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Appropriate statistical model for zero-inflated count data: simulation based study

Ayan CHOWDHURY[1*], Soma Chowdhury BISWAS[2]
[1]Department of Statistics, University of Chittagong, ayan.statcu09@yahoo.com, Chittagong-4331, Bangladesh
[2]Department of Statistics, University of Chittagong, soma.stat@cu.ac.bd, Chittagong-4331, Bangladesh

Abstract

Zero-inflated count data is easily reached in real field. Over-dispersion is the consequence of zero inflation in count data. For modeling this kind of count data, several zero adjusted models such as Zero Inflated Poisson, Zero Inflated Negative Binomial, Hurdle Poisson and Hurdle Negative Binomial models are more suitable than basic statistical models. The best zero adjusted model selection is the key aim of this research. In this study, R code has been used to simulate datasets as well as to compare these models based on Akaike information criterion, Bayesian information criterion and Vuong test. The result of this study suggests that Hurdle Negative Binomial model has been preferred as the best fitted model for count data with excess of zero.

Keywords: ***Hurdle model, Simulation, Vuong test, Zero-inflated model.***

1. Introduction

Count data means discrete number of occurrences of an event in a fixed period of time. A count variable can takes positive integer values or zero because an event cannot occur a negative number of times. There are numerous example of the use of count variables in psychology, public health, insurance, epidemiology, behavioral sciences and many other research areas. Poisson regression analysis is a technique used for modeling the count data [2]. It is a non-linear regression analysis of the Poisson distribution, where the analysis is highly suitable for use in analyzing count data. Poisson model is a part of class of models in generalized linear models (GLM). It uses natural log as the link function and models the expected value of response variable. The natural log in the model ensures that the predicted values of response variable will never be negative. This model is used under two principal assumptions: one is that events occur independently over given time and the other is that the conditional mean and variance are equal. However, this restriction is violated in many applications because data often exhibits over-dispersion. Over-dispersion occurs when the variance is significantly larger than the mean. Generally, two sources of over-dispersion are determined which are heterogeneity of the data and excess of zeros.

In case of over-dispersion problem due to heterogeneity of the data, Negative Binomial (NB) model may be used instead of Poisson model [4], [10]. In real field, it is possible that count data is heterogeneous with excess of zero. As a result, over-dispersion problem is occurred due to both causes heterogeneity of the data and excess of zero. Zero-inflated count data cannot be modeled accurately with Negative Binomial model.

In such situation, zero-inflated models (i.e. Zero Inflated Poisson and Zero Inflated Negative Binomial) and hurdle models (i.e. Hurdle Poisson and Hurdle Negative Binomial) are more appropriate for modeling this kind of count data. The main motivation for zero-inflated count models is that real life data frequently display over-dispersion and excess of zero [5]. In zero-inflated model it is assumed that the zero observation have two different sources i.e. “structural” and “sampling”. The structural zero observation happened naturally but the sampling zero observation happened by chance.

Hurdle model is another model which also provides a way of modeling the excess zeros in addition to allowing for over-dispersion, which is proposed by Mullahy (1986) [8]. But hurdle model assumes that all zeros of data are from only “structural” source. Moreover, both zero-inflated and hurdle models have statistical advantage to standard Poisson and Negative Binomial models in such a way that these models the preponderance of zeros as well as the distribution of positive counts simultaneously. This study has been conducted to compare zero inflated models (ZIP, ZINB) and hurdle models (HP, HNB) using simulated data. Furthermore, this study

[*] Corresponding author: ayan.statcu09@yahoo.com

will provide valuable information about several zero adjusted models as well as will present the best model for modeling zero-inflated count data which is selected based on AIC, BIC and Vuong test.

2. Materials and Methods

2.1. Models

2.1.1. Zero-inflated Model

Zero-inflated model is a mixture of two statistical processes, one always generating zero counts and the other generating both zero and non-zero counts, which is introduced by Lambert (1992) [5]. This is a two parts model which provides a way of count data modeling with excess zeros additionally to allowing for over-dispersion. In case of zero inflated model, a Logit model with Binomial assumption is used to determine if an individual count outcome is from the always zero or the not always zero group and then Poisson or Negative Binomial model is used to model outcomes in the not always zero group [3], [6]. For case *i*, with probability π_i the only possible response of the first process is zero counts, and with probability of $(1-\pi_i)$ the response of the second process is governed by Poisson or Negative Binomial distribution with mean μ_i .

The probability mass function of Zero Inflated Poisson (ZIP) distribution is given by:

$$\Pr(Y_i = y_i) = \begin{cases} \pi_i + (1-\pi_i)e^{-\mu_i} & ;y_l = 0 \\ (1-\pi_i)\dfrac{e^{-\mu_i}\mu_i y_i}{y_i!} & ;y_l > 0 \end{cases} \quad (1)$$

And the probability mass function [14] of Zero Inflated Negative Binomial (ZINB) distribution is given by:

$$\Pr(Y_i = y_i) = \begin{cases} \pi_i + (1-\pi_i)(1+\alpha\mu_i)^{-\alpha^{-1}} & ;y_i = 0 \\ (1-\pi_i)\dfrac{\Gamma(y_i+\alpha^{-1})(\alpha\mu_i)^{y_i}}{\Gamma(y_i+1)\Gamma(\alpha^{-1})(1+\alpha\mu_i)^{y_i+\alpha^{-1}}} & ;y_i > 0 \end{cases} \quad (2)$$

where $0 \le \pi_i \le 1$, $\mu_i \ge 0$ and α is the dispersion parameter. The parameter μ_i is expressed as: $\mu_i = \exp(\theta' x_i)$ where, θ is the (p+1)×1 vector of unknown parameters associated with the known covariates vector x_i and p is the number of covariates.

The parameter π_i is often referred as the zero-inflation factor, which is the probability of zero counts from the binary process. According to Lambert, we can model π_i using a Logit model given by: $\log it(\pi_i) = \delta' z_i$, where, δ is the (q+1)×1 vector of zero-inflated coefficients to be estimated which is associated with the known zero-inflation covariates vector z_i and q is the number of the covariates in the model. In the terminology of generalized linear models (GLMs), $\log(\mu_i)$ and $\text{logit}(\pi_i)$ are the log link for the Poisson or Negative Binomial mean and logit link for Bernoulli probability of success respectively [5].

Zero-inflated models (ZIP and ZINB) are expressed as:

$$\begin{aligned} \log(\mu_i) &= \theta_0 + \theta_1 x_{i1} + \theta_2 x_{i2} + \theta_3 x_{i3} + \ldots\ldots\ldots\ldots + \theta_p x_{ip} \\ \log it(\pi_i) &= \delta_0 + \delta_1 z_{i1} + \delta_2 z_{i2} + \delta_3 z_{i3} + \ldots\ldots\ldots\ldots + \delta_q z_{iq} \end{aligned} \quad (3)$$

The log-likelihood function of ZIP model is:

$$\log L = \sum_{y_i=0} \log\left[\pi_i + (1-\pi_i)e^{-\mu_i}\right] + \sum_{y_i\neq 0}\left[\log(1-\pi_i) - \mu_i + y_i \log\mu_i - \log(y_i!)\right] \quad (4)$$

And the log-likelihood function of ZINB model is:

$$\log L = \sum_{y_i=0} \log\left[\pi_i + (1-\pi_i)(1+\alpha\mu_i)^{-1/\alpha}\right] + \sum_{y_i\neq 0}\left[\log(1-\pi_i) + \log\frac{\Gamma(y_i+1/\alpha\alpha}{\Gamma(y_i+1)\Gamma 1/\alpha\alpha} + y_i\log(\alpha\alpha_i) - (y_i+1/\alpha\alpha\log(1+\alpha\mu_i)\right] \quad (5)$$

The parameters of this model can be estimated using maximum likelihood estimation.

2.1.2. Hurdle Model

Hurdle model is another model for modeling over-dispersed count data with excess zeros which is introduced by Mullahy (1986) [8]. This model assumes that two different processes drive the zero and non-zero counts respectively. The hurdle component of the model corresponds to the probability that the count is non-zero, while the count component corresponds to the distribution of positive counts. This model contains also two parts: the first part is a binary (presence/absence) outcome model (e.g. a logistic regression) and the second part is a count model which is governed by truncated distribution. In case of Hurdle Poisson (HP) model and Hurdle Negative Binomial (HNB) model, second part is governed by truncated Poisson distribution and truncated Negative Binomial distribution respectively.

The unconditional probability mass function of Hurdle Poison (HP) distribution is:

$$\Pr(Y_i = y_i) = \begin{cases} \pi_i & ;y_i = 0 \\ (1-\pi_i)\dfrac{e^{-\mu_i}\mu_i y_i}{(1-e^{-\mu_i})y_i!} & ;y_i > 0 \end{cases} \quad (6)$$

And the unconditional probability mass function of Hurdle Negative Binomial (HNB) distribution is:

$$\Pr(Y_i = y_i) = \begin{cases} \pi_i & ;y_i = 0 \\ (1-\pi_i)\dfrac{\Gamma(y_i+\alpha^{-1})}{\Gamma(y_i+1)\Gamma(\alpha^{-1})}\dfrac{(1+\alpha\mu_i)^{-\alpha^{-1}-y_i}\alpha^{y_i}\mu_i^{y_i}}{1-(1+\alpha\mu_i)^{-\alpha^{-1}}} & ;y_i > 0 \end{cases} \quad (7)$$

where, $0 \le \pi_i \le 1$, $\mu_i \ge 0$ and α is the dispersion parameter. The conditional mean μ_i of the Poisson or Negative Binomial distribution is expressed as, $\mu_i = \exp(\theta' x_i)$, where x_i is a $(p+1)\times 1$ vector of covariates, θ is a $(p+1)\times 1$ vector of parameters to be estimated and p is the number of covariates in the model.

The parameter π_i is the probability of observing a zero count and $(1-\pi_i)$ is the probability of observing a positive count. For the hurdle model, the zero hurdle component describes the probability of observing a positive count whereas, for the zero-inflated model, the zero-inflation component predicts the probability of observing a zero count from the point mass component [15]. We can model $(1-\pi_i)$ using a Logit model given by: $\log it(1-\pi_i) = \delta' z_i'$, where z_i is a $(q+1)\times 1$ vector of covariates, δ is a $(q+1)\times 1$ vector of parameters to be estimated and q is the number of the covariates in the model.

Hurdle models (HP and HNB) are expressed as:

$$\begin{aligned} \log(\mu_i) &= \theta_0 + \theta_1 x_{i1} + \theta_2 x_{i2} + \theta_3 x_{i3} + \ldots\ldots\ldots\ldots + \theta_p x_{ip} \\ \log it(1-\pi_i) &= \delta_0 + \delta_1 z_{i1} + \delta_2 z_{i2} + \delta_3 z_{i3} + \ldots\ldots\ldots + \delta_q z_{iq} \end{aligned} \quad (8)$$

The log-likelihood function of HP is:

$$\log L = \sum_{y_i=0} \log \pi_i + \sum_{y_i \neq 0} \left[\log(1-\pi_i) - \mu_i + y_i \log \mu_i - \log\left(1-e^{-\mu_i}\right) - \log(y_i!) \right] \quad (9)$$

And the log-likelihood function of HNB is:

$$\log L = \sum_{y_i=0} \log \pi_i + \sum_{y_i \neq 0} \left[\log(1-\pi_i) + \log \gamma - \log\left\{1-(1+\alpha\mu_i)^{-\alpha^{-1}}\right\} \right] \quad (10)$$

where, $\gamma = \frac{\Gamma(y_i+\alpha^{-1})}{\Gamma(y_i+1)\Gamma\Gamma(\alpha^{-1})}(1+\alpha\mu_i)^{-\alpha^{-1}-y_i}(\alpha\mu_i)^{y_i}$ (11)

The parameters of this model can be estimated using maximum likelihood estimation.

2.2. Model Selection

In this study, to select the best model among ZIP, ZINB, HP and HNB models Akaike information criterion (AIC), Bayesian information criterion (BIC) and Vuong test have been used.

2.2.1. AIC and BIC

Information criteria such as the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) are extensively used to compare and select the best model among a set of models. Akaike information criterion (AIC) is a measure of the relative quality of statistical models for a given set of data which is introduced by Akaike (1973) [1]. Bayesian information criterion (BIC) is another important approach to compare and select the consistent model from a set of candidate models which is introduced by Schwarz (1978) [11]. Given a set of candidate models for the data, the preferred model is the one with the minimum AIC and BIC value.

Akaike information criterion (AIC) is defined as:

$$AIC = -2\log(L) + 2k \quad (12)$$

Bayesian information criterion (BIC) is defined as:

$$BIC = -2\log(L) + k\log(n) \quad (13)$$

where, L is maximum value of the likelihood function for the model, n is sample size and k is the number of parameters to be estimated.

2.2.2. Vuong Test

Vuong test is used to compare two statistical models for count data [6], [7] which is introduced by Vuong (1989) [12]. It is a test that is based on a comparison of the predicted probabilities of two models.

Let's define,

$$u_i = \log\left\{\frac{P_1(Y_i|X_i)}{P_2(Y_i|X_i)}\right\} \quad (14)$$

where, $P_1(Y_i|X_i)$ and $P_2(Y_i|X_i)$ are the predicted probability of observed count for case *i* from model 1 and model 2 respectively.

Null hypothesis of Vuong test is considered as:

H_0: Both models are equally appropriate.

Against the hypothesis:

H_A: Model 1 is better than model 2,

or model 2 is better than model 1.

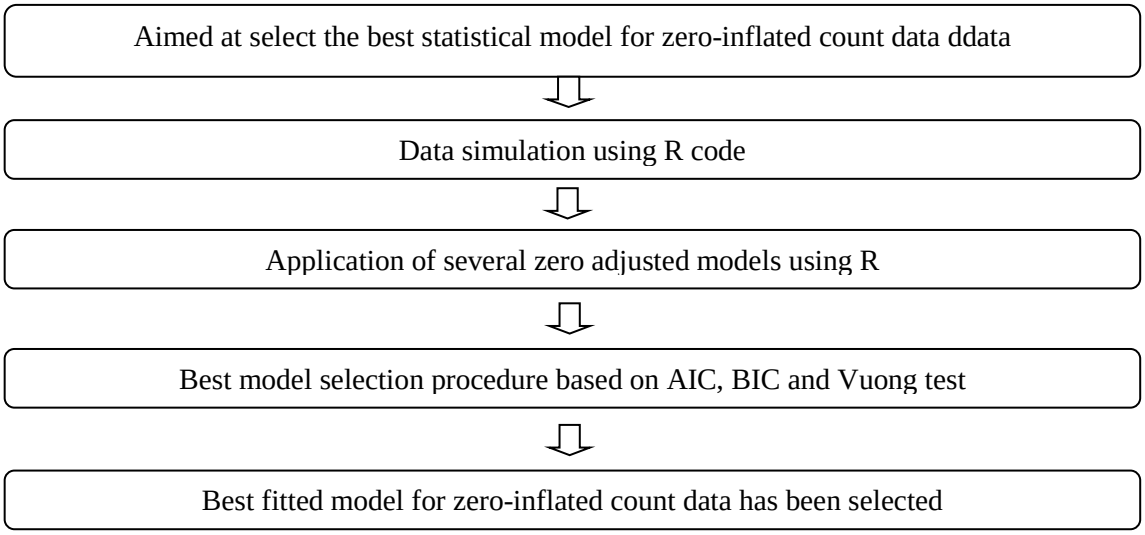
Under the null hypothesis, the Vuong test statistic is given by:

$$V = \frac{\bar{u}\sqrt{n}}{\sqrt{\mathrm{var}(u)}} \sim N(0,1) \tag{15}$$

where, $\bar{u} = \frac{1}{n}\sum_{i=1}^{n} u_i$, $Var(u) = \frac{1}{n}\sum_{i=1}^{n}(u_i - \bar{u})^2$ and n is sample size.

Mathematically, if V is greater than Z_α then model 1 is better than model 2 at α level of significance. Conversely, if V is less than $-Z_\alpha$ then model 2 is better than model 1 at α level of significance. Otherwise, model 1 and model 2 both models are equally appropriate at α level of significance.

The flowchart of this study has been shown in **Fig. 1**.



[1]
[2] **Fig. 1.** Flowchart of this study

2.3. Simulation Study

Simulation studies allow researchers to answer specific questions about data analysis, statistical power and best practices for obtaining accurate results in empirical research. This study has been conducted based on simulated datasets. To complete this study all programs have been written in **R** (**version 3.2.3; packages: MASS, pscl)** codes. The parameter vector $(\beta_0, \beta_1, \beta_2)$ has been used in the simulation study. The parameters values have been fixed as $\beta_0 = 0.5, \beta_1 = 1, \beta_2 = 1$ to simulate count data with excess zeros. In this study, 3 (three) sets zero-inflated count data consisting of 100, 500 and 1000 observations respectively have been simulated. The following equation(s) has been used to simulate zero-inflated count datasets using R.

$$Y \sim Poisson(\mu)$$

$$\log \mu = 0.5 + X_1 + X_2 \tag{16}$$

where, X_1 and X_2 have been generated from Normal distribution. For simplicity of zero-inflated count data modeling, 2 (two) binary covariates have been generated by random sampling method and then ZIP, ZINB, HP and HNB models have been applied to each dataset. AIC, BIC and Vuong test values have been computed for

ZIP, ZINB, HP and HNB models using each simulated dataset to compare these models as well as to select the best model.

3. Results

Each dataset contains with excess of zero (i.e. frequency of zero is maximum). The percentage of zero in case of each dataset has been shown in the Table 1.

Table 1. Percentage of zero in several datasets

Dataset (sample size)	Dataset 1 (n = 100)	Dataset 2 (n = 500)	Dataset 3 (n = 1000)
Percentage (%) of zero	28.0	33.4	29.5

The result of AIC, BIC and Vuong test values of ZIP, ZINB, HP and HNB in case of several datasets have been shown in the following Table(s).

Table 2. AIC and BIC value of ZIP, ZINB, HP and HNB models

Model	Data set 1 (n = 100)		Data set 2 (n = 500)		Data set 3 (n = 1000)	
	AIC	BIC	AIC	BIC	AIC	BIC
ZIP	859.60	875.23	4350.00	4375.29	9820.00	9849.45
ZINB	498.40	516.64	2402.00	2431.50	5042.00	5076.35
HP	859.60	875.23	4350.00	4375.29	9820.00	9849.45
HNB	487.20	505.44	2384.00	2413.50	4992.00	5026.35

Table 3. Vuong test result to compare ZIP, ZINB, HP and HNB models

[3]

Data set	Model	ZIP	ZINB	HP	HNB
Data set 1 (n = 100)	ZIP	----------			
	ZINB	V = -2.8501 P = 0.002 ZINB is better	----------		
	HP	V = -0.8479 P = 0.198 ZIP = HP	V = 2.8468 P = 0.002 ZINB is better	----------	
	HNB	V = -2.8730 P = 0.002 HNB is better	V = -1.7754 P = 0.038 HNB is better	V = -2.8700 P = 0.002 HNB is better	----------
Data set 2 (n = 500)	ZIP	----------			
	ZINB	V = -3.4546 P = 0.002 ZINB is better	----------		
	HP	V = -0.03641 P = 0.485 ZIP = HP	V = 3.4546 P = 0.002 ZINB is better	----------	
	HNB	V = -3.4394 P = 0.002 HNB is better	V = -1.6826 P = 0.046 HNB is better	V = -3.4394 P = 0.002 HNB is better	----------
Data set 3 (n = 1000)	ZIP	----------			
	ZINB	V = -6.2726 P = 0.000	----------		

		ZINB is better			
	HP	V = -0.2548 P = 0.399 ZIP = HP	V = 6.2726 P = 0.000 ZINB is better	----------	
	HNB	V = -6.2487 P = 0.000 HNB is better	V = -3.113 P = 0.001 HNB is better	V = -6.2487 P = 0.000 HNB is better	----------

[4] V=Vuong statistic, P = P-value; V > 1.64 indicates that row model had significantly better fit than the column model and V < -1.64 indicates that column model better fit than the row model had significantly at 5% level of significance.

From Table 2 it is seen that, the AIC and BIC value of Hurdle Negative Binomial (HNB) model is lowest in case of each dataset, which indicate that HNB model is the best model for modeling zero-inflated count data. The result of Vuong test has been shown in the Table 3 for 3 (three) datasets of sample size 100, 500 and 1000 respectively, which also indicates that HNB model is the best model for modeling this kind of count data.

4. Discussion

For modeling over-dispersed count data with excess of zero, zero-inflated models and hurdle models are more suitable than standard Poisson and Negative Binomial (NB) models [5], [8]. Although the choice between the hurdle and zero-inflated models should be based on the aim and endpoints of the study, but it is noted that hurdle model allows for over-dispersion and also accommodates presence of excess zeros, is more appropriate than zero-inflated model [3]. In some real fields, Zero-Inflated Negative Binomial (ZINB) and Hurdle Negative Binomial (HNB) models both lead to the same qualitative results and very similar model fits. But the Hurdle Negative Binomial (HNB) model is slightly preferable because it has the nicer interpretation [15]. Under the conditions of zero-inflation and over-dispersion, the hurdle model is more suitable because it performed well consistently and relatively easy to interpret and implement [9]. This study has been conducted using simulated data to compare several zero adjusted count data models such as ZIP, ZINB, HP and HNB models. According to AIC, BIC and Vuong test values, this study has been focused on Hurdle Negative Binomial (HNB) model as the best fitted model for modeling zero-inflated count data.

5. Conclusions

Zero-inflated count data have been implemented in real life and zero adjusted count models are being usually used in various disciplines such as public health, insurance, epidemiology, behavioral sciences, econometrics etc. Over-dispersion is the result zero-inflation which leads to serious underestimation of standard errors and ambiguous implication for the estimated parameters [13]. As a result, several estimation methods for several models have been anticipated to handle over-dispersed count data. Appropriate statistical model is indispensable for estimating parameters correctly which play significant role on interpretations of any study. The estimated parameters of the best fitted statistical model lead the accurate result of the analysis. According to this study, we suggest to apply Hurdle Negative Binomial (HNB) model as the best fitted statistical model in case of zero-inflated count data modeling which overcomes the over-dispersion problem.

An appropriate statistical model for zero-inflated over-dispersed count data has been suggested in this research. Hurdle model may be also applied for under-dispersed count data with zero-inflation. In rare practical field, under-dispersion may be occurred in case of count data without excess of zero which is also a crisis to estimate the parameters accurately. Further study may be conducted to choice a suitable statistical model for under-dispersed count data without zero-inflation.

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Assessing the Reliability and Validity of Online Tax System Determinants: Using A Confirmatory Factor Analysis

Bojuwon MUSTAPHA[1]
[1]Department of Accounting College of Management and Social Science Fountain University Oshogbo Nigeria

Abstract

This paper examined the determinants of an online tax system model using a confirmatory factor analysis onto the income taxpayers' in Nigeria. The data were collected through a questionnaire distributed to the income taxpayers in Nigeria. This questionnaire is constructed based on five variables which are the intention to adopt, information security, government support, compatibility, and complexity. The data were distributed to 600 income taxpayers with 400 returned. Out of which 55 were deleted as a result of missing data. In all, 345 completed questionnaires were used for the analysis. The data were analyzed using Analysis of Moment of Structural (AMOS) Version 21.0 through model specification, model evaluation, model modification, model verification and model estimation to improve the reliability and validity of the online tax system determinant. The result signifies that the variables are statistically significant and practically important as a determinant of the online tax system in Nigeria. The paper is accomplished by discussing the implication, limitation and suggestion for future study.

Keywords: ***information security, information security, government support, complexity, compatibility and relative advantage.***

1. Introduction

This paper laid emphasis to the reliability and validity of the variables that serves as the determinants of an online tax system. The constructs were analyzed by using confirmatory factor analysis (CFA) with five measures of model specification, model evaluation, model modification, model verification and model estimation. Thus, the five listed measure play a significant role in the goodness-of-fit indices of an underlying construct. The importance of measurement model is it is more reliable and valid in the alleviation of multicollinearity issues in a data. The adoption of more than one variable in a model appears as a way of modeling variable that are related to one another which means that, the issues of multicollinearity in an interrelated variable may exist (Dijkstra & Henseler, 2015). It is explained that confirmatory factor analysis can also be referred to as a measurement model (Hair, Tatham, Anderson, & Black, 2006). In the use of Analysis of Moment of Structural (AMOS) software two main types of modeling are applied, which is the confirmatory factor analysis (measurement model) and the structural model (Path Analysis) called structural equation modeling (SEM). The use of confirmatory factor analysis by researchers is now frequent in validating the instrument before proceeding for the structural model. In the case of this study, the confirmatory factor analysis is used for validating the instrument before proceeding for any other form of analysis. The application of measurement model was used to identify if there are any items of unidimensional to remove an item that loaded below the minimum threshold of (≥ 0.50). The presentation of a unidimensionality procedure is achieved when a researcher is able to measure items with an acceptable factor loading ≥ 0.50 for each item in a particular construct (Chapman & Feit, 2015). This study adopts the variable and the items were adapted from existing studies of the REF. Therefore, an item that is newly developed is measured with the minimum threshold ≥ 0.50 while an established scale is measured with a minimum threshold of ≥ 0.60. Hence, the study applies ≥ 0.60 as a threshold for the analysis.

Compatiblity

Compatibility is the process by which an invention is perceived as reliable with the present structure, experience and values within the system (Rogers et al., 2004). It refers to the compatibility of the innovation with the prevailing system which includes the software and hardware. The lack of compatibility with the application of any innovation by an organization can affect its implementation (Atif, Richards, & Bigin, 2012; Sahin & Rogers, 2006). The compatibility of a new system depends on how fast the integration of the new system to the existing practice (Tornatkzy & Klein, 1982). There are limited studies on the determinants of an online tax

system: survey evidence onto self-employed taxpayers are limited in the context of Nigeria. This study examines the innovation factor as a determinant of online tax system with survey evidence from self-employed taxpayers. This study uses compatibility and relative advantage as underlying variables to measure the determinant of an online tax system.

Considerable segments of self-employed taxpayers in Nigeria have no access to the Internet (Yesegat, 2009). At present, most self-employed taxpayers do not keep an adequate record of their businesses as a result of lack of support from the government (Soos, 1990). Furthermore, the government which is meant to be a motivator for the self-employed and make the environment conducive does not fully support them in terms of policies and regulations (McQuaid, 2002).

Hansen, Rand and Tarp (2009) examined government assistance during the start–up the rate that influences the long run of adoption of innovation. In addition, Fernández, Junquera and Vazquez (1996) identify managerial and sectorial characteristics which determine the range of government support received by innovation users in Spain. The finding shows that sectorial differences were minimal with regard to the importance of government support and it shows a significant correlation with government support. In this study, government support and online security as an underlying variable to measure the external factor in finding the relationship on the determinant of the self-employed taxpayers' usage of an online tax system in Nigeria.

(b) Security

Perceived security is one of the critical external factor that impact on the effectiveness of any technology adoption. Zhu and Kreamer (2005) have previously suggested the evaluation of the concept of security in the use of the online tax system. The study reveals that business operations in an environment with inadequate policy will have low levels of innovation adoption. Increasingly complex and security policy will slow down the usage of a new innovation like online tax system (Johnson & Lundvall, 2000). In a study conducted by Awogbade (2012) the inadequate existence of security framework in the electronic system in Nigeria is an issue to be addressed.

In the context of an online tax system which is related to e-tax transaction and e-tax payment, the government's inability to monitor all online tax systems adequately may arise. In this respect, the Internet service providers as well as tax officers and other trading partners have the chance to leak private tax information sent online by self-employed taxpayers to unauthorized users. More so, the environmental uncertainty that exists because of the inherent and the unpredictable nature of the Internet may be beyond the control of the service provider or the tax administrators. Hong and Cha (2013) found that two forms of security are specifically present in an online transaction; that is either behavioural or environmental uncertainty as a result of security.

In developing an online tax system and the application, the developer as well as the service provider can take measures to enhance the security of the tax transaction by way of encryption and firewall. There is still the possibility of third party users manipulating the transaction process. Another key factor in using an online filing system software online is the fact that there is security involved and outsiders can easily access these files from a secure browser. This means that encryption is about 256 bits and would take some time to get through it.

Lai, Normala and Meera (2004) observed that the effect in the use of security will stall the effective use of online tax system due to the uncertainty in the security system. Finding shows that online security has an effect on the use of information technology. Hence, this study examines the implication of the variables government support and perceived security as measures of external factor.

2. Methodology

2.1. Target Population

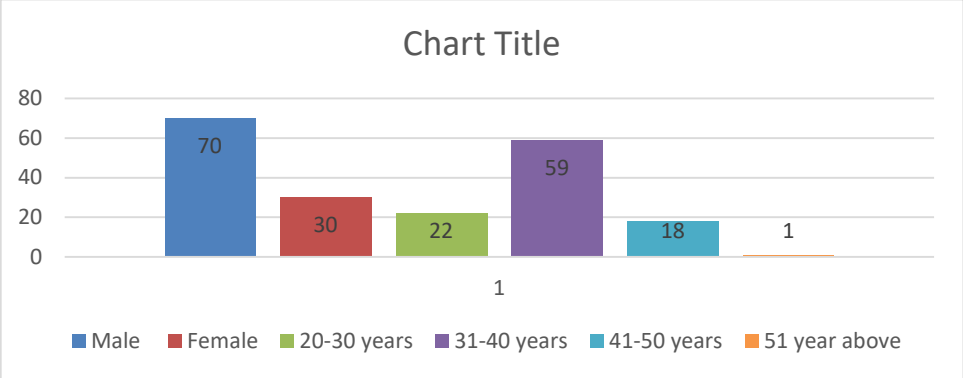
This paper applied a quantitative method of analysis with the means of distributing a survey questionnaire to the sampled population of income taxpayers in Nigeria. The questionnaire comprises of 19 items related to the five underlying variables used for this paper. The items adapted and modified on a five-point Likert Scale ranging from

1= strongly disagree, 2= disagree, 3= neutral, 4= agree and 5= strongly agree. A total number of 300 questionnaires were distributed, and 129 were returned out of which only 100 usable. The reaming 29 were discarded as a result of missing data and respondent ticking to scale in a particular item.

Respondent's profile

The preliminary analysis starts by understanding the respondent's demographic information which shows that the majority of the respondents are Male with a total number of 70 (70%), while the Female were with a total number of 0 (30%). On the respondent age, Majority of them were between the age of 31 and 40 years with total number of 59 (59%). The next were respondents aged between 20 and 30 years with total number of 22 (22%), age between 41 and 50 years were with a total number of 18 (18%). Finally, respondents age above 51 years were with a total number of 1 (1%) respectively. The third demographic variable is the respondent educational qualification. Table 1 exhibit the detail

Figure 1



2.2. The Measuring Instruments in the Study

The measurement of adapted and modified items emerged from the review of an existing literature to measure the level of involvement of the determinant of online tax system among the income taxpayers. The variable online tax system is referred to as the transmission of tax information directly to the tax administration through the use of internet (Edwards-dowe, 2008). This study looked at how variables such as compatibility, relative advantage information security, government support and complexity interact with each other. Thus, the items were encompassed on six sections. Since the paper is developed from the view of the income taxpayers in Nigeria, this paper would be used to customize the adapted and modified items accordingly in an order to suit the income taxpayers in the tax administration sector.

3. The Process Of Data Analysis

3.1. Unidimensionality

Unidimensionality refers to the degree by which the items single-handedly load on their respective construct without a parallel inter-correlation pattern with others (Segars, 1997). According to Gefen (2003) the unidimensionality of items cannot be passed using exploratory factor analysis with the Cronbach Alpha. In finding a unidimensionality in a construct, it means that there is no significantly shared variance among the variable they reflect.

In addition, the confirmatory factor analysis and the structural equation modeling provide for covariance of factor analysis with the ability to compare revised or re-specified measurement model through the statically significance of the data with the model (Bojuwon & Normala, 2015; Segars, 1997). The unidimensionality procedure is said to be classified as the model specification to specify which items to be retained in the construct as a measure based on the factor loading values. On these notes, when the confirmatory factor analysis has passed through the unidimensionality process, the discriminant and convergent validity is then followed. Finally, the goodness-of-fit indices are conducted in the confirmatory factor analysis model after the items have

successfully met the requirement of the unidimensionality procedure. The goodness-of-fit indices to measure the finding of this paper are in three groups, parsimonious fit: the Chi-square (x^2) and the chi-square divided by the degree of freedom (CMIN/DF); absolute find index: root mean square error of approximation (RMSEA); incremental fit: Tucker-Lewis index (TLI), normed fit index (NFI) and comparative fit index (CFI).

3.2. Model Estimation

The statistical inference and hypothesis testing as regards the specified model and parameters are appropriate when the sample size for the analysis is not too small for the selected model estimation method. A general guiding principle and the rule of thumb is that the minimum sample size should not be less than 200 cases when the observed variables are not multivariate and normally distributed (Bollen, 1989, 2014; Chen, Curran, Bollen, Kirby, & Paxton, 2008). According to the estimation of a model, may fail to converge as a result of an improper specification of the model provided. The use of structural equation modeling software is generally sensitive when there is an error in the steps with a message of warning on the screen of your system. Furthermore, all the parameter estimates are interpreted because they are within the correlation margin of the negative value of 1 and positive value of 1. There was no issue of ill-specified in the model, but in term of the data the sample size was small and still the variables are moderately correlated. This gives the evidence that there is no issue of multicollinearity since it is as a result of dependent variable having a high correlation with one another with a maximum value of threshold of > 0.85 (Westlund, Källström, & Parmler, 2008).

3.3. Model Evaluation

On the basis that the parameters of the model have been estimated with the model estimation, model evaluation would now be used to see which of the hypothesized model is to be retained or rejected using the classification of goodness-of-fit indices. The process of testing the hypothesis is essential by considering the null hypothesis being that the hypothesized model fits the data. The table 3 below classifies the fit of the model to the data into to 3 categories which are absolute fits, incremental feats and parsimonious fits to support the fitness with existing papers.

Table 1

Name of Category	Index full Name	Name of Index	Level of Acceptance	Literature
Absolute fit	Goodness0of-fit index	GFI	GFI > 0.90	Joreskog and Sorbom (1986)
	Absolute goodness-of-fit test	AGFI	AGFI > 0.90	Joreskog and Sorbom (1986)
	Standard root means square residual	SRMR	SRMR < 0.08	Bentler (1995)
	Root mean square error approximation	RMSEA	RMSEA < 0.8	Steiger and Lind (1982)
Comment	The higher the value of GFI and AGFI, as well as the lower value of SRMR and RMSEA, shows a better fit model to the data			
Incremental fit	Normed fit index	NFI	NFI > 0.90	Bentler and Bonett (1980)
	Tucker Lewis index	TLI	TLI > 0.95	Tucker and Lewis (1973)
	Relative non-centrality index	RNI	RNI > 0.90	McDonald and Marsh (1990)
	Comparative fit index	CFI	CFI > 0.95	Bentler (1990)
	Incremental fit index	IFI	IFI > 0.90	Bollen (1989)
Comment	The higher the value of the incremental fit indices shows an improvement of the model over the baseline model fit.			
Parsimonious fit	Chi-square/Df	Chi-square/Df	Chi-sq./Df < 5.0	Marsh and Hancover

				(1985)
Comment	The above information is sensitive to sample size of the study			

3.4. Model Modification

The process of model modification is required when the analysis is run and the model does not fit the data by checking the goodness-of-fit indices and the parameter loadings. Therefore, the step my looking at the modification indices from the output will give some evidence of some of the items that are needed to be covariance with each other to improve the fitness of the model to fit the data. In doing so, the existence of high correlation for each of the exogenous variables will result to the existence of multicollinearity. Apart from theses statistical assumption the item error terms must not correlate with each other. Based on the above scenario, scholars are advised against the regular changes of that are not strongly supported by an extensive theory (Byrne, 2009, 2012, 2013; Byrne, Shavelson, & Muthen, 1989). In conclusion the changes made based on the modification indices may not give the true model in term of the reality situation because it has been modified to fit the present situation (Jöreskog & Sörbom, 1982; Kaplan, 1990).

3.5. Discriminant validity

Discriminant validity is a process whereby the latent variable in a construct has the ability to account for more variance in the observed variable within the same conceptual framework. In case it does not happen, the evidence of individual item validity and the construct may be questionable (Fornell & Larcker, 1981). The share variance which is another name for the discriminant validity is also the total variance in a variable or construct that can be explained in another variable or construct of the same hypothesized model. The share variance is represented by the square, correlation between any two variable and construct a model. If the correlation between Y1 and Y2 is 0.6, then the shared shared variance between Y1 and Y2 is 0.36, and the if independent variable is correlated the predictive power will be shared over the dependent variable (Hair et al., 2006)

3.6. Average Variance Extracted (AVE)

The average variance extracted (AVE) is the amount of variance that the underlying variable is able to explain in the observed variable which is to be theoretically linked. The correlation between an underlying observed variable of construct B will correlate with the observed variable Y1 and Y2 that is theoretically related and are within the same construct of B. The correlation is generally denoted as a factor loading of the items in a model. The square of the factor loading will give the total variation in each of the observed variables the underlying variable accounted for in the model as share variance. Hence, the summation of all the variance across all the items that theoretically relate to a particular construct we lead to the generation of the Average variance extracted (Kline, 2005). According to Fornell and Larcker (1981), the method of assessing the discriminant validity of multiple variables is when the Average variance extracted of a construct is higher than the share variance with any other construct, then the discriminant validity is supported. The next table will present the summary if the type of reliability and validity with evidence of previous study. The next table will present the summarized type of reliability and validity with evidence of previous study to justify the use of confirmatory factor analysis in measuring items for the enhancement of the model for the further type of analysis.

Table 2: The Identified type of Reliability and Validity Measure

Validity	Technique	Description
Construct Validity		
Convergent Validity	Confirmatory factor analysis used in covariance based structural equation modeling only	GFI > 0.90, NFI> 0.90, AGFI > 0.90 and significant x^2 to indicate the evidence of unidimensionality. The items loading should be > 0.50 to show that more than half of the variance is captured by the latent construct Hair (2006)
Discriminant Validity	Confirmatory factor analysis used in covariance-based structural equation modeling only	Comparing the x^2 of the initial model with the revised model where the constructs in question

		are used as a construct. Hence, if the x^2 is significantly smaller in the original model that is the evidence of discriminant validity (Segars, 1997).
Convergent and Discriminant Validity	The principle component analysis and partial least square can be used to assess factors analysis, but it will not be as rigorous as confirmatory factor analysis in SEM with or without examining unidimensionality if the variables	The construct average variance extracted of each variable should be higher than its correlations in term of the construct. Also, each of the items should be higher on the assigned construct than on the other construct in the conceptual framework (Heller et al., 2015; Ramamurthy, Sen, & Sinha, 2008)
Construct Reliability		
Internal Consistency	This is measured with Cronbach Alpha	The reliability is measured with Cronbach alpha with a minimum threshold of 0.60 using exploratory factor analysis and 0.70 using confirmatory analysis (Nunnally, 1978).
	Structural Equation Modeling (SEM)	This is used to check the internal consistency coefficient is expected to greater than 0.70 (Hair et al., 2006).
Unidimensionality Reliability	The technique is based on the covariance in the Structural equation modeling only	The model comparison is better used in because is of important when we are talking of unidimensionality with significant value lower than the x^2 in the initial model before comparing with the revised model (Segars, 1997).

4. Data Analysis

With regard to the research objective of this paper which is to examine the determinants of an online tax system model using a confirmatory factor analysis onto the income taxpayers,' the confirmatory factor analysis is conducted. The first stage was to validate the measurement model prior to the modeling of the full flesh structural model. This paper has five construct dimension which is the intention to adopt (5 items), Information security (4 items), Compatibility (4), Government support (3) and Complexity (3). The evidence of good measurement model should have all the items loading greater than 0.50 (Hair et al., 2006) Table 3 shows the details of the items used for each of the variables.

Table 3 number of items on each variable

Construct	Number of items before remove	Number of Items after remove
Intention to adopt	7	5
Information Security	6	4
Compatibility	5	4
Government Support	5	3
Complexity	4	3
Total number of Items	27	19

Despite the procedure of unidimensionality, the model estimation, model evaluation, the model modification was applied to obtain the actual result from the analysis. On the basis of the unidimensionality measure mentioned above, the model evaluation is considered as the goodness-of-fit indices which was obtained based on

the Root Mean Square Approximation, the baseline comparison of (CFI, TLI and IFI) and the Chi-square divided by the degree of freedom (CMIN/Df). The full details are presented in Table 4.

Table 4 fitness before constraints

Variables	Chi-square	RMSEA	CFI	IFI	TLI
Types of fits	Parsimonious fits	Absolute fits	Incremental fits		
Intention to adopt	7.730	0.194	0.930	0.932	0.877
Information security	5.763	0.115	0.891	0.892	0.867
Compatibility	6.021	0.163	0.944	0.945	0.835
Complexity	10.75	0.184	0.912	0.913	0.849
Government support	8.433	0.142	0.972	0.972	0.868

The initial analysis result does not meet the requirement of a good fit model for the parsimonious fit all the fit indices are ≥ 5 given the evidence that the requirement is not achieved. The non-fit of indices in the initial analysis is as a result of multicollinearity issue when the model variables are run unilaterally. Based on the assumption of statistics the variables must be independent and not correlated with each other. The item with the lowest factor loading are removed and the model was re-specify to achieve a better model fit. The evidence of the data not fit with the model we employ the model modification to reduce the level of multicollinearity issues among the items. Thus, the model modification is important in this paper to ascertain the best fitting model. Table 5 gives the details of the result after the modification.

Table 5 fitness after constraints

Variables	Chi-square	RMSEA	CFI	IFI	TLI
Types of fits	Parsimonious fits	Absolute fits	Incremental fits		
Intention to adopt	2.109	0.051	0.978	0.978	0.970
Information security	1.133	0.054	0.982	0.982	0.955
Compatibility	1.061	0.025	0.955	0.955	0.967
Complexity	2.213	0.031	0.967	0.967	0.984
Government support	2.542	0.043	0.984	0.984	0.999
Intention to adopt	1.112	0.077	0.988	0.981	0.982

With regard to the table 6 below, all the variable shows that the correlation measure are ≥ 0.85. Thus, the evidence of discriminant validity is achieved and all these variables can be analyzed in the structural equation modeling for further analysis. According to Fornell and Larcker (1981) if the correlation between exogenous variables is higher than 0.85, the researcher can conclude that the discriminant validity is not achieved or not accepted. The correlation value ranged from 0.399 to 0.750 respectively. It is hence concluded that the variable shows a satisfactory result of discriminant validity to proceed for further analysis

Table 6: Correlation Result

			Estimate
INTA	<-->	COMP	.658
COMP	<-->	GOVS	.740
ISEC	<-->	COMP	.617
COPX	<-->	COMP	.399
COPX	<-->	INTA	.646
INTA	<-->	GOVS	.750
ISEC	<-->	GOVS	.729
INTA	<-->	ISEC	.661
COPX	<-->	ISEC	.467
COPX	<-->	GOVS	.683

The revised model has shown a good-of-fit indices after the removal of loading that are ≤ 0.50 and the constraint of the items that represent the model modification. Therefore, the construct validity was employed to validate the measurement model that consists of Average Variance Extracted (AVE) and the bivariate correlation (CR). If the bivariate correlation is ≥ 0.85 among the exogenous variables, the researcher should choose either one to remove from the subsequent analysis. This is because it is indicated that a highly bivariate correlation is having the same contribution among the same variable in a construct.

4.1. Convergent Validity

Accordingly, the convergent validity of the measurement model proposed three procedures to assess the convergent validity, which is the traditional method (Cronbach Alpha), Composite Reliability (CR) and Average variance extracted (AVE). According to Heller et al. (2015) the traditional method with the use of Cronbach alpha is with the minimum threshold of 0.70. This is also applied with the use of the Composite reliability with a threshold value of 0.70. While the average variance extracted is set to the minimum threshold of 0.50

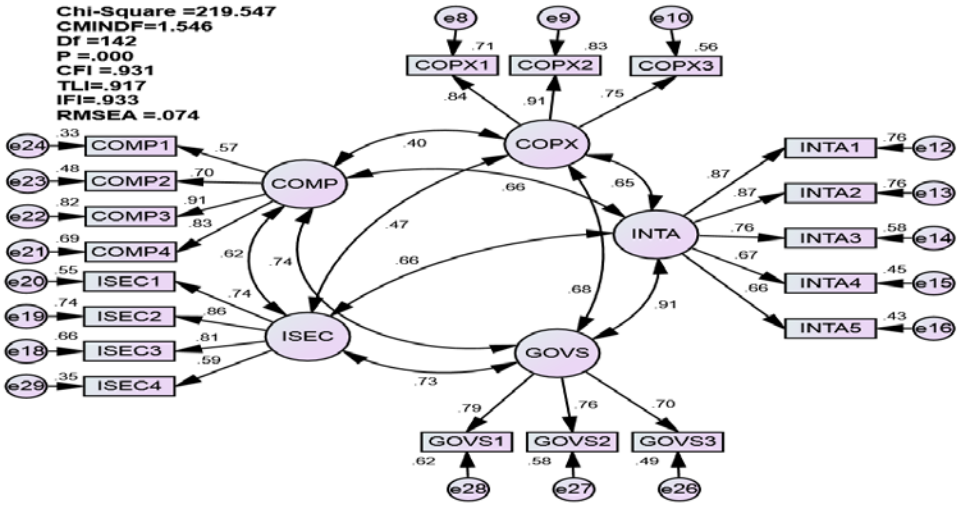
Composite reliability for all the variables in the model were above 0.80. The average variance extracted based on the result were all higher than the minimum threshold of 0.05 (Byrne, 2012, 2013). The evaluation of convergent validity was by examining the items loading and the squared multiple correlations from the measurement model. It shows that all the items loading is greater than 0.60 given the evidence of convergent validity as details in Table 7. Thus, all the variables in the measurement model had satisfactory reliability value and evidence of convergent validity.

Table 7: Convergent Validity

Construct	Items loadings	Factor loading	Cronbach Alpha	CR	AVE
	INTA	.873			
	INTA	.873			
Intention to adopt	INTA	.759	0.881	0.880	0.598
	INTA	.673			
	INTA	.659			
	ISEC	.810			
Information security	ISEC	.859	0.830	0.841	0.574
	ISEC	.745			
	ISEC	.688			
	COMP	.833			
Compatibility	COMP	.907	.831	0.845	0.583
	COMP	.696			
	COMP	.675			
	COPX	.840			
Complexity	COPX	.910	0.863	0.873	0.697
	COPX	.746			
	GOVS	.697			
Government support	GOVS	.763	0.789	0.883	0.662
	GOVS	.786			

The figure 2 below shows the structural model after evaluating the goodness of fit with a value of the correlation. This step is important to develop the discriminant validity for latent exogenous and endogenous variables. Hence, the constraint or double-headed arrow is required to examine the strength correlation between these constructs. Further analysis in the measurement model shows the df = 142, Chi-square value = 219.547 given the normed chi-square value to CMIN/DF = 1.546, P-value =0. 000, CFI= 0.931, IFI =0. 933, TLI = 0.9I7, and RMSEA = 0.074 which met all the requirements that the variables met the variance of observation in the study to proceed for the structural model for future study.

Figure 1: Construct Validity



4.1. Discriminant Validity

The discriminant validity is to measure and share the variance that exist between the variables and the average variance extracted from each of the individual variables. According to Fornell and Larcker (1981), discriminant validity is presented when the variance shared variables of a construct with another construct is less than the variance that the construct shares with it items. The analysis reveals that the shared variance among the variables were lower than the variance extracted for each of the variables. This gives the evidence of discriminant validity which is detailed in table 8. In conclusion, the analysis using confirmatory factor analysis for the measurement model demonstrated adequate reliability convergent and discriminant validity to proceed for the hypothesized structural model.

Table 8: Discriminant Validity

	COPX	INTA	COMP	GOVS	ISEC
COPX	0.835				
INTA	0.446	0.843			
COMP	0.399	0.658	0.763		
GOVS	0.483	0.605	0.740	0.849	
ISEC	0.467	0.661	0.617	0.729	0.757

5. Discussion and Conclusion

Using the determinant of the online tax system in the measurement model, the result revalued that the validity and reliability value by applying measurement model as a procedure is achieved through the confirmatory factor analysis. The confirmatory factor analysis is an important method of analysis when a researcher is trying to examine whether a particular item is measuring what is been required to measure. Hence, the reliability and validity applied in this study is to address the issue of multicollinearity and to improve the fitness of the specified model. In conclusion, a better model is said to depend on the goodness-0f-fit indices of the measurement model. Thus the requirement for the unidimensionality, validity and reliability needs to be addressed prior to the use of the full structural model.

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Structural Breaks in Potential GDP for Romanian Economy

Dorin JULA[1], Nicoleta JULA[2].
[1]Ph.D, Financial Management Faculty, Ecological University of Bucharest and Institute for Economic Forecasting, Romanian Academy
[2]Ph.D, Faculty of Economics and Business Administration, "Nicolae Titulescu" University of Bucharest

Abstract

In the paper we have calculated the potential gross domestic product for Romanian economy, by using both the trend functions (deterministic and stochastic) and the filters (Hodrick-Prescott filter and band-pass filters). We found that the log-quadratic deterministic trend with structural breaks method offer the best outcomes. Bai-Perron tests has selected 1999q1 and 2009q1 as moments of structural breaks. According this technique, the Romanian potential GDP was over 6% during the 2004-2008 period and returns to around 6% in the years 2016-2017. With a few exceptions (recorded before 2010), output gap was above -0.5 and below +0.5% of GDP. This mean that the evolution of economic growth in Romania (especially after 2010) do not has induced inflationary pressures, through supply-side.

Keywords: ***potential gross domestic product, output gap, trend functions, structural breaks filters***

JEL Classification: C22, C24, O11

Introduction

In Gavin (2012) words, *potential gross domestic product* (GDP) is "a theoretical concept that means different things to different people" (Gavin 2012, 1). Hence, in the economic literature there are several definitions of *potential gross domestic product* (GDP).

In the OECD's Economic Outlook publication, potential GDP is defined "as the level of output that an economy can produce at a constant inflation rate […] Potential output depends on the capital stock, the potential labour force (which depends on demographic factors and on participation rates), the non-accelerating inflation rate of unemployment (NAIRU), and the level of labour efficiency" (OECD 2014). European Union adopts a similar definition: "Potential output is a concept used to measure the highest level of production that an economy can reach without generating inflationary pressures" (European Parliament 2015).

In Gavin opinion, "[monetary policymakers] estimate potential GDP by constructing measures of the trend in actual GDP that smooth out business cycle fluctuations" (Gavin 2012, 1). Therefore, in Romania, the national monetary policymakers, namely the National Bank of Romania (NBR) keeps the following definition: "The equilibrium level of GDP at which the ratio between the capital stock and the amount of labour employed generates no inflationary pressures is called the potential GDP." (National Bank of Romania August 2005, 41). Recently, the National Commission for Prognosis (NCP) keep hold of a more complex definition: "Potential GDP stands for a stable level of gross domestic product corresponding to the aggregate supply curve over the medium and long term, so that the transient effects of macroeconomic distortions disappear. Potential GDP explains that growth in relative equilibrium conditions, i.e. without pressure on inflation and employment" (National Commission for Prognosis 2018, 4).

Whatever the method of calculating potential GDP, *output gap* is calculated as the difference between a real (actual) level and the potential level of gross domestic product:

GDP Gap = Real (actual) GDP – Potential GDP.

Potential gross domestic product and *output gap* are some of the most widely used variables by policymakers in building monetary and fiscal macroeconomic policies. In European Union, "the surveillance of fiscal policies of EU Member States makes extensive use of estimates of the potential output and related concepts, including output gap and structural budget balance" and "the role of output gap estimates in economic analysis and fiscal policy is twofold: to quantify the nature of the economic cycle and identify the actual economic situation within the cycle, and to suggest counter-cyclical economic policies aimed at influencing the length and the effects of the cycle itself" (European Parliament 2015).

Table 1. Annual fiscal adjustments towards the medium-term objective (MTO) under the preventive arm of the Stability and Growth Pact (SGP)

Economic cycle	Condition	Required annual fiscal adjustment (in percentage points of GDP)			
		Debt below 60 % and no sustainability risk		Debt above 60 % or sustainability risk	
		growth < potential	growth > potential	growth < potential	growth > potential
Exceptionally bad times	real growth < 0 or output gap < -4	no adjustment needed			
Very bad times	-4 ≤ output gap <-3	0		0.25	
Bad times	-3 ≤ output gap < -1.5	0	0.25	0.25	0.5
Normal times	-1.5 ≤ output gap < 1.5	0.5		> 0.5	
Good times	output gap ≥ 1.5 %	0.5	≥ 0.75	≥ 0.75	≥ 1

Source: Synthesis according to European Commission (Strasbourg, 13.1.2015 COM(2015) 12 final) Communication from the Commission to the European Parliament, The Council, The European Central Bank, The Economic and Social Committee, The Committee of the Regions and The European Investment Bank: *Making the Best Use of the Flexibility Within the Existing Rules of the Stability and Growth Pact*, Annex 2, p. 20. Available at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0012&from=EN

1. Basic methods for potential gross domestic product and output gap calculation

The basic methods for potential gross domestic product (and thereby, output gap) calculation can be lay out into three broad classes: methods derived from economic theory (structural methods); a-theoretical methods (that determine the trend by using statistical techniques – trend function and/or filters); and mixed methods (that combine statistical procedures with elements based on relations brought from economic theory).

1.1. Methods derived from economic theory

These methods start from the fact that potential output is a measure of production capacity of the economy, therefore any estimation of potential output must be based on explicit dependence of inputs. This relationship between inputs (usually, capital, labour, and total factors productivity) and outputs is expressed through a production function, most often by the Cobb-Douglas type production function. This type of calculation allows to draw out the contribution of each factor to (real or potential) economic growth (i.e. bringing to light the sources of economic growth).

As disadvantages, we notice that methods derived from economic theory are based on the acceptance of strongly restrictive assumptions, which may not be consistent with the data. More exactly, some values are required for model parameters - for example, the factors elasticity in the production function (take usually as a steady weight of labour costs in production value). Moreover, as a rule, the models derived from economic theory use deterministic trends for cyclical adjustment of potential output. But, there are empirical studies on business cycles that shows that variable trends are more proper than deterministic ones to most macroeconomic data series. Additionally, models based on economic theory typically use estimations of some thresholds (e.g. non-accelerating inflation rate of unemployment – NAIRU). And a such estimates are uncertain. Or, the models use various techniques (accept assumptions) to evaluate the expected values of some variables (e.g., expected inflation). And, by that, uncertainty about the potential GDP determination is transferred to the NAIRU calculation.

1.2. A-theoretical methods

Broadly speaking, these methods estimate the trend of output (e.g. GDP) by using statistical techniques – trend function and/or filters. As advantages, we bring up the fact that, technically, they are simple (easy) to apply, are transparent and easy to understand. Furthermore, the statistical techniques do not depend by the context in which they are applied (e.g. the nature, or the significances of data series), or by the constraints imposed by a certain economic theory.

As disadvantages, we point out that they are not explicitly rooted in economic theory. As United States Congressional Budget Office emphasizes: "they provide a measure of trend output but not potential output" (Congressional Budget Office 2004, March, 2). Likewise, technically, these methods arise the risk of generating false cycles.

These methods try to estimate the trend for the whole-time series. To achieve this goal, a-theoretical methods use trend functions (deterministic or stochastic trend) or apply different filters (e.g. Hodrick-Prescott, Band-Pass Filters).

A summary of different methods used for estimating potential GDP can be found in (Congressional Budget Office 2004, March).

2. Potential gross domestic product in Romania

2.1. Economic literature on Romanian potential GDP

A 2007 study, conducted at the National Bank of Romania (Gălăţescu, Rădulescu and Copaciu 2007) has set as objective "to estimate the growth rates of potential GDP for Romania". To this end, the authors "implement several univariate and multivariate methods for the measurement of potential GDP growth: production function, filters with unobservable components, structural vector autoregressions" (Gălăţescu, Rădulescu and Copaciu 2007, 3). They found that "the estimates arrived at with different methods and specifications offer similar conclusions" (Gălăţescu, Rădulescu and Copaciu 2007, 16). The authors' main findings are synthesized in the following statements: "The results indicate an increasing annual potential GDP growth rate, from an average of 3-4 percent in the 2000-2002 period to values of around 6 percent in recent periods [2003q1-2006q2, *our note*]. Thus, Romania's potential GDP has grown at rates significantly above those registered by new EU Central and Eastern European member states and South European states in their periods of high growth; the magnitude of Romania's growth rates is comparable to that of growth rates in the Baltic countries, being exceeded only by the size of growth rates estimated for Ireland and Latvia" (Gălăţescu, Rădulescu and Copaciu 2007, 16).

By using both a HP filter and a Cobb-Douglas production function (Andrei and Păun 2011, 19) estimated the growth of potential GDP for Romania between -0.36% and 2% during the 1994-2000 period and an increase to 5%-6.7%, over 2004-2008. In a later article, (Andrei and Păun 2015) used more filters (Hodrick-Prescott, Baxter-King, Christiano-Fritzgerald) and the same Cobb-Douglas production function. The authors found that the Christiano-Fritzgerald band-pass filters performed better for the end to extract Romanian potential GDP over the period 2000-2012.

(Altăr, Necula and Bobeică 2010) estimated potential GDP for the Romanian economy by using a production function structural method, combined with several filtering methods. Authors found "for the period 2001-2008 an average annual growth rate of the potential output equal to 5.8%, but on a descending slope, due to the adverse developments in the macroeconomic context" (Altăr, Necula and Bobeică 2010, 5).

The Economic Programming Council, from National Commission for Prognosis has recently published an analysis of potential GDP for the Romanian economy (National Commission for Prognosis 2018). Correspondingly, in *Spring forecast 2018*, National Commission for Strategy and Prognosis, estimate the following values for potential GDP:

Table 2. CNSP estimating of potential GDP

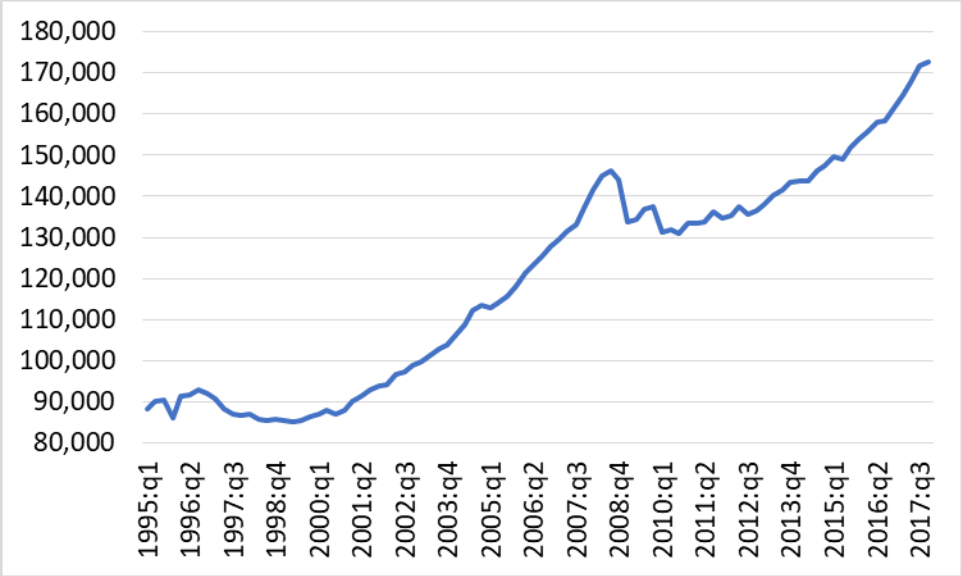
Year	2016	2017	2018	2019	2020	2021
Potential GDP (% change on previous year)	4.3	4.7	5.2	5.4	5.3	4.9

Source: National Commission for Strategy and Prognosis, *Spring forecast 2018: Projection of the main macroeconomic indicators, 2018-2021,* p.2. Online at: http://www.cnp.ro/user/ repository/ prognoze/prognoza_2018_ 2021_varianta_de_primavara_2018. pdf

2.2. Estimating the potential GDP for Romanian economy

In figure 1, we depict the Romanian Gross Domestic Product, where the data are for the period between 1995 and 2017. On these data we estimate the potential GDP.

Figure 1. Romania - Gross domestic product at market prices, quarterly data, chain linked volumes (2010), million units of national currency, seasonally and calendar adjusted data



Source: *Eurostat* (table *namq_10_gdp*), http://ec.europa.eu/eurostat/data/database

Deterministic Trend

Log-linear Deterministic Trend

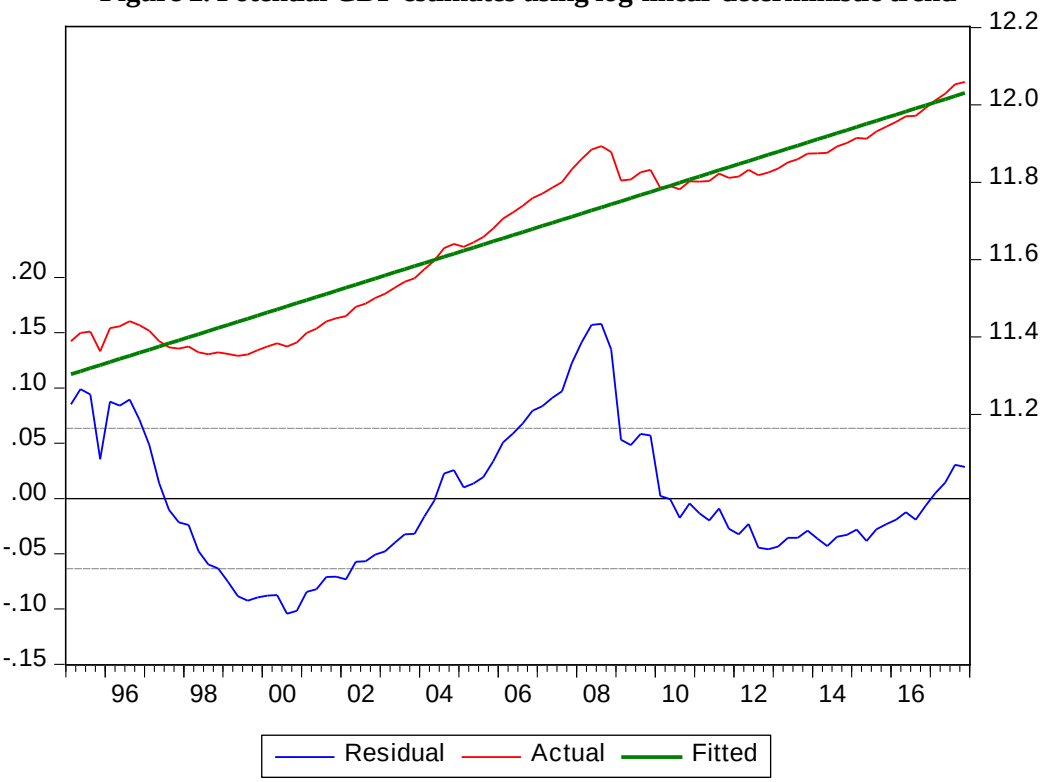
For the time series data depicts in figure 1 (GDP means *Gross domestic product* at market prices, quarterly data, chain linked volumes (2010), million units of national currency, seasonally and calendar adjusted data), we first estimate the potential GDP through the log linear deterministic trend (figure 2). The results are the following:

Model: $\ln(GDP_t) = a_0 + a_1 t + e_t$,

Estimated model: $\underset{}{\ln(GDP_t)} = \underset{(0.01314)}{11.30363} + \underset{(0.00025)}{0.00799} \cdot t,\ R^2 = 0.9194$

(in parenthesis, under estimators: standard deviation)

Figure 2. Potential GDP estimates using log-linear deterministic trend



Source: authors' calculations in EViews-10, based on the *Eurostat* (table *namq_10_gdp*) data (http://ec.europa.eu/eurostat/data/database)

Log-Quadratic Deterministic Trend with Structural Breaks

The data depicts in figure 2 suggest a more complex dynamic of real and potential GDP. Therefore, we built a deterministic log-quadratic trend model with structural breaks (figure 3). The model is:

$\ln(GDP) = a_0 + a_1 t + a_2 t^2 + e_t$

(Method: Least Squares with Breaks: Break type: Bai-Perron tests of L+1 vs. L sequentially determined breaks, Breaks: 1999Q1, 2009Q1). EViews-10 solutions:

1995q1 – 1998q4: $\ln(GDP_t) = \underset{(0.00837)}{11.39502} + \underset{(0.00259)}{0.007366}\cdot t - \underset{(0.00017)}{0.000730}\cdot t^2$

1999q1 – 2008q4: $\ln(GDP_t) = \underset{(0.01990)}{11.23071} + \underset{(0.00120)}{0.004148}\cdot t + \underset{(0.00002)}{0.000149}\cdot t^2$

2009q1 – 2017q4: $\ln(GDP_t) = \underset{(0.11616)}{12.83203} - \underset{(0.00120)}{0.033954}\cdot t + \underset{(0.000022)}{0.00028}\cdot t^2$

$R^2 = 0.9971$, dw = 1.36

(in parenthesis under estimators: standard deviation)

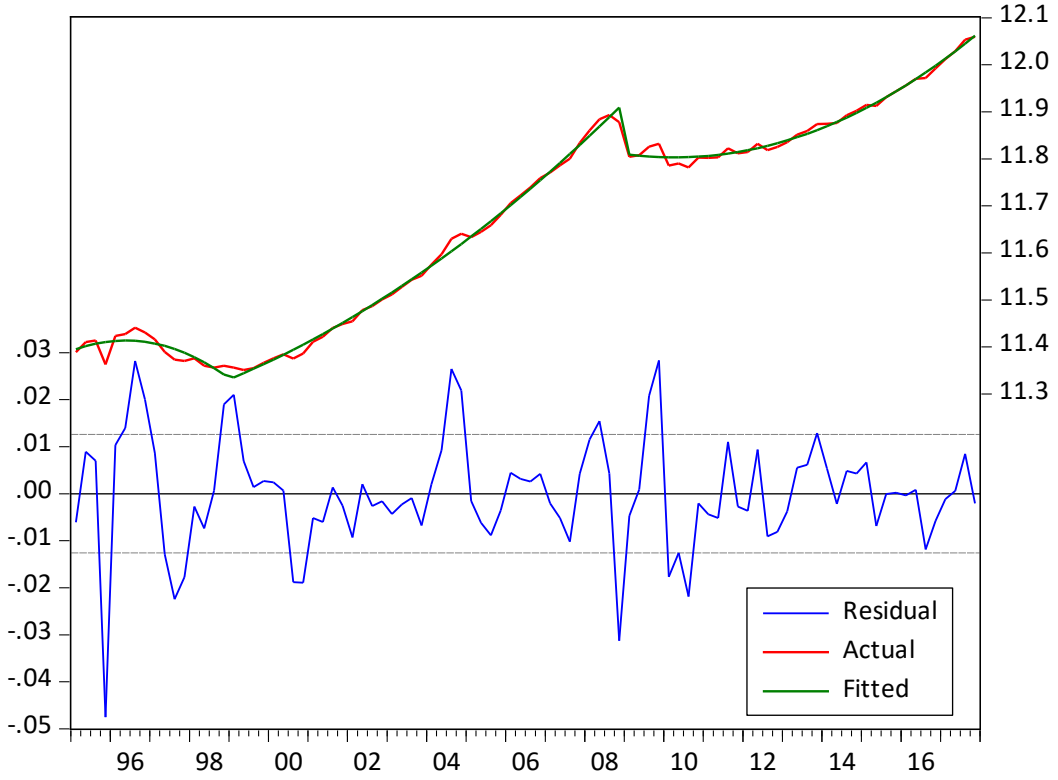
By combining the previous relationships, we obtain the following model:

$\ln(GDP_t)$ = @before("1999q1")·(11.39502 + 0.007366·t - 0.00073·t^2) +

+ @during("1999q1 2008q4")·(11.23071 + 0.004148·t + 0.000149·t^2) +

+ @after("2009q1")·(12.832023 - 0.033954·t + 0.000280·t^2)

Figure 3. Potential GDP estimates using log-quadratic deterministic trend model with structural breaks



Source: authors' calculations based on the *Eurostat* (table *namq_10_gdp*) data (http://ec.europa.eu/eurostat/data/database)

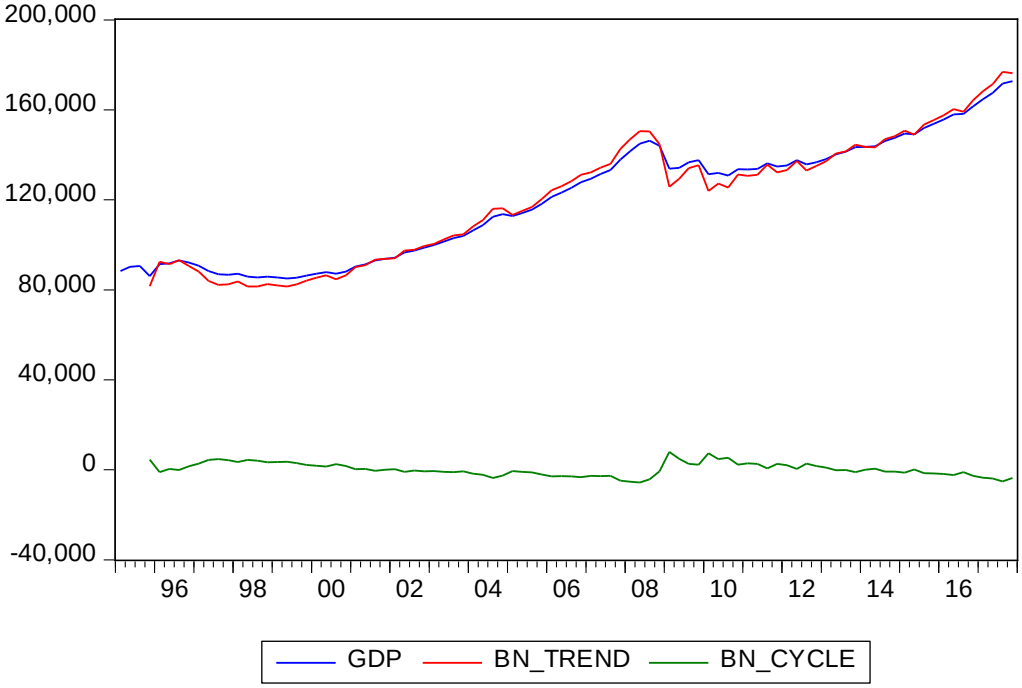
Bai-Perron tests has selected 1999q1 and 2009q1 as moments of structural breaks. Both moments are explicable, given the economic developments in Romania. The first, 1999q1, marks the resumption of economic growth after the strong depression registered in the years 1997-1998, and the second moment, 2009q1, is related to the economic and financial crisis registered at the end of the first decade of this century.

Stochastic Trend

Beveridge-Nelson (1981) proposes a method of decomposing a non-stationary series into a **permanent component** (trend) and a **transitory** (cyclic) component, by using an ARIMA(p, 1, q) model. The procedure allows both components to be stochastic. The trend (τ_t – the permanent component) is produced by a series of non-predictable shocks (innovations) and is modelled as a *random walk with drift.*

$y_t = y_{t-1} + e_t$, where e_t is an ARMA(p,q) process.

Figure 4. Potential GDP estimates (trend) and output gap (cycle) using Beveridge-Nelson decomposing



Source: authors' calculations in EViews-10, based on the *Eurostat* (table *namq_10_gdp*) data (http://ec.europa.eu/eurostat/data/database)

Beveridge and Nelson decompose the time series $y_t = y_{t-1} + e_t$ [where e_t is an ARMA(p,q) process] into two parts:

$$y_t = \tau_t + \xi_t$$

where the permanent component is

$$\tau_t = \tau_{t-1} + \varepsilon_t,$$

(ε_t is white noise). Also, the cyclic (transitory) component (ξ_t) is a *stationary process with zero mean*.

To apply a such model, first we test if real GDP are I(1), and if the shocks may be described as ARMA process.

Indeed GDP is nonstationary I(1) process, even if we admit the structural breaks in trend (the tests are detailed in Annex A1). But, $\xi_t = d(GDP_t)$ is not an ARMA process. According to the BDS test and the Variance Ratio Test, d(GDP) is a series with i.i.d. values (the tests are detailed in Annex A2). Nevertheless, for comparison, we apply the Beveridge-Nelson decomposing on GDP. The results are depicted in figure 4.

Filters

Hodrick-Prescott Filter

The Hodrick-Prescott Filter (1981, 1997) is one of the most popular and used methods for extracting a trend from a time series. Let X_t a time series which should be decomposed into two components: a trend (TR_t) and a cyclic component (C_t):

$$X_t = TR_t + C_t.$$

The Hodrick-Prescott filter extracts the trend by minimizing the following expression:

$$\sum_{t=1}^{T}\left(x_t - TR_t\right)^2 + \lambda\sum_{t=2}^{T-1}\left[\left(TR_{t+1} - TR_t\right) - \left(TR_t - TR_{t-1}\right)\right]^2$$

The first term measures the degree of deviation from the trend, and the second term is a measure of smoothing the series. Because there is a conflict between adjustment and smoothing, a compromise parameter is used, λ. If λ = 0 then the trend becomes equal to the initial series, and if λ goes to infinity, then HP approximates a linear trend. In the literature, λ = 1600 is the value suggested for the quarterly data. For λ = 1600 (GDP is calculated as quarterly data), the HP trend and HP-cycle are depicted in figure 5.

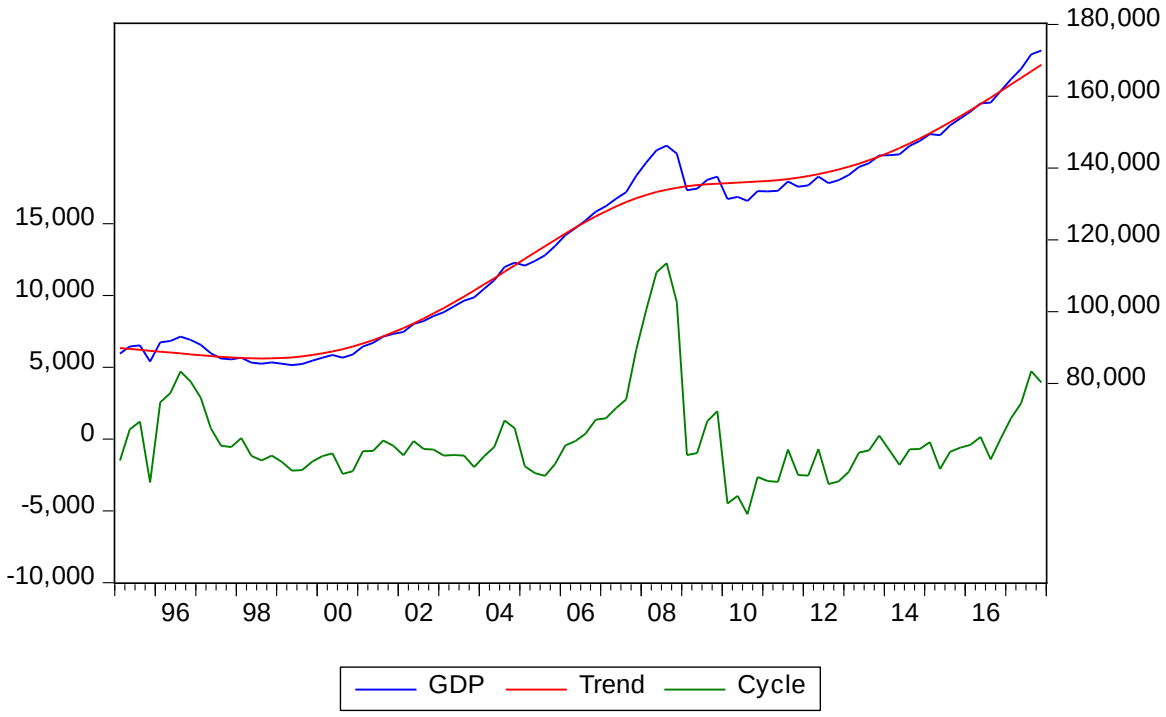
Band-Pass filters

Band-Pass filters are used to extract the cyclical component of a time series by specifying a range of the cycle (periodicities). For annual frequency data, for example, a filter (2; 8) is usually used, i.e. fluctuations lasting at least 2 years and maximum 8 are considered cyclical. For quarterly Frequency Data, a filter (6; 32) is usually used.

Symmetric filters

In symmetric filter the lead and lag length are fixed. The result of applying the Baxer-King symmetric filter (1999) to the GDP series, with cycle low period = 6, and high = 32, is shown in figure 6.

Figure 5. Potential GDP estimates (trend) and output gap (cycle) using Hodrick-Prescott Filter



Source: authors' calculations in EViews-10, based on the *Eurostat* (table *namq_10_gdp*) data (http://ec.europa.eu/eurostat/data/database)

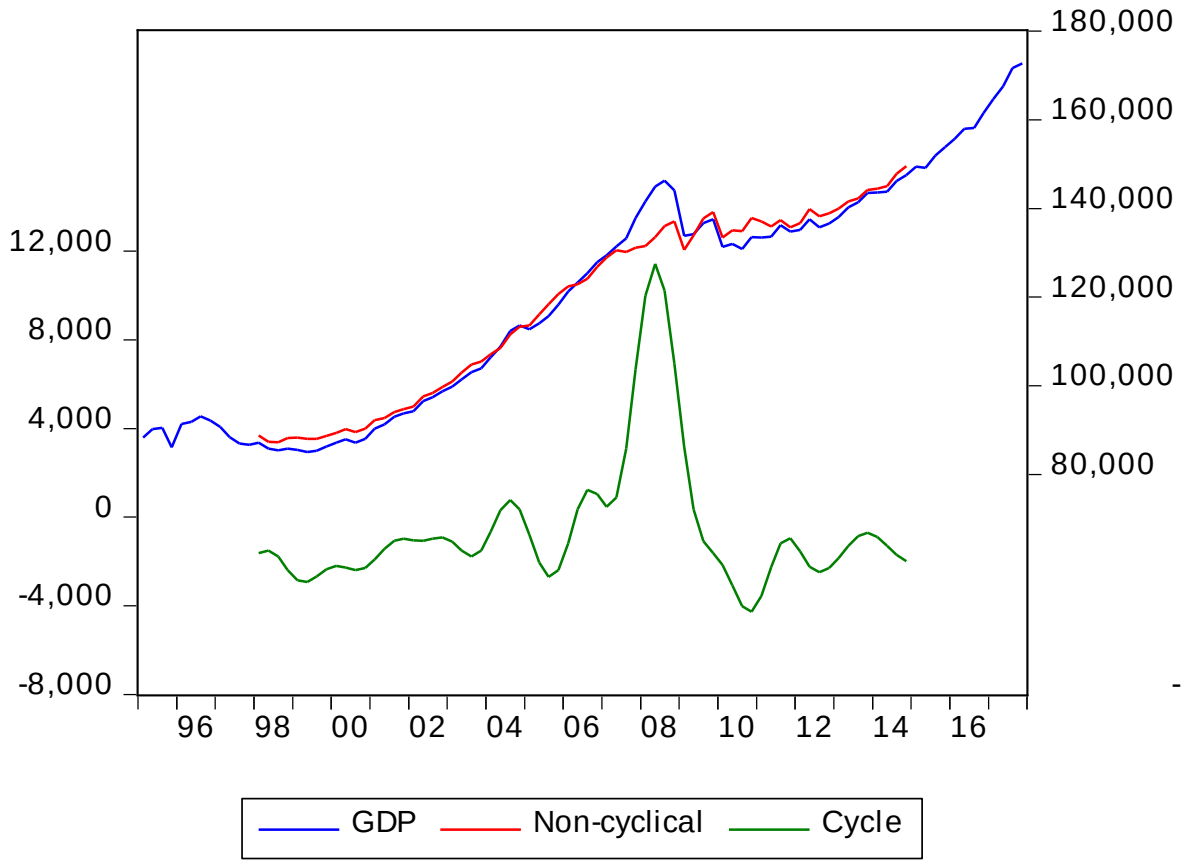
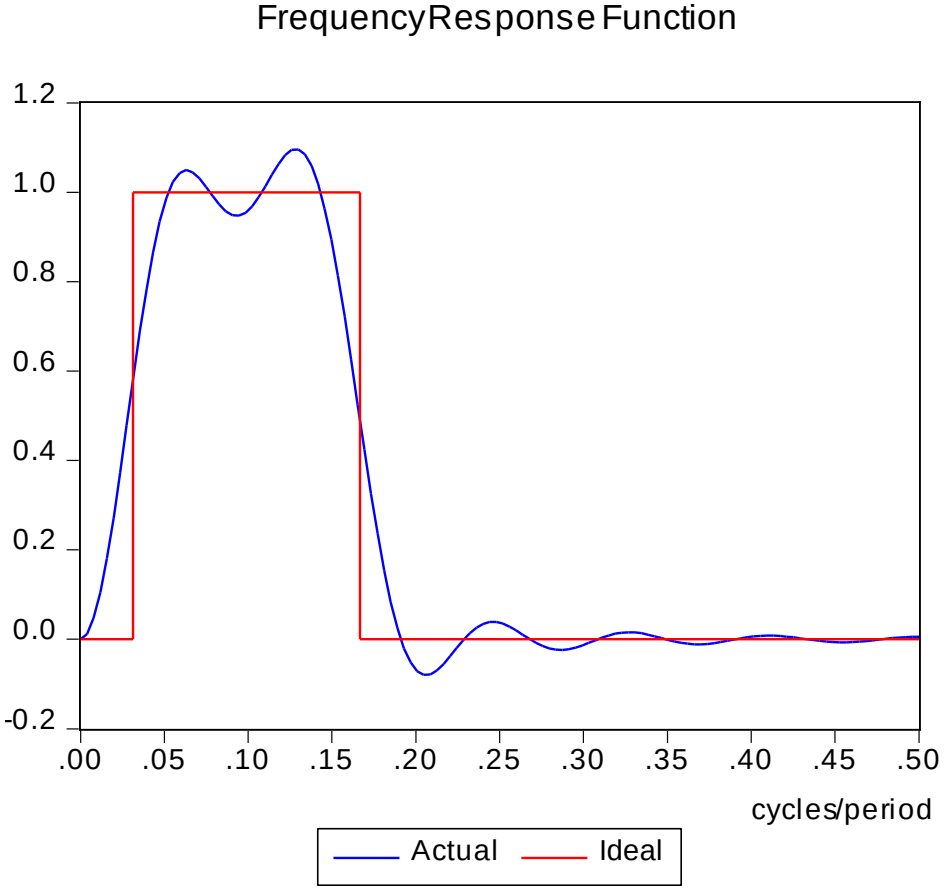

180,000
160,000
140,000
120,000
100,000
80,000
12,000
8,000
4,000
0
-4,000
-8,000
96
98
00
02
04
06
08
10
12
14
16
GDP
Non-cyclical
Cycle

Figure 6. Potential GDP estimates (non-cyclical) and output gap (cycle) using Baxer-King symmetric filter



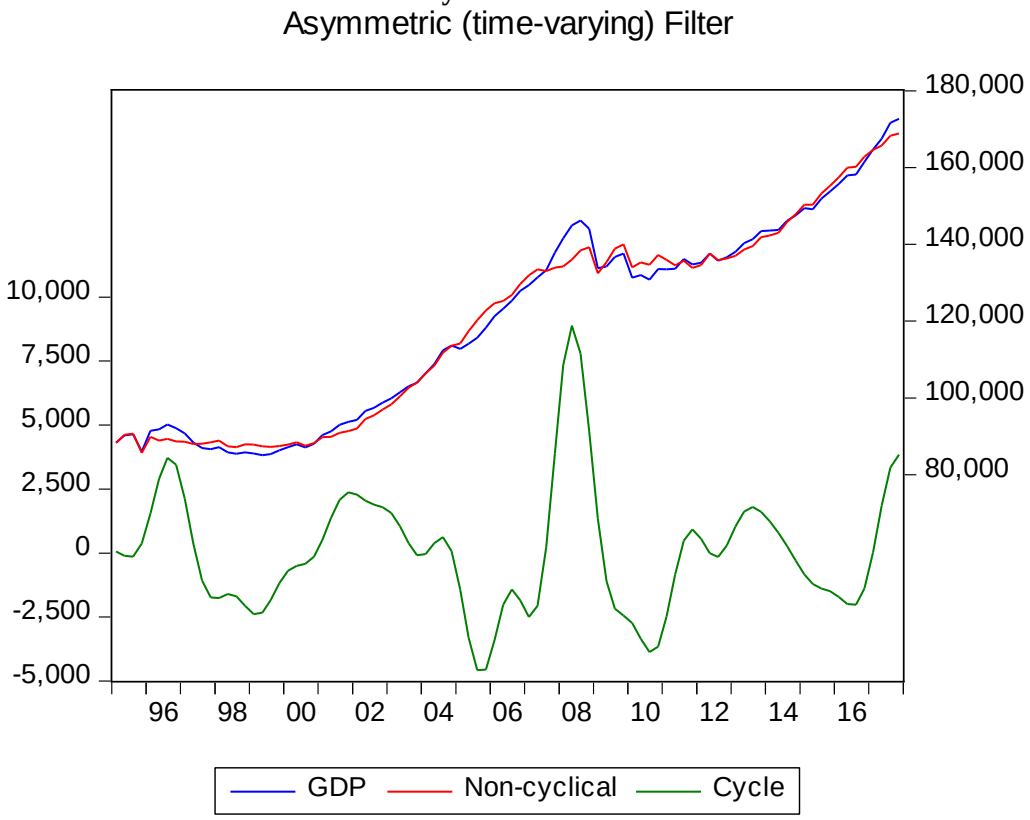
Source: authors' calculations in EViews-10 based on the *Eurostat* (table *namq_10_gdp*) data (http://ec.europa.eu/eurostat/data/database)

The BK filter do not calculate the values for the first 12 and last 12 terms of time series. And this creates difficulties in forecasting the potential GDP.

Asymmetric filters

For asymmetric filters the weights on the leads may differ from the and weights on the lags. The result of applying the Christiano-Fitzgerald (2003) asymmetric filter to the GDP series, with I(1) assumption, without detrending method, is shown in figure 7.

Figure 7. Potential GDP estimates (non-cyclical) and output gap (cycle) using Christiano-Fitzgerald (2003) asymmetric filter



Source: authors' calculations in EViews-10 based on the *Eurostat* (table *namq_10_gdp*) data (http://ec.europa.eu/eurostat/data/database)

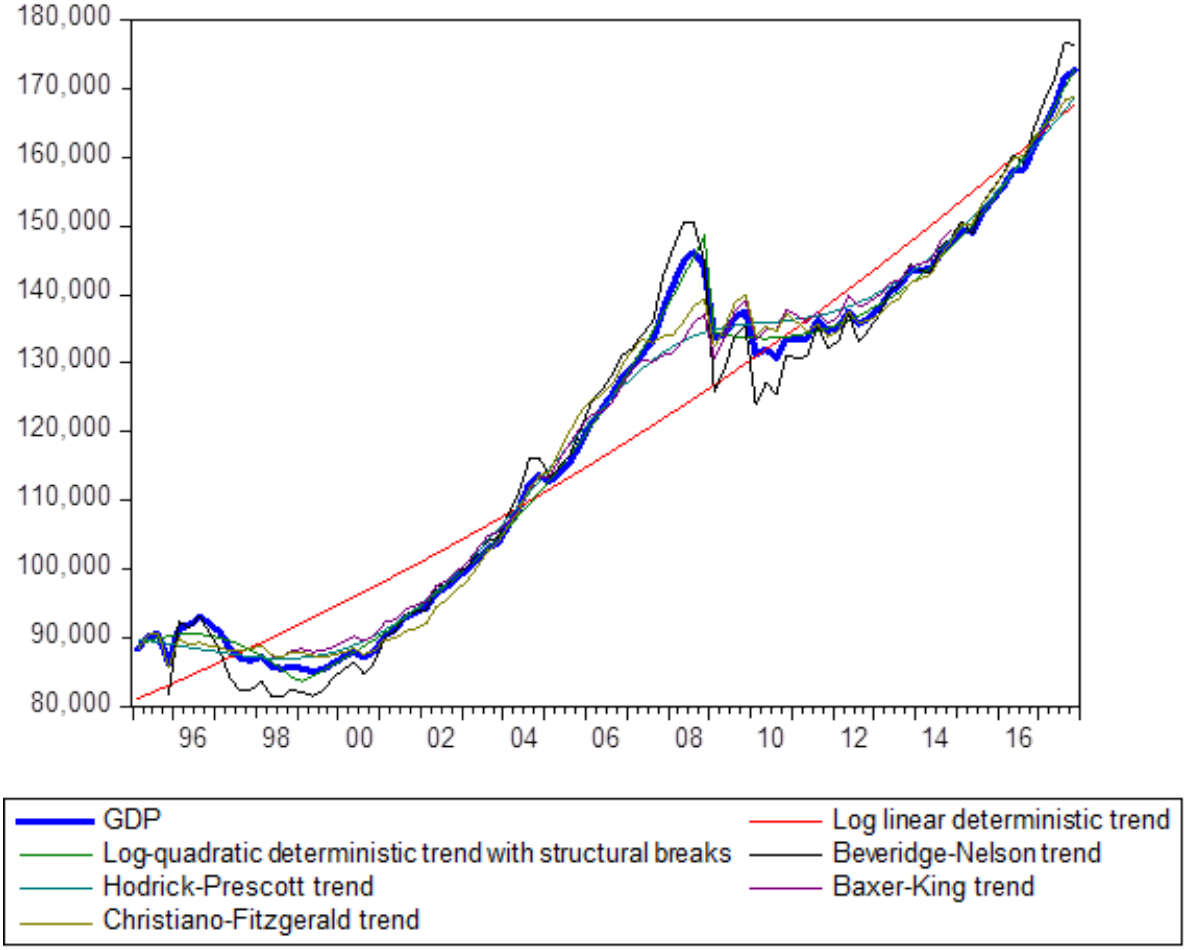
3. Comparison of potential GDP estimation methods

Figure 8 depicts the potential GDP estimates for Romanian economy using the six econometric methods: deterministic trend (log-linear and log-quadratic with structural breaks), stochastic trend (Beveridge-Nelson decomposing), Hodrick-Prescott Filter, Band-Pass filters (symmetric and asymmetric). Except for the log-linear trend, the paths followed by the other five estimates are similar.

For comparison, we calculate the sum of squares of differences between real GDP and the potential GDP estimates. The values in figure 9 are compared with those obtained by log-quadratic trend with structural breaks. We do not show the log-linear estimates, because the value is 31.8, much higher than any of the other values.

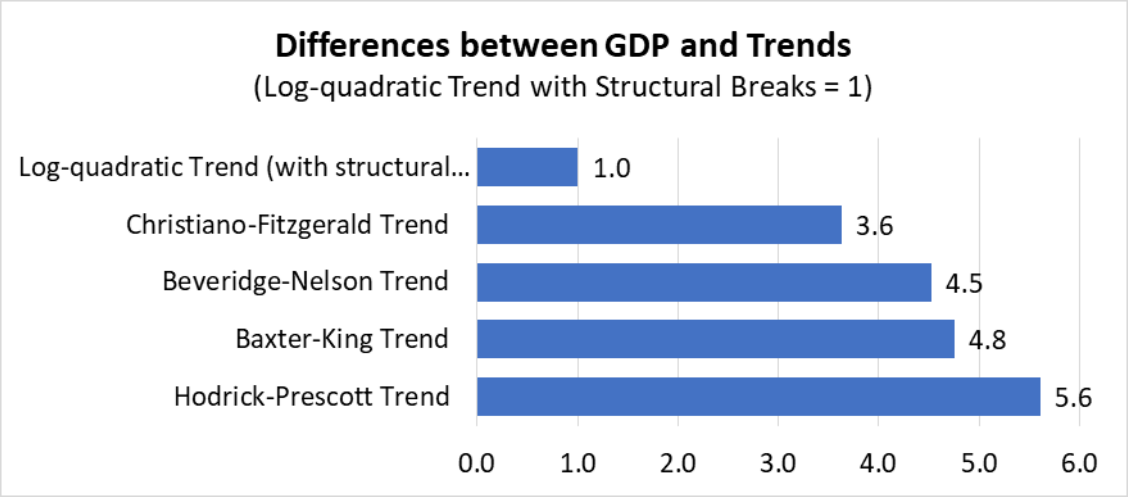
The most powerful model is the one that is calculated as log-quadratic trend with structural breaks. The detailed shapes are show in figure 10.

Figure 8. Potential GDP estimates using econometric methods



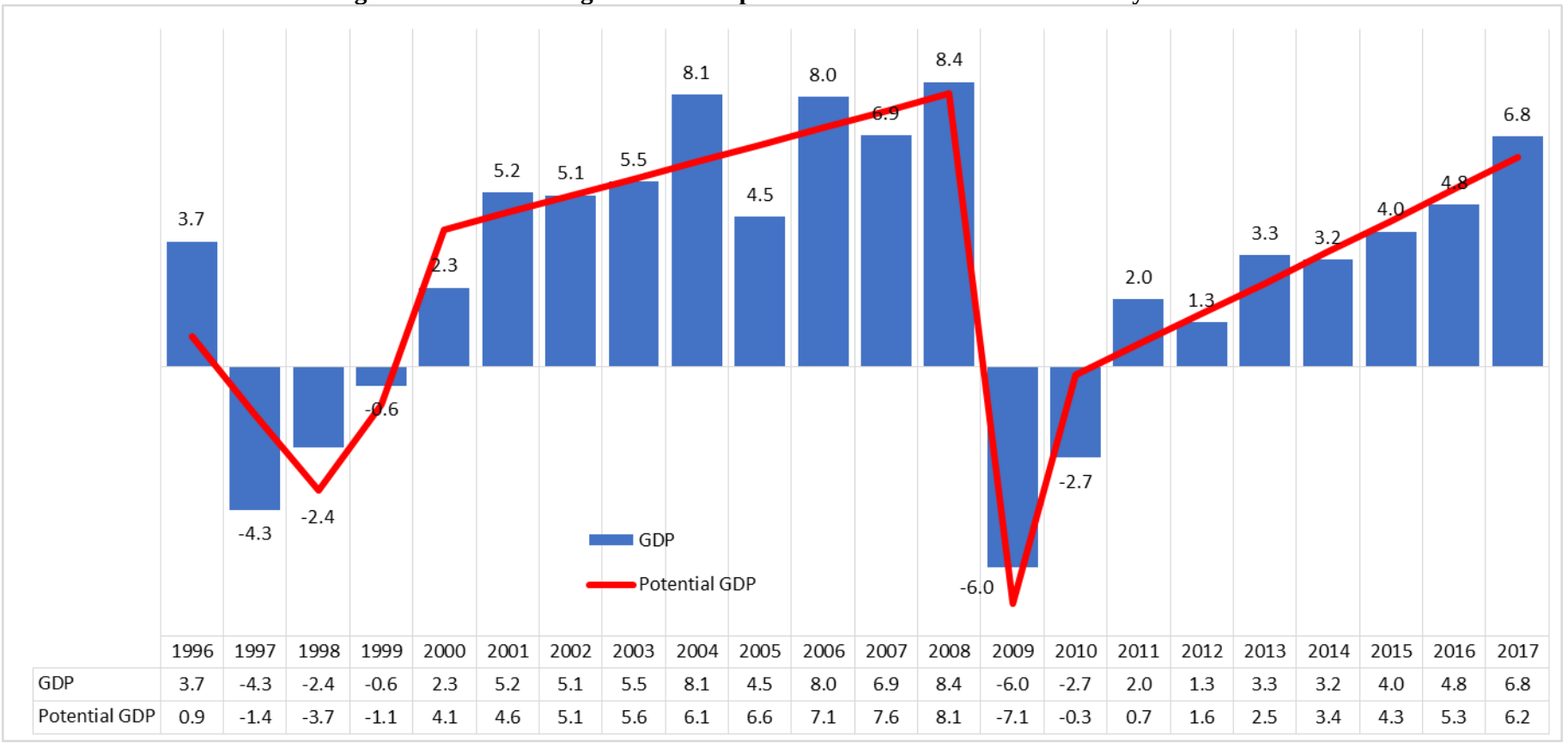
Source: authors' calculations in EViews-10 based on the *Eurostat* (table *namq_10_gdp*) data (http://ec.europa.eu/eurostat/data/database)

Figure 9. Performances of the econometric models in potential GDP estimates



Source: authors' calculations in EViews-10 based on the *Eurostat* (table *namq_10_gdp*) data (http://ec.europa.eu/eurostat/data/database)

Figure 10. Annual changes in real and potential GDP for Romanian economy



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP	3.7	-4.3	-2.4	-0.6	2.3	5.2	5.1	5.5	8.1	4.5	8.0	6.9	8.4	-6.0	-2.7	2.0	1.3	3.3	3.2	4.0	4.8	6.8
Potential GDP	0.9	-1.4	-3.7	-1.1	4.1	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1	-7.1	-0.3	0.7	1.6	2.5	3.4	4.3	5.3	6.2

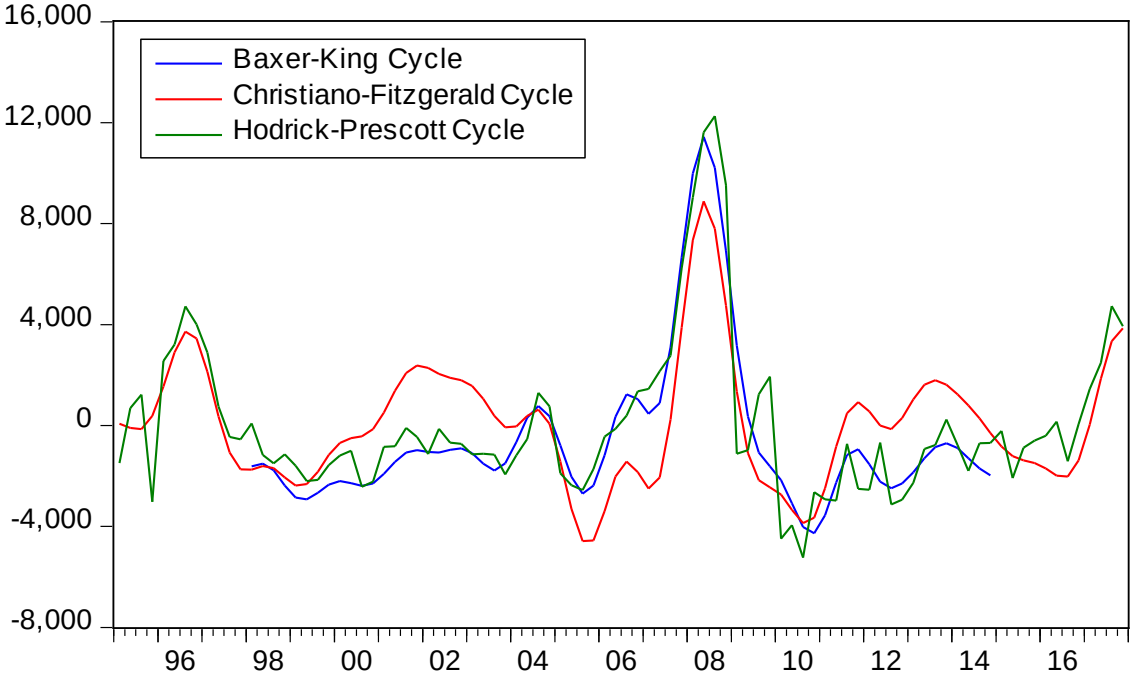
Source: authors' calculations in EViews-10, based on econometric model.

Legend: *GDP*: Romanian Gross Domestic Product at market prices, quarterly data, chain linked volumes (2010), million ron, seasonally and calendar adjusted data, year % changes

Potential GDP: deterministic log-quadratic trend with structural breaks.

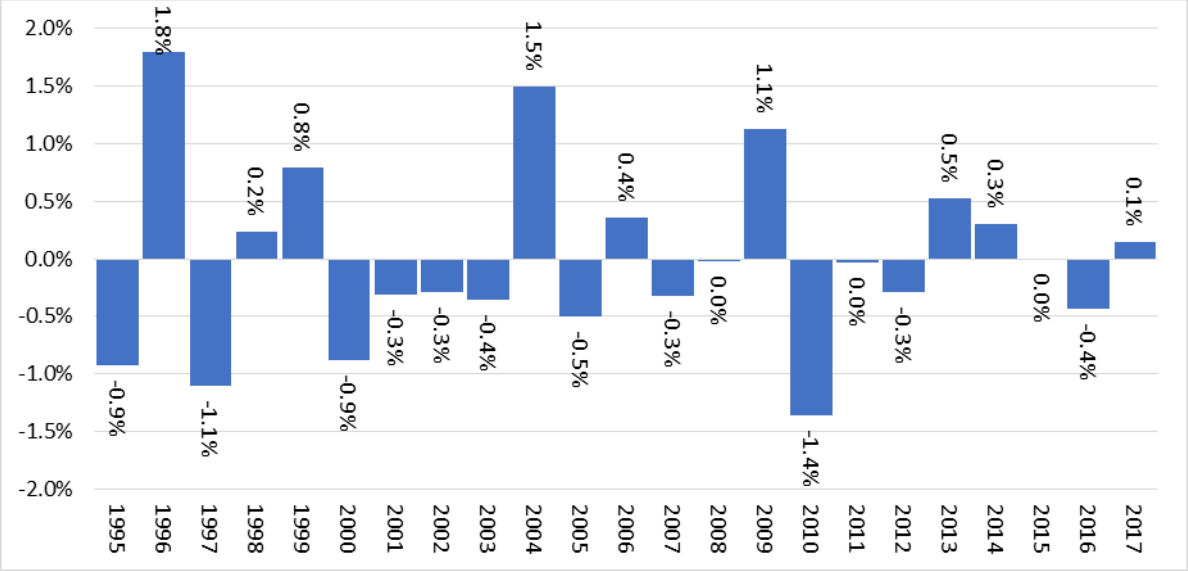
The output gaps calculate from Hodrick-Prescott Filter, Band-Pass Baxer-King symmetric and Christiano-Fitzgerald (2003) asymmetric filter are similar (see figure 10).

Figure 11. Output gap estimates with Hodrick-Prescott, Band-Pass Baxer-King symmetric and Christiano-Fitzgerald asymmetric filters



Source: authors' calculations in EViews-10 based on the *Eurostat* (table *namq_10_gdp*) data (http://ec.europa.eu/eurostat/data/database)

Figure 12. Output gap – potential GDP estimated as deterministic log-quadratic trend with structural breaks



Source: authors' calculations in EViews-10 based on the *Eurostat* (table *namq_10_gdp*) data (http://ec.europa.eu/eurostat/data/database)

After 2011, the output gaps calculated through log-quadratic deterministic trend with structural breaks did not exceed ± 0.5 percentage points of real annual GDP (see figure 12). This mean that the evolution of economic growth in Romania (especially after 2010) do not has induced inflationary pressures, through supply-side. However, such pressures existed with positive sign between 1996-2000 and negative sign towards the end of the crisis (2010).

Conclusions

We have calculated the potential gross domestic product for Romanian economy by using a several econometric methods. On the one hand, we used trend functions and filters, on the other hand. As trend functions we calculated deterministic trend (log-linear and log-quadratic with structural breaks) and stochastic trend (Beveridge-Nelson decomposing procedure). As for the filters, we have applied both the Hodrick-Prescott and the band-pass filters (Baxter-King fixed length symmetric filter and Christiano-Fitzgerald full sample asymmetric filter with random walk assumption, without supplementary detrending). We found that the log-quadratic deterministic trend with structural breaks method offer the best outcomes. Bai-Perron test has selected 1999q1 and 2009q1 as moments of structural breaks. Both moments are explicable, given the economic developments in Romania. The first, 1999q1, marks the resumption of economic growth after the strong depression registered in the years 1997-1998, and the second moment, 2009q1, is related to the economic and financial crisis registered at the end of the first decade of this century. According this technique, the Romanian potential GDP was over 4-5% during the 2000-2003, over 6-7% in 2004-2007 period and even 8.1% in 2008. Potential GDP drops dramatically during the crisis (2009-2010) and has risen steadily after 2010, so that it returns to around 6% in the years 2016-2017. With a few exceptions (recorded between 1996-2000, in 2004 and during the economic crisis at the end of the first decade of the current century), output gap was above -0.5 and below +0.5% of GDP. This mean that the evolution of economic growth in Romania (especially after 2010) do not has induced inflationary pressures, through supply-side.

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Annexes

A1. Testing the nature of GDP series

We tested the hypothesis that the GDP series is stationary with structural breaks. For this purpose, we applied in EViews-10 the Perron Breakpoint Unit Root Test. The outcomes are presented in the following table:

Table A1: Unit Root with Break Test on GDP

Null Hypothesis: GDP has a unit root

Trend Specification: Trend and intercept

Break Specification: Trend and intercept

Break Date: 2011Q3

Break Selection: Minimize Dickey-Fuller t-statistic

Lag Length: 6 (Automatic - based on Akaike information criterion, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.475386	0.8248
Test critical values:	1% level	-5.719131	
	5% level	-5.175710	
	10% level	-4.893950	

Source: EViews estimates on Romanian GDP data

The test does not reject the hypothesis of unit root with break (the probability associated to null hypothesis is 0.8248).

Then we tested the hypothesis that the GDP series is stationary by applying the Augmented Dickey-Fuller test, Phillips-Perron test and Ng-Perron optimal tests. We depicted in the following tables only the EViews-10 outcomes for Ng-Perron tests:

Table A2. Ng-Perron tests for GDP series

Null Hypothesis: GDP has a unit root

Exogenous: Constant

		MZa	MZt	MSB	MPT
Null Hypothesis: GDP has a unit root					
Ng-Perron test statistics		2.28199	2.54339	1.11455	107.048
Null Hypothesis: D(GDP) has a unit root					
Ng-Perron test statistics		-41.5278	-4.55550	0.10970	0.59342
Asymptotic critical values*:	1%	-13.8000	-2.58000	0.17400	1.78000
	5%	-8.10000	-1.98000	0.23300	3.17000
	10%	-5.70000	-1.62000	0.27500	4.45000

The tests do not reject the hypothesis of unit root for GDP, and do not confirm the unit root for d(GDP). Accordingly, we consider GDP as non-stationary series, more exactly, GDP is an I(1) series.

Annex A2: ARIMA structure of d(GDP) series

We have tested if d(GDP) has or not an ARMA type structure. First, we applied an automatic ARIMA selection for d(GDP)

Table A.3. Automatic ARIMA selection for d(GDP)

AR / MA	0	1	2	3	4
0	18.14196	18.10868	18.11418	18.13155	18.14385
1	18.09589	18.11815	18.13681	18.15714	18.15251
2	18.11811	18.12413	18.14232	18.15866	18.16834
3	18.14022	18.14361	18.16798	18.15523	18.16988
4	18.12996	18.15206	18.17286	18.17977	18.20113

Then, we estimated the model in the selected structure specification: AR(1,0). The EViews-10 output is the following:

Dependent Variable: D(GDP)

Method: ARMA Maximum Likelihood (OPG - BHHH)

Sample: 1995Q2 2017Q4

Included observations: 91

Convergence achieved after 12 iterations

Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	930.8045	364.6589	2.552535	0.0124
AR(1)	0.215228	0.091947	2.340796	0.0215
SIGMASQ	4314879.	375234.8	11.49914	0.0000
R-squared	0.047224	Mean dependent var		927.4022
Adjusted R-squared	0.025570	S.D. dependent var		2139.875
S.E. of regression	2112.339	Akaike info criterion		18.18191
Sum squared resid	3.93E+08	Schwarz criterion		18.26469
Log likelihood	-824.2770	Hannan-Quinn criter.		18.21531

F-statistic	2.180854	Durbin-Watson stat	2.011775
Prob(F-statistic)	0.119012		
Inverted AR Roots	.22		

The AR coefficient is significantly different from zero, but R^2 is very small and the correlogram of d(GDP) significantly differ from the estimated correlogram through model figure A1.

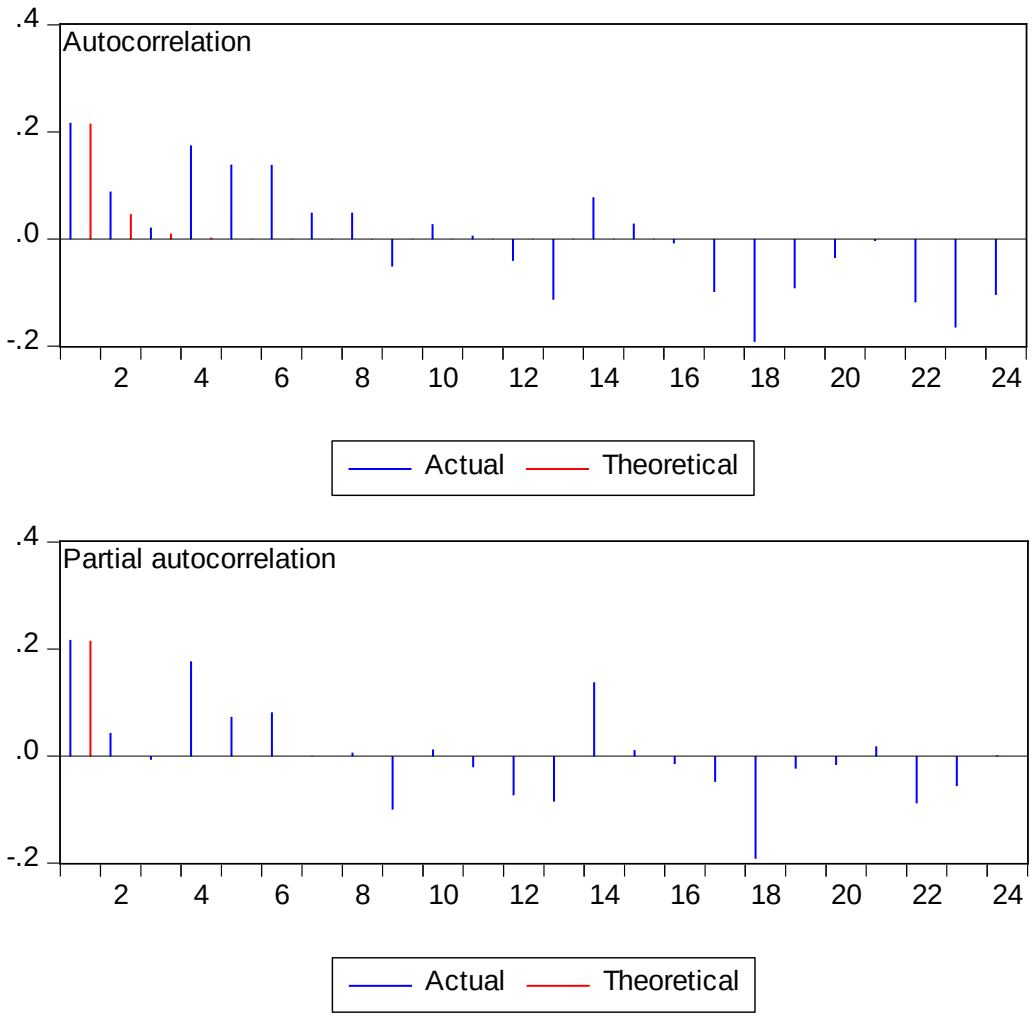


Figure A1: Actual and theoretical correlogram for d(GDP)

We explain this by saying that d(GDP) is a variable with independent and identically distributed (i.i.d.) values. Indeed, the BDS test applied on d(GDP) series does not reject the i.i.d. hypothesis.

The BDS test is presented in the following table ($\varepsilon = 1.5\sigma$, bootstrap repetitions = 10000, maximum correlation dimension = 4):

Table A.4. BDS Test for d(GDP)

Sample: 1995Q1 2017Q4

Included observations: 92

Dimension	BDS Statistic	Std. Error	z-Statistic	Normal Prob.	Bootstrap Prob.
2	0.019019	0.007982	2.382774	0.0172	0.0614
3	0.022366	0.014577	1.534363	0.1249	0.1718
4	0.043913	0.019940	2.202231	0.0276	0.0652

Furthermore, the Variance Ratio Test on d(GDP) does not reject the null hypothesis that d(GDP) is a martingale.

Table A.5. Variance Ratio Test on d(GDP)

Null Hypothesis: DGDP is a martingale

Sample: 1995Q1 2017Q4

Included observations: 90 (after adjustments)

Heteroskedasticity robust standard error estimates

User-specified lags: 2 4 8 16

Joint Tests	Value	df	Probability
Max |z| (at period 4)	2.268700	90	0.0899

Consistent with both tests (BDS and VRT), we do not reject the hypothesis that d(GDP) has not an ARMA structure.

The link between international trade flows of "*Machinery and transport equipment*" and foreign direct investment in Romania

Florentina Viorica GHEORGHE[1], Artur - Emilian SIMION[2]
[1]Romanian Academy, Institute of National Economy, SCOSAAR, florentina.gheorghe@insse.ro, Calea 13 Septembrie, no. 13, Sector 5, Bucharest, Romania
[2]Romanian Academy, Institute of National Economy, SCOSAAR, artur.simion@insse.ro, Calea 13 Septembrie, no. 13, Sector 5, Bucharest, Romania

Abstract

The paper investigates the causal relationship between the Romania's exports and imports of "Machinery and transport equipment", the group of goods with the largest percentage share in the international trade and foreign direct investments, using annual data series for the period 1990-2016. The developed econometric model has demonstrated the strong connection between these indicators, showing that exports of machinery and transport equipment are 85% influenced by imports of similar goods and by foreign direct investments. In the long run, the study reveals a direct link between foreign direct investments and growth in exports, as confirmed by other empirical studies on exports and imports at national and international level, too. The VECM analysis was performed using EViews 10 statistical software and it is based on data extracted from the United Nation statistical database (UNCTAD database).

Keywords*: export, import, foreign direct investment, Johansen cointegration test, Granger causality test, vector correction error*

1. Introduction

The evolution of international trade during the period 1990-2016 has made Romania's economy relatively open to the outside, which implies not only opportunities for external exchanges but also concerns for increasing the economic resilience to possible external shocks and vulnerabilities. If at the beginning of the EU pre-accession period in 1990goods exports were about 5.8 billion USD, by the end of 2016 they had more than 11 times increased, to around 64 billion USD. Also, the imports of goods have increased by about 8.2 times in 2016 compared to 1990. Although in the year 2016 compared to 1990 export dynamics is higher than that of imports, the volume of imports steadily exceeded that of exports, generating a trade deficit with an upward trend over the period under review. A 60-70% proportion of Romania's external trade is dominated by companies with foreign capital (foreign direct investment), mostly subsidiaries of multinational companies, which implies certain structural peculiarities and challenges. The causal relationship between FDI, exports, imports and even GDP remains an open question for research as regards the mutual influences between explained and explanatory variables.

At a macroeconomic level, in the period 2008-2016, FDI companies have had an unfavorable effect on the trade balance, mainly in the trade and services sectors. Industry, especially manufacturing, has generated a trade surplus (since 2009) helping to reduce the negative sold of the overall trade balance. In this context, given that the most of the national exports and imports belong to the manufacturing industries of transport machinery and equipment, the present paper aims to answer, on the basis of empirical analyzes, the question of the research "*How can evaluate the link between international trade flows of cars and transport equipment and foreign direct investments in Romania?* "

The paper is organized as follows: section 2 summarizes the role of exports, imports and foreign direct investments in the economic evolution of Romania; section 3 provides a brief review of the literature on this subject, followed, in section 4, by the econometric methodology used to examine the relationship between variables; section 5 analyzes empirical results. The conclusions are presented in section 6.

Role of international trade with "Machinery and transport equipment" and of the foreign direct investment in evolution of Romania's economy

The Standard International Trade Classification (SITC) developed by the United Nations Statistics Division (UNSD) is recommended to be used for analytical purposes. International trade statistics are originally based on the Combined Nomenclature but, using conversion tables, statistical data can be aggregated by different characteristics, according to other classifications and nomenclatures, including the SITC.

International trade with "Machinery and transport equipment"

According to the statistical data presented in Table 1, SITC 7 *"Machinery and transport equipment"* account for the largest share of Romania's total exports and imports (46.9% and respectively 38.0%, in 2016).

Table 1 Exports and imports of Romania according to SITC in 2016

SITC group	*2016*	Export		Import	
		Bil.USD	share in total (%)	Bil.USD	share in total (%)
	Total	**63.6**	**100.0**	**74.6**	**100.0**
0	Food and live animals	4.4	6.9	6.1	8.1
1	Beverages and tobacco	1.0	1.5	0.7	0.9
2	Crude materials, inedible, except fuels	2.5	4.0	2.2	2.9
3	Mineral fuels, lubrifiants and related materials	2.3	3.6	4.2	5.7
4	Animal and vegetable oils, fats and waxes	0.2	0.3	0.2	0.2
5	Chemicals and related products,n.e.s.	2.8	4.3	10.0	13.4
6	Manufactured goods classified chiefly by material	10.2	16.1	15.1	20.2
7	**Machinery and transport equipment**	**29.9**	**46.9**	**28.3**	**38.0**
8	Miscellaneous manufactured articles	10.1	15.9	7.9	10.6
9	Good not classified in other section	0.2	0.4	0.0	0.0

Source: Own calculations based on UNCTAD data (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx) available in April 2018

The products covered of the SITC 7 *"Machinery and transport equipment"* are presented in Table 2, which contains data broken down by SITC 2 digits level. For even more analytical purposes, the breakdown can be done by SITC codes up to the level maximum 5 digits.

Table 2 Exports and imports of "Machinery and transport equipment", by product subgroups, in 2016

Codes SITC Rev.4	SITC description	billion USD - 2016	
		Export	Import
Total SITC 7, from which:		**29.9**	**28.3**
71	Power-generating machinery and equipment	1.7	2.0
72	Machinery specialized for particular industries	0.9	2.1
73	Metalworking machinery	0.2	0.5
74	General industrial machinery and equipment, n.e.s., and machine parts	4.0	3.9
75	Office machines and automatic data-processing machines	0.3	1.1
76	Telecommunications and sound-recording and reproducing apparatus and equipment	1.6	2.8
77	Electrical machinery, apparatus and appliances and electrical parts thereof	10.1	8.6
78	Road vehicles (including air-cushion vehicles)	9.8	6.9
79	Other transport equipment	1.4	0.4

Source: Own calculations based on UNCTAD data (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx) available in April 2018

The profile of specialization, usually measured by the *revealed comparative advantage indicator*, has a major importance in studying the trade performance.

The indicator of the revealed comparative advantage reflects the extent to which Romania has exploited its relative cost advantages. On the basis of this indicator, conclusions can be drawn regarding the apparent capacity to capitalize the national advantages compared to other sectors, but also on the contribution of the main product groups in generating the trade deficit.

Romania's revealed comparative advantages obtained for the SITC group 7 "*Machinery and transport equipment*", in the years 2006 (preceding the EU accession of Romania) to 2016 (the 10th year after EU accession) are presented in the table 3.

Table 3 Revealed comparative advantages in the period 2006 - 2016 for SITC group 7, *Machinery and transport equipment"*

SITC Code	SITC description	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	the difference between 2016 and 2006	Comments RCA-Revealed Comparative Advantage
71	Power generating machinery and equipment	0.889	0.933	0.833	0.825	0.687	0.692	0.854	1.150	1.050	1.068	1.081	0.193	RCA kept, in growing
72	Specialised machinery	0.537	0.488	0.573	0.576	0.436	0.396	0.468	0.461	0.538	0.568	0.575	0.039	RCA kept, relatively constant
73	Metal working machinery	1.274	1.128	1.098	0.973	0.637	0.738	0.620	0.728	0.651	0.650	0.592	-0.681	RCA lost
74	Other industrial machinery and parts	1.050	1.314	1.239	1.226	1.403	1.509	1.558	1.574	1.610	1.537	1.548	0.498	RCA kept, significant growth
75	Office machines and automatic data processing machines	0.214	0.236	0.467	0.222	0.209	0.214	0.219	0.176	0.150	0.145	0.155	-0.058	RCA lost
76	Telecommunication and sound recording apparatus	0.227	0.238	0.564	1.380	1.758	1.786	0.998	0.788	0.727	0.591	0.512	0.285	RCA kept, significant growth
77	Electrical machinery, apparatus and appliances	1.237	1.357	1.514	1.411	1.343	1.509	1.586	1.481	1.557	1.589	1.724	0.487	RCA kept, significant growth
78	Road vehicles	0.748	0.965	1.090	1.829	1.768	1.734	1.820	1.997	1.915	1.799	1.807	1.058	RCA kept, significant growth
79	Other transport equipment	1.599	1.620	1.661	1.914	1.304	1.175	1.185	1.430	1.114	0.971	0.964	-0.635	RCA lost

Source: Own calculations based on UNCTAD data (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx) available in April 2018

The indicator of the apparent / revealed comparative advantage (Bella Balassa, 1965) was calculated on the basis of the formula:

$$RCA = \frac{x_j^i / \sum_{j=1}^{n} x_j^i}{x_j^{wi} / \sum_{j=1}^{n} x_j^{wi}} \quad (1)$$

where:

x_j^i - represents the exports of product j from the country i, and

x_j^{Wi} - represents the world export of product j.

The revealed comparative advantage in 2016 compared to 2006 for the SITC group 7 "Machinery and transport equipment" (Table 3) emphasizes different situations, depending on the each different product groups. We found product groups that, in the 10 years after the EU accession of Romania:

- have significantly increased their comparative advantage, for example: road vehicles, other industrial machinery and parts, telecommunication and sound recording apparatus and electrical machinery, apparatus and appliances;
- have relatively constant the comparative advantage: specialised machinery;

- have lost their comparative advantage: metal working machinery, office machines and automatic data processing machines and other transport equipment.

Foreign Direct Investments (FDIs)

Foreign direct investment, according to the economic literature, has an advantage over the external credit because the investors, usually represented by multinational companies, contribute to the consolidation of an investment project not only with capital flows but also with technological know-how and managerial experience, technical and organizational innovation, highly skilled workforce and increased access to sales markets.

The link between foreign direct investments and foreign trade may be bivalent. On the one hand, trade policy measures can generate and influence investment flows received by a country, and on the other hand, foreign capital affects the trade of the host (receiver) country. From historical point of view, a producing company firstly has foreign trade transactions with other country and, later on, starts foreign direct investment in that country.

The influences of FDIs on the economy of the host country vary from one country to another. The analysis of these influences requires particular attention given the diversity of both positive and negative effects that can be generated by the characteristics of FDI flows and by the particularities of the host country's economic environment, as for example: local infrastructure, labor market, communications systems, economic policies and general macroeconomic climate.

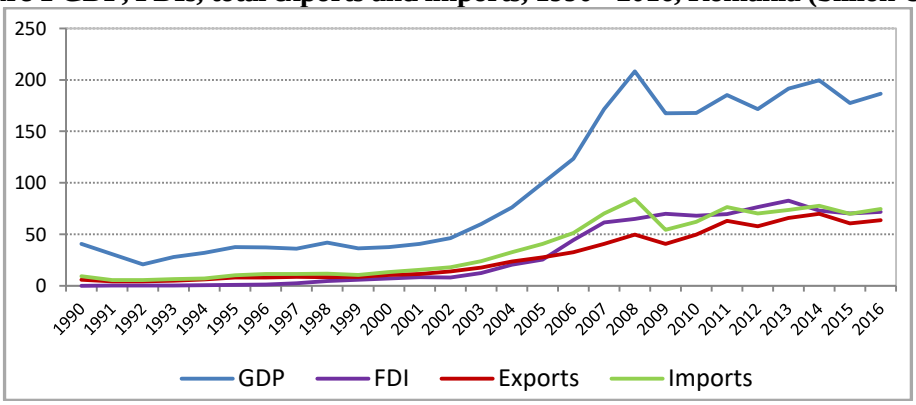
The practice has shown that developed countries, as main FDI receivers, obtain significantly higher benefits than developing countries, which justifies the reserve of economists in judging the negative or positive nature of FDIs flows received by a certain country. Opinions on the influence of FDIs on foreign trade and on the economies of host countries, with a relatively low level of development, can be divided into three main categories, namely:

a. The FDIs has a favorable influence on economic growth (Albu, 2013, Damijan, 2003, De Mello, 1997);
b. The influence of FDIs on the economy of the host country is both positive and negative (Agosin 2010, Borensztein, 1998);
c. There is still no clear conclusion as to the impact of FDIs on the economies of host countries (Cole, 2008).

Many economic studies identified that, for a given country, periods of intense economic growth are characterized by attracting important foreign direct investment flows. In Romania, although high rates of economic growth were recorded, this was not supported by foreign direct investments. At the level of 2016 year, the share of foreign direct investments in GDP was 39.8%, below the EU28 average rate (47.1%).

Comparative evolution between GDP, FDIs and international trade flows as well as between GDP, FDI and trade with *"Machinery and transport equipment"* are shown by the Figure 1, respectively by the Figure 2.

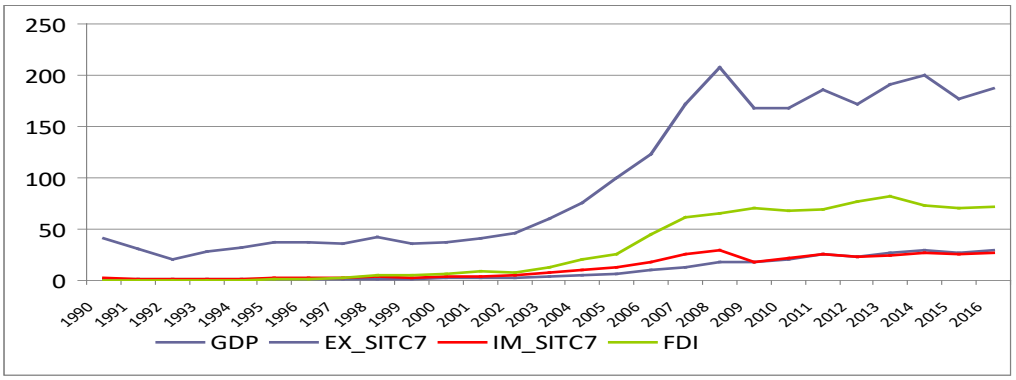
Figure 1 GDP, FDIs, total exports and imports, 1990 - 2016, Romania (billion USD)



Source: Own calculations based on UNCTAD data (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx) available in April 2018

While the effects of the 2008 global economic crisis have had a significant impact on GDP and on total trade flows, the impact on the exports of SITC group 7 *"Machinery and transport equipment"* was insignificant, with reductions having lower amplitudes than the country's overall level.

Figure 2 GDP, FDIs, exports and imports of "*Machinery and transport equipment*" (SITC 7), 1990-2016, Romania (USD billion)



Source: Own calculations based on UNCTAD data (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx) available in April 2018

Since 1990, the Romania's current account has deficit. Throughout this period, FDIs has managed to fully fund this deficit only in three years - 2004, 2013 and 2014.

The level of amounts brought by foreign investors in Romania fluctuated over time, most of them being in line with the trend of the economy. As economic analysts say, in the years of crisis, the decline in foreign investment took place in the context of corporations adopting a more conservative attitude towards growth through acquisitions, focusing more on preserving or reducing activity which they already have at international level and the use of excess liquidity in order to lower the indebtedness.

Romania's Export Strategy horizon 2020 is aimed at promoting export-oriented foreign direct investment. According to this Strategy, the activity of foreign investors, as well as the increase of investments in the domestic market, contributed significantly to the implementation of previous strategies and to the current performances of exports, especially in the industries producing transport equipment, industrial equipment and components, IT and electronics. The presence of large investors was a determining factor in changing the export structure and increasing the share of the mentioned industries in total export. Also, in other strategic industries such as furniture, clothing, footwear, the presence of FDIs has been significant in exports, as shown by Romania's Export Strategy.

As well as exports, foreign investments experienced a rebound during the crisis. Foreign direct investments has “returned” to Romania after the recovery of the global economy and overcoming the crisis.

The link between FDIs and economic growth is achieved through exports and imports. The balance of foreign direct investment amounted to around 72 billion USD in 2016, a third of GDP. The activity of foreign direct investment companies contributes to exports by 74.0% and to imports by 66.3%.

Table 5 Exports, imports and trade balance of FDIs companies in Romania in 2016

2016	Exports (FOB)			Imports (CIF)			Trade balance FOB-CIF (USD million)
	FDI companies (USD million)	(%) FDI companies		FDI companies (USD million)	(%) FDI companies		
		in total economy *)	in total sector		in total economy *)	in total sector	
TOTAL, of which:	**50631**	**74.0**	**74.0**	**53384**	**66.3**	**66.3**	**-2752**
Industry, of which:	45792	69.9	82.0	35110	43.6	81.4	10682
Mining	512	0.7	87.4	417	0.5	93.5	96
Manufacturing, of which:	44794	65.5	82.1	34360	42.7	82.0	10433
– manufacture of computer, electronic, optical and electrical products	5356	7.8	89.4	4700	5.8	89.6	656
– machinery and equipment	2791	4.1	92.0	1626	2.0	90.9	1165
– metallurgy	4212	6.1	84.1	2219	2.8	79.4	1993
– transport equipment	18173	26.6	88.6	12708	15.8	89.7	5465

SOURCE: own calculations based on NBR data, "Foreign direct investments in Romania in 2016"*) Exports and imports related to activities of NACE Rev.2 divisions 84 - Public administration, 94 - Associative activities, 97/98 - Activities of households and 99 - Extraterritorial activities, are not included: Note: Exports and imports of goods are aggregated according to the basic activity of FDI enterprises, according to NACE Rev. 2.

As regards the trade balance of the FDIs companies in various economic sectors, it is found that the manufacturing industry is the main sector registering trade surplus (about 10.4 billion USD).

3. Literature review

No studies and analyzes on exports and imports of goods from the SITC group 7 *"Machinery and transport equipment"* have been identified. Therefore, inventory of specialized literature has been extended to all trade flows and FDIs respectively. Existing practical approaches at international and national levels can be categorized according to the level of aggregation of statistical data used in modeling. There are studies conducted at a high level of aggregation - at country level, as well as at sector level, company level and product level. Most studies are based on annual data series and only few used data series with a lower frequency (quarterly, monthly).

Country-level analysis shows a strong relationship between international trade flows and FDIs. In his analysis, Pfaffermayr (1994, 1996) uses the causality of Granger for the link between Austrian FDIs and exports, obtaining a positive, significant causality link in both directions. The same type of analysis was made by Bajo-Rubio and Montero-Munoz in 1999 and Alguacil in 2002 for Spain, the conclusion leading to the identification of a long-term causality between FDI and export. In 1997, Pajot uses the panel method for 21 countries, identifying a positive effect of FDI on exports, with different magnitudes depending on the country under review. Wong and Tang in 2007, demonstrates, in the case of Malaysia, the existence of a unique, long-term causal link between FDI, exports and imports. They also identified the existence of a two-way causal relationship between exports and imports. In contrast, Sultan in 2013 has studied India's case by showing that there is a stable long-term bilateral equilibrium between FDI and export growth but not vice versa (FDI does not influence exports). In addition, it has shown that, on the short term, there is no mutual influence between FDIs and exports to India. In 2014, Sithikun analyzed the case of Cambodia, concluding that there is a positive link between FDI, export and import. Anagaw and Demissie in July 2015 identified a strong relationship between FDI and export growth in Ethiopia.

Empirical studies on sector level have mixed results. Lipsey and Weiss (1981) show a positive relationship between US exports and FDIs for 40 countries in 1970. They believe that an additional dollar affiliate sales lead to an increase from 2 to 78 cents of additional exports to the corresponding market. Marchant et al. (2002) also demonstrates a complementarity relationship between FDI and trade for the US food industry. Graham's findings (1996) generally support the complementary relationship between FDI outward flows and US exports. Falke and Hake in 2008 concluded that exports are influencing FDI but not vice versa. There is a significant long-term elasticity of FDI relative to exports.

Using data at the ***company level***, Lipsey and Weiss (1981) determined strong complementary effects between US production of intermediate goods in the host country and US exports to the same region in 1970. Their results showed that a dollar of additional production in the host country induce 9 to 25 cents of additional exports.

At ***the product level***, in 2001 Blonigen analyzed the data for the "car parts" group for Japan and concluded that there was a complementary effect in the case of vertical production relations. Türkan in 2006 also identified a strong complementary relationship between US trade and FDI stocks of intermediate goods exports, while there is a slight negative relationship between FDIs and end-use trade transactions.

Table 6 Relevant empirical studies on the link between FDIs, Export and Import

Author (s), years	*Aggregation level*	*Reference data*	*Analysis method*	*Results*
Acaravici, Ozturk (2012)	Data at country level (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia)	1994-2008 quarterly data, 10 new Member States	ARDL model, cointegration analysis	FDI influences GDP more strongly than exports. There is no single or long-term balance between FDI, export and GDP in BG, EE, HU, LT, RO and SI.
Alguacil si al. (2002)	Data at country level (Spain)	1970-1992, quarterly data	Time series, VAR with Granger causality test	Long-term Granger Positive Causality between FDI and Exports
Ahmadi, Ghanbarzadeh (2011)	Data at country level	1970 - 2008, MENA countries	VAR panel model	There is a bidirectional causality relationship between the FDI, export and GDP variables
Anagaw, Demissie (2015)	Data at country level (Ethiopia)	1971-2011	VAR model, Johansen cointegration analysis	Strong relationship between investment and growth in exports
Bajo-Rubio, Montero-Munoz (1999)	Data at country level (Spain)	1977-1992, quarterly data	Cointegration, Granger causality tests	Long-term Granger Causality between FDI vs. Export (without short-term effects)
Blonigen (2001)	Product-level data (car parts), Japan	1978-1994	Time series, regression	Complementarity effect on vertical production relationships, otherwise substitution effect ISD - Export
Chakrabartya, Chakravartyb (2012)	Product data - crude oil (India)	1971-2010	VECM model	There is a causal link between oil exports and economic growth. There is no immediate econometric link between exports and imports, but exports positively influence imports with a lag of 7 years
Falk, Hake (2008)	Branch / sector data and 7 EU member states	1973-2004	Panel analysis, GMM estimation	Export affects FDI but not vice versa. There is a significant long-term elasticity of FDI relative to exports
Fontagné, Pajot (1997)	Data at country level (21 countries)	panel data	Time Fixed Effects	Positive effect of FDI on exports, different magnitudes for different countries
Graham (1996)	Branch / sector data - USA and Japan	1983, 1988, 1991	The gravitational model	The predominant complementarity relationship between FDI - export
Lipsey, Weiss (1981)	Branch / sector data (14 countries)	1970	OLS	Complementarity between FDI - export
Lipsey,Weiss (1984)	Company-level data	1970	OLS	High complementarity between FDI - export for intermediate goods; poor for end-use goods; possible substitution effect for end-use goods
Marchant si al. (2002)	Branch / sector data (US food processing industry)	1989-1998	Time series, cross-section. Full-information maximum likelihood (FIML) method	Complementarity between FDI - export
Oberhofer si Pfaffermayr (2007)	Company-level data	19,079 companies, 10 countries, Amadeus database	Bivariate Probit Model with Maximum Likelihood approach	Complementarity between FDI - export
Pfaffermayr (1994)	Data at country level (Austria)	1969-1991	Time series, OLS, VAR with Granger causality	Complementarity between FDI - export
Pffafermayr (1996)	Data at country level (Austria)	1980-1994, Time series, cross-section data	Dynamic fixed effects model, GMM estimation	Complementarity between FDI - export
Sithikun (2014)	Data at country level (Cambodia)	1995-2010, 25 partner countries	The gravitational model	Positive link between FDI, export and import
Sultan (2013)	Data at country level (India)	1998-2010	VECM model, Granger causality	There is a stable long-term relationship between FDI and export growth. In the long term, exports influence inflows of FDI and not vice versa. In the short term, there is no mutual influence between FDI and exports to India.
Türkan (2006)	Date la nivel de produs (US)	1989-2003, panel data	Gravitational Model, Fixed Effects, Random Effects	Complementarity of FDI-exports for intermediate goods; easy to substitute FDI-exports for end-use goods
Wong, Tang (2007)	Data at country level (Malaysia)	1999-2006, quarterly data	VECM model, Granger causality	There is a unique, long-term causalilty link between FDI, exports and imports. There is a two-way causality relationship between exports and imports. However, FDI does not cause long-term exports.

Source: personal research on the Internet

4. Methodological considerations

The methodology of research is based on the econometric methods of the time series. The Augmented Dickey-Fuller (ADF) root test, the Johansen co-integration test, the Granger causality test in the context of auto-regression models were used to examine the relationship between the dynamics of the export and import of *"Machinery and transport equipment"* and FDIs stocks of Romania, both on the short and long term, with the assessment of causality and its direction.

Selection and description of variables

The analysis is based on time series for FDI stock and exports, respectively imports of *"Machinery and transport equipment"*. The statistical data used have annual frequency, covering the period 1990-2016; for comparability, statistical data were downloaded from the UNCTAD website.

In terms of international trade in goods statistics, depending on the reference period, they have different but comparable data sources and compilation methods. Between 1990 and 2006, data are exhaustively collected and processed on the basis of customs declarations. Since 2007, after Romania's accession to the EU, international trade statistics are established based on the Intrastat system for intra-EU trade (goods exchanges between Romania and the other EU Member States) and Extrastat system for extra-EU trade (goods exchanged between Romania and non-EU countries).

Values are expressed in FOB prices for exports and CIF prices for imports. FOB price (Free on Board) represents the price at the border of exporting country, and includes the value of the commodity, all transport expenditures to the shipping point, as well as all the fees for the commodity to be loaded on board. CIF price (Cost, Insurance and Freight) represents the price at the border of the importing country and includes both the components of the FOB price and the cost of the insurance, as well as the cost of the international transport.

Theoretical presentation of the proposed analysis

In order to verify if there is a relationship between FDIs, exports and imports of *"Machinery and transport equipment"* (EX_SITC7) we considered the following hypotheses (theoretical model):

$$H1: FDI = f(EX\_SITC7, IM\_SITC7) \quad (2)$$

$$H2: EX\_SITC7 = f(FDI, IM\_SITC7) \quad (3)$$

$$H3: IM\_SITC7 = f(FDI, EX\_SITC7) \quad (4)$$

For all three data series (EX_SITC7, IM_SITC7 and FDI) were tested:

- stationarity - root unit test - Dickey-Fuller Augmented,
- cointegration - Johansen cointegration test.

Given the nature of the series - stationary and cointegrated - the VEC model was used; the "white noise" properties of the residual terms (normal distribution, lack of autocorrelation and heterodasticity) were tested and the Granger causality between the three variables considered was assessed.

5. Data analysis

Basic statistics

Table 7 shows the basic statistics (average, median, maximum, minimum, standard deviation, etc.) for each of the three variables analyzed: foreign direct investment (FDI), exports of *"Machinery and transport equipment"* (EX_SITC7) and imports of *"Machinery and transport equipment"* (IM_SITC7).

Table 7 – Descriptive statistic

	EX_SITC7	IM_SITC7	ISD
Mean	10.15660	12.28252	31.44291
Median	3.792184	7.080112	12.20247
Maximum	29.40139	29.14783	82.68803
Minimum	0.836000	0.943000	0.000010
Std. Dev.	10.72424	10.58349	32.32307
Skewness	0.693354	0.350597	0.382016
Kurtosis	1.824285	1.390200	1.329684
Jarque-Bera	3.718423	3.468519	3.795414
Probability	0.155795	0.176531	0.149912
Sum	274.2281	331.6280	848.9585
Sum Sq. Dev.	2990.243	2912.268	27164.31
Observations	27	27	27

Source: Data processed with Eviews 10

Based on these statistics, we can establish that the value of exports of *"Machinery and transport equipment"* ranges between 0.8 billion USD in 1993 and 29.4 billion USD in 2016. The average value of this indicator for the period 1990-2016 is 10.2 billion USD. The values of the Skewness and Kurtosis tests indicate that the distribution of the series is not perfectly symmetrical, predominantly between the minimum and average of the data series (the median of the series is less than the average of the series).

In terms of imports, the value of imports of *"Machinery and transport equipment"* ranged between 0.9 billion USD in 1991 and 29.1 billion USD in 2008, before the start of the global economic crisis. The average value of this indicator for the period 1990 - 2016 is 12.3 billion USD. Also, the values of the Skewness and Kurtosis tests show that the considered distribution is not a perfectly symmetrical one, predominantly between the minimum and the average of the series of data (the median of the series is less than the average of the series).

Stationary series tests

The evolution of a stationary series is not affected by the time; the media, the dispersion and the covariance of such a series are constant over time. The time series are often non-static, so the first step in this time series economic modeling is to establish the stationary relationship between the variables to avoid false regressions. Also, Granger causality can only be tested for stationary variables; therefore unit root tests must be performed on all variables considered in order to ensure the validity of common statistical tests (F-statistic, t-statistic, R-square).

From economic point of view, a series is stationary if a shock on the series has a temporary effect (it is absorbed over time) and not permanently. Unit root detection for a series indicates that the shocks on that series will be permanent and not transient.

To test the stationarity of the export, import and FDIs series, the Augmented Dickey Fuller - ADF test was used (Dickey and Fuller, 1981). The ADF test also highlights the degree of integration of the series, knowing that many macroeconomic series are unstable, leading to false results when applying the Ordinary Least Squares method (OLS). The non-stationary series transforms into stationary series by differentiating them, after which they can be used in regression analyzes.

For each of the three series, the stationary test (Augmented Dickey-Fuller Test) was performed on both the initial series and the differentiated series (order 1 and order 2).

Hypotheses:

H0: series is non-stationary (p-value <0.05 - H0 rejected and H1 is accepted),

H1: the series is stationary (p-value> 0.05 - H0 is accepted and the H1 is rejected).

The root unit test results for the level and for the first and second difference:

Table 8 - The results of stationary test on the given series

	Level series (initial)			series 1st differentiated			2nd order differentiated series		
	$EX7_t$	$IM7_t$	ISD	$\Delta EX7_t$	$\Delta IM7_t$	ΔISD_t	$\Delta(\Delta EX7_t)$	$\Delta(\Delta IM7_t)$	$\Delta(\Delta ISD_t)$
t -statistic	-1,9926	-0,4341	-0,6364	-1,2478	-4,8290	-2,9245	-12,8908	-7,9361	-5,6688
p value	0,2877	0,8890	0,8451	0,6353	0,0008	0,0567	0,0000	0,0000	0,0001
critical value (5%)	-2,9981	-2,9810	-2,9862	-2,9981	-2,9919	-2,9862	-2,9981	-2,9981	-2,9919

Source: Data processed with Eviews 10

In the table 8, for the series and series 1st differentiated export and FDI series, the p-value associated with the t-statistical test is greater than 0.05, H0 is accepted (the series is non-stationary) and the H1 alternative is rejected (the series is stationary).

P-value ≈ 0.000 associated with the t-static 2nd order differentiated series indicates a clear rejection of the non-stationarity hypothesis for the three time series, FDI, export and import of *"Machinery and transport equipment"*; thus, we can state that the three series of data are stationary after the 2nd order differentiated.

The time series Cointegration Test (Johansen Test)

Cointegration means that, despite the fact that the series are non-stationary, a linear combination with the same degree of integration of two or more time series can be stationary. The cointegration of more than two time series suggests a long-term relationship or equilibrium between them.

In general, two series are cointegrated if two conditions are met:

- the series are affected by a random trend with the same degree of integration ***d***;
- the linear combination of these series allows for a series with a lower integration order.
- Since our series are integrated by the same order I (2), we can verify whether the data series are cointegrated by applying the Johansen procedure.

The cointegration test of the FDI, EX_SITC7, IM_SITC7 series indicates the presence of at least one and not more than 2 long-term cointegration equations between FDI, export and import of *"Machinery and transport equipment"* (Trace test, respectively Maximum Eigenvalue test).

Because the time series is relatively short (27 years) we choose a single cointegration equation.

Table 9 Cointegration test of the series (Johansen Test)

Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	2	2	2	2	2
Max-Eig	2	2	2	2	2

Source: Data processed with Eviews 10

Lag order selection (Schwarz criterion)

Lag order selection is based on the Schwarz criterion (SC): the lowest SC coefficient indicates the lag order - in this case the selected lag order is 1.

Table 10 VAR Lag Order Selection Criteria

Lag	0	1	2
SC	19.73844	14.57454*	18.23568

Source: Data processed with Eviews 10

Based on the above-mentioned analyzes we decided to analyze the long-term relationship between FDI and export and import of *"Machinery and transport equipment"*, using the VEC model with the 1st order differentiated data, 1st lag order and one cointegration equation.

Estimation of the model parameters

The VEC model was performed by using the facilities offered by Eviews 10 application. The resulted regression equation is the following:

$$\Delta^2(EX\_SITC7)=C_{(1)}*(\Delta(EX\_SITC7_{(-1)})+1.1809*\Delta(IM\_SITC7_{(-1)})-0.5748*\Delta(ISD_{(-1)}) - 0.5670) +\Delta^2(EX\_SITC7_{(-1)}) + C_{(3)}* \Delta^2(IM\_SITC7_{(-1)}) +C_{(4)}* \Delta^2(ISD_{(-1)}) + C_{(5)} \quad (5)$$

According to the ANOVA test results, the selected model is valid (F-statistic = 33.2 and Prob (F-statistic) = 0.000000 <0.05). Most of the coefficients of the equation are significant, indicating that imports of *"Machinery and transport equipment"* and FDI influence the exports of *"Machinery and transport equipment"*, both in the short and long term (the coefficient of the cointegration equation is negative and significant).

The adjusted R^2 indicates that the simultaneous action of imports of *"Machinery and transport equipment"* and FDI determines 85.0% of the variation in the export of *"Machinery and transport equipment"*.

In the short term, the results show that the evolution of imports of *"Machinery and transport equipment"* from the previous period has a major impact on the exports of *"Machinery and transport equipment"* in the current period (an increase of imports with 1 million USD generate an increase of exports with 0.57 million USD). In the long run, exports of *"Machinery and transport equipment"* are negatively affected by similar imports (-0.59 * 1.18 = -0.70) and positive by FDI (+0.34).

It should be noted, however, that in the model considered, the influence of the free term, as a picture of factors not included in the model, is significant. Thus, we can say that factors, which were not taken into account at the time of the construction of the econometric model, determine an increase (not very significant) in the value of exports.

Tests diagnosis for residues

- ❖ Autocorrelation of errors

The Residue Correlation Test (Breusch-Godfrey test) shows that errors are not correlated (does not reject the null hypothesis: there is no correlation of errors – Chi-Square Probability = 0.14> 0.05)

- ❖ Homoscedasticity of random errors

The Breusch-Pagan-Godfrey and ARCH tests show that the errors are not heteroscedastic (do not reject the null hypothesis: errors are homoscedastic):

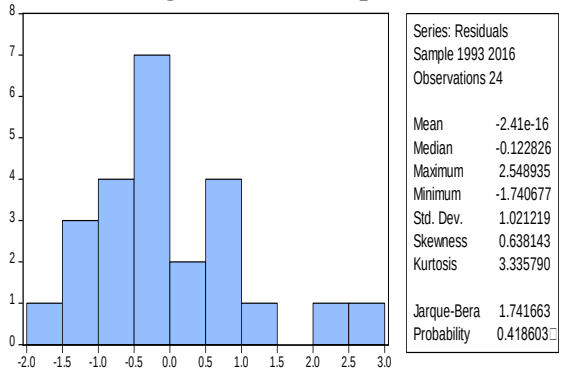
- Breusch-Pagan-Godfrey test (Prob. Chi-Square = 0.48> 0.05)
- ARCH test (Prob. Chi-Square(1)=0.75>0.05)

- ❖ Random errors have normal distribution

The Jarque-Bera test and the histogram indicate a normal distribution of residues – Figure 3 (Jarque-Bera = 1.74 and probability = 0.42> 0.05 – does not reject the null hypothesis that residues are normally distributed)

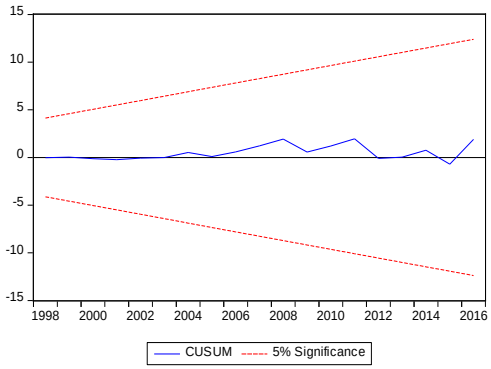
CUSUM test indicates the stability of the regression coefficients, as shown in the Figure 4.

Figure 3. The Jarque-Bera test and the histogram



Source: Eviews 10 output on the Jarque-Bera test and the histogram

Figure 4. The CUSUM test



Source: Eviews 10 output on CUSUM test

The previously generated regression function (export of SITC 7 depending on import of SITC 7 and FDI) has the following characteristics:

- the R-adjusted is close to 1 (0.85), which means that import of *SITC 7* and FDI determine for 85% of export of *SITC 7* and are very close to 1; it results that there is a strong link between variables;
- The ANOVA test indicates the validity of the model (F-statistic = 33.2 and Prob (F-statistic) = 0.000000 <0.05);
- Most of the coefficients are significant, indicating import of *SITC 7* and FDI influence export of *SITC 7*, both in the short and long term (coefficient of cointegration is negative and significant);
- Residues are not autocorrelated, have a normal distribution and are homoscedastic.

In conclusion, the previously VEC model can be considered representative to describe autoregressive links between export of *SITC group 7* as the dependent variable and import of *SITC group 7* and FDI as independent variables.

6. Conclusions

As a whole, the exports of "*Machinery and transport equipment*" are 85% influenced by imports of "*Machinery and transport equipment*" and FDIs. In the long run, the study reveals a direct link to FDIs and the growth of exports. Also, in the long run, the results show a reverse link between exports of machinery and transport equipment and imports of similar products (the decrease in imports by 1 currency unit determines the increase of exports by 0.70 monetary units). The result is not always supported by the economic reality and requires further investigation.

A reliable conclusion on the characteristics of the link between the FDIs, export and import of "*Machinery and transport equipment*" requires further investigations, taking into account other aspects of the national macroeconomic context – the total trade balance, trade balance of SITC group 7 "*Machinery and transport equipment*", trade balance by types of technologies, the dynamics of trade flows and FDI, GDP, etc.

Regarding the evolution of exports and imports of FDIs companies (aggregated data by main activities) it is observed that the manufacturing industry is the main export sector (over 80% of the total). In turn, the manufacturing industry includes an important part of the SITC 7 "*Machinery and transport equipment*", which should facilitate the image of a strong link between FDIs and the export and import of goods from the SITC 7.

Taking into account the determining contribution of the FDIs companies to Romania's foreign trade, it can be said that many foreign investments were attracted by the comparative advantages of our country in the competition of globalization (especially in the case of producing branches for groups presented in Tables 2 and 3 in Section 2 of this paper), either by export-oriented production or by exports with a significant import content (including processing and assembling).

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The relationship between product match-up in advertisement and consumers' purchase intention of personal care products

Mark Dirikorigha SALVATION
Faculty of Industrial Management, Universiti Malaysia Pahang, Kuantan, Lebuhraya Tun Razak, Gambang – 26300,Pahang, Malaysia, salvationmark214@gmail.com.

Abstract

The changing business environment has propelled marketers to use different kinds of marketing strategies to achieve their organizational goals and celebrity endorsement is one of the marketing strategies adopted by many companies today to attain their marketing objectives. A search of leading electronic journal databases indicates that limited studies that specifically investigate the effectiveness of product up in celebrity endorsement in advertisements on young consumers' purchase intentions of skin-care products in Malaysia. Much research has been documented on the effect of product match-up on consumers' decision to purchase advertised products. However, there are mixed and inconclusive findings. Therefore, the study determined how a match-up between a spokespersons' image and the product image may influence consumers' purchase intentions of L'Oreal's skin-care products. A sample of 280 respondents were surveyed using random sampling. The study found that consumers are more likely to be influenced by advertising messages communicated by spokespersons that have similar interest with the target audience. Therefore, L'Oreal needs to only select endorsers based on their ability to relate with the target audience and enhance sales messages because endorsing celebrities whose image matches the brand and the target audience can convey a more convincing message which can lead to increased purchase intentions. Thus, it is recommended here that L'Oreal should only endorse spokespersons whose image and lifestyles is similar to the desire brand image being communicated to the target audience because sales revenue can be increased when celebrities who share similar values and personalities with both the brand are endorsed. This is because endorsers transfer their unique images into the product and this stimulates the chances of consumers buying the advertised brand.

Keywords: ***Product, match-up, advertisement, purchase intention, care-products***

1. Introduction

The changing business environment has propelled marketers to use different kinds of marketing strategies to achieve their organizational goals. Celebrity endorsement is one of the marketing strategies adopted by many companies today to attain their marketing objectives (Lee and Thorson, 2008). Driven by this, celebrity endorsement advertisement has become a common feature of modern marketing all over the world. For example, about 25% of all television advertisements feature celebrity endorsers in the United States (Erdogan *et al.*, 2001) while over 12% of all advertising campaigns use celebrity endorsers in Germany. Similarly, studies from Korea indicate that 32% of television advertisements and 59% of prime-time television commercial uses celebrities while over 70% of Japanese television advertisements endorse celebrities (Shukre and Dugar, 2012). Although the use of celebrity in advertising appears to be more recent when compared to the Western countries, Malaysian marketers are rapidly embracing celebrity endorsement practice in their commercials with appropriately 15% of advertisements (Rashid, *et al.* 2002) using diverse celebrities including Chef Wan for endorsing Vesawit, Siti Nurhaliza endorsing Pepsi, Sarimah endorsing Rejoice, Erra Fazira endorsing beauty products such as Lux (Kok and Li, 2013), Aiman Hakim Ridza endorsing Garnier Men and Diana Danielle promoting L'Oreal's skin-care products.

When implemented correctly, advertising strategy that endorses credible celebrities as spokespersons positively influences the image of the advertised brand, thereby creating favourable brand association that differentiates a company's products from other competing brands. In supporting this claim, the study of Seno and Lukas, (2007) assert that quite number of companies now explore the possibilities of making their advertisements more compelling, eye-catching and noticeable to their target audience because capturing consumers' attention is becoming very tough in today's changing business environment with increasing competition. Thus, celebrity endorsement has become a popular advertising strategy to make products more noticeable, attractive and compelling to the target audience. However, other views seem to offer a competing perspective. According to this latter claim, endorsing celebrities in advertisements costs marketers' huge amount of money and this increases the marketing costs of the company, thereby reducing the net profit of the business

(Jaiprakash, 2008; Klaus and Bailey, 2008). Besides, when a celebrity is overexposed – that is, endorsing too many products – his or her perceived credibility may suffer and this may reduce the effectiveness and persuasiveness of the advertisement (Francis and Yazdanifard, 2013). Therefore, the study aims to ascertain whether there is a correlation between celebrity endorsement in advertising campaigns and young consumer's purchase intentions of L'Oreal's skin-care products.

Furthermore, studies show that advertising and marketing managers take various factors into account when choosing a spokesperson for an advertising campaign. Among the most important factors is to determine whether the spokespersons are better fit for the features of the advertised product and or service and match up with the target audience and the overall image of the endorser (Zoubi and Bataineh, 2011; Zafar and Rafique, 2012). However, many companies tend to select the wrong endorsers whose image does not match the intended brand or product image during advertisement campaigns. For example, Amitabh Bachchan endorsed Maruti Versa but this ad was a failure and it affected the brand negatively (Prasad, 2012). This is because the consumers could not see a close resemblance between the endorsers' image and the image of the product which the company wanted to communicate to the target audience (Zoubi and Bataineh, 2011). Besides, a search of leading electronic journal databases indicates that limited studies that specifically investigate the effectiveness of product up in celebrity endorsement in advertisements on young consumers' purchase intentions of skin-care products in Malaysia. This is because most of the prior studies conducted in Malaysia tend to focus only on the attitudes and perceptions of consumers towards celebrity endorsements. For example, while many researches tend to study the response of Malaysian media audience on celebrity advertisements, others study the consumers' responses toward celebrity endorsements base on gender differences.

Besides, extant celebrity endorsement studies are limited to literature concerning the selection of celebrity endorsers meanwhile selection is just one aspect of the development and execution of a celebrity endorsed advertising campaign (Goldsmith, Lafferty and Newell, 2000; Bahrom and Idris, 2013). This indicates that there is an incomplete picture of the impact of celebrity endorsement on young consumers' purchase intentions of skin-care products. To this end, it is posited here that prior studies on celebrity endorsement has concentrated more on the attitudes and perceptions of consumers towards celebrity endorsements in the consumer market due to the difficulty in measuring the impact of celebrity endorsement on consumers as a psychological construct as shown in the significant increase in the number of academic studies but with little attention on young consumers' purchase intentions of skin-care products. This indicates that the literature is almost silent on the details of how endorsing celebrities in advertisements can influence or suppress young consumers' attitudes towards the advertised brand and ultimately persuade them to purchase the product. Given this, there is an incomplete picture of the way celebrity endorsement influences or suppresses consumer's behavioral beliefs and intentions especially when it comes to skin-care products in the Malaysia cosmetic and beauty product market. Driven by these gaps, this study is conducted to help the company better understand the growing importance of selecting the right fit endorsers and the need for evaluating celebrity endorsement advertisements after its implementation. The study attempts to determine how a match-up between the celebrity endorser's image and the product image may influence young consumers' decision to buy L'Oreal's skin-care products in Malaysia. The main objective of this study is to determine how a match-up between an endorser's image and the product image may influence young consumers' purchase intentions of L'Oreal's personal care products.

2. Literature review

The following issues will be discussed here: an overview of the consumers' purchase intentions and product match-up.

2.1. Consumers' purchase intentions

Purchase intention entails the likelihood of a person buying certain product over competing brands due to an interaction between the needs and expectations, perception toward the brand and promotional efforts (Tirtiroglu and Elbeck, 2008; Kotler and Armstrong, 2010). According to this claim, purchase intention is known as a consumer's interest shown towards a particular brand after a careful evaluation of the competing brands which may influence his or her decision to buy the brand among the numerous options. This indicates that a consumers' decision to purchase L'Oreal skin-care product is seen as the end result of consumer's behaviour process which starts from the need identification to information searching and the evaluation of the available

product options. However, the studies of Sam and Tahir, (2009); Khan, *et al.* (2012) defined purchase intention as the degree of future behavioral orientation shown by consumers in purchasing a brand shown in an advertisement. According to this perspective, purchase intention is the chances of a potential customer buying a particular product advertised by a marketer. However, both claims show that purchase intention is the probability of a customer buying L'Oreal's skin-care products after a careful evaluation of other competing brands due to marketing efforts.

There is no gain saying the fact that consumers are the most significant people for any business and every marketer intents to attract and retain as many customers as possible. This is because the chances of consumers buying L'Oreal's skin-care products among other competing brands determine both the short-term and long-term survival and success of the business as measured by increased sales revenue, bottom line performance and market share (Sivesan, 2013). However, increased purchase intentions can only be determined by how well the company provides quality products that will meet the expectations and needs of the consumers at competitive prices. This indicates that consumers play a critical role in the marketing process of the company because the main goal of any marketing strategy is to identify and meet the needs and expectations of the consumers (Belch and Belch, 2009; Fah, *et al*. 2011). Driven by this, the marketing communication department of L'Oreal should remember that the consumer is the central element of all decisions concerning marketing especially when developing the marketing plan. Given this, all advertisements need to take the consumer's perspective into consideration and it should reflect the buying habits and needs of the customers so as to raise brand awareness and attract and retain customers. In supporting this claim, the studies of Baheti, *et al.* (2012); Weng and Run, (2013) opine that marketers believe that the power of a brand relies in the mind of existing or potential customers and what they experience either directly or indirectly about the brand determines their behavioural attitudes and purchase intentions. This indicates that consumers determine the success or failure of L'Oreal company, thus their needs and expectations should be put into consideration when designing the marketing campaign.

2.2. Product match-up

The product match-up is congruence between the characteristics of the chosen spokesperson and the features of the brand contained in the advertisement. Product match-up is construed as ensuring a similarity between the spokesperson's characteristics and the product attributes so as to enhance the advertisement effectiveness (Amos, *et al*. 2008). Erdogan, (2010) indicates that the congruence between the celebrity endorser's characteristics and the product attributes is critical in order to enable the correct meaning transfer and to enhance the credibility of the source used to endorse the product. This indicates that product match-up is a natural development from the meaning transfer and the source credibility theories because the similarities between the endorser and the image of the product contained in the advertisement helps meaning to be conveyed by synthesizing information concerning the celebrity and the brand. However, the 'cultural milieu' of the target audience influences the way in which the behaviour of consumers is interpreted and meaning given to the advertised brand (Nelson, *et al.* 2012). This indicates that when a consumer perceives an endorser on a negative light, it may trigger negative attitude and this will be transferred to the brand. However, when a positively perceived celebrity is endorsed in an advertising campaign, the image of the endorser triggers the desired recognition, thereby transferring positive meaning to the advertised brand

2.3. The relationship between product match-up and consumers' decision to purchase products

Much research has been documented on the effect of product match-up on consumers' decision to purchase advertised products. According to this claim, a close resemblance between the celebrity endorser's image and the brand image can enhance the effectiveness of the advertising campaign. For example, the marketing department of L'Oreal can only use beautiful endorsers with fair skin to promote their fairness skin products. This indicates that the target audience can only respond to the advertising campaign if there is a best fit between the spokesperson's characteristics and the brand or product image. In supporting this claim, the study of Choi and Rifon, (2012) assert that a perfect match-up between the communicator and the product tends to produce favorable attitudinal and behavioral responses among target audience. However, Rashid, *et al.* (2002) assert that finding and selecting a celebrity that ensures a perfect match-up with the product image is a major challenge to marketers. According to this claim, since a high degree of congruence between the celebrity endorser and the product image determines the way the target audience will view the spokesperson as whether credible or

attractive, using a person who does not mirror the image of the product may result to ineffective advertising campaign.

2.4. Theoretical framework

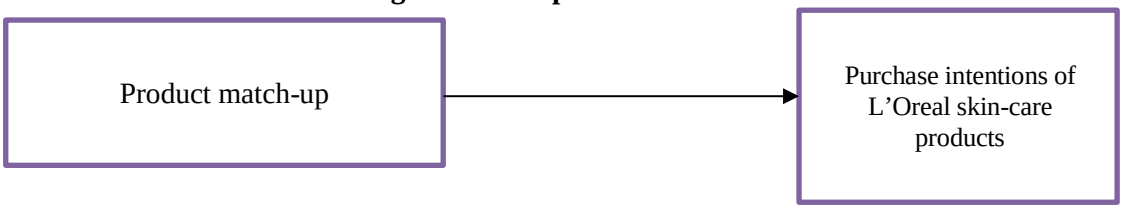
Celebrity endorsement theory has been developed over the years through empirical studies based on two key models: Ohanian's Source Credibility and Kamin's Match-up Hypothesis. However, the study only focused on the Match-up Hypothesis theory to determine impact of celebrity endorsement on young consumers' purchase intentions of L'Oreal's skin-care products. The Match-up Hypothesis theory underlines the congruence between the characteristics of the chosen spokesperson for a brand and the features of the brand contained in the advertisement (Choi and Rifon, 2007; Agarwal, *et al.* 2011). According to this theory, there should be a close resemblance between the celebrity endorser's image and the brand image. For example, the marketing department of L'Oreal can only use beautiful endorsers with fair skin to promote their fairs kin products. This indicates that the target audience can only respond to the advertising campaign if there is a best fit between the spokesperson's characteristics and the brand or product image. This is because the selected celebrities bring meaning to the endorsement process by communicating a message that suggests a similarity between the chosen elements of the celebrity's image and the product. In supporting this claim, the study of Choi and Rifon, (2007) assert that a perfect match-up between the communicator and the product tends to produce favorable attitudinal and behavioral responses among target audience.

However, the 'cultural milieu' of the target audience influences the way in which the behaviour of consumers is interpreted and meaning given to the advertised brand (Nelson, *et al.* 2012). This indicates that when a consumer perceives an endorser on a negative light, it may trigger negative attitude and this will be transferred to the brand. However, when a positively perceived celebrity is endorsed in an advertising campaign, the image of the endorser triggers the desired recognition, thereby transferring positive meaning to the advertised brand

2.5. Conceptual framework

Figure 1 below shows the conceptual framework of the study. The framework is adapted from the study of Sivesan, (2013) on the impact of celebrity endorsement on brand equity in cosmetic products which was conducted in Jaffan peninsula in Sri Lanka. The framework highlights the interrelationship between the variables and it shows that endorsing celebrities in advertisements is related to consumers' purchase intentions of L'Oreal skin-care products due to celebrities' unique characteristics and their ability to match up their characteristics with the brand the company wished to convey to the target audience.

Figure 1 Conceptual framework



3. Methodology

3.1. Participants' (subjects) Characteristics

The participants of this study consist of young consumers between the age bracket of 18 to 40 years old who often purchase L'Oreal's skin-care products who live in Serdang. Young consumers were selected as the subjects of the study because they tend to be more beauty and image conscious and they are always on the lookout for innovative beauty and skin-care products that will enhance their self-esteem.

3.2. Sampling Procedures

The target respondents for this study are chosen randomly in order to ensure adequate representativeness of the study population. This indicates that the study uses random sampling technique when choosing 280 respondents who live in Serdang based on Morgan's sampling chart and a 95% Confidence Level with 5%

Margin of Error. Random sampling is construed as giving every unit in the population an equal and independent chance of being chosen as a subject. Simple random sampling technique was used for this study because it has a high generalizability of the findings to the whole population because it reduces sampling error. In supporting this claim, Sekaran and Bougie, (2010) opine that random sampling helps a researcher to study a small sampling frame without biasing the results and it enhances the ability of the study to be generalized beyond the sample size to the larger population because all elements in the population is considered and given an even opportunity to be included in the study.

3.3. Sample size analysis

The target population of this research consists of young consumers of L'Oreal's skin-care products who live in Serdang and the unit of analysis is the individual shoppers. However, since it appears to be difficult to include every member of the target population, a sample size of 280 from the total population is selected to represent the population and they were surveyed through face-to-face personal delivery. The sample size selection is based on Morgan's sampling chart and a 95% Confidence Level with 5% Margin of Error. The sample size selection is based on the ease and convenience of collecting and analysing a manageable sample given the limited budget and time meant for completing the study. Collis and Hussey, (2009) assert that a manageable sample size should be selected to represent the population since it is not feasible to study the entire population. However, a large enough sample size reduces the level of sampling error because it ensures adequate representativeness of the population. Fosgate, (2009) assert that the probability of a study yielding statistically sound findings is based on a large sample size.

3.4. Research instrument

Since the study uses quantitative research method, questionnaire is used to collect the required data. Questionnaire was used in this study because it is less expensive in collecting a large amount of data within a short period of time. Also, questionnaire was used because the respondents can answer at their convenience and the response rate is high. In supporting these claims, the study of Bluman, (2001); White, *et al*. (2005) assert that questionnaire happens to be the only feasible tool for collecting quantitative data when conducting quantitative studies. Similarly, the study of Lefever, *et al*. (2007) opines that questionnaire is easy to administer and when personally administered, it can establish rapport and motivate respondents to answer the questions at their own convenient time.

4. Results

4.1. Respondents' demographic profile

Table 1 in Appendix 1 provides the profile of the respondents. The data indicate that over half of the respondents are Malay consumers followed by the Chinese. This is because there are more Malays than any other ethnic group in Malaysia. This supports the report of the Department of Statistics Malaysia, (2010) that Malays account for over half of the total Malaysian population (i.e. 67.4%) followed by the Chinese (24.6%). The data further shows that over half of the respondents are female consumers. This is because women are beauty and image conscious and they are more likely to seek for personal care products so as to enhance the need to feel good and portray their beauty. The study of Azuizkulov, (2013) support that there is a growing demand of colored personal care products such as anti-ageing, UV protection and skin protection among Malaysian women so as satisfy their beauty needs. The data from the age group show that majority of the respondents are young adults. This is because young adults are more concerned about feeling good, portraying the beauty and satisfying their egoistic needs and these elements justify the reason for increase purchase intention of cosmetic products among young adults in Malaysia. This supports the study of Norudin, (2005) that youths tend to place more interest in maintaining their self-image and beauty and this account for the increase use of personal care products among young Malaysia adults especially the female consumers.

The data on the educational status of the respondents indicate that nearly half of the respondents are undergraduate degree holders followed by the master degree holders. This indicates that majority of the

respondents are well educated to make well-informed purchasing decision. However, the data on the income distribution show that more respondents earn an average income level of RM2,301 – M2,900. This reflects the country's minimum wage rate in that undergraduate degree holders tend to earn within this income level.

4.2. The effect of product match-up on consumers' buying decisions

Table 2 in Appendix 1 presents the data on how well the respondents can positively relate to L'Oreal's endorser. The results show that majority of the respondents agree to relating well with the endorser. This is because the endorser's image and features match well with many members of the company's target audience among the beauty and image conscious consumers. For example, L'Oreal endorses a beautiful American-born Malaysian actress, Diana Danielle, to appeal to the younger female consumers and Aiman Hakim Ridza, a Malaysian actor and a singer, to target the young male consumers' audience and all these endorsers seem to perfectly match with the target audience. This is because both of the endorsers are young and each of them targets their gender group. Also, they are both good looking and this may influence the predominantly teenage and young adult audience to aspire to look like them by using L'Oreal's skin-care products. The implication of the finding is that endorsing celebrities whose image and personality match with the target audience will enhance the ability of the consumers to relate with the celebrity. Therefore, it is suggested that L'Oreal can enhance the effectiveness of the advertising by ensuring that the chosen celebrity matches the target audience. This supports the claims of Shimp, (2007) that the first question a brand manager must pose when selecting an endorser is, "will the target market positively relate to this endorser?".

Further results presented in Table 3 in Appendix 1 shows the results on how the respondents are persuaded by the advertisement when there is a match between the celebrity's image and the product image. The results indicate that over half of the respondents agree that they are persuaded by the advertisement message when the image and personality of the celebrity match with the brand image L'Oreal wishes to communicate to the target audience. This is because celebrity and product match-up enhances the consumers' ability to relate positively with the endorser. Supporting this claim, Shimp, (2009) asserts that advertising executives require that the celebrity's values and appearance need to be compatible with the image desired for the advertised brand. The implication of this finding is that the company can persuade young consumers to try its skin-care products by selecting celebrities whose image and lifestyle match with the brand image been portrayed in the advertisement. Therefore, it is suggested here that the marketing manager of L'Oreal should only select endorsers who have similar image and lifestyle with the desired brand image being communicated in the ad.

Moreover, Table 4 in Appendix 1 presents the results of how compatibility between the celebrity's behaviour and target audience can create favourable attitude toward L'Oreal's brand. The results show over half of the respondents agree that when the celebrity's behavior is compatible with their values, it will enhance favourable attitude and perception about the advertised brand. This is because consumers are more likely to be influenced by a message coming from someone with whom they feel a sense of similarity. This supports the findings of Choi and Rifon, (2007) who found that when an endorser and the target audience have similar product needs and lifestyles, the advertising message by the endorser will be better understood and received by the consumers. The implication of this finding is that the company can enhance favourable brand image when it selects people whose characteristics match well with their customers. Therefore, it is suggested that L'Oreal should only select celebrities who share similar features or image with the target audience so as to enhance the chances of influencing the consumers to respond to the advertisement. Also, Table 5 in Appendix 1 shows the results of how consumers can be persuaded by the advertisement campaign when the endorser's image match-up with the brand. The results indicate that majority of the respondents agree that when L'Oreal endorses people who share similar image with the brand being endorsed, it will enhance the chances of the consumers being persuaded by the advertisement. This is because when the marketing managers of L'Oreal use beautiful endorsers with fair skin to promote their beauty care products, the consumers will be easily persuaded to try the products. Supporting this claim, the study of Choi and Rifon, (2007) assert that the target audience can only respond to the advertising campaign if there is a best fit between the spokesperson's characteristics and the brand or product image. The implication of the findings is that the company can only select celebrities whose image matches the desired product image.

Furthermore, Table 6 in Appendix 1 shows that while a total of 61.5% of the respondents agree that celebrity and brand image match-up can enhance their purchase intentions, only 10.7% of the respondents seem to

disagree. This indicates that a similarity between the celebrity's image and the product image can influence the consumers' purchasing decision to buy L'Oreal's skin-care products. This supports the findings of Lin, (2011) who found that endorsing celebrities whose image matches the desired brand image will enhance purchase intentions of the products. The implication of this finding is that L'Oreal can enhance its sales revenue by endorsing celebrities who share similar values, personalities and lifestyles with both the brand and the target audience. This is because endorsers transfer their unique images into the product and this stimulates the chances of consumers buying the advertised brand.

To conclude, endorsing spokespersons whose image matches the brand and the target audience can convey a more convincing message which can lead to increased purchase intentions because endorsers are seen as dynamic and they possess likable characteristics.

Outcomes of statistical analysis

Table 7 in Appendix 1 presents the hypothesis findings from the Pearson correlation test and it indicates that the hypothesis is supported. This indicates that there is a significant relationship between product match-up and young consumers' purchase intentions of L'Oreal's skin-care products.

Hypothesis 1: There is a significant relationship between product match-up and young consumers' purchase intention of L'Oreal's skin-care products

The aim of this hypothesis is to determine how the similarity between the celebrity's image and brand can influence young consumers to buy L'Oreal's skin-care products. The alternate hypothesis is stated below:

H_a**:** There is a significant relationship between product match-up and the consumers' purchase intention of L'Oreal's skin-care products

As shown in Table 7 in Appendix 1, while the Pearson r correlation coefficient value is 0.585, the significant value is 0.000. The result shows that the significant value is less than the significant level. This indicates that the alternate hypothesis is accepted and it can be concluded here that there is a significant relationship between product match-up and the consumers' purchase intention of L'Oreal's skin-care products. This indicates that a similarity between the celebrity's image and the product image can influence the consumers' purchasing decision to buy L'Oreal's skin-care products. This supports the findings of Lin, (2011) who found that endorsing celebrities whose image matches the desired brand image will enhance purchase intentions of the products. The implication of this finding is that L'Oreal can enhance its sales revenue by endorsing celebrities who share similar values, personalities and lifestyles with both the brand and the target audience. This is because endorsers transfer their unique images into the product and this stimulates the chances of consumers buying the advertised brand. Therefore, it is suggested here that L'Oreal should only endorse celebrities whose image and lifestyles is similar to the desire brand image being communicated to the target audience.

5. Discussions

The study has examined rather extensively the impact of product match-up on consumers' decision to buy personal care products in Serdang and the findings generated from this study clearly justified the research objective as it was found that the effectiveness of the advertising campaign is determined by how well the audience can relate with the endorser. This indicates that a similarity between the celebrity's image and the product image can influence the consumers' purchasing decision to buy L'Oreal's skin-care products. This finding supports Kamins' Match-up Hypothesis Theory developed in 1990 which underlines the congruence between the image of the chosen spokesperson and the desired brand image communicated by the company. The theory postulates that the effectiveness of the advertisement campaign is determined by how well the spokesperson's image matches the desired brand image communicated by the company. This supports the findings of Lin, (2011) who found that endorsing celebrities whose image matches the desired brand image and audience will enhance purchase intentions of the products. The implication of this finding is that L'Oreal can enhance its sales revenue by endorsing celebrities who share similar values, personalities and lifestyles with both the brand and the target audience. This is because endorsers transfer their unique images into the product and this stimulates the chances of consumers buying the advertised brand.

6. Conclusion

The study indicates that consumers are more likely to be influenced by advertising messages communicated by spokespersons that may have similar needs and goals and interest with the target audience. The implication is that L'Oreal needs to select celebrity endorsers based on their ability to relate with the target audience and enhance sales messages. This indicates that endorsing celebrities whose image matches the brand and the target audience can convey a more convincing message which can lead to increased purchase intentions because endorsers are seen as dynamic and they possess likable characteristics. Since the study further found a significant relationship between product match-up and the consumers' purchase intention of L'Oreal's skin-care products, it is recommended here that L'Oreal should only endorse spokespersons whose image and lifestyles is similar to the desire brand image being communicated to the target audience. It is further recommended here that L'Oreal should select endorsers based on how well the target audience can relate with them. This is because L'Oreal can enhance its sales revenue by endorsing celebrities who share similar values, personalities and lifestyles with both the brand and the target audience. This is because endorsers transfer their unique images into the product and this stimulates the chances of consumers buying the advertised brand.

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Appendix 1: List of Tables

Table 1: Profile of the respondents

Respondents' demographic	Variables	Number	Percentage (%)
Race	Malay	180	64.3
	Indian	26	9.3
	Chinese	39	13.9
	Others	35	12.5
	Total	280	100
Gender	Male	100	35.7
	Female	180	64.3
	Total	280	100
	18 -22 years old	110	39.3
Age group	23 -27 years old	98	35
	28 -32 years old	52	18.6
	33 – 40 years old	20	7.1
	Total	280	100
	SPM	20	7
Educational level	Foundation	30	10.7
	Diploma	50	17.9
	Bachelor degree	120	42.9
	Master	50	17.9
	PhD	10	3.6
	Total	280	100
	Less than RM1,000	10	3.6
	RM1,000 – M1,600	50	17.9
Monthly income	RM1,601 – M2,300	90	32.1
	RM2,301 – M2,900	100	35.7
	Above RM2,900	30	10.7
	Total	280	100

Table 2: Results on how well the target audience can relate with the endorser

Measurement scales	Frequency	Percent
Strongly Agree	53	18.9
Agree	136	48.6
Neutral	66	23.6
Disagree	20	7.1
Strongly Disagree	5	1.8
Total	280	100.0

Table 3: Consumers' persuasion of celebrity and product match-up

Measurement scale	Frequency	Percent
Strongly Agree	42	15.0
Agree	140	50.0
Neutral	73	26.1
Disagree	21	7.5
Strongly Disagree	4	1.4
Total	280	100.0

Table 4: Favourable attitude toward L'Oreal's brand being influence by audience match-up

Measurement scale	Frequency	Percent
Strongly Agree	47	16.8

Agree	139	49.6
Neutral	63	22.5
Disagree	28	10.0
Strongly Disagree	3	1.1
Total	280	100.0

Table 5: Influence of celebrity and brand match-up on consumers' persuasion

Measurement scale	Frequency	Percent
Strongly Agree	51	18.2
Agree	121	43.2
Neutral	77	27.5
Disagree	26	9.3
Strongly Disagree	5	1.8
Total	280	100.0

Table 6: Influence of celebrity and brand match-up on consumers' purchase intentions

Measurement scale	Frequency	Percentage
Strongly Agree	50	17.9
Agree	122	43.6
Neutral	78	27.9
Disagree	26	9.3
Strongly Disagree	4	1.4
Total	280	100.0

Table 7: Pearson correlation results

		Purchase intention
Product match up	Pearson Correlation	0.585**
	Sig. (2-tailed)	.000
	N	280

Title: The role of social media marketing and product involvement on consumers' purchase intentions of smartphones

Mark Dirikorigha SALVATION[1], Shahryar SOROOSHIAN[2],
[1](Corresponding author) Faculty of Industrial Management, Universiti Malaysia Pahang, Kuantan, Lebuhraya Tun Razak, Gambang – 26300, Pahang, Malaysia, marksalvation214@gmail.com
[2]Faculty of Industrial Management, Universiti Malaysia Pahang, Kuantan, Lebuhraya Tun Razak, Gambang – 26300, Pahang, Malaysia, sorooshian@ump.edu.my

Abstract

The technological development in general and the growing popularity of social media in particular has opened a new opportunity for companies to better engage consumers through online communities, social networking sites and blogs. Despite the growing market potential of the social media, many companies are still reluctant to incorporate it into their marketing campaign on the premise that social media advertising is a very personalized way of advertisement and promotions which target only a certain small groups which are interested in a particular domain, quite unlike conventional advertising strategy. Thus, the study examined the role of social media marketing and product involvement on consumers' purchase intentions of smartphones. A sample of 200 college students were surveyed and the data analyzed using SPSS. On analyzing the study, it was found that companies use social media to engage their target consumers online. This indicates that social media do not only help smartphone marketers to effectively interact with their target audience given its ability to encourage back-and-forth interaction between the consumers and the company unlike the one-way traditional media but it also encourages the readers to buy the advertised products. On the findings from the hypotheses, it was found that all the hypotheses were supported and this indicates that social media marketing significantly influences consumers' decision to buy smartphones. However, this is mediated by the type of advertisement and product involvement. These findings would help marketers and firms to make hard economic decisions.

Keywords: ***Social media marketing, product involvement, consumers' purchase intentions***

1. Introduction

The technological development in general and the growing popularity of social media in particular has opened a new opportunity for companies to better engage consumers through online communities, social networking sites and blogs. Many companies today have come to realize that there is the need to keep up with the fast pace of the changing business environment or risk being outdated. It is no longer feasible for a pure-bricks business model and marketing strategy to thrive well in the current market scenario without considering social media (Bashar, *et al*. 2012). Thus, social media has become really a vital gradient in today's marketing mix in general and in promotional mix in particular. Although many social media sites were initially designed for socializing purposes (Boyd and Ellison, 2007; Kaplan and Haenlein, 2010), the growing traffic among many online communities, social network sites and blogs have driven many companies to establish their presence in one social media site or the other in order to not only create brand awareness especially among young consumers but also to cultivate favourable brand impression which may ultimately stimulate trial purchase. This indicates that adapting some form of marketing online through social media is a critical edge for major businesses to thrive in their marketing efforts. However, while much studies on social networking has been documented over the years, a review of the literature indicates that there are relatively few studies which specifically considers the marketing potential of these online communities. Driven by this, the current study intends to investigate the role of social media marketing and product involvement on consumers' purchase intentions of smartphones.

Two main problem areas motivated the conducting of this study. First, there is little prior research that has specifically investigated the impact of social media marketing and product involvement on consumer's intentions to buy smartphones. This is because many of the prior studies conducted on social media tend to focus on the communication potential and marketing potential. However, research into this issue has produced mainly general overviews on social media marketing with a theoretical perspective. Missing are actual research studies of social media marketing in specific organizations. Instead, research needs to document different voices in the social media marketing and product involvement, especially those that have been marginalized. For example, Kim, *et al.* (2013) studied the impact of social network sites ad type and product involvement on consumers' purchase

intentions of some selected products. Also, Bashar, *et al*. (2012) studied the effectiveness of social media as a marketing tool without focusing on any specific product. This indicates that despite the growing body of studies investigating the impact of social media advertising on consumer's purchase intentions of products, there are limited studies which specifically focus on how social media marketing advertising type and product involvement can influence consumers to buy smartphones. Besides, many of the few studies were conducted in the western countries and given the sociocultural differences between the west and east, this current study is designed to examine the impact of social media marketing advertising type and product involvement on consumers' purchase intentions. Secondly, despite the growing market potential of the social media, many companies are still reluctant to incorporate it into their marketing campaign on the premise that social media advertising is a very personalized way of advertisement and promotions which target only a certain small groups which are interested in a particular domain, quite unlike conventional advertising strategy. For example, the study of Neti, (2011) found that only 23% of marketers seem to be using social media to engage customers and promote their products and services. The study is conducted to help such companies to better understand the benefits of adopting social media in their marketing campaign so as to enhance not only brand awareness but also to enhance their sales performance. Therefore, this research intends to identify the impact of social media marketing on consumer's intention to buy smartphones, investigate the role of ad type on the effectiveness of social media marketing and determine the role of product involvement on consumer's purchase intentions. The findings of this study will help companies who are still reluctant to adopt social media marketing to better understand the benefits of adopting social media in their marketing campaign so as to enhance not only brand awareness but also to enhance their sales performance.

2. Literature review

2.1. Definition of purchase intention

Purchase intention can be defined as the probability of a consumer buying a product after an evaluation of competing brands (Tirtiroglu and Elbeck, 2008). However, another study considers purchase intention to be the extent of a future behavioral orientation shown by a customer in buying products or services shown in advertisements (Baheti, *et al.* 2012). While the former claim indicates that purchase intention is the chances of a person choosing a brand as a result of his or her need recognition and alternative product evaluation, the latter definition indicates that purchase intention is the degree of a consumer buying a product he or she sees in an advertisement. However, both claims indicate that purchase intention is the likelihood of a consumer patronizing a marketer.

2.1.1. The importance of consumers' purchase intentions to smartphones companies

Consumers' purchases are vital for the survival and success of smartphone companies and this is determined by their purchase intentions. This shows that consumers are the essence of the existence of the business because they help to buy the products or services that the companies produce. It indicates that consumers' purchases determine the market potential for the companies, without which, no market will exist (Tirtiroglu and Elbeck, 2008). According to this view, the sales revenue and bottom line performance of the smartphone companies relies on consumers' purchases. This indicates that the higher the purchase intentions of consumers, the more chances of survival and success the company will achieve and vice versa. Besides, smartphone companies use consumers' purchase behaviour data to measure their supply and demand business operations. For example, the data obtained from consumers' purchase patterns can help the companies produce the products at the most favorable consumer price points. In supporting this claim, the study of Barber, *et al.* (2012) found that data collected from consumer's purchase intention can help the business identify which products have the most economic value. Also, the information on consumer's spending behaviour can help to identify consumer's unmet needs, thereby opening new market opportunities for them to enhance their competitiveness. This indicates that consumer purchase intention can generate information for marketers to streamline their business strategies, thereby enhancing their bottom line performance.

However, consumer's purchase intentions can only be enhanced through certain factors. According to this latter claim, smartphone companies can only encourage higher purchase intentions when they provide superior customer value at competitive prices. In supporting this claim, Belch and Belch, (2009); Kotler and Armstrong,

(2010) opine that in a highly competitive business environment, the company can only motivate consumers to patronize them when the product and service quality meets or surpasses the consumers' expectations. This indicates that competitive advantage can only be achieved when they have better knowledge about the needs and preferences of consumers and satisfy them better than their competitors. Similarly, a study conducted by Sunday and Bayode, (2011) opine that companies can boost consumers' purchases intentions by offering superior products and services at a competitive price. This indicates that consumer's purchases intentions can only be motivated by understanding and satisfying consumers' needs and expectations better than competing rivals since consumers today are more informed and they have a wide variety of product range to choose when making purchase decisions.

2.1.2. Measuring purchase intention

Since purchase intention forecasts consumers' actual purchase and the future decisions of the consumers, it is very imperative for the companies to constantly measure consumers' purchase intentions of smartphones. This is very relevant because it will help the marketing department of the company to enhance the company's sales revenue and market position. Driven by this, quite a number of scholars have proposed different indicators and dimensions in measuring purchase intentions after studying the concept of purchase intentions over the years. Among the various studies, for example, Laroche, *et al.* (1996) proposes two variables in measuring purchase intentions: a consumer's consideration in purchasing a brand and expectation to buy a brand. According to this proposition, the likelihood to purchase smartphones by consumers can be determined by personal and product characteristics. This indicates that smartphone companies can project consumers' likelihood to purchase their products by looking at their needs identification and product features, benefits and functionality. However, Hosein, (2002) propose four variables to measure purchase intentions which include consumer's interest, attending, information and evaluation. According to this latter view, the likelihood of a consumer to buy a product depends on his or her personal feelings and preference for the product or brand and this will influence the consumer to seek for information about the product while evaluating the various options. However, both claims seem to suggest that a consumer's intent to buy a specific product brand is an aspect of both affective and cognitive behavior and it can be determined through attitude and likeability measurement.

2.2. Social media marketing as antecedent of consumer's purchase intentions of smartphones

The focus of this section is placed on the relationship between social media marketing and purchase intention of consumers of smartphones. The following issues will be discussed here: definition of social media marketing, the relationship between social media marketing and consumer's purchase intentions.

2.2.1. Definition of social media marketing

Social media marketing is construed as marketing effort aimed to gain traffic or attention through online communities, social networks and blogs (Neti, 2011; Bashar, *et al*. 2012). However, another view defined social media marketing as using social network services to persuade consumers that a marketer's products or services are worthwhile (Kim, *et al.* 2013). While the former definition considers social media marketing as marketing programs which centres on an effort to generate contents which will not only attract attention but also encourage readers to share such product information with their friends and families, the latter definition indicates that social media marketing is using social networking sites to communicate with a target audience about one's company products, thus creating a positive impression about the marketer's brand and making them respond toward the advertisement in a favourable way. Although expressed differently, both claims show that social media marketing is the process of using social media applications to inform, persuade and remind consumers about the existence of certain products and services so as to achieve some social and economic ends.

2.2.2. The relationship between social media marketing and consumer's purchase intentions of smartphones

There are two views on the relationship between social media marketing and consumer's purchase intentions. On one hand, studies portray the relationship between social media marketing and consumer's purchase intentions on a positive light. According to these studies, social media do not only help marketers to effectively interact with their target audience given its ability to encourage back-and-forth interaction between the consumers and the company unlike the one-way traditional media but it also encourages the readers to buy the

advertised products. This is because social media offers marketing applications where readers tend to share product information with their friends and families and such information is considered to be more credible since it involves a friend who may not have financial motives (Leng, *et al*. 2011). For example, international companies such as Starbucks and IBM use social media as a potential marketing platform to promote their advertisements campaign, thereby enhancing their ability to engage the young consumers and enhance sales. In supporting these claims, the study of Thackeray, *et al*. (2012); Leung, *et al.* (2013) assert that social media helps to spread a corporate message from user to user and presumably resonates because it appears to come from a trusted source, as opposed to the brand or company itself. Similarly, a survey conducted by Dimensional Research found that 90% of the respondents affirm that reading social media advertising reviews positively influence their purchase decisions (Gesenhues, 2013). This indicates that social media advertising enhances the marketers' ability to effectively communicate their product features and benefits at costs effective way so as to consumers to buy their products or services.

However, a conflicting view casts the relationship between social media marketing and consumer's purchase intentions on a more negative light. According to this pessimistic perspective, social media is not a strong determinant of consumer's purchase intentions. For example, while some studies assert that consumer's inability to touch or feel products and technical problems about the website may reduce purchase intentions, another argue that social media only focuses on a narrow target group. In supporting these claims, the study of Choi and Lee, (2003); Quinton and Fennemore, (2013) opine that social media advertisement effectiveness is reduced by consumers' inability to examine products or services details effectively, websites' technical problems and privacy or security considerations. Similarly, Cha, (2009); Bruhn, *et al.* (2012) assert that social media advertising is a very personalized way of advertisement and promotions which target only a certain small groups which are interested in a particular domain, quite unlike conventional advertising strategy. Given this, the study of Neti, (2011) found that only 23% of marketers seem to be using social media to engage customers and promote their products and services. This indicates that social media advertising has its own limitation just like every other advertising medium.

2.3. Potential mediators of the social media marketing and consumers purchase intentions relationship

2.3.1. Ad type as a mediator

Social media types of ads are classified into three basic types which include advertising through homepage, fan page and events advertising (Kim, *et al.* 2013). This indicates that marketers can engage in social media advertising by creating a company's homepage, fan page or through certain events that may be of interest to the consumers. Although research on social media marketing ad type is scant, there is evidence to believe that the effectiveness of social media marketing in persuading people to purchase products will depend on the type of advertising in question. According to this claim, advertising through fan page may be more effective in persuading users to purchase the advertised product than advertisement through the company's homepage (Kim, *et al.* 2007). This is because fan page may encourage users to share the advertised products with their friends and families and people tend to place more trust on products recommended by their friends since they are believed not to have any financial motives. However, products advertised through the company's homepage may be perceived otherwise because they may be considered as a medium to convince them to buy products they may not even need. In supporting this claim, the study of Harris and Dennis, (2011); Wang, *et al*. (2012) found that many social media users respond positively to advertisement associated with product comments or recommendations from friends. For example, Emerson, (2013) reports that Facebook has 1,000 stores and Polkadot Alley, a US-based clothes company, is on pace to produce $1.5 million in revenue — 95% of it coming from people who purchase goods through the comments or recommendations section of the fan page. It can be concluded here that the ad type mediates the relationship between social media advertising and consumer's purchase intentions.

2.3.2. Product involvement as a mediator

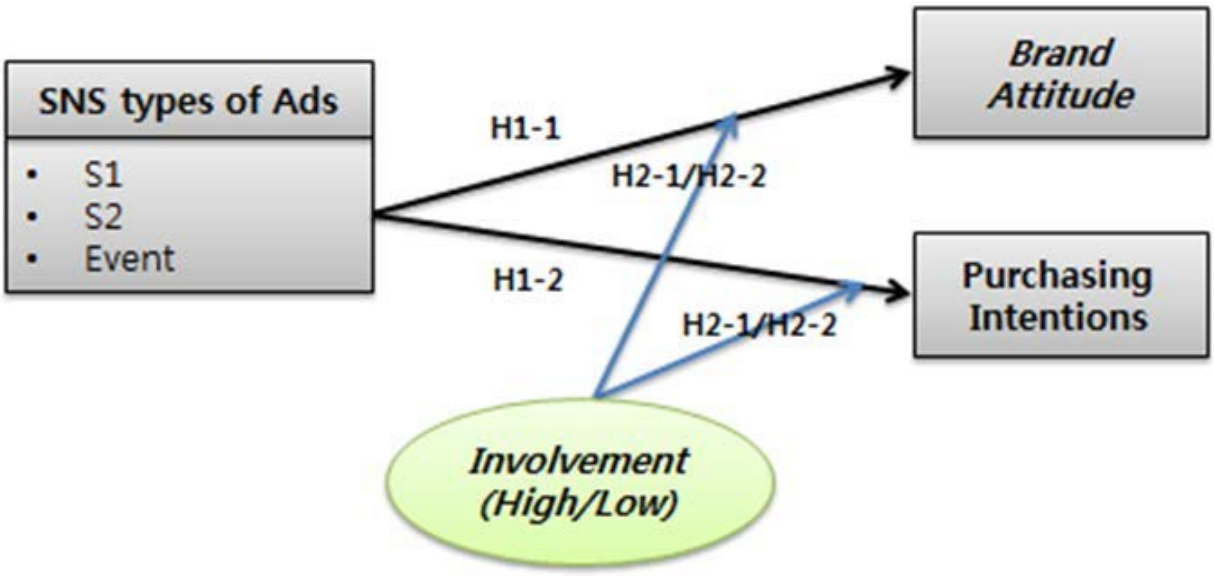
Product involvement is construed as a personal importance and interest placed on a product which is caused by the stimulation of certain circumstances (Kim, *et al.* 2013). This indicates that product involvement entails a consumer's personal feelings and preference for the product or brand and this will influence him or her to seek

for information about the product although there are limited studies to support this claim (Jothi, *et al*. 2011). This indicates that product involvement is an individual difference variable which may mediate the relationship between social media marketing and consumer's purchase intentions because consumer's personal feelings and preference for the product will determine consumers' decision making and communication behaviors although there are limited studies on this line of inquiry. However, another view seems to offer a conflicting perspective. According to this latter claim, there is no significant relationship between product involvement, social media marketing and consumer's purchase intentions. In supporting this claim, the study of Huang, (2012) opine that consumer's purchase intention of virtual goods is primarily influenced by the user's online experiences and the ease of navigating around the website.

2.4. Theoretical framework

Kim, *et al.* (2013) studied the impact of social network sites ad type and product involvement on consumer's purchase intention and Figure 2.1 below shows the research model of the study. The main objective of the study was to investigate the role of SNS on the type of advertising depending on the involvement of the product to the sense of usefulness or ease of consumers' purchase intention. The study used an experimental research design with questionnaire measuring a total of 180 respondents who have experience on the use of SNS. On analysing the differences on the impact of product involvement and advertising types, the study found that the purchase of low involvement products was higher than the high involvement products from all forms of advertising. However, the findings on consumers' purchase intention on all types of advertisement shows that there is a statistically significant difference between product involvements. This indicates that advertisements for low involvement products are more relevant than the high involvement product based on the SNS advertising types.

Figure 2.1 The research model



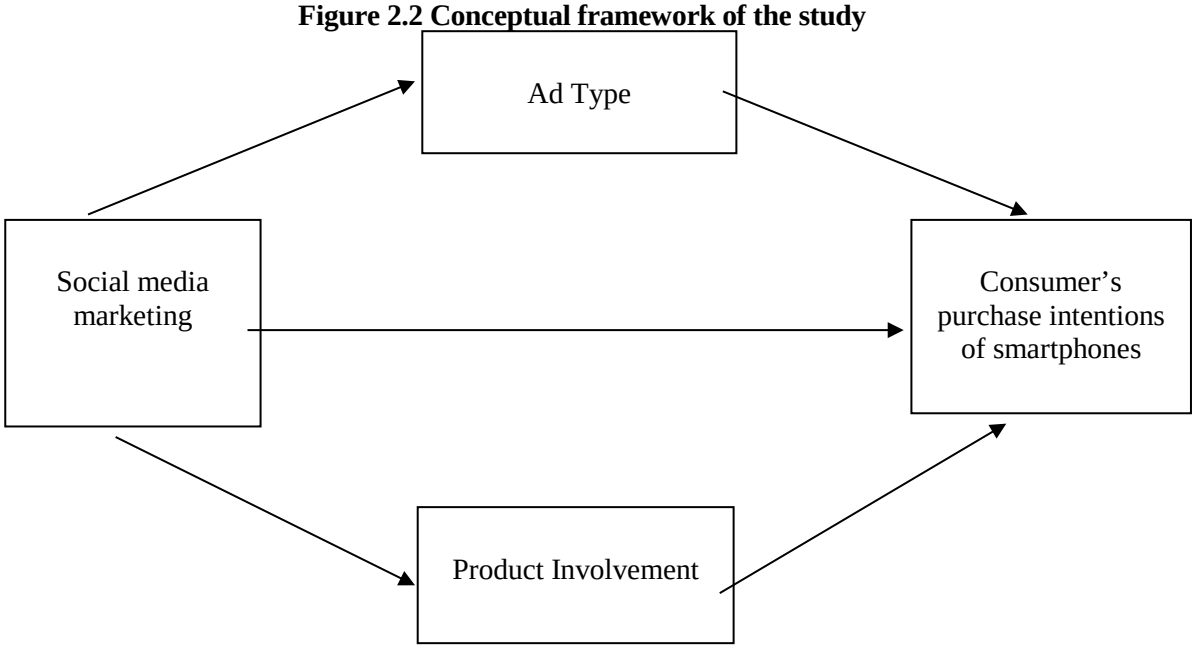
Adapted from the study of Kim, *et al.* (2013)

However, while the study offers some insights on how SNS advertising type can enhance consumer's purchase intention, the findings cannot be generalized beyond the sample size to the larger population given the small sample size. This claim is based on the assertion of Fosgate, (2009); Bryman and Bell, (2011) that the probability of a study to yield a statistically sound conclusion is based on large enough sample because large sample size reduces the chances of missing important units during study, thereby ensuring adequate representativeness of the population. Besides, the study was conducted in South Korea and given the sociocultural and technological differences between Malaysia and South Korea, this study is conducted to determine if similar findings will be obtained in the current location.

2.5. Conceptual framework

The focus here is placed on the conceptual framework of the study. Figure 2.2 below shows the framework of the study and it was adapted from the study of Kim, *et al.* (2013) on the impact of social network sites ad type and product involvement on consumer's purchase intention. The framework shows the interrelationship between the variables which explains that SNS advertising may influence consumer's purchase intentions. However, the framework explains that ad type and product involvement mediate the relationship between SNS advertising and consumer's purchase intentions.

Figure 2.2 Conceptual framework of the study



2.6. Conclusion

Although many social networking sites were created for socializing purposes in that users sign up to connect and share information with their friends and families, the growing popularity and traffic of many social media sites has opened new doors for marketers to promote their products. Given this, there has been a growing body of studies investigating the impact of social network sites advertising on consumer's purchase intentions. However, a review of leading academic journals database indicates that there are limited studies on the impact of social media marketing advertising type and product involvement on consumers' purchase intentions. Besides, many of the few studies were conducted in the west and given the sociocultural differences between the west and east, this current study is designed to examine the impact of social media marketing advertising type and product involvement on consumers' purchase intentions.

3. Research methodology

This chapter discusses the methodology of the study. Thus, the following issues will be discussed here: the research approach, geographical location, population and sample size analysis, sampling technique, data collection instrument, measurement of the variables, statistical tools used for data analysis and pretesting and research assumptions.

3.1. The research approach

This study uses a quantitative approach to conduct the study. A quantitative study is a number based study which tends to produce a quantifiable data. A quantitative approach was used because of the numerous advantages it has over qualitative approach. For example, a quantitative approach helps to effectively measure cause and effect of the variables and the study has higher chances of generating results that can be generalized to

the larger population. In supporting this claim, Bryman and Bell, (2011) indicate that a quantitative study tends to be more objective since it relates with quantifiable data and the findings can be generalized beyond the sample size. However, unlike qualitative study, a quantitative approach lacks the in-depth and rich of data associated with qualitative studies. This is because the quantitative approach is a number based study which produces only quantifiable data.

3.2. Population and sample size analysis

The target population of this study is undergraduate students living in Seremban, Malaysia. The decision to target this population is based on the fact that both the use of social media and the purchase of smartphones seem to be more popular among young adults such as undergraduate students who use such new technology for gratification-seeking purposes. However, since it is not feasible to study the whole target population, a sample of about 200 respondents will be selected to represent the population. The decision to selected this sample size is based on the recommendation of Collis and Hussey, (2009) propose that a manageable sample size should be selected to represent the population since it is difficult to include everybody in the study. The authors further indicate that selecting a manageable sample size can enhance the convenience of collecting and analysing the data while reducing the time and budget spent in conducting the study. However, selecting a small sample size out of a large population can compromise the results of the study because it may not ensure adequate representation of the population. Given this, Fosgate, (200) argues that the probability of a study to yield a statistically sound conclusion is based on large enough sample because large sample size reduces the chances of missing important units during study, thereby ensuring adequate representativeness of the population.

3.3. Sampling technique

The study uses a simple random sampling technique in that the respondents were selected randomly. A simple random sampling is a sampling technique in that everybody in the population has an equal and independent chance of being included and selected for the study. A simple random sampling technique was used in this study because it ensures adequate representation of the population since every unit has an equal opportunity of being included in the study. In supporting this claim, Sekaran and Bougie, (2010) indicate that simple random sampling technique enhances the representativeness of the population since there is an equal and independent probability of including every sections of the population. However, simple random sampling technique is not as simple as it sounds because the profile of the respondents must be known prior to conducting the study in order to randomly select them during data collection as indicated by Bluman, (2001).

3.4. Data collection instrument

This study uses questionnaire to collect the data. Questionnaire was used because of the numerous advantages it has over other methods such as focus group discussion and interview or observation. For example, questionnaire is more convenient for the respondents because it helps them to answer the questions in their own convenient time. Besides, questionnaire can be used to collect large amount of data within a short period of time. Also, unlike observations and focus group discussions, questionnaire helps to collect a more objective and accurate data because standardized questions are presented to the target subjects. In supporting this claim, the study of Lefever, *et al*. (2007) opine that questionnaires is a convenient technique of collecting large quantifiable data whose results maybe be generalized to the larger population. However, questionnaire does not make room for asking probing question unlike interview and focus group discussions where complex and probing questions can be asked so as to obtain detail information about the subject matter.

3.5. Measurement of the variables

A total of 25 questions are used to measure the consumer's responses toward the issues and a multidimensional scale of a Five point Likert scales is adapted to measure the social media marketing, ad type, product involvement and consumer's purchase intentions of smartphones. However, ordinal and normal dimensions are used to measure the respondents' demographic profile.

3.6. Statistical tools used for data analysis

Being a quantitative study, some statistical tools are used to compute and analyze the data. For example, SPSS is used to compute and analyze the data collected from the subjects. Also, Pearson correlation and Multi Regression are used to test the hypotheses so as to determine the ones that are supported or rejected. Similarly, SPSS is used to determine the reliability of the research instrument.

3.7. Pretesting

Pretesting entails studying a few selected people to determine how well the wordings of the questions will be understood by the target respondents. Prior to conducting the main study, a sample of 20 subjects will be selected and the questionnaire will be distributed among them. This is done to know how easy the question will be for them to easily answer them. At the end of the exercise, the subjects will be asked if the questions are easy to understand. The responses obtained will determine whether to modify the questions or not. Subsequently, the data will be computed and analyzed using Statistical Package for Social Sciences (SPSS) and the reliability of the research instrument will be tested to determine the reliability rate.

3.8. Research assumptions

It is assumed in this study that the respondents will be willing to provide accurate and objective responses to the questions. Also, it is assumed that the study will yield statistically sound results whose findings can be generalized beyond the sample size to the larger population.

4.0. Data analysis and discussion

The focus of this chapter is to analyze and discuss the results of the study. The following issues are discussed here: demographic profile of the respondents, social media marketing, ad types, product involvement and purchase intentions of smartphones as well as discussions of the hypotheses.

4.1. Demographic profile of the respondents

Table 4.1 below shows the results from the respondents' demographic profile. The data was dominated by more male Malaysian undergraduate students while Indians are the least represented in the data. This is because there are more Malays in the target study location with few other nationalities. However, the reason why the data is dominated by more male respondents is because there are more males than females according to the Malaysian population statistics. In supporting this claim, the United Nations Department of Economic and Social Affairs, (2009) reports that Malaysia gender ratio is placed at 103 males to 100 females.

Also, the data is dominated by younger students within the age bracket of 18-22 years old. The reason why there are more young students is because many of them left high schools at earlier age and proceed immediately to the university without wasting time. On the monthly income, the result shows that majority of the respondents earn between RM1,000 -RM2,000. The low-income range is because majority of the respondents are full time students who do not work but rely on either parents or sponsors to provide their living expenses.

Table 4.1: Respondents' demographic data

Respondents' demographic variables		Number	Percentage (%)
Nationality	Malays	44	29.3
	Indians	27	18
	Chinese	42	28
	Others	37	24.7
	Total	150	100
Gender	Male	76	50.7
	Female	74	49.3
	Total	150	100
Age range	18-22 years old	56	37.3
	23-27 years old	69	46
	28-32 years old	23	15.3
	Above 32 years old	2	1.3
	Total	150	100

Monthly income	Less than RM1,000	42	28
	RM1,000-RM2,000	61	40.7
	RM2,001-RM3,000	29	19.3
	RM3,001-RM4,000	14	9.3
	Above RM4,000	4	2.7
	Total	150	100

4.2. Social media marketing

Table 4.1 below provides the results of how social media marketing centres on efforts to create content that attract attentions on the advertised product. The results show that majority of the respondents agree to the claim of social media marketing helping to create attention about the advertised product. This is because there is a growing interest and traffic on social media and this indicates that social media is a potential marketing tool where smartphone companies can effectively create media contents that will generate much traffic to the brand. This finding is supported by prior studies on social media marketing among such includes the study of Kim, *et al.* (2013) who opine that the growing popularity and traffic of many social media sites has opened new doors for marketers to promote their products and attract attention to their brands.

Table 4.1: Social media marketing create content that attract attentions

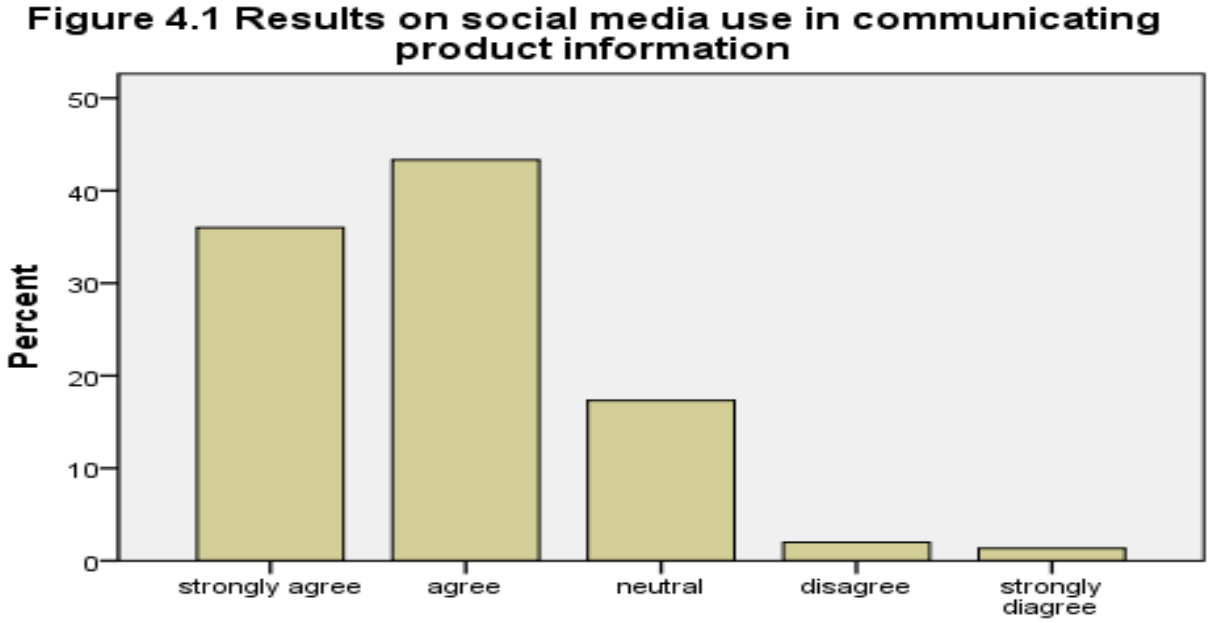
	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	42	28.0	28.0	28.0
Agree	96	64.0	64.0	92.0
Neutral	10	6.7	6.7	98.7
Disagree	2	1.3	1.3	100.0
Total	150	100.0	100.0	

Table 4.2 below provides the result of the role of social media marketing. The results show that majority of the respondents agree that social media marketing encourages readers to share advertised products with their friends on social networking sites which results to the spread of word of mouth marketing and consequently consumers tend to trust advertising messages shared by friends because they tend not to have financial motives unlike advertisement sent by corporate bodies. This finding is supported by the study of Neti, (2012) who found that social media marketing creates room for gaining traffic and attention and the spread of word of mouth marketing through online communities, social networks and blogs. However, less than 1% of the respondents disagree with the claim of social media marketing encouraging users to share the product information with friends. This may be because such users do not engage in sharing product advertisement with other users perhaps due to lack of interest on such products or trust on such ads.

Table 4.2: Results on social media marketing encourages readers to share advertised products

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	43	28.7	28.7	28.7
Agree	59	39.3	39.3	68.0
Neutral	42	28.0	28.0	96.0
Disagree	5	3.3	3.3	99.3
Strongly Disagree	1	.7	.7	100.0
Total	150	100.0	100.0	

Figure 4.1 below provides the results for how social media enable smartphone companies to effectively communicate their product information with their target audience. The result shows that majority of the respondents believe that social media is a good avenue for the smartphone companies to interact more effectively with consumers thereby creating brand awareness while few respondents tend to argue otherwise. The reason why more respondents support the claim is because many social media sites are originally designed to enable people connect and share ideas and information and the case of smartphone companies, they share their product information with the target audience and this result to brand awareness. This is supported by the study of Kaplan and Haenlein, (2010) that the retail industry uses this new interactive communication channel to engage their customers and encourage them to buy their products.



To conclude, social media has provided a good avenue for smartphone companies to use this new interactive communication channel to create media contents that attract attentions and interact more effectively with their target consumers so as to encourage them not only to share the product information with their friends and families thereby resulting to the spread of word of mouth but also encouraging them to buy their products. The next section focuses on discussing specific advertising types.

4.3. Types of advertising

Table 4.3 below provides the results on fan page advertisement and the result shows that majority of the respondents agree that advertisements placed on fan pages of social media tend to generate more word of mouth marketing among the users. This indicates that when smartphone companies advertise their products on fan pages, it will generate more results because the users tend to share such product information among their friends and family members. This is because product information shared by friends and family members are more trusted since they consider them not to have any financial motive in the cause of sharing such products information. In supporting this finding, the study of Harris and Dennis, (2011) found that product advertisements placed on fan page generates more positive returns because it tends to create more brand awareness among the social media users.

Table 4.3: Results on fan page advertising generating word of mouth marketing

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	18	12.0	12.0	12.0
Agree	92	61.3	61.3	73.3
Neutral	33	22.0	22.0	95.3
Disagree	7	4.7	4.7	100.0
Total	150	100.0	100.0	

Table 4.4 below shows the results on fan page ads and the results indicates that majority of the respondents support the claim that product advertising placed on fan pages of social media generates more interest about the advertised brand among the users. This indicates that when smartphone companies advertise their smartphones through fan page, it tends to create attract more attention and interest on the product. This is because perhaps fan page is mainly created for the companies' followers and fans to freely share their views and opinions about the company as whole and the brands in particular. This is supported by the study of Dekay, (2012) that fan page advertisement enhances the effectiveness and persuasive of production promotion because unlike company's

websites, the consumers have the opportunity to comment, contribute and participate in the advertisement process.

Table 4.4: Results on fan page generating interest on ads

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	24	16.0	16.0	16.0
Agree	76	50.7	50.7	66.7
Neutral	38	25.3	25.3	92.0
Disagree	11	7.3	7.3	99.3
Strongly disagree	1	.7	.7	100.0
Total	150	100.0	100.0	

Table 4.5 below shows the results for event advertising. The results show that majority of the respondents indicate that event advertisements creates favourable impression about the brand among the social media users. The reason why majority of the respondents support this claim is because event advertisement involves promoting or sponsoring certain events or good cause and many consumers prefer companies that engage in corporate social responsibilities. In supporting this claim, Belch and Belch, (2009) report a survey that 9 out of 10 consumers are willing to buy from companies that promote goods causes and events. This indicates that promoting events and causes through social media a good marketing strategy among smartphone companies because it tends to generate much favourable impression about the company and this may enhance the chances of consumers trying the product.

Table 4.5: Results on event advertising creating favourable impression about the brand

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	38	25.3	25.3	25.3
Agree	73	48.7	48.7	74.0
Neutral	33	22.0	22.0	96.0
Disagree	5	3.3	3.3	99.3
Strongly disagree	1	.7	.7	100.0
Total	150	100.0	100.0	

To conclude, the study indicates that the effectiveness of social media marketing in general and advertising in particular depends on the type of advertisement and where it is placed. For example, the study shows that advertisements placed on fan pages tends to work better than advertisements placed on companies' homepage because consumers tend to trust the former more since the messages spread from friends and family members who may not have financial motive in the spread of the information about the product. Consequently, the study indicates that fan page advertisements create more interest on the advertised brand. Lastly, it was gathered that event advertising creates favourable impression on the brand because many consumers prefer companies that promote good events and causes seeing it as a way of giving back to the society.

4.4. Product involvement

Table 4.6 below shows the results for high product involvement. The results show that majority of the respondents agree that high product involvement influences social media users to place more importance and interest on the advertised smartphone brand while few respondents seem to disagree with the claim. The reason why more respondents support this claim is because the way consumers feel about the product will determine whether they will like it or otherwise. This claim is supported by the study of Kim, *et al.* (2013) who assert that consumer's personal feelings about both the company and brand will influence the importance and interest placed on a product which is caused by the stimulation of certain circumstances.

Table 4.6: Results on high product involvement

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	31	20.7	20.7	20.7
Agree	93	62.0	62.0	82.7
Neutral	22	14.7	14.7	97.3
Disagree	4	2.7	2.7	100.0
Total	150	100.0	100.0	

Table 4.7 below shows the results consumer's personal feelings about the product. The results show that majority of the respondents agree that a consumer's personal feelings toward the brand will determine his/her effort to seek for information about the product although few respondents tend to disagree with this claim. This is because when consumers have a high value on the product, they will search for relevant information sources to obtain the product features and benefits. This claim is supported by Belch and Belch, (2009) that consumer decision making process involves searching for product information in order to satisfy their needs.

Table 4.7: Responses on consumer's personal feelings about the product

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	47	31.3	31.3	31.3
Agree	66	44.0	44.0	75.3
Neutral	32	21.3	21.3	96.7
Disagree	4	2.7	2.7	99.3
Strongly disagree	1	.7	.7	100.0
Total	150	100.0	100.0	

Table 4.8 below shows the results of consumer's willingness to share product information. The results show that majority of the respondents agree that a consumer's interest on the advertisement will influence him/her to share the product information with other social media users. This is because when consumers perceive the product being advertise to have the required customer value at the right price, there is a higher chance of consumers sharing such information with their friends and family members both on social media and offline as indicated by the study of Bashar, *et al*. (2012). However, a less than 1% of the respondents tend to refute this claim on the basis of lack of interest and trust on the marketer believing that the sole purpose is to convince them to purchase such products.

Table 4.8: Responses on consumer's interest on the ad

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	35	23.3	23.3	23.3
Agree	76	50.7	50.7	74.0
Neutral	31	20.7	20.7	94.7
Disagree	7	4.7	4.7	99.3
Strongly disagree	1	.7	.7	100.0
Total	150	100.0	100.0	

Table 4.9 below shows the results of consumer's willingness to purchase the advertised product. The results show that majority of the respondents support the claim of consumers' interest on the advertisement determining their intention to purchase the advertised smartphones. This is because advertisement placed on the fan page of social media tends to generate not only more interest on the advertised brand but also creates favourable impression and ultimately influences the consumers to try such a product.

Table 4.9: Consumer's intention to buy the advertised products

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	41	27.3	27.3	27.3
Agree	57	38.0	38.0	65.3
Neutral	42	28.0	28.0	93.3
Disagree	7	4.7	4.7	98.0
Strongly disagree	3	2.0	2.0	100.0
Total	150	100.0	100.0	

To conclude, the study shows that high product involvement influences social media users to place importance and interest on the advertised product and consumers' personal feelings toward the brand will enhance their effort to seek for information about the product. This will subsequently create brand interest and ultimately the chances of buying such product. Also, the study indicates that consumers' interest on the advertisement will influence them to share product information with other social media users.

4.5. Purchase intentions of smartphones

Table 4.10 below shows the results of how social media help smartphone companies to better engage the target audience. The results show that majority of the respondents agree that social media marketing helps smartphone companies engage target audience. This is because the growing traffic on social media helps the companies to interact and communicate their product features and benefits in a participatory way with the consumers. This support the findings of Leng, *et al.* (2011) that social media do not only help smartphone companies to effectively interact with their target audience given its ability to encourage back-and-forth interaction between the consumers and the company unlike the one-way traditional media but it also encourages the readers to buy the advertised products. However, few other respondents seem to disagree with the above claims on the grounds that social media marketing tends to target a narrower domain audience.

Table 4.10: Responses on social media marketing engaging consumers

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	52	34.7	34.7	34.7
Agree	77	51.3	51.3	86.0
Neutral	19	12.7	12.7	98.7
Disagree	1	.7	.7	99.3
Strongly disagree	1	.7	.7	100.0
Total	150	100.0	100.0	

Table 4.10 below shows the results of how social media marketing encourage brand association. The results indicate that majority of the respondents show that social media marketing is a potential mans of encouraging brand association. This is because advertisement placed on fan page can create the spread of positive word of mouth and the consumers become brand ambassadors who will go about influencing their friends about the product values. However, one respondent seems to disagree with the foregoing claim due to perhaps unfavorable perception and behavioural attitudes about the brand or the company.

Table: 4.10: Responses on social media marketing influence on brand association

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	65	43.3	43.3	43.3
Agree	59	39.3	39.3	82.7
Neutral	22	14.7	14.7	97.3
Disagree	3	2.0	2.0	99.3
Strongly disagree	1	.7	.7	100.0
Total	150	100.0	100.0	

Table 4.11 below provides the data on the persuasiveness of social media marketing. The results show that while majority of the respondents believe that smartphone companies use social media to persuade consumers that their product are good to purchase, few others seem to disagree. The result been dominated by supporters indicates that social media marketing can serve as good place to not only create brand awareness but also to convince consumers about the product values. This is supported by Gesenhues, (2013) that social media advertising enhances the marketers' ability to effectively communicate their product features and benefits at costs effective way so as to influence impression about the brand.

Table 4.11: The persuasiveness of social media marketing

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	47	31.3	31.3	31.3
Agree	66	44.0	44.0	75.3
Neutral	32	21.3	21.3	96.7
Disagree	3	2.0	2.0	98.7
Strongly disagree	2	1.3	1.3	100.0
Total	150	100.0	100.0	

Table 4.12 below provides the data on social media marketing ability to encourage trial purchase. The results show that majority of the respondents agree to smartphone companies using social media marketing to persuade consumers to buy their products. This is because the back-and-forth feature of social media enables the consumers to fully engage the companies and comment or make inquiry about the advertisement and the product features and benefits. The majority supporting the claim indicates that smartphone companies can social media to effectively interact with consumers and persuade them to buy their products through social media. This is supported by Thackeray, *et al*. (2012) that social media is a potential marketing platform to promote advertisements campaign and enhance the ability to engage the young consumers and enhance sales.

4.6. Discussions of the hypotheses

The focus here is the discussion of the hypotheses and Table 4.13 below shows the results of the hypotheses. The results show that the all the hypotheses are supported and this indicates that social media marketing significantly influences consumers' decision to buy smartphones.

Table 4.13: Results of the hypotheses

		Social media marketing	Ad type	Product involvement	Purchase intentions
Social media marketing	Pearson Correlation	1	.553**	.649**	.530**
	Sig. (2-tailed)		.000	.000	.000
	N	150	150	150	150
Ad type	Pearson Correlation	.553**	1	.557**	.503**
	Sig. (2-tailed)	.000		.000	.000
	N	150	150	150	150
Product involvement	Pearson Correlation	.649**	.557**	1	.564**
	Sig. (2-tailed)	.000	.000		.000
	N	150	150	150	150
Purchase intentions	Pearson Correlation	.530**	.503**	.564**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	150	150	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

Hypothesis 1: Social media marketing effectiveness depends on the ad type

This hypothesis focuses on determining the effectiveness of social media marketing. The null and alternate hypotheses of are stated below:

H_a: Social media marketing effectiveness does not depend on the ad type

H_1: Social media marketing effectiveness depends on the ad type

Table 4.13 above shows that while the r value is 0.503, the p-value is 0.000 which is less than the confidence level and this indicates that the null hypothesis is rejected while the alternate is accepted. To this end, it is concluded that social media marketing effectiveness depends on the ad type. This finding is supported by the study of Kim, *et al.* (2007) that the effectiveness of social media marketing in persuading people to purchase products will depend on the type of advertising in question. According to this claim, advertising through fan page may be more effective in persuading users to purchase the advertised product than advertisement through the company's homepage.

Hypothesis 2: Consumer's purchase intentions of smartphones depends on the ad type

This hypothesis focuses on determining the effectiveness of ad type. The null and alternate hypotheses of are stated below:

H_a: Consumer's purchase intentions of smartphones does not depend on the ad type

H_1: Consumer's purchase intentions of smartphones depends on the ad type

Table 4.13 above shows that while the r value is 0.503, the p-value is 0.000 which is less than the confidence level and this indicates that the null hypothesis is rejected while the alternate is accepted. This indicates that consumer's purchase intentions of smartphones depend on the ad type. This supports the findings of Harris and Dennis, (2011) that advertising through fan page may encourage users to share the advertised products with their friends and families and people tend to place more trust on products recommended by their friends since they are believed not to have any financial motives.

Hypothesis 3: There is a significant relationship between social media marketing and consumer's intention to purchase smartphones

This hypothesis focuses on determining the relationship between social media marketing and consumer's purchase intentions of smartphones. The null and alternate hypotheses of are stated below:

H_a: There is no significant relationship between social media marketing and consumer's intention to purchase smartphones

H_1: There is a significant relationship between social media marketing and consumer's intention to purchase smartphones

Table 4.13 above shows that while the r value is 0.530, the p-value is 0.000 which is less than the confidence level and this indicates that the null hypothesis is rejected while the alternate is accepted. This indicates that there is a significant relationship between social media marketing and consumer's intention to purchase smartphones and this supports the findings of a survey conducted by Dimensional Research that 90% of the respondents affirm that reading social media advertising reviews positively influence their purchase decisions as reported by Gesenhues, (2013).

Hypothesis 4: Ad type mediates social media marketing

This hypothesis focuses on determining how ad type mediates the effectiveness of social media marketing. The null and alternate hypotheses of are stated below:

H_a: Ad type does not mediate social media marketing

H_1: Ad type mediates social media marketing

Table 4.13 above shows that while the r value is 0.553, the p-value is 0.000 which is less than the confidence level and this indicates that the null hypothesis is rejected while the alternate is accepted. This indicates that ad type mediates social media marketing. This shows that the effectiveness of social media marketing will depend on the type of advertisement and the specific place of ad. For example, when smartphone companies advertise on fan page, it will enhance the effectiveness of the ad and vice versa. This is supported by Emerson, (2013) who reports that 95% of Polkadot Alley's Facebook sales come from people who purchase goods through the comments or recommendations section of the fan page.

Hypothesis 5: Product involvement mediates consumer's purchase intentions of smartphones. This hypothesis focuses on determining how product involvement mediates consumers' purchase intentions of smartphones. The null and alternate hypotheses are stated below:

H_a: Product involvement does not mediate consumer's purchase intentions of smartphones

H_1: Product involvement mediates consumer's purchase intentions of smartphones

Table 4.13 above shows that while the r value is 0.564, the p-value is 0.000 which is less than the confidence level and this indicates that the null hypothesis is rejected while the alternate is accepted. This indicates that product involvement mediates consumer's purchase intentions of smartphones and the study of Jothi, *et al.* (2011) supports this finding that product involvement is an individual difference variable which may mediate the relationship between social media marketing and consumer's purchase intentions because consumer's personal feelings and preference for the product will determine consumers' decision making and communication behaviors.

Table 4.14 below provides the results of the Multiple Regression analysis. The results show that product involvement seems to have the more impact on consumers' intention to buy smartphones followed by social media marketing. This is because product involvement is an individual difference variable and Harris and Dennis, (2011) found that consumers are more influenced to make purchase when the product recommended by a trusted friend or family since they may not have a financial motive unlike the companies.

Table 4.14: Results of the Multiple Regression Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.183	.185		.987	.325
Social media marketing	.240	.100	.213	2.393	.018
Ad type	.249	.094	.215	2.641	.009
Product involvement	.349	.102	.306	3.428	.001

4.7. Conclusion

On analyzing the study, it was found that companies use social media to engage their target consumers online. This indicates that social media do not only help smartphone marketers to effectively interact with their target audience given its ability to encourage back-and-forth interaction between the consumers and the company unlike the one-way traditional media but it also encourages the readers to buy the advertised products. On the findings from the hypotheses, it was found that all the hypotheses were supported and this indicates that social media marketing significantly influences consumers' decision to buy smartphones. However, this is mediated by the type of advertisement and product involvement.

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Forecasting the Trend of Art Market

Mihaela-Eugenia VASILACHE
Ph.D. Student, School of Advanced Studies of the Romanian Academy (SCOSAAR) - Economic, Social and Legal Sciences Department

Abstract

The paper discusses two different methods to forecasting the global index of Art Market: a Holt-Winters type exponential smoothing method for times series with additive components (time trend and seasonal variation) and a Seasonal Autoregressive Integrated Moving Average (SARIMA) model. Both methods point out that the decline of Art Market started in 2015 will continue in 2018 and 2019, and a slight recovery will be possible by 2020. We also presented a method for combining forecasts.

Keywords: ***Index of Art Market, forecasts, Holt-Winters method, SARIMA model.***

JEL Classification: C22, C53, Z10

Introduction

In Eli Anapur terms, "any guesses regarding the art market trends may seem an impossible, if not an obsolete task" (Anapur 2016). This is because, when it comes to making forecasts, it should be taken into account that the art market is extremely volatile. An authority in the field of art market, explained this thing: "my annual attempt at gazing into my crystal ball to predict what will happen in the coming year in the art market has been comprehensively blown up by a single event in 2017: the astonishing, record-shattering, beyond-predictable price made by Leonardo Da Vinci's *Salvator Mundi*" (Adam 2018). On the other hand, the Deloitte Art & Finance Report 2017 predicts that the UHNWI [Ultra High Net Worth Individual – *our note*] will allocate US$2.706 trillion by 2026 to art and collectibles, as against to US$1.622 trillion allocated in 2016 (Deloitte 2017, 36).

In the same field, of art market, we mention the paper of (Filipiak and Filipowska 2016), that analysed art price databases, the price indices (calculating for the purpose of "measuring financial performance, evaluating diversification of a potential portfolio and describing trends on the market") and evaluated the employment of IT support in art market analysis.

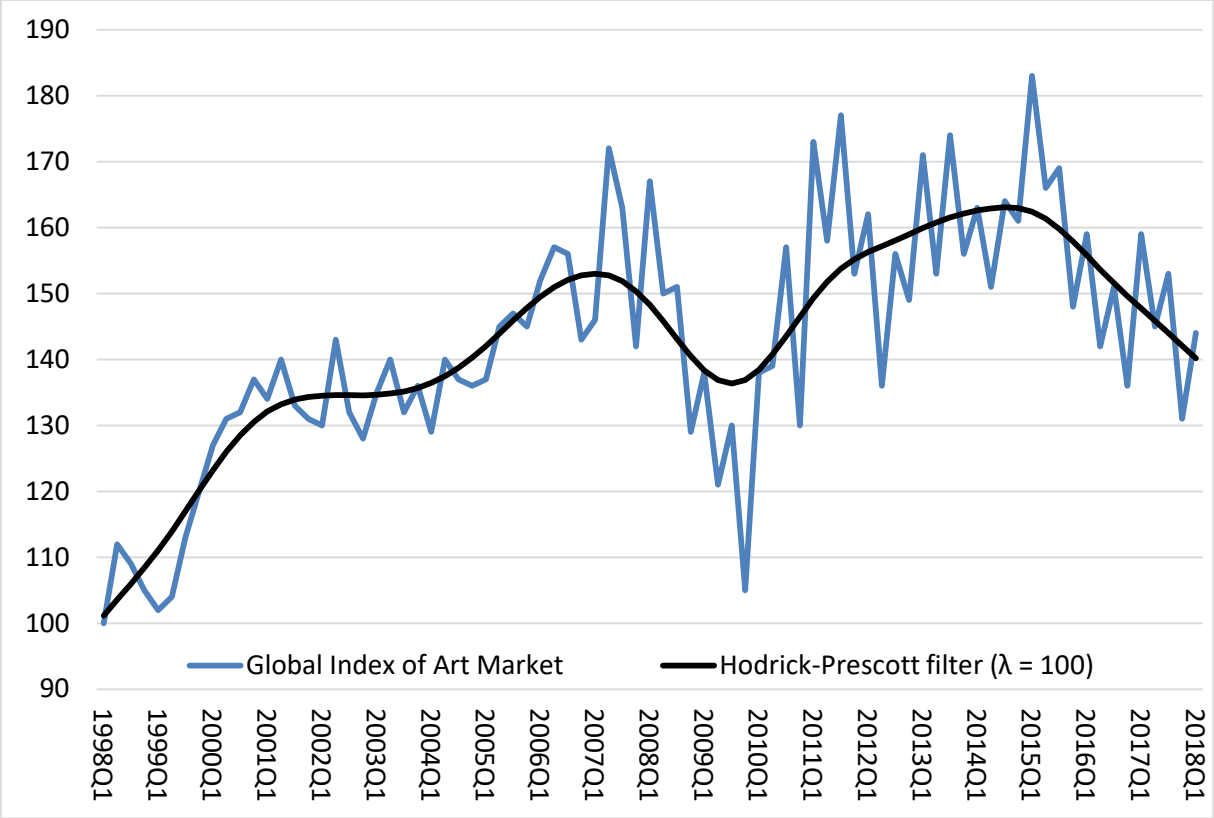
As a methodological approach, we point out the (Jurevičienė and Kostecka 2014) study, that applied ARIMA method to forecast "changes of art prices in 2014-2015 for the aggregate Artmarket Global index and for different art movements (old masters, impressionism and post-impressionism, modern art, contemporary art)". As the structure of the models, by using data from 1998q1 to 2013q2, they have chosen the description ARIMA (5,1,1) for *Old Masters Artprice Global Index* (Jurevičienė and Kostecka 2014, 78) and an ARIMA(2,1,2) structure for *Impressionism and Post-Impressionism Index*, for *Modern art Index* and for *Contemporary Art Index* (pp. 79-80).

1. Data and Methodology of Forecasting

1.1. Data

We extract the data concerning the Index of Art Market comes from Copyright Artprice.com available at http://imgpublic.artprice.com/pdf/agi.xls. Indexes are calculated based on pricing for auction results: "All the prices […] indicate auction results – including buyer's premium – at public sales of Fine Art. […] Fine Art means paintings, sculptures, drawings, photographs, prints, videos, installations, tapestries, but excludes antiques, anonymous cultural goods and furniture" (according to the methodological note from https://www.artprice.com/artprice-reports/the-art-market-in-2017). The data, calculated in euro, for 1998q1, to 2018q1 are detailed in Annex 1 and depicted in figure 1.

Figure 13. Global Index of Art Market



Source: Author' calculation in EViews, based on *Artprice* data, available at http://imgpublic.artprice.com/pdf/agi.xls

1.2. The forecasting methods

To forecasting the trend of art market we have used two classes of methods. On the one hand we apply a Holt-Winters type exponential smoothing method for times series with additive components (time trend and seasonal variation) and, on the other hand, we apply a Seasonal Autoregressive Integrated Moving Average (SARIMA) models.

According to Holt-Winters exponential smoothing method, the time series y_t can be written as follows (Jula and Jula 2018, 167-198):

$$y_t = L_t + T_t + S_t + e_t,$$

where e_t is the disturbances variable

and L_t smoothing mean series level at the *t* moment;

T_t trend at the *t* moment;

S_t additive seasonal coefficient the *t* moment.

The three components are calculated by the following recursive relationships:

$$L_t = \alpha(y_t - S_{t-s}) + (1 - \alpha)(L_{t-1} + T_{t-1})$$

$$T_t = \beta(L_t - L_{t-1}) + (1 - \beta)T_{t-1}$$

$$S_t = \gamma(y_t - L_t) + (1 - \gamma)S_{t-s},$$

where $0 \leq \alpha, \beta, \gamma \leq 1$ are the damping factors and *s* is the seasonal frequency (*s* = 4 for quarterly data).

Forecasts are computed through the following relationship:

$F_{t+h} = L_t + hT_t + S_{t+h-s}$.

Seasonal Autoregressive Integrated Moving Average (SARIMA) models are denoted SARIMA(p,d,q)(P,D,Q)s, where "p is the order (number of time lags) of the autoregressive model, d is the degree of differencing [i.e. the necessary number of differentiations to ensure the stationarity of the series, *own note*]), and q is the order of the moving-average model. Similarly, P, D and Q refer to the autoregressive, differencing, and moving average terms for the seasonal part of the SARIMA model, and *s* refers to the number of periods in each season" (Jula and Jula 2018). In this model, all the parameters (both *p*, *d*, *q*, and *P*, *D*, *Q*, and *s*) are non-negative integers.

In the following models we adopted the relationships and notations described in (Jula and Jula 2018). The ARMA(p,q) models can be write as follow:

$y_t - \mu - \varphi_1 y_{t-1} - \varphi_2 y_{t-2} - \ldots - \varphi_p y_{t-p}) = \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \ldots + \theta_q \varepsilon_{t-q}$.

where φ are the coefficients from autoregressive part of the process, θ are the coefficients from the moving average part, μ is the mean of the time series and ε_t is an error term, usually, a random (normal) i.i.d. variable (i.e. white noise).

By using the lag operator, defined as $Ly_t = y_{t-1}$, ARMA model is given by:

$\Phi(L)y_t = \mu + \Theta(L)\varepsilon_t$,

where $\Phi(L) = 1 - \varphi_1 L - \varphi_2 L^2 - \ldots - \varphi_p L^p$ is the polynomial for the autoregressive part and $\Theta(L) = 1 + \theta_1 L + \theta_2 L^2 + \ldots + \theta_q L^q$ stands for the polynomial aimed at the moving average part.

Through defining the differentiation operator $\Delta = 1 - L$, i.e. $\Delta y_t = y_t - y_{t-1}$, ARIMA(p,d,q) process can be written as follow:

$\Phi(L)(1 - L)^d y_t = \varphi_0 + \Theta(L)\varepsilon_t$

and SARIMA(p,d,q)(P,D,Q)s model is given by

$\Phi(L)\varphi(L^s)(1 - L)^d(1 - L^s)^D(y_t - \mu) = \Theta(L)\Theta(L^s)\varepsilon_t$.

The seasonal parts of the model are constructed for autoregressive seasonal part by the polynomial $\varphi(L^s) = 1 - \varphi_1 L^s - \varphi_2 L^{2s} - \ldots - \varphi_p L^{P \cdot s}$ and $\Theta(L^s) = 1 - \Theta_1 L^s - \Theta_2 L^{2s} - \ldots - \Theta_Q L^{Q \cdot s}$, for moving average seasonal part. We selected the periodicity of series at s = 4 (quarters) and used SARIMA(p,d,q)$(P,Q)_4$ models to forecast the trend of art market, over the 2018 - 2020 years.

2. Outcomes of Forecasting the Global Index of Art Market

2.1. Holt-Winters Exponential Smoothing Method

We have applied a Holt-Winters Exponential Smoothing Method with additive components (time trend and seasonal variation). The outcomes from the model with multiplicative components do not differ significantly from the additive model. The detailed EViews-10 solution for the series *Global Index of Art Market* is the following:

Table 3. Holt-Winters Exponential Smoothing Model

Sample: 1998Q1 2018Q1

Included observations: 81

Method: Holt-Winters Additive Seasonal

Original Series: Global Index of Art Market

Parameters:	Alpha		0.6600
	Beta		0.0000
	Gamma		1.0000
	Sum of Squared Residuals		7159.539
	Root Mean Squared Error		9.401562
End of Period Levels:	Mean		136.2456
	Trend		0.532895
	Seasonals:	2017Q2	-5.112847
		2017Q3	4.556749
		2017Q4	-10.53401
		2018Q1	11.09011

Source: Author' calculation in EViews, based on *Artprice* data, available at http://imgpublic.artprice.com/pdf/agi.xls

Given the fact that the values estimated through the Holt-Winters exponential model are $\alpha = 0.66$, $\beta = 0$ and $\gamma = 1$, the projected model (for periodicity $s = 4$) is

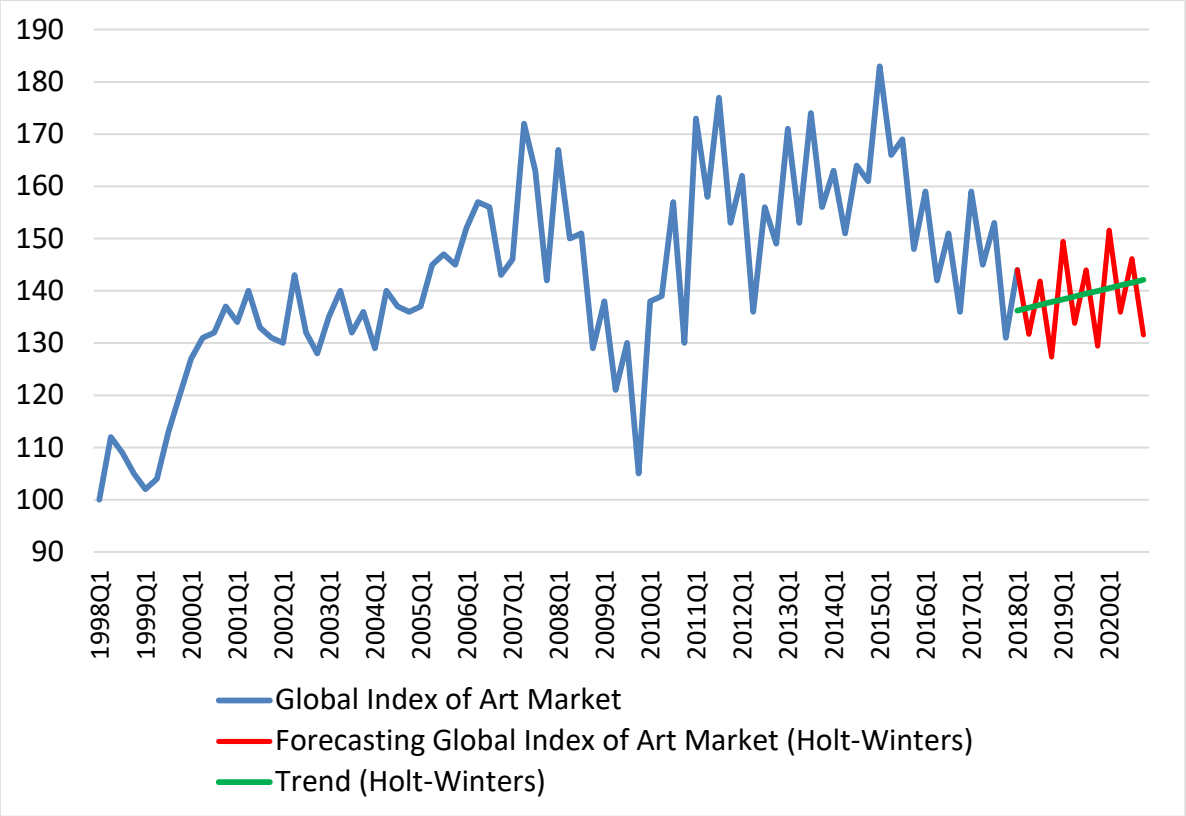
$L_t = 0.66(y_t - S_{t-s}) + 0.44(L_{t-1} + T_{t-1})$,

with $L_{2018q1} = 136.2456$

$T_t = T_{t-1} = 0.532895$

$$\text{And } S_t = y_t - L_t = = \begin{cases} -5.112847, \text{ for } q = 1 \\ 4.556749, \text{ for } q = 2 \\ -10.53401, \text{ for } q = 3 \\ 11.09011, \text{ for } q = 4 \end{cases}$$

Figure 14. Actual data and forecast (Holt-Winters) for Global Index of Art Market



Source: Author' calculation in EViews-10, based on *Artprice* data, available at http://imgpublic.artprice.com/pdf/agi.xls

The forecasts are computed through the following relationship $F_{t+h} = L_t + hT_t + S_{t+h-4}$, for h = 1 to 11, i.e. the time from 2018q2 (h = 1) to 2020q4 (h = 11). The series *Global Index of Art Market* (GIE) and the *forecasting* obtained by Holt-Winters exponential smoothing model for times series with additive components are described in figure 2. The Holt-Winters Exponential Smoothing model estimates that, for the global index of the art market, the fall registered between 2015-2017 will be stopped only in 2019 and even it will register a slight return over the next years. The average 2018 projected index is 138.6, compared to 148.9 in 2017, while for 2019 is estimated at and 139.2 and 141.3 points for 2020.

2.2. SARIMA models

For the alternative forecasting, we have applied a SARIMA type model. Concretely, in SARIMA(p,d,q)$(P,Q)_4$ we have fixed the largest number of differences to d = 2, the maximum order of autoregressive terms to p = 12 (i.e. twelve quarters = 3 years), and for moving average part, the choice for the maximum order was, also, q = 12 (quarters). The largest values for the seasonal components was restricted at 2 seasons, both for autoregressive, and for the moving average part: P = 2s, and Q = 2s (where the periodicity is s = 4 quarters). Too, the series concerning the global index of the art market (GIEAM) has been studied both in the level, and through the logarithmic transformation. With these chosen values, the possible number of SARIMA models was 1521. In order to calculate the model, we used the EViews-10 software package. Of all these 1521 possible combinations, the model that minimizes the Schwarz Information Criterion (SIC) was found to be SARIMA$(1,1,1)(1,0)_4$, applied on ln(GIEAM). The differencing selection order was performed through KPSS test (with 10% level of significance). The estimators of the model are the following (table 2):

Table 4. SARIMA model for Global Index of Art Market

Selected dependent variable: dlog(GIAM)

Number of estimated ARMA models: **1521**

Selected model: (1,1,1)(1,0)

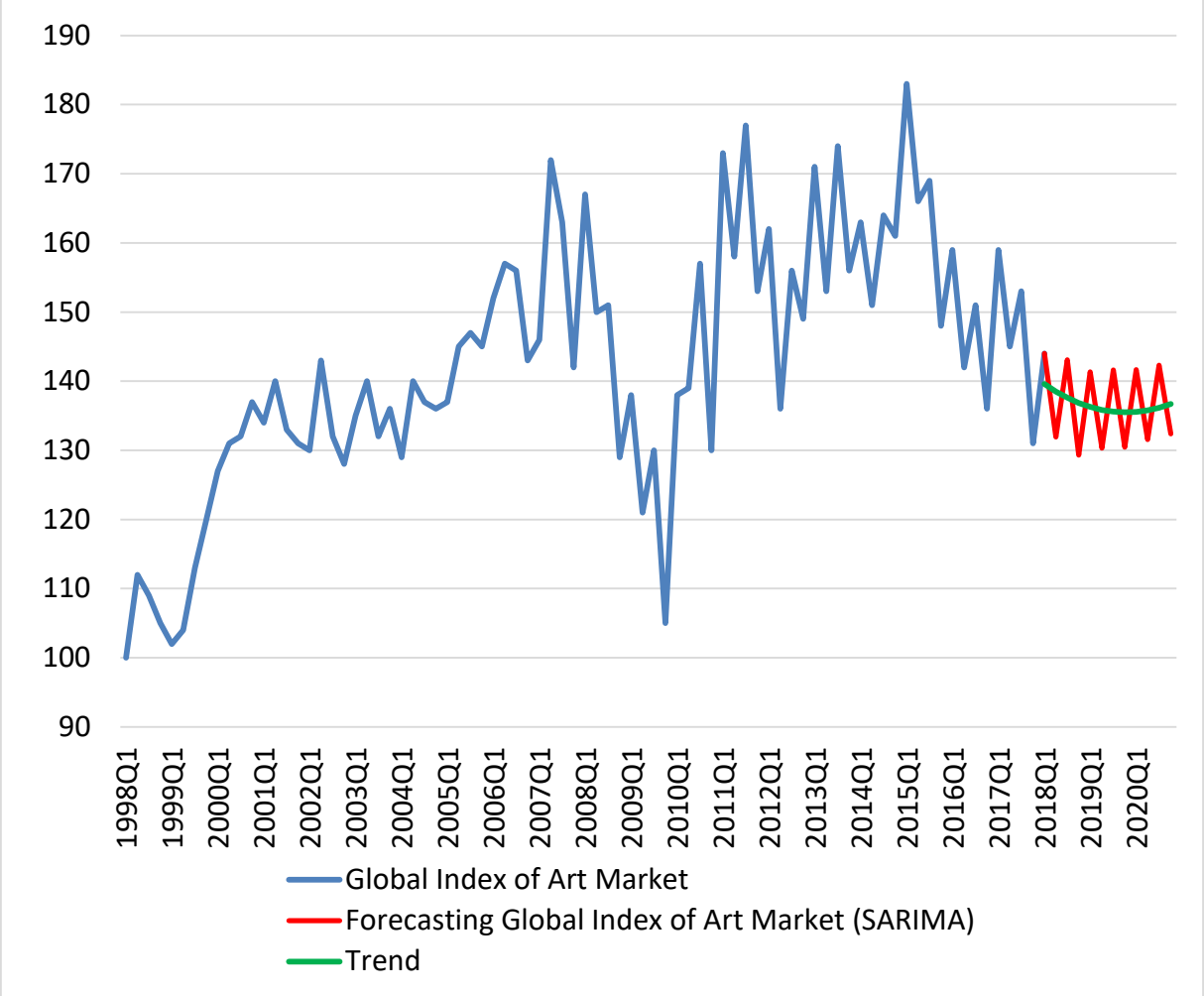
Sample: 1998Q2 2018Q1 (80 observations)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003346	0.009452	0.354008	0.7243
AR(1)	-0.978432	0.037069	-26.39463	0.0000
SAR(4)	0.260329	0.094490	2.755098	0.0074
MA(1)	0.813773	0.077796	10.46030	0.0000
SIGMASQ	0.004183	0.000648	6.456726	0.0000
R-squared	0.578560	Akaike info criterion		-2.493386
Durbin-Watson stat	2.005832	Schwarz criterion		-2.344509
F-statistic	25.74031	Hannan-Quinn criter.		-2.433697

Source: Author' calculation in EViews-10, based on *Artprice* data, available at http://imgpublic.artprice.com/pdf/agi.xls

The detailed calculations are presented in Annex 2. The series *Global Index of Art Market* and the *forecasting* obtained by SARIMA model are depicted in figure 3.

Figure 15. Actual data and forecast (SARIMA model) for Global Index of Art Market

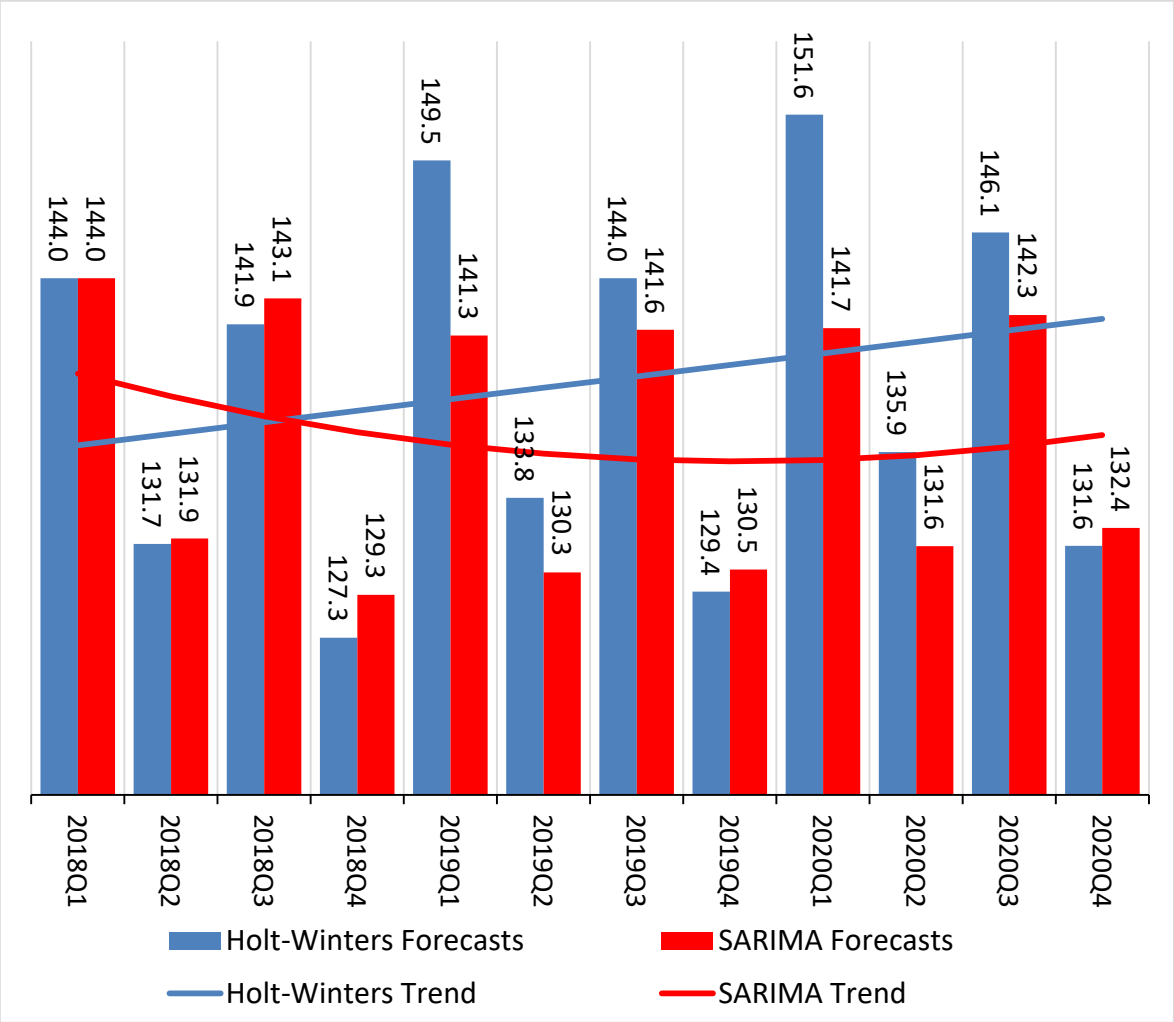


Source: Author' calculation in EViews-10, based on *Artprice* data, available at http://imgpublic.artprice.com/pdf/agi.xls

According to the SARIMA(1,1,1)(1,0)4 model, the Global Index of Art Market will continue the fall that started in 2015, until 2019, then a smooth recovery process will begin. The average 2018 projected index is 137.1, and it is 135.9 for 2018, compared to 147 in 2017, while for 2020 is estimated a return to 137 points.

A comparison between the two forecasting methods (Hodrick-Prescott and SARIMA) is depicted in figure 4.

Figure 16. Forecasting of Global Index of Art Market – Holt-Winters and SARIMA methods



Source: Author' calculation in EViews-10, based on *Artprice* data, available at http://imgpublic.artprice.com/pdf/agi.xls

2.3. Combining Forecasts

Forecast averaging combines a variety of disponible forecasts, for each out-of-sample observation, into a single result, by calculating a weighted average of multiple forecasts. There are several ways to combine forecasts (Steel 2017). We used the classical (Stock and Watson 2004) Mean Square Error (MSE) weighting method. For each forecast (*i*) is computed a weight as:

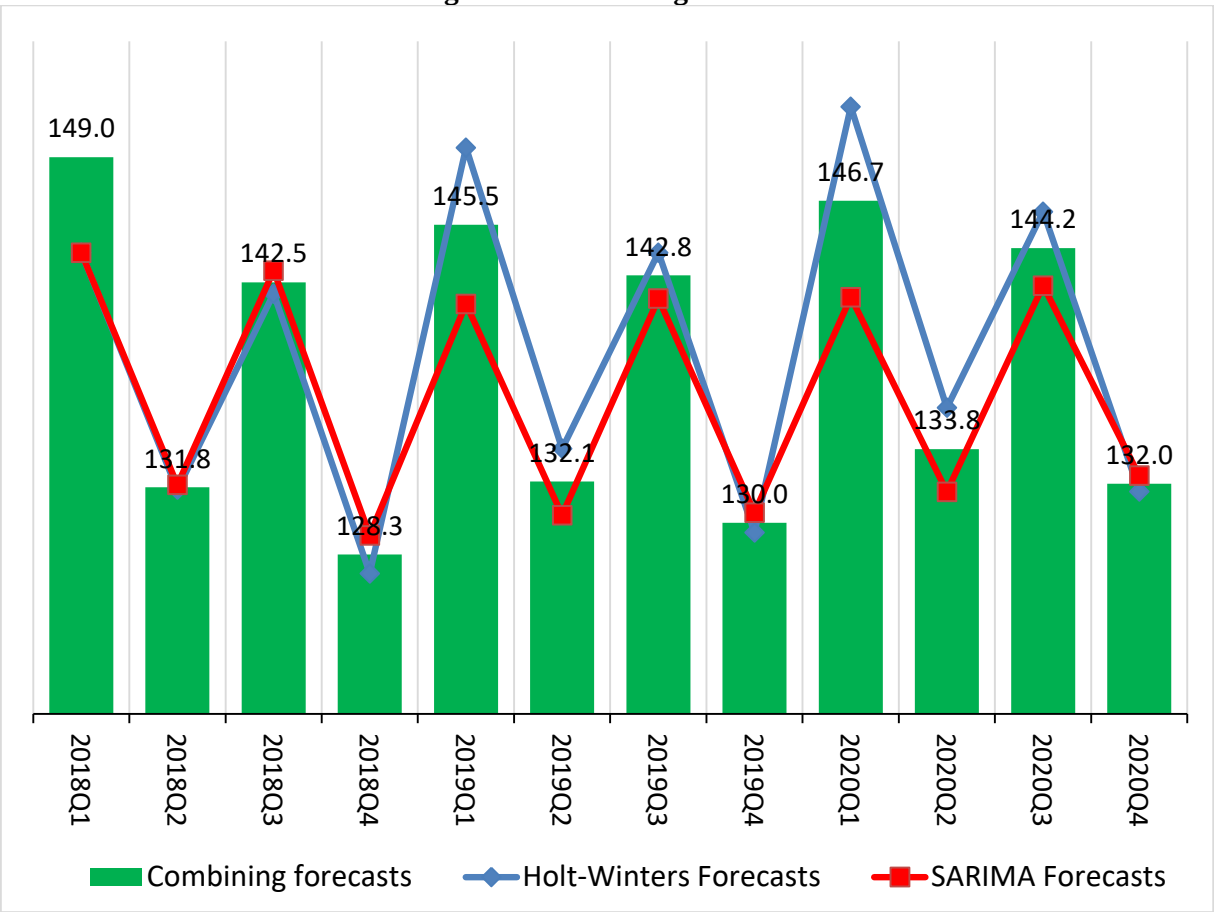
$$w_i = \frac{\frac{1}{MSE_i^k}}{\sum_{j=1}^{f} \frac{1}{MSE_j^k}}$$

where MSE_i is the mean square error of forecast (*i*), who is computes over some in-sample period, while k is a power. Usually, is taken k = 1, and we assume this value in our calculations.

The in-sample period taken into consideration is 2000q1-2018q1. Over this period, the sum square error (SSE) for the two forecasts (Holt-Winters and SARIMA) does not differ greatly. They have the following values:

$SSE_{HoltWinters}$ = 6420.51 and SSE_{SARIMA} = 6593.86. As a result, the two weights do not significantly differ, more exactly they are: $w_{HoltWinters}$ = 0.5067 and w_{SARIMA} = 0.4933. The results are depicted in the figure 5.

Figure 17. Combining forecasts



Source: see sources for figures 3 and 4

The average Global Index of Art Market is projected at 139.2 points in 2020 (with seasonal variations), increasing compared to 2018 and 2019, but still below the average 2017 level (147 points).

Conclusions

To forecast the Global Index of Art Market we have used a Holt-Winters type exponential smoothing method for times series with additive components (time trend and seasonal variation) and a Seasonal Autoregressive Integrated Moving Average (SARIMA) model. By running 1521 models type SARIMA(p,d,q)$(P,Q)_4$ (for p and q between 0 and 12, d between 0 and 2, P and Q between 0 and 2s), we selected SARIMA(1,1,1)$(1,0)_4$ (this is the model that minimizes the Schwarz Information Criterion (SIC).

Both methods (Holt-Winters) point out that the decline of Art Market started in 2015 will continue in 2018 and 2019, and a slight recovery will be possible by 2020. Concretely, the Holt-Winters Exponential Smoothing model estimated that the fall registered between 2015-2017 to Art Market will be stopped only in 2019 and even it will register a slight return over the next years. The average 2018 projected index is 138.6, compared to 148.9 in 2017, while for 2019 is estimated at and 139.2 and 141.3 points for 2020. Similarly, according to the SARIMA(1,1,1)(1,0)4 model, the Global Index of Art Market will continue the fall that started in 2015, until 2019, then a smooth recovery process will begin. The average 2018 projected index is 137.1, and it is 135.9 for 2018, compared to 147 in 2017, while for 2020 is estimated a return to 137 points.

We also presented a method for combining forecasts. As averaging forecasts methodology, we used a (Stock and Watson 2004) Mean Square Error (MSE) weighting method. The average Global Index of Art Market is projected at 139.2 points in 2020 (with seasonal variations), increasing compared to 2018 and 2019, but still below the average 2017 level (147 points).

Annexes

Annex 1. Global Index of Art Market

	Global Index of Art Market		Global Index of Art Market		Global Index of Art Market
1998q1	100	2005q1	137	2012q1	162
1998q2	112	2005q2	145	2012q2	136
1998q3	109	2005q3	147	2012q3	156
1998q4	105	2005q4	145	2012q4	149
1999q1	102	2006q1	152	2013q1	171
1999q2	104	2006q2	157	2013q2	153
1999q3	113	2006q3	156	2013q3	174
1999q4	120	2006q4	143	2013q4	156
2000q1	127	2007q1	146	2014q1	163
2000q2	131	2007q2	172	2014q2	151
2000q3	132	2007q3	163	2014q3	164
2000q4	137	2007q4	142	2014q4	161
2001q1	134	2008q1	167	2015q1	183
2001q2	140	2008q2	150	2015q2	166
2001q3	133	2008q3	151	2015q3	169
2001q4	131	2008q4	129	2015q4	148
2002q1	130	2009q1	138	2016q1	159
2002q2	143	2009q2	121	2016q2	142
2002q3	132	2009q3	130	2016q3	151
2002q4	128	2009q4	105	2016q4	136
2003q1	135	2010q1	138	2017q1	159
2003q2	140	2010q2	139	2017q2	145
2003q3	132	2010q3	157	2017q3	153
2003q4	136	2010q4	130	2017q4	131
2004q1	129	2011q1	173	2018q1	144
2004q2	140	2011q2	158		
2004q3	137	2011q3	177		
2004q4	136	2011q4	153		

Source: *Artprice* data, available at http://imgpublic.artprice.com/pdf/agi.xls

Annex 2. Automatic SARIMA model selection to forecasting the Global Index of Art Market (GIEAM)

Selected dependent variable: dlog(GIAMI)

Number of estimated ARMA models: **1521.**

Selected model: (1,1,1)(1,0)

Method: ARMA Maximum Likelihood (BFGS)

Sample: 1998Q2 2018Q1

Included observations: 80

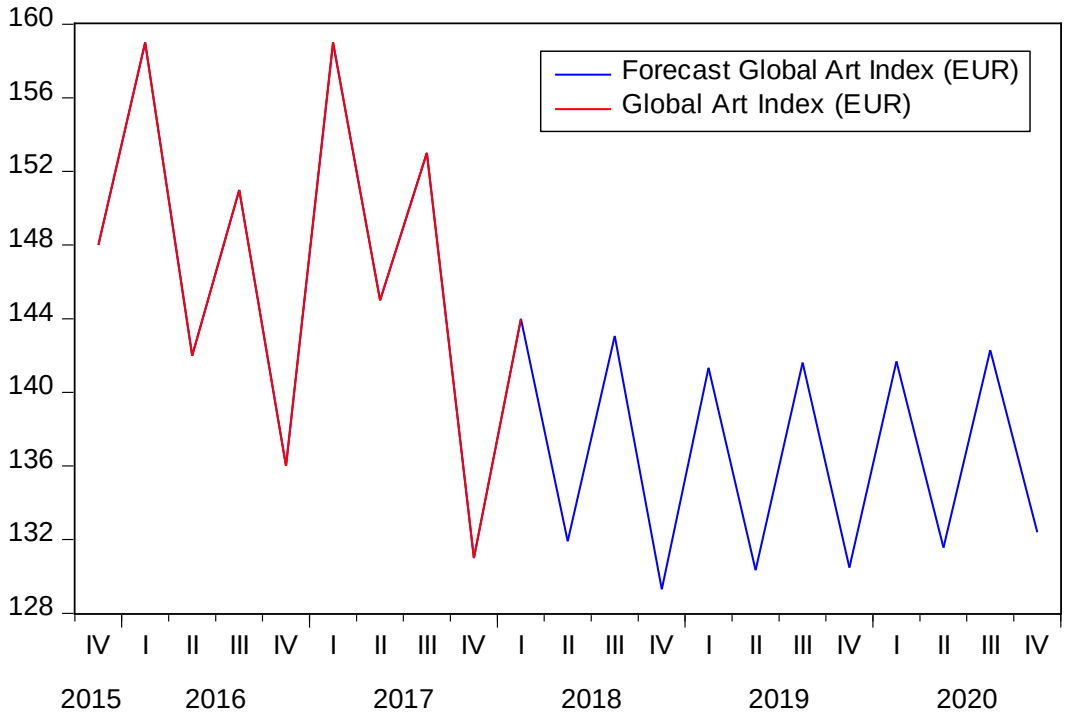
Convergence achieved after 35 iterations

Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003346	0.009452	0.354008	0.7243
AR(1)	-0.978432	0.037069	-26.39463	0.0000
SAR(4)	0.260329	0.094490	2.755098	0.0074
MA(1)	0.813773	0.077796	10.46030	0.0000
SIGMASQ	0.004183	0.000648	6.456726	0.0000
R-squared	0.578560	Mean dependent var		0.004558
Adjusted R-squared	0.556083	S.D. dependent var		0.100253
S.E. of regression	0.066795	Akaike info criterion		-2.493386
Sum squared resid	0.334621	Schwarz criterion		-2.344509
Log likelihood	104.7354	Hannan-Quinn criter.		-2.433697
F-statistic	25.74031	Durbin-Watson stat		2.005832
Prob(F-statistic)	0.000000			
Inverted AR Roots	.71	.00-.71i	-.00+.71i	-.71
	-.98			
Inverted MA Roots	-.81			

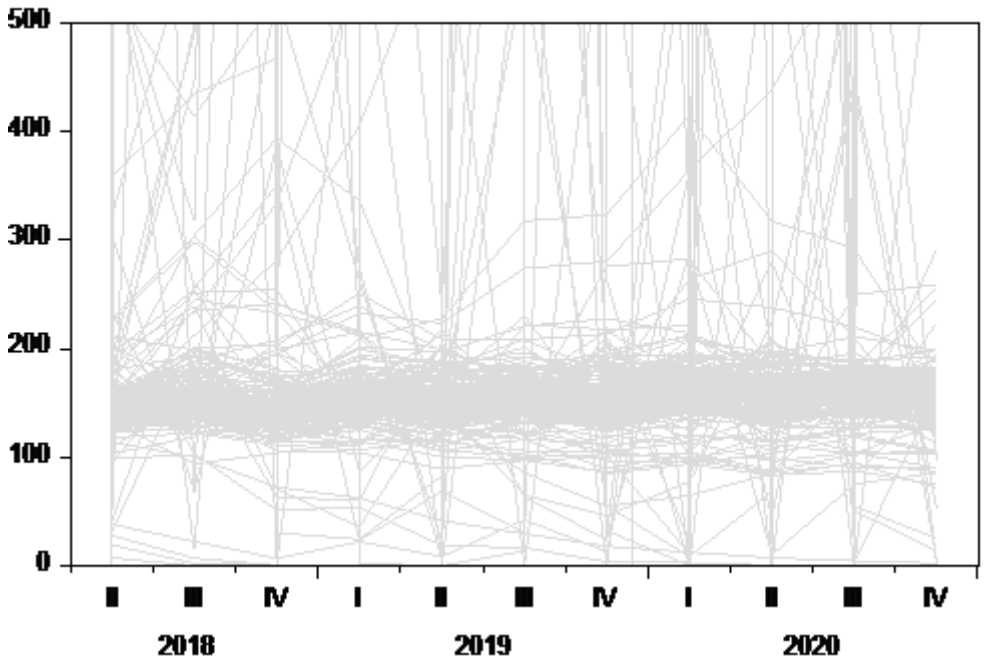
Source: Author' calculation in EViews-10, based on *Artprice* data, available at http://imgpublic.artprice.com/pdf/agi.xls

Actual and Forecast Global Index of Art Market

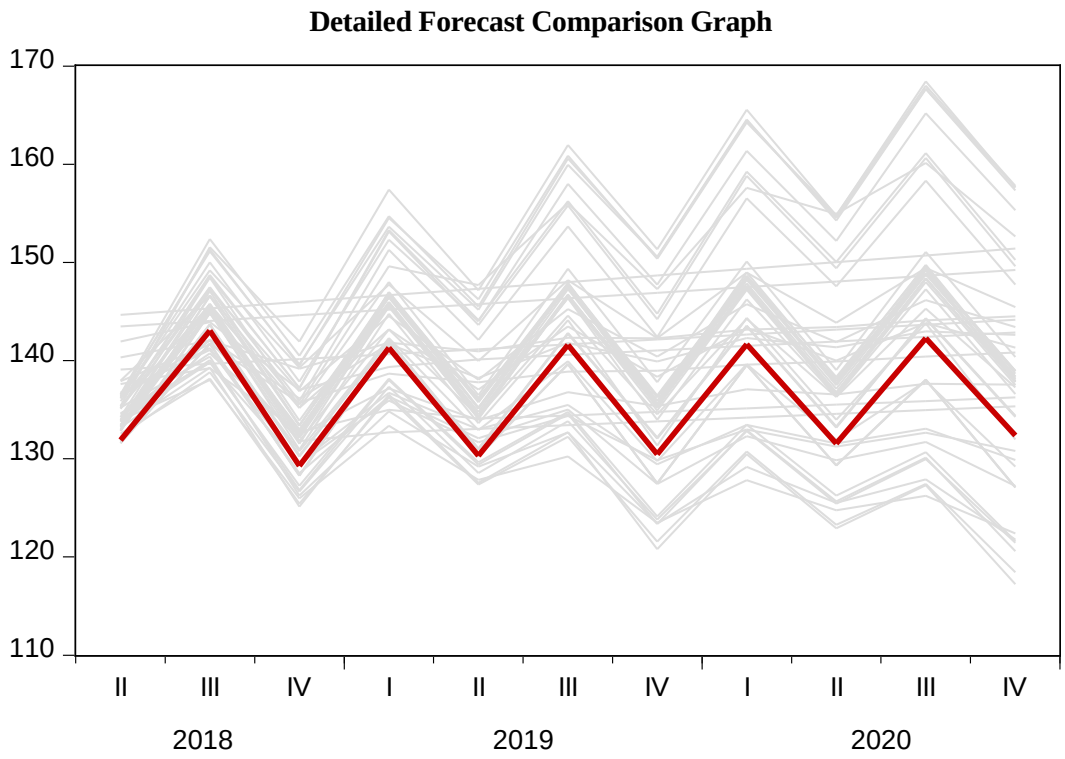


Source: see Annex 1

Forecast Comparison Graph



Source: see Annex 1



Source: see Annex 1

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