levels:
1. At the European level,
2. National level

1. Analysis at European level
European Social Survey (ESS) is a multi-country academic – led study, which was administered in more than 30 countries so far. Romania is not among the states that participated in the research, instead there are: Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Finland, France, Ireland, Netherlands, Norway, Poland, Sweden and Slovenia. Respondents were presented a few cases, and they had to compare their situation to that shown according to the importance of creativity, decision, admiration and equality in the workplace (see Table 1, Table 2, Table 3 and Table 4).

Table 1. Important to think new ideas and being creative

	Frequency	% of all	% of valid
Very much like me	9,445	33.5	34.2
Like me	11,466	40.6	41.6
Somewhat like me	4,328	15.3	15.7
A little like me	1,526	5.4	5.5
Not like me	648	2.3	2.3
Not like me at all	176	0.6	0.6
Refusal	52	0.2	-
Don't know	452	1.6	-
No answer	108	0.4	-
SYSMIS	20	0.1	-
Total	28,221	100.0	100.0

Source:http://nesstar.ess.nsd.uib.no/webview/

According to the research, comparing the answers of participants' situation with the cases presented by the importance of creativity emphasizes that there are no differences in perception for 88% of European respondents.

Table 2. Important to make own decisions and be free

	Frequency	% of all	% of valid
Very much like me	6,099	21.6	22.1
Like me	9,141	32.4	33.2
Somewhat like me	6,960	24.7	25.2
A little like me	3,042	10.8	11.0
Not like me	1,862	6.6	6.8
Not like me at all	469	1.7	1.7
Refusal	47	0.2	-
Don't know	467	1.7	-
No answer	114	0.4	-
SYSMIS	20	0.1	-

Source: http://nesstar.ess.nsd.uib.no/webview/

The answers to this question are as follows: 24.7% of the research participants think ,, somewhat like me ", 21% of respondents think,, very much like me", 32.4% of respondents think ,, like me ' 10.8% of respondents consider,, a little like me. "

Table 3. The importance of equality of chances

	Frequency	% of all	% of valid
Very much like me	8,611	30.5	31.2
Like me	10,898	38.6	39.5
Somewhat like me	5,071	18.0	18.4
A little like me	1,974	7.0	7.1
Not like me	892	3.2	3.2
Not like me at all	170	0.6	0.6
Refusal	50	0.2	-
Don't know	418	1.5	-
No answer	117	0.4	-
SYSMIS	20	0.1	-
Total	28,221	100.0	100.0

Source: http://nesstar.ess.nsd.uib.no/webview/

On the importance of equal opportunities from the perspective of comparison it is found that respondents considered important the equal opportunities and situations presented.

Table 4. Important to show abilities and be admired

	Frequency	% of all	% of valid
Very much like me	2,374	8.4	8.6
Like me	6,692	23.7	24.3
Somewhat like me	6,636	23.5	24.1
A little like me	5,109	18.1	18.5
Not like me	5,241	18.6	19.0
Not like me at all	1,525	5.4	5.5
Refusal	49	0.2	-
Don't know	460	1.6	-
No answer	115	0.4	-
SYSMIS	20	0.1	-
Total	28,221	100.0	100.0

Source: http://nesstar.ess.nsd.uib.no/webview/

For 62% of respondents the desire to be admired is similar with the case presented. Tables 5 and 6 last are correlation tested through the last two assumptions.

Table 5. The correlation between sex and the importance of creativity

Gender		
	Correlation	0.052 **
Important to think new ideas and being creative	Significance	0.0000
	Count	27573

Table 6. The relationship between happiness and own decision

How happy are you		
Important to make own decisions and be free	Correlation	0.052 **
	Significance	0.0000
	Count	27573

In both cases the tests are statistically significant, between sex and the importance of creativity there is a direct link and between the level of happiness and the power to make their own decisions is a reverse link.

Table 7. Enjoyed life, how often past week

	Code	Frequency	% of all	% of valid
None or almost none of the time	1	1,288	4.6	4.6
Some of the time	2	5,590	19.8	19.9
Most of the time	3	12,634	44.8	45.1
All or almost all of the time	4	8,531	30.2	30.4
Refusal	7	17	0.1	-
Don't know	8	150	0.5	-
No answer	9	11	0.0	-
Total		28,221	100.0	100.0

Source: http://nesstar.ess.nsd.uib.no/webview/

Most Europeans said that they enjoyed life several times during the last weekend.

2. Nationwide analysis

For this analysis the data was obtained as a result of the survey results published by the World Values Survey in 2012. We took the information and processed it in Excel.. The sample consists of 1500 people, of Romanian origin. The questionnaire was applied on the phone, and the data obtained was taken and processed.

Table 8. Feeling of happiness

	Number of cases	%/Total
Very happy	205	13.6%
Rather happy	833	55.4%
Not very happy	397	26.4%
Not at all happy	60	4.0%
No answer	4	0.3%
Don´t know	4	0.3%
(N)	(1,503)	100%

Source: http://www.worldvaluessurvey.org/WVSOnline.jsp

70% of Romanian respondents declare themselves happy, and the remaining percentages declared themselves as being unhappy

Table 9. Incomes should be made more equal

	Number of cases	%/Total
Incomes should be made more equal	259	17.2%
2	84	5.6%
3	101	6.7%
4	49	3.3%
5	158	10.5%
6	75	5.0%
7	99	6.6%
8	116	7.7%
9	109	7.3%
We need larger income differences as incentives for individual effort	403	26.8%
No answer	8	0.5%
Don´t know	41	2.7%
(N)	(1,503)	100%

Source: http://www.worldvaluessurvey.org/WVSOnline.jsp

Regarding equality of chances the majority of respondents said that there should be more equality in their lives.

Table 10. Happiness as seen by Romanians

	Romania				
	Years 1989-1993	Years 1994-1998	Years 1999-2004	Years 2005-2009	Years 2010-2014
Very happy	6%	5%	4%	10%	14%
Quite happy	55%	51%	43%	53%	55%
Not very happy	33%	35%	40%	30%	26%
Not at all happy	5%	7%	12%	6%	4%
No answer	-	-	1%	0%	0%
Don´t know	0%	2%	1%	1%	0%
(N)	1,103	1,239	1,146	3,265	1,50

Source: http://www.worldvaluessurvey.org/WVSOnline.jsp

Analysis of the degree of happiness of Romanians from 1989 until 2014 show that for the entire period analyzed Romanians declare themselves happy.

3. Conclusions

Through this article we achieved two objectives formulated under the methodology part of the research. Frequencies and linkage have demonstrated that none of the assumptions verify. Most Romanians and Europeans declare themselves happy, first hypothesis is verified using frequencies. Equality is seen as important, and so the hypothesis number two is checked. European respondents' gender influences the perception of the importance of creativity and Pearson's test verifies this hypothesis. Europeans' ability to make their own decision affects their level of happiness - the last hypothesis is verified through correlation. In conclusion, Europeans and Romanians focus on human values and overall they are happy with the life they lead.

Bibliography

[1]	Cheng A., FleischmannK , Wang, P, Ishita, E, Oard, D, ,, *Values of stakeholders in the Net neutrality debate: Applying content analysis to telecommunications policy"*. Proceedings of the 43rd Hawai'i International Conference on System Sciences (HICSS), 2010.
[2]	Koivula N, ,,Basic Human Values in the Workplace", Ed. P.O. Box 4 , Helsinki, 2008.
[3]	Schwartz S, ..*An Overview of the Schwartz Theory of Basic Value*", The psychology of values: The Ontario Symposium (Vol. 8, pp. 1-24). Hillsdale, NJ: Erlbaum , 2012.
[4]	Shou A, Kenneth R, ,,Developing a Meta-Inventory of Human Values" ,, October 22–27, 2010, Pittsburgh, PA, USA, 2012.
[5]	http://www.worldvaluessurvey.org/WVSOnline.jsp
[6]	http://nesstar.ess.nsd.uib.no/webview/

Workplace for individuals in the context of recession

Mohammad Jaradat[1], Cicioc Nicoleta[2*], Şerb Diana[3]

[1]PhD Professor, University "Bogdan Voda" Cluj-Napoca, Nr. 22, str. Brâncoveanu, 400467, ClujNapoca, Romania

[2]University Valahia Târgovişte, Nr 23, Valulul lui Traian Baia Mare Maramures, Romania

[3] University Valahia Târgovişte, Nr. 190, Gheboieni, Dambovita, Romania

Abstract

Work has been and remains a topic of interest to specialists in the field, but also for labor market actors (bearers of demand and supply, and intermediates). In the present period of economic and financial crisis, the level of interest of many academics and practitioners increases on the analysis of this concept. The purpose of this article is to present the place occupied by work in people's lives. It includes some stages of knowledge and some applied stages. The first part deals with conceptual work and outlines its role in the opinion of specialists. The second part is a desk research based on the analysis of secondary sources, and it comprises two parts: a comparative analysis of the perception of residents of three states in terms of work (Romania, Australia and Germany) and the second part comprises the Europeans satisfaction on the job.Data was collected from two sites, one European (Eurofaund) and one international (World Values Survey) and processed in its own way with the help of Excel and SPSS. The central conclusion of the scientific endeavor is that regardless of nationality respondent acknowledges the place of work in his life.

Keywords*: work, job, satisfaction*

Jel: J20

1. Knowledge stage

The meaning of work is profound, has a variety of descriptions and definitions given by specialists. Any human activity of whatever nature matters at work. The role of labor varies from one individual to another, and it generates a good understanding outlining goals, meanings and values in a person's life. Some people work for a living and others to achieve professional goals. The concept of work is widely debated and there are many definitions assigned in this regard. Work is a set of human activities, with different purposes, meanings and values. It is a process of transient behavior and procedure, not a static structure. Work is often partially shared(Attfield S, Blandford A, Dowell J, 2003).

Work characteristics drawn as a result of the above definition are as follows:

1. Work is a group of closely related human activities,
2. Work is a process, behavior and transient procedure,
3. Work is a subjective concept,
4. Work is conceived as being in a permanent state of establishment and restoration of self.

Human resources management at the top level is focused on a specific task and should be based on sets of intuitive procedures that are known. The structure of human activity within an organization can be seen in the figure below:

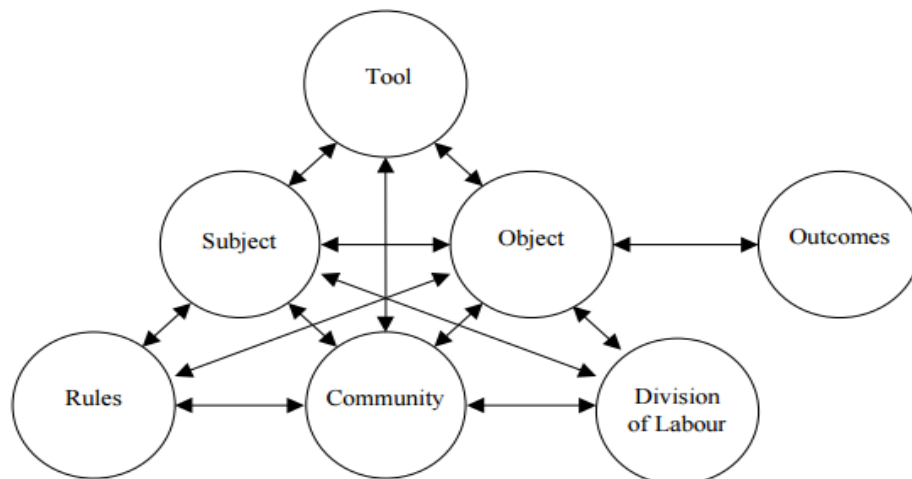* corresponding author email: ciciocn@yahoo.com

Figure 1. Structure of human activities
Source: Larkin P, Gould E, The definition of work roles within organisations , (Eds), Harrisburg, Pa. Idea Group Pub. 1995, p 45

Work is seen both in relation to family and individual life. The work / family factor has been mainly used in recent years. The current trend is to use the term work / life, offering many connotations of life or specific labeling that relate to areas of support (ie, quality of life, flexible working options, life balance)(Lambert S, 2000).

Not all employees maintain a balance between personal life and work. Wishing to surpass the individual wants to work as much as he can, implicitly wants to prove that he is able, and in this respect neglects their family.

Activities that take the form of paid work ensures the existence of the individual, and in this respect should not be neglected, nor lead to mental- exhaustion at work. The work involves a number of tasks. They provide control, progress and practical results. The working relationship is characterized by the tasks and duties that are incorporated in the work, incorporating work tasks, but not necessarily well defined (Byström K, Hansen P, 2005).

Support of human resource managers is beneficial both for the individual and for the organization. The experience and employer surveillance ability and support contribute to successfully achieving tasks at work. A labor resource operating in a balanced climate achieves performances(Bloom N, Kretschmer T, Van T, 2006).

2. Study regarding the work place in the lives of individuals

2.1. Research methodology

The method of gathering the information was -Analysis of secondary sources. A survey was conducted structured in two parts: an analysis of comparative perception of individuals with regard to the role of work in their lives (respondents were part of several countries among which is Romania) as well as an analysis of satisfaction of Europeans at work. This is a desk research based on secondary sources, the results obtained from the surveys conducted by: World Values Survey and Eurofound. Its role is to help scientists better understand a change in beliefs, values and motivations of people around the world. Since the last survey we selected relevant data applied on the job.

The survey conducted among Europeans by Eurofound. This site deals with issues related to quality of work. The topics: exposure to physical and psychosocial risks, duration and organization of working time, employment status and work contract, organization, the balance between work and personal life, consequences of work on personal life, training and learning, employee voice in the workplace, health and welfare, and income. From 1991 until 2015 the sample was increased.

The latest round of polling EWCS took place in 2015: survey of employees in the EU 28. The fifth EWCS took place in 2010: the workers interviewed were in the EU 27. Round number four EWCS took place in 2005:

EU 27 plus Norway, Croatia, Turkey and Switzerland. Round number two took place in 1995/1996: workers in the EU15. In the first round EWCS 1990/1991: workers in EC 12 were interviewed.

Objectives:
1. Principal: - Knowledge of the role of labor respondents.
2. Derivatives:
   a. Identification of choice,
   b. Knowledge of independence offered by job,
   c. Observing the share of respondents that are satisfied with the current job.

Hypotheses:
1. Regardless of the state they're from, the majority of research participants believes that the work offers independence.
2. The decrease the importance of work in the lives of individuals contemporary society is not seen as a good thing for society.
3. Balance on the job is conditional on the involvement of the manager.

2.2. Research results

Data obtained from the research was structured on two levels: a comparative analysis of perceptions about the work role and job satisfaction. It starts through comparative analysis of respondents' perception of the states participating in research Australia, Germany and Romania.

I. Comparative analysis of the perception of the role of labor

The first question analyzed

Some people think they have total freedom of choice and control over their lives, and other people think everything they do it cannot influence what happens in life. Please use the following scale to indicate how much freedom of choice you think you have, giving a mark from 1 to 10, where 1 means "I have no freedom" and 10 that "I have complete freedom".

Table 1. I have full freedom

	Australia	Germany	Romania
No choice at all	0.8	1.6	2.5
2	1.1	1.3	0.9
3	2.4	4.3	1.6
4	3	4.7	2.7
5	7.5	14.9	8.6
6	6.7	13.7	8.6
7	15.7	20.8	10.5
8	25.6	18.8	15.7
9	15.7	6.4	11.9
A great deal of choice	20.4	13.2	35.6
SG: Missing; DE:Inapplicable; RU: Inappropriate response	0	0	0
No answer	1.2	0	0.2
Don´t know	0	0.3	1.1
(N)	1.477	2.046	1.503

Source: http://www.worldvaluessurvey.org/

Regarding the respondents' perception of freedom of choice to decide it appears that in Australia the percentage of those showing agreeing attitude reaches 20%, Germany reaches 13% and in Romania's case the value is 35.6 %.

Question number two:

Having a job is the best way for a woman to be independent person year. To what extent do you agree?

Tabel 2. The job is the best way for a woman to be independent

	Australia	Germany	Romania
Agree strongly	19.1	21.8	13.4
Agree	48	30.6	19
Disagree	25.9	31.3	33.3
Strongly disagree	6	11.7	28.3
No answer	1	0.1	0.9
Don´t know	0	4.6	5.2
(N)	**1.477**	**2.046**	**1.503**

Source: http://www.worldvaluessurvey.org/

It was used as a scale method the Likert. Most respondents in each State agree that work gives an individual independence. In Romania and Germany the percentage of user reaches 70% and for Germany it reaches a value of 45%.

Question number three

„ Less importance placed on work in our lives"

Tabel 3. Place occupied by labor

	Australia	Germany	Romania
Good thing	39.1	41.9	11.5
Don´t mind	40	17.8	12.3
Bad thing	18.2	37.9	72
Missing; RU,DE: Inappropriate response	0	1	0
No answer	2.6	0	0.9
Don´t know	0	1.3	3.4
(N)	**1.477**	**2.046**	**1.503**

**Source:** http://www.worldvaluessurvey.org/

This question is designed to present the perception of respondents on easing the place occupied by labor in their lives. According to the answers of respondents: 40% of Australian participants show an indifferent attitude, 41% of Germans believe that it is a good thing, while 72% of Romanians participant believe that this is a bad thing.

II. Job satisfaction study

Research conducted in all EU countries.

Question 4.

Comfort at work depends on the involvement of the manager.
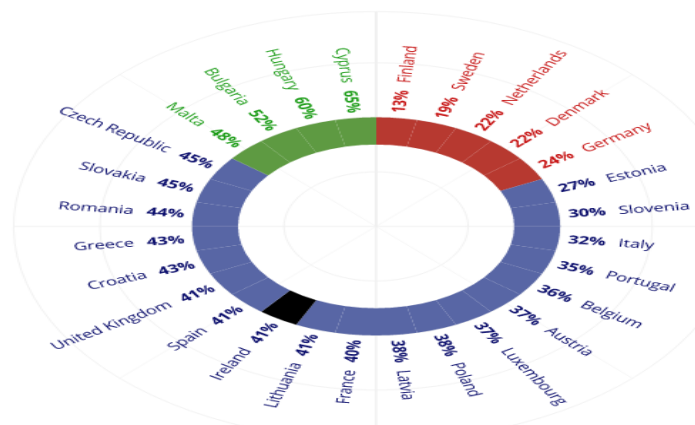
Figure 1. The role of Manager's involvement in ensuring balance in the workplace
Source: http://www.eurofound.europa.eu/

The percentage of Europeans who think that the balance in the workplace is conditioned by the involvement of the manager is as follows: 44% of Romanian, 65% of Cypriots, 60% of Hungarians, 36% of Belgians.

Question 5.

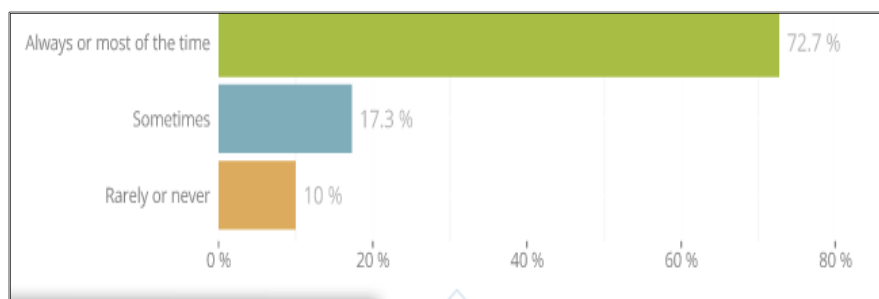The time designated for the job tasks is enough for me

Figure 2. The time spent for job
Source: http://www.eurofound.europa.eu/

90% of European research participants believe that the time spent for job tasks is enough.
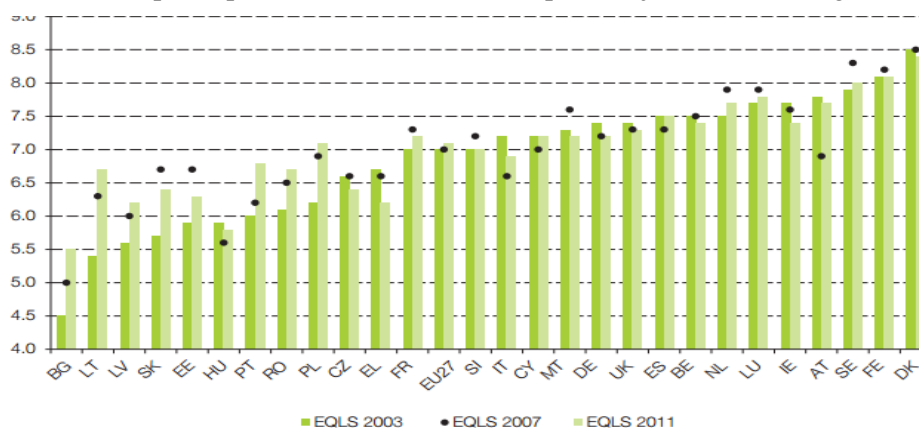
Figure 3. Satisfaction with current job
Source: http://www.eurofound.europa.eu/

We make a comparison of the level of satisfaction perceived by Europeans in the three rounds of this survey: 2003, 2007 and 2011.

In the case of Romania we see that in 2011 the perceived level of satisfaction is lower than in 2007.

3. Conclusions

Work has an important role for Europeans because on one hand it ensures money to fulfill the needs (food, clothing, travel, recreation), and on the other hand it gives the feeling of safety. Individuals who have a job feel independent and their self-esteem is increased.The majority of Europeans consider that the freedom to decide at the workplace ensures comfort and the intervention of Manager generates a poor climate. Studies conducted by the Eurofaund showed that respondents in our country perceive a lower level of satisfaction at work by comparison with previous years.

The average level of satisfaction according to the survey of 2011 the Romanians reached a value of 6.5, while in 2007 it was 7. Comparing our country with the neighboring Bulgaria shows that Romanians are more satisfied than Bulgarians. Even though respondents in Germany, Romania and Australia are aware that work gives them independence, they show an attitude of disapproval on the fact that the best way to get independence is work, and according to their view the independence is made out of other aspects too.

References

[1]   Attfield S, Blandford, A, Dowell J(2003), „ Information seeking in the context of writing A design psychology interpretation of the problematic situation", Journal of Documentation, Vol. 59 No. 4, London.

[2]   Byström K, Hansen P(2005), „ Conceptual framework for tasks in information studies", Journal of the American Society for Information Science and Technology, Vol. 56 No. 10, London.

[3]   Larkin P, Gould E(1995), „ The definition of work roles within organisations ", (Eds), Harrisburg, Pa. Idea Group Pub.,

[4]   Lambert S. (2000), „Added benefits: The link between work-life benefits and organizational citizenship". Academy of Management Journal, London.

[5]   Bloom N , Kretschmer T, Van J(2006), „ Work-Life Balance, Management Practices and Productivity" January, The London School of Economics and Political Science , London.

[6]   http://www.eurofound.europa.eu/

[7]   http://www.worldvaluessurvey.org/

Establishing the health status of Romanians in a European context

Maria Livia Ştefănescu [*]

Research Institute for Quality of Life – Romanian Academy, Calea 13 Septembrie, no 13, Bucharest, Romania

Abstract

We intend to analyze the opinion of the population about the health status of the individuals from 20 European countries. The self assessed health (SAH) data are associated to an ordinal variable X. Our final aim is to establish the position of Romania in this European context from the health status point of view.

The statistical analysis is based on more complementary indices. The mean of X is generally not adequate as an indicator for this type of data. Our study used also two other indicators which are specific for ordinal variables. So, in the present research it was applied a polarization index POA and also an inequality Gini coefficient IGO adapted for SAH data. Comparisons of all these results are also made.

Keywords: *SAH data, health status, mean, polarization, inequality, indicators, Europe.*

1. Problem formulation

The present paper's aim is to establish Romania's position in a European context, taking as a unique evaluation criterion the health status of the inhabitants of the corresponding countries.

In the current research we have used representative samples containing responses from persons from 20 European countries. In fact, the data regarding the health status in European states was obtained from the paper of Cowell and Flachaire ([8], 2014). The initial source of the data used in [8] is in fact World Values Survey 1981- 2008, Official aggregate v.20090901, year 2009, which used data from the 5th wave, conducted in 2005-2008 over 56 countries which belong to the entire world.

We shall focus our statistical analysis on the population's answers to the question *Q1* regarding the individual health status. In fact, we have the following form of question *Q1*: "All in all, how would you describe your state of health these days? Would you say it is : poor (code 1), fair (code 2), good (code 3), very good (code 4)". So, the persons who were interviewed have four possibilities to answer with a codification that is inversed compared to that used in [8].

In the following paragraphs, we will attempt to construct a hierarchy for the 20 European countries for which we have answers to question *Q1* regarding the perception of the individual health status.

2. Data and indicators

We must underline the fact that the answers to question *Q1* are actually self-assessed health data (SAH data, for short). The random variables attached to SAH data are ordinal and there is a hierarchy between the answering classes. As a consequence, the selected statistical analysis models will have to work with ordinal variables. We mention for this step, the book of Agresti [1] in which are presented the different particularities of modelling systems which have ordinal variables as components.

We consider an ordinal variable *X* defined by 4 classes C_1 , C_2 , C_3 , C_4. All the elements within a class C_i are indistinguishable one from the other. Nevertheless, if $1 \leq i < j \leq 4$, then any element belong to class C_i is considered "inferior" to any of the elements from class C_j .

We will denote respectively by f_j , p_j , s_j the frequency, the probability and the score associated to the given importance of a group C_j , $1 \leq j \leq 4$. Evidently we have the following relations :

$$p_j = f_j / (f_1 + f_2 + f_3 + f_4) \qquad\qquad 0 \leq s_1 < s_2 < s_3 < s_4$$

---

[*] corresponding author email: livia.stefanescu@gmail.com

Within a European country t , $1 \le t \le 20$, we have data concerning the frequencies $f_{k,t}$ for which the responds to question *Q1*, have chosen the answer code k, $k \in \{1 , 2 , 3 , 4\}$. The information regarding the distribution of the types of answers by country is presented in *Table 2.1*.

Table 2.1. Frequences of the population response at the question *Q1*.

Nr.	Country	Abbv.	Health code			
			1	2	3	4
1	Bulgaria	BG	150	310	389	149
2	Switzerland	CH	33	173	635	400
3	Cyprus	CY	65	184	387	413
4	Spain	ES	48	195	716	237
5	Finland	FI	61	284	437	232
6	France	FR	58	225	418	300
7	United_Kingdom	GB	87	196	412	345
8	Georgia	GE	296	574	439	189
9	Germany	DE	148	538	908	458
10	Italy	IT	34	228	562	188
11	Moldova	MD	117	354	443	107
12	Netherlands	NL	42	262	497	247
13	Norway	NO	46	165	388	426
14	Poland	PL	127	331	365	175
15	Romania	RO	254	569	776	175
16	Russia	RU	256	911	721	134
17	Serbia	RS	147	406	431	226
18	Slovenia	SI	144	302	369	220
19	Sweden	SE	33	187	430	353
20	Ukraine	UA	132	378	412	76

In order to establish Romania's position in a European context using as unique criterion the health status perceived by the population, we will choose several indicators which are attached to the evaluation processes of the mean, polarization and inequality. Concretely, for an ordinal variable X with four classes, we will use the indexes: $Mean(X ; \underline{s})$, $POA(X)$, $IGO(X)$. In the following we will be presenting more details.

Therefore, $Mean(X ; \underline{s})$ represents the mean of variable X weighted with the scores $\underline{s} = (s_1 , s_2 , s_3 , s_4)$, that is:

$$Mean(X ; \underline{s}) = s_1 . p_1 + s_2 . p_2 + s_3 . p_3 + s_4 . p_4$$

Practically, the value $Mean(X ; \underline{s})$ cannot be effectively evaluated since we do not know the values of the scores $\underline{s}$ attached to the ordinal classes. The weights $\underline{s}$ are subjective and modifying these scores affects the value of the coefficient $Mean(X ; \underline{s})$.

So, for the ordinal variables X we cannot talk of a classical variance coefficient, since we cannot compute the mean of X.

In the papers of Berry & Mielke [3] and Blair & Lacy [4] there are proposed different variation indicators for ordinal variables. Blair & Lacy suggests in [4] several classes of variation indicators based on the cumulative distribution function of the ordinal variable. In the following, we will denote *POA* one of the variation indicators mentionned in [4] and which has been subsequently studied in the doctoral thesis of Apouey [2]. The interesting properties of the index *POA* are described at length by Apouey in his paper [2]. This index was used in [2] to measure the polarization level for SAH data. It was proved in [2] that the index POA verifies axioms that are characteristic to the bipolarization phenomenon for ordinal classes.

Using the previous notations, for variable X with four ordinal classes we have ([2], [4]):

$$POA(X) = 1 - (| 2p_1 - 1 | + | 2p_1 + 2p_2 - 1 | + | 2p_1 + 2p_2 + 2p_3 - 1 |) / 3$$

Constructing indicators for measuring the inequality phenomenon supposes to mandatorily respect several axioms (Cowell & Kuga [5]). We mention in particular the work of Cowell ([7], 2011) regarding a detailed

description of the properties of indexes for the inequality process. Cowell and Ebert discuss in [6] several approaches of the inequality process. Lately, Cowell and Flachaire suggest a class of indicators for inequality used for ordinal variables ([8], 2014).

The Gini indicator is the most popular coefficient used for measuring the inequality that exists in the distributions of discrete and continuous variables.. Giudici and Raffinetti extend the use of the Gini index for ordinal variables X ([9], 2011). In the following, we will denote by $IGO(X)$ the value of the inequality coefficient Gini-Raffinetti applied to variable X. The papers [9] and [10] contain details regarding the construction of the coefficient IGO which is based on attributing ranks to the ordinal classes, creating in a later phase the Lorenz curve.

The values of indexes *Mean*, *POA* și *IGO* regarding the 20 European countries which will be analyzed is synthesized in *Table 2.2.* In order to compute the means, we use different weights $\underline{s}$ associated with the ordinal groups.

Table 2.2. The values of the coefficients Mean, POA and IGO.

Nr.	Country	Abbv.	Mean values weights: 1, 2, 3, 4	Mean values weights: 1,4,9,16	Mean values weights: 2,4,8,16	*POA* index	IGO index
1	Bulgaria	BG	2.538	7.290	7.050	0.507	0.412
2	Switzerland	CH	3.130	10.347	9.861	0.343	0.428
3	Cyprus	CY	3.094	10.383	10.076	0.462	0.365
4	Spain	ES	2.955	9.251	8.692	0.294	0.427
5	Finland	FI	2.828	8.720	8.349	0.419	0.417
6	France	FR	2.959	9.511	9.151	0.427	0.399
7	United_Kingdom	GB	2.976	9.711	9.398	0.458	0.380
8	Georgia	GE	2.348	6.387	6.291	0.495	0.440
9	Germany	DE	2.817	8.675	8.304	0.420	0.411
10	Italy	IT	2.893	8.905	8.383	0.319	0.423
11	Moldova	MD	2.529	7.083	6.764	0.454	0.414
12	Netherlands	NL	2.906	9.079	8.645	0.377	0.421
13	Norway	NO	3.165	10.745	10.412	0.444	0.365
14	Poland	PL	2.589	7.551	7.313	0.508	0.420
15	Romania	RO	2.492	6.941	6.647	0.471	0.403
16	Russia	RU	2.363	6.198	5.968	0.410	0.449
17	Serbia	RS	2.608	7.658	7.423	0.510	0.422
18	Slovenia	SI	2.643	7.916	7.699	0.522	0.408
19	Sweden	SE	3.100	10.268	9.872	0.403	0.397
20	Ukraine	UA	2.433	6.581	6.301	0.465	0.418

3. Mean index

We denote by X the ordinal variable attached to the population's answers to question *Q1*. We consider three variants of scores $\underline{s}$ atributed to the four ordinal classes defining variable X. More precisely, we will use the following scores: $\underline{s}^{(1)} = (1, 2, 3, 4)$, $\underline{s}^{(2)} = (1, 4, 9, 16)$, $\underline{s}^{(3)} = (2, 4, 8, 16)$. So, a score k from the vector $\underline{s}^{(1)}$ becomes k^2 in the vector $\underline{s}^{(2)}$ and 2^k in $\underline{s}^{(3)}$.

We denote by X_t the ordinal variable that characterizes the distribution of answers to question *Q1* for the persons from country t , $1 \leq t \leq 20$. In *Fig. 3.1-3.3* we find the positions of the European countries in regard to the values of the indicator $Mean(X_t ; \underline{s}^{(j)})$, $1 \leq t \leq 20$, $j \in \{ 1 , 2 , 3 \}$. The values $Mean(X_t ; \underline{s}^{(j)})$ were already computed in *Table 2.2.*
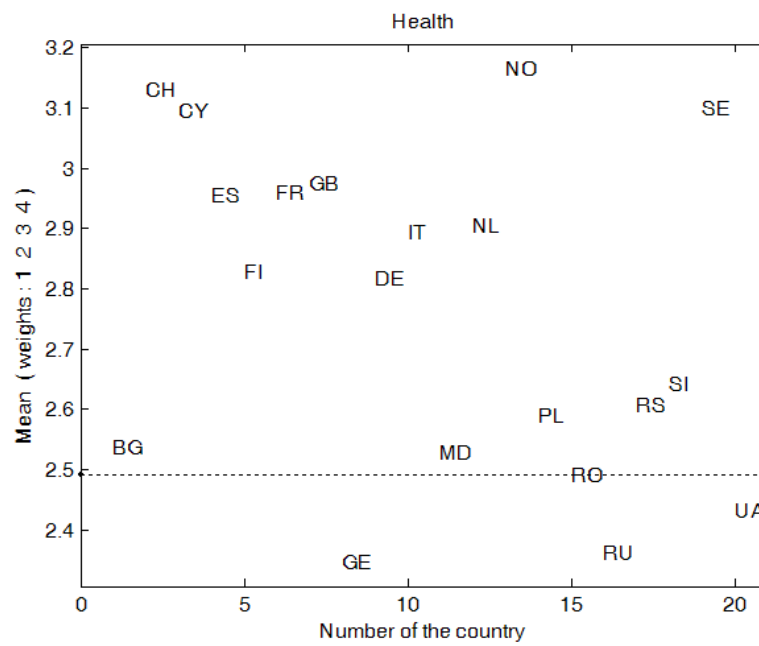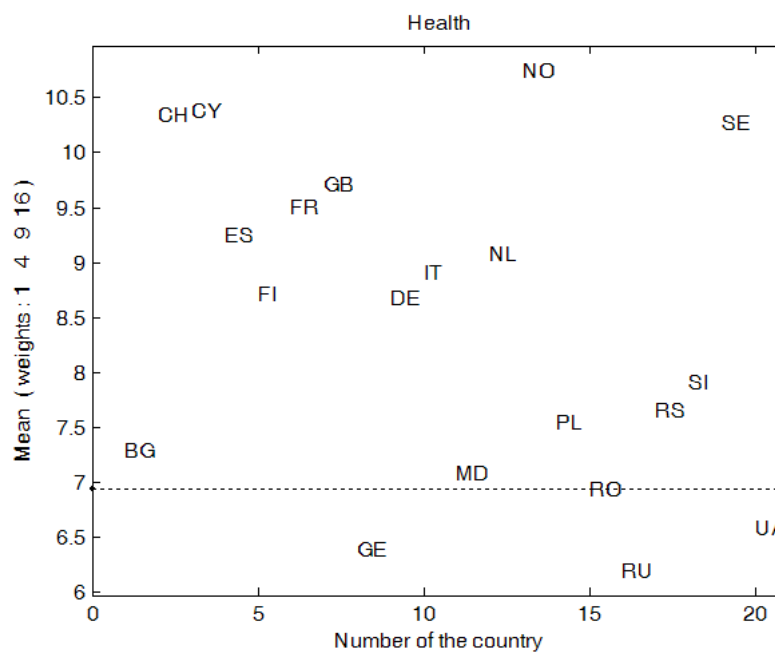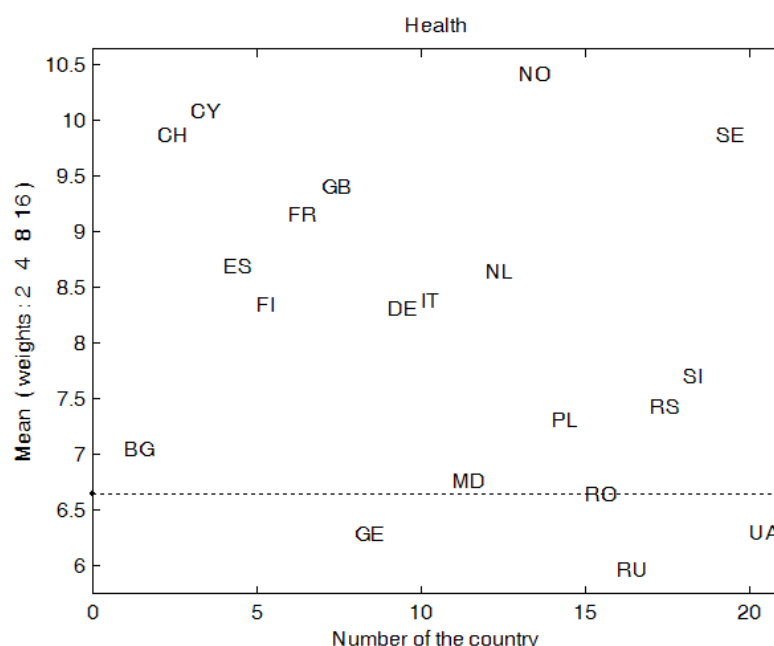
Fig. 3.1. The position of the European countries t after *Mean*(X_t ; $\underline{s}^{(1)}$).

Fig. 3.2. The position of the European countries t after *Mean*(X_t ; $\underline{s}^{(2)}$).

Fig. 3.3. The position of the European countries t after $Mean(X_t ; \underline{s}^{(3)})$.

Without having a linear relationship between the weights $\underline{s}^{(1)}$, $\underline{s}^{(2)}$, $\underline{s}^{(3)}$ attached to the ordinal classes of variables X_t and ignoring the measurement scale, we observe that *Fig. 3.1-3.3* are very similar. This may result from a structural similarity of the distributions of the answers in the European countries t, which are involved in the current statistical analysis. Theoretically, the means $Mean(X_t ; \underline{s}^{(j)})$ have, in general, distinct values compared with the used scores $\underline{s}^{(1)}$, $\underline{s}^{(2)}$, $\underline{s}^{(3)}$.

Considering the means $Mean(X_t ; \underline{s}^{(j)})$, $1 \le j \le 3$, *Tables 3.4-3.6* establish the hierarchy between the studied countries t, $1 \le t \le 20$.

Table 3.4. The hierarchy of the European countries t considering $Mean(X_t ; \underline{s}^{(1)})$.

Rank	1	2	3	4	5	6	7	8	9	10
Country	NO	CH	SE	CY	GB	FR	ES	NL	IT	FI
Mean	3.165	3.130	3.100	3.094	2.976	2.959	2.955	2.906	2.893	2.828
Rank	11	12	13	14	15	16	17	18	19	20
Country	DE	SI	RS	PL	BG	MD	RO	UA	RU	GE
Mean	2.817	2.643	2.608	2.589	2.538	2.529	2.492	2.433	2.363	2.348

Table 3.5. The hierarchy of the European countries t considering $Mean(X_t ; \underline{s}^{(2)})$.

Rank	1	2	3	4	5	6	7	8	9	10
Country	NO	CY	CH	SE	GB	FR	ES	NL	IT	FI
Mean	10.745	10.383	10.347	10.268	9.711	9.511	9.251	9.079	8.905	8.720
Rank	11	12	13	14	15	16	17	18	19	20
Country	DE	SI	RS	PL	BG	MD	RO	UA	GE	RU
Mean	8.675	7.916	7.658	7.551	7.290	7.083	6.941	6.581	6.387	6.198

Table 3.6. The hierarchy of the European countries t considering $Mean(X_t ; \underline{s}^{(3)})$.

Rank	1	2	3	4	5	6	7	8	9	10
Country	NO	CY	SE	CH	GB	FR	ES	NL	IT	FI
Mean	10.412	10.076	9.872	9.861	9.398	9.151	8.692	8.645	8.383	8.349
Rank	11	12	13	14	15	16	17	18	19	20
Country	DE	SI	RS	PL	BG	MD	RO	UA	GE	RU
Mean	8.304	7.699	7.423	7.313	7.050	6.764	6.647	6.301	6.291	5.968

Comparing *Tables 3.4-3.6* we observe the following:

- The obtained hierarchies suffer small modifications in regard to the scores $\underline{s}^{(1)}$, $\underline{s}^{(2)}$, $\underline{s}^{(3)}$ which are attached to the ordinal classes. The classiffications which result are stable, usually maintaining the order between the countries.

- Romania is always situated on the 17th place out of the 20 countries considered. Georgia, Ukraine and Russia are the only countries that are situated below Romania from the point of view of the health status of their corresponding population. Bulgaria and Moldova have a slightly better position than Romania.
- Norway is on the first place in all three variants of scores *s*.
- On the last place we find Russia, no matter what scores *s* are used.
- Regarding the different scores *s* attributed to the ordinal classes, the places 2-4 from the classification are divided between Cyprus, Sweden and Switzerland.
- The averages resulted from the three hierarchies differ sometimes significantly with respect to the scores *s*.

4. Polarization coefficient

We will attempt to produce a hierarchization of the 20 European countries taking under account the polarization of answers from the population regarding the individual health status. Concretely, in *Fig 4.1* we represent graphically the position of the countries t , $1 \le t \le 20$, with respect to $POA(X_t)$ the degree of bipolarization of the ordinal variables X_t . The values of $POA(X_t)$ can be found in *Table 2.2*.

Fig. 4.1. The position of the European countries t using the values $POA(X_t)$.
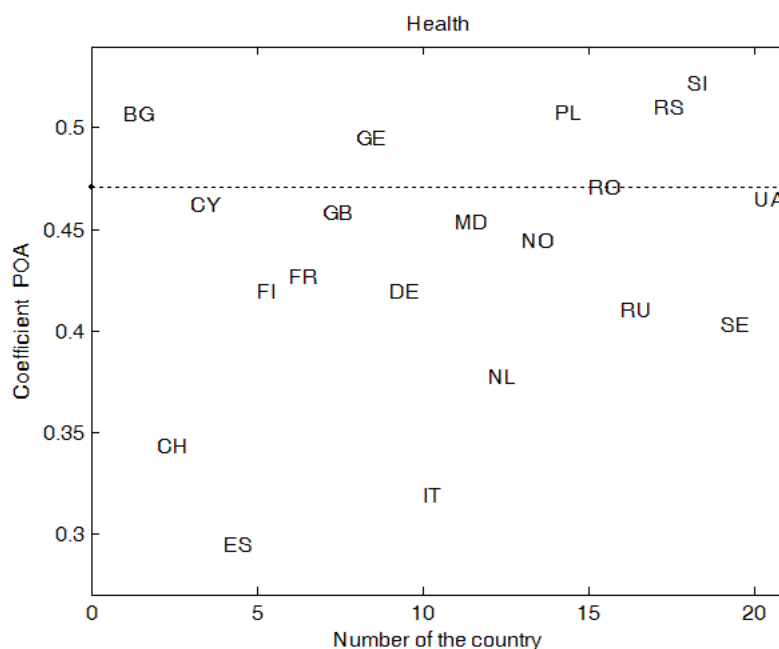
Taking into account the polarization level of the population's answers we obtain in *Table 4.2* a new hierarchization of the European states.

Table 4.2. The hierarchy of the European countries t based on $POA(X_t)$.

Rank	1	2	3	4	5	6	7	8	9	10
Country	ES	IT	CH	NL	SE	RU	FI	DE	FR	NO
POA	0.294	0.319	0.343	0.377	0.403	0.410	0.419	0.420	0.427	0.444
Rank	11	12	13	14	15	16	17	18	19	20
Country	MD	GB	CY	UA	RO	GE	BG	PL	RS	SI
POA	0.454	0.458	0.462	0.465	0.471	0.495	0.507	0.508	0.510	0.522

Analyzing the graphical representation from *Fig. 4.1*, as well as the data from *Table 4.2*, we mention the following:

- The new hierarchy given by *Table 4.*2 differs significantly from the hierarchies in *Tables 3.4-3.6*.
- Taking into account, the polarization degree of answers to question *Q1* , Romania is situated on the 15th place. In the preceeding hierarchizations, Romania was on the 17th place.

- This time, besides Georgia, we find a polarization that is higher than Romania's in: Bulgaria, Poland, Serbia and Slovenia.
- From the studied countries, Slovenia presents the highest degree of polarization of the population's answers.
- Compared to the hierarchizations from *Tables 3.4-3.*6, in the new classification Russia and Ukraine have a lower polarization than Românâ.
- The smallest polarization is found in Spain and Italy.
- Norway is on the 10th place when it comes to the polarization index. In the previous hierarchizations, which used the mean indicator, Norway was on the first place.
- Taking into account the mean criterion or the value of the bipolarization index, Romania is situated on an inferiour position, that is in the last quarter of the studied countries.

5. Inequality indicator

In this section, we will use a new coefficient of hierarchization, that is the inequality degree which is present in the answers of the population at question *Q1*.

Concretely, we will use for the hierarchization the values of the indicator *IGO* , which were presented in *Table 2.2*.

Fig. 5.1 gives us a suggestive graphical image regarding the positioning of the European countries with respect to the *IGO* level of inequality.

By making a synthetical presentation, *Table 5.2* suggests a hierachization of the 20 countries studied regarded the inequality appeared in the distribution of answers of the persons interviewed.

By interpreting *Fig. 5.1* and the data from *Table 5.2* we observe the following :

- The hierarchy based on the value of the indicator *IGO* of inequality differs significantly from all the previous classifications (to compare *Tables 3.4-3.6*, *4.2* with *Table 5.2*).
- Regarding the level of inequality of the distribution of answers to question *Q1*, Romania has a top position, that is place 6 out of 20 countries. In the previous classifications, Romania had one of the last places.
- With an inequality coefficient smaller than Romania's, we find the following five countries: Cyprus, Norway, United Kingdom, France and Sweden.
- Cyprus is the country in which the inequality of the answers' distribution is the smallest.
- Georgia and Russia are positionned on the final two places regarding the inequality degree.
- Norway and Spain who were on the first place in the preceeding classifications are now on the 2nd place and 17 place respectively. A very small polarization in Spain is superposed over a very high inequality for the population's answers.
- This last classification based on the inequality phenomenon seems unrealistic in many situation. See for example the cases of Romania and Spain.
- When referring to the population's opinion regarding the individual health status, for many developed European countries like Germany, Switzland, Netherlands or Italy we notice a higher degree of inequality in the answers, compared to the perceived inequality in Romania. In this situation we must take into account that there are different standards and expectations from one country to the next.

Fig. 5.1. The position of the European countries t using the values *IGO(X*t*)*.
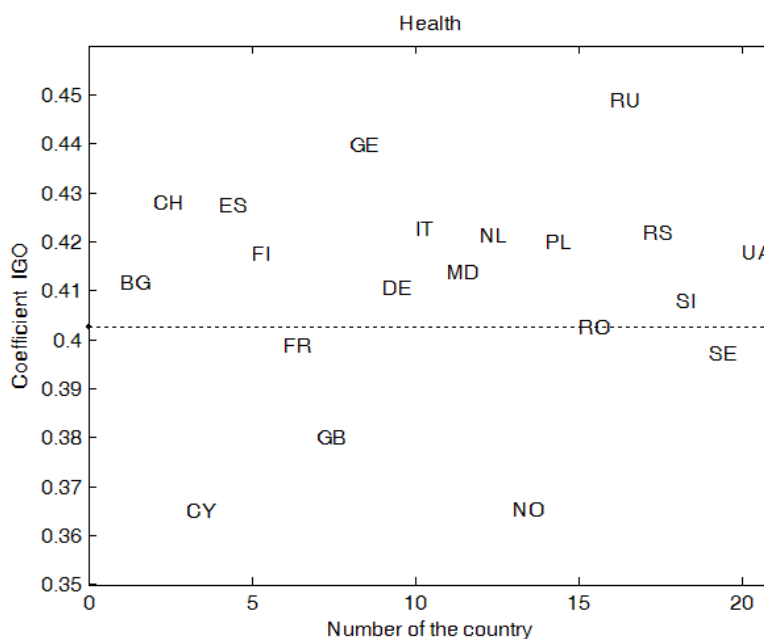
Table 5.2. The hierarchy of the European countries t based on *POA(X*t*)*.

Rank	1	2	3	4	5	6	7	8	9	10
Country	CY	NO	GB	SE	FR	RO	SI	DE	BG	MD
IGO	0.365	0.365	0.380	0.397	0.399	0.403	0.408	0.411	0.412	0.414
Rank	11	12	13	14	15	16	17	18	19	20
Country	FI	UA	PL	NL	RS	IT	ES	CH	GE	RU
IGO	0.417	0.418	0.420	0.421	0.422	0.423	0.427	0.428	0.440	0.449

6. Final conclusions

We do not recommend for SAH data to be used the mean indicator, because in the case of ordinal variables the attribution of subjective scores *s* attached to the classes does not have a theoretical basis. In the situation that we have presented, there are no significant fluctuations in the ordering of the studied European countries. (*Table 3.4-3.6*). Romania is constantly on the 17th place out of the 20 countries.

Evidently, the resulting classification depends on the applied criterion (*Tables 3.4-3.6, 4.2, 5.2*) . We have used three indicators for the hierarchization of the European states, that are the following: evaluation index for the mean, polarization coefficient, inequality coefficient. (*Fig. 3.1-3.3, 4.1, 5.1*).

 It is preferable that the countries hierarchization is not made by using a single criterion. The polarization and inequality criterion are distinct, a fact that is shown by the values of the indicators *POA* and *IGO* respectively (*Table 2.2*). In fact, the indicators *POA* and *IGO* are independent (Ştefănescu [10] , *Table 4.1* and *Graphic 4.2*). The hierarchization of the countries using separately the three indicators are sometimes very different (*Tables 3.4-3.6, 4.2 , 5.2*). This fact determines distinct positionings for Romania in regard to the used indicators.

In order to obtain a more precise classification, we propuse the simultaneous use of the two indicators *POA* and *IGO* by creating an aggregate indicator.

References

[1]   Agresti, A., "*An introduction to categorical data analysis*", Wiley Interscience, New Jersey, second edition, 2007.
[2]   Apouey, B., "*Measuring health polarization with self-assessed health data*", Health Economics, 16 (9), pp.875–894, 2007.
[3]   Berry, K.J., Mielke, P.W., "*Indices of ordinal variation*", Perceptual and Motor Skills, 74, pp. 576-578, 1992.
[4]   Blair, J., Lacy, M.G., "*Measures of variation for ordinal data as functions of the cumulative distribution*", Perceptual & Motor Skills, *82*(2), pp. 411-418, 1996.
[5]   Cowell, F. A., Kuga, K., "*Inequality measurement: an axiomatic approach*", European Economic Review 15, pp. 287-305, 1981.

[6]   Cowell, F.A., Ebert, U., "*Complaints and inequality*", Social Choice and Welfare, 23, pp. 71-89, 2004.

[7]   Cowell, F.A., "*Measuring Inequality*", Oxford University Press, Oxford, 2011 (third edition).

[8]   Cowell, F.A., Flachaire, E., "*Inequality with ordinal data*", STICERD London School of Economics, Aix-Marseille University, Working paper, pp. 1-50, October 2014.

[9]   Giudici, P., Raffinetti, E., "*A Gini concentration quality measure for ordinal variables*", Quaderni del Dipartimento di Economia, Statistica e Diritto, Università di Pavia, Serie Statistica, pp. 1-18, no. 1/2011 (April 7, 2011).

[10]   Ştefănescu, M. L. "*Analyzing the health status of the population using ordinal data*", Computational Methods in Social Sciences, 3(1), pp. 1-9, 2015.