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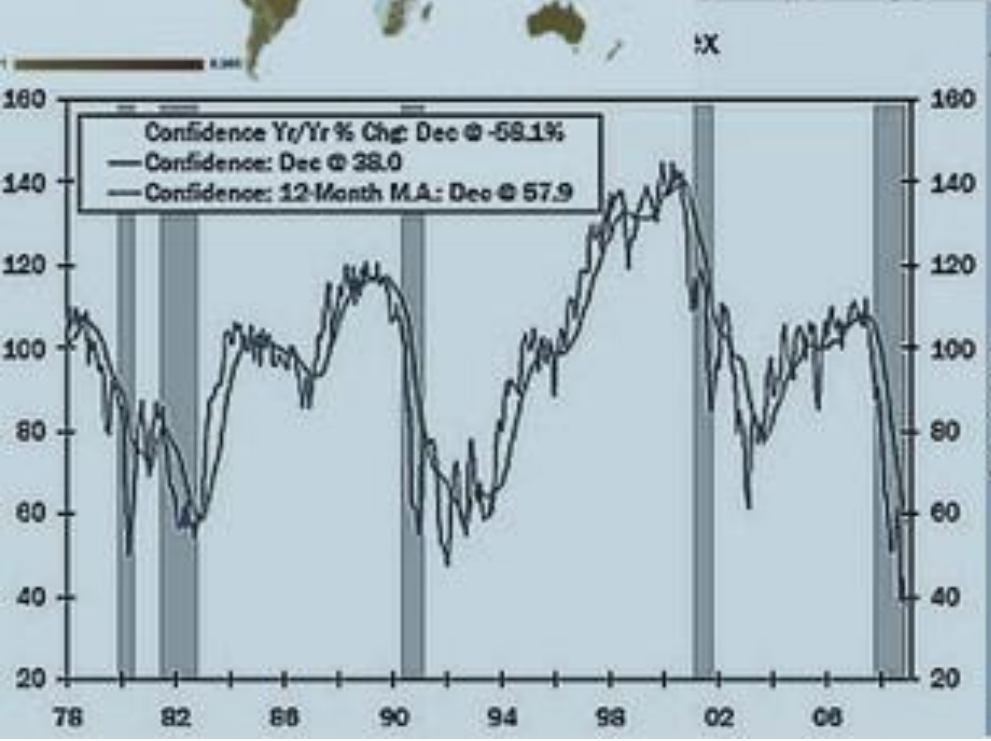

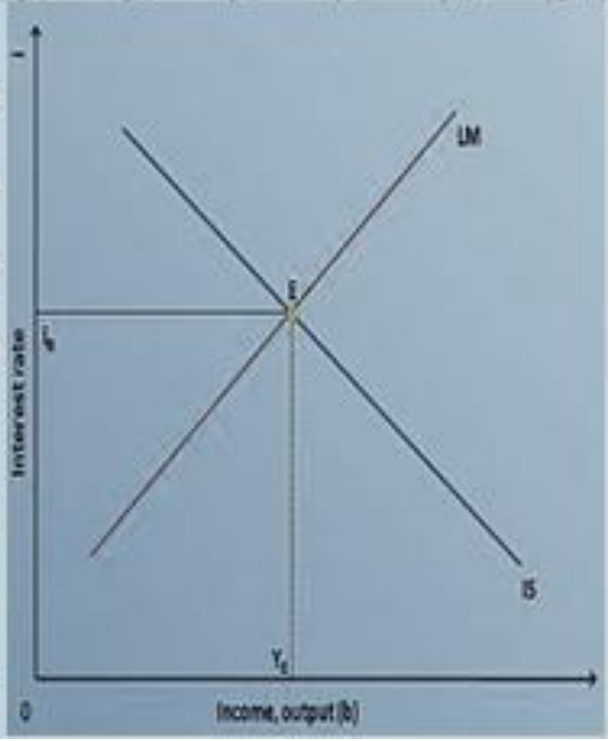

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ART MARKET vs. FINANCIAL MARKETS

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Abstract: *In this paper we analise the short- and long-run relationship between the price indices of art market and of financial market. Through an econometric nonlinear (exponential-quadratic) model with structural breaks, as well as through a Structural Vector Error Correction (SVEC) model, we show that, contrary to many opinions in the literature, between 1998 – 2018q1, the dynamics of art market – assessed through the Artprice Global Index of the Art Market and the changes on the financial market – brought nearby through S&P 500 index are strong positively correlated. In our interpretation, this means that the art market could not have been widely used as an alternative to the capital market, not even during the crisis. We find that S&P 500 index may be a cause for Global Index of the Art Market, but, the inverse causality relationship can be rejected: Global Index of the Art Market does not Granger cause S&P 500.*

Keywords: Artprice Global Index of the Art Market, Lee-Strazicich unit root test, Toda-Yamamoto causality test, nonlinear model with structural breaks, SVEC.

JEL Classification: C51, G15, Z11

Introduction

In (Pownall 2007, 1) words, the Art Market "appear to offer a highly beneficial diversification strategy with extremely low correlation with traditional asset classes". In a similar reasoning, (Mamarbachi, Day and Favato 2008, 1-2) write that "art as an alternative asset class is being incorporated into portfolios in the interest of diversification. Art's low correlation with the equities market and desirable risk and reward ratio, as price appreciation defies all logic, makes it an attractive investment.

Art as an investment has an increasing demand coupled with an absolutely limited supply and the ability to survive the economic downturn." As well, (Mei and Moses 2002), by estimating an annual index of art prices for the period 1875-2000, found that "art outperforms fixed income securities as an investment" (Mei and Moses 2002, 1), and "art has been a more glamorous investment than some fixed income securities" (Mei and Moses 2002, 2), moreover "art is also found to have lower volatility and lower correlation with other assets, making it more attractive for portfolio diversification" (Mei and Moses 2002, 1).

On the other hand, (Goetzmann, Renneboog and Spaenjers 2010) showed that "equity market returns have had a significant impact on the price level in the art market over the last two centuries."

In the paper, we analyse the relationships between art market and financial market, over the period 1998 – 2018(q1).

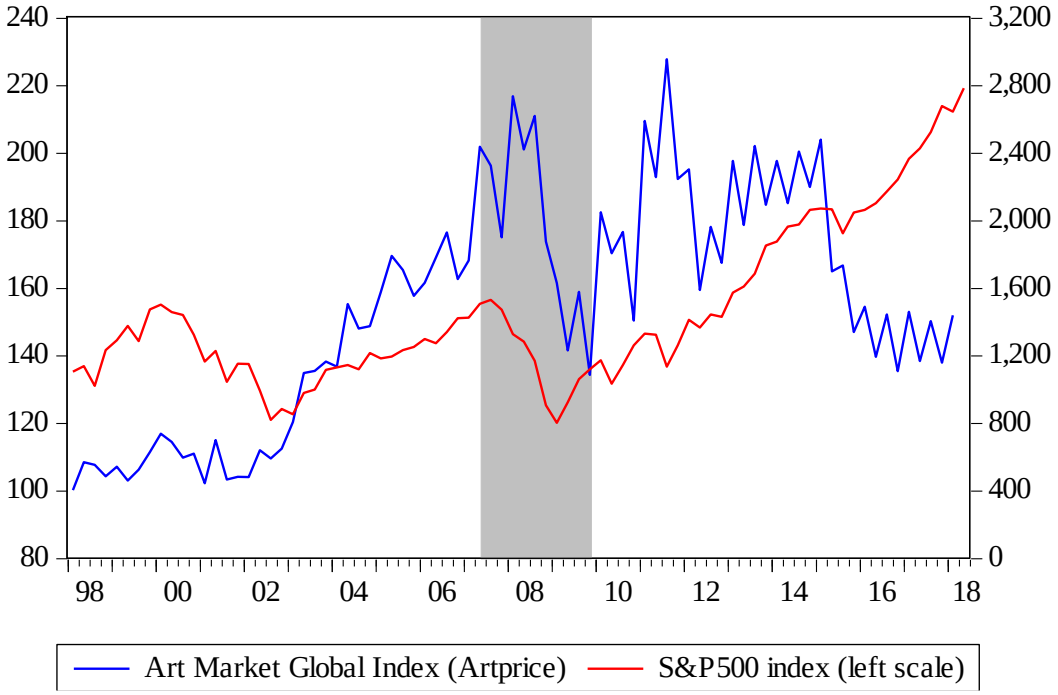
1. Data and Methodology

To analise the relationships between art market and financial market we use the *Artprice Index of Global Art Market* and the *S&P 500 index*. We extract the *Global Index of the Art Market* from Artprice.com data, available at http://imgpublic.artprice.com/pdf/agi.xls. Also, we have found the data

related to *S&P 500 index* on (Yahoo Finance 2018), data available at https://finance.yahoo.com/quote/%5EGSPC?p=%5EGSPC.

The dynamics of the *S&P500* index and the *Global Index of the Art Market (Artprice)* are shown in the following figure below.

Figure 1. The dynamics of the S&P500 index and the Global Index of the Art Market (Artprice index)



Source:

- ✓ For the *Global Index of the Art Market*: Artprice.com data, available at http://imgpublic.artprice.com/pdf/agi.xls (accessed May 6, 2018).
- ✓ For the *S&P 500 index*: (Yahoo Finance 2018) data, available at https://finance.yahoo.com/quote/%5EGSPC?p=%5EGSPC (accessed May 6, 2018).

Legend: in the chart, we have marked the period of the financial crisis (2007-2009)

According the standard unit root tests [Augmented Dickey-Fuller (ADF), GLS transformed Dickey-Fuller (DFGLS), Phillips-Perron (PP), Kwiatkowski, et. al. (KPSS), Elliot, Richardson and Stock (ERS) Point Optimal, and Ng and Perron (NP)], both the *global index of the art market* and the *S&P500 index* are nonstationary series. The single point break unit root tests lead to the same conclusion. But the Lee-Strazicich unit root test with one or two structural breaks (Lee and Strazicich 2003) reject the unit root under the hypothesis of two structural breaks at 10% for *Global Index of the Art Market* and at (near) 10% for *S&P500 index*.

As methodology, we analysed the causal relationship between the two index, through Toda-Yamamoto version of Granger causality test. To estimate the relationship between the *Artprice Global Art Market Index* and the *S&P 500 index* we used a following relationship:

$$art_t = \alpha(S\&P\ 500)_t + f(t) + e_t,$$

where *art* is the *Artprice Global Art Market Index, S&P500* stand for the *S&P 500* financial market index, f (t) is a trend (linear, or nonlinear) function, *e* - error variable, *t* – time index (quarterly intervals for 1998 to 2018q1). Model allows for trend breaks (i.e. coefficients variability by periods).

2. The Causality Relationship between Art Market and Financial Market

Since, according to standard unit root tests, both the *global index of the art market* and the *S&P500 index* are nonstationary series, more exactly, I(1), we tested the presence of a causality relationship through Toda-Yamamoto version of Granger causality test. By using VAR Lag Order Selection Criteria to estimate the lag structure of VAR model, we found the following outputs:

Table 1. VAR Lag Order Selection Criteria

Endogenous variables: Global Index of the Art Market *and* S&P500 index

Exogenous variables: C

Sample: 1998Q1 2018Q1

Included observations: 74

Lag	Sequential modified LR test statistic	Final prediction error	Akaike information criterion	Schwarz information criterion	Hannan-Quinn information criterion
0	NA	2.16e+08	24.86808	24.93035	24.89292
1	302.0931	3421835	20.72135	20.90817	20.79588
2	26.24695	2607047	20.44907	20.7604*	20.57328
3	14.75767	2332136	20.33691	20.77282	20.51080
4	11.8368*	2168582*	20.2629*	20.82337	20.4865*
5	6.195047	2194306.	20.27269	20.95768	20.54594

* indicates lag order selected by the criterion

Source: Estimates based on the Artprice.com and S&P 500 data (see *Source* of Figure 1).

Most criteria (4 of 5) have selected *l = 4*, so we built an VAR(4) model. According to Toda-Yamamoto methodology, in VAR(4) model we include, as exogenous, the variables with lag = 5. In this model, we apply the VAR Granger Causality/Block Exogeneity Wald Tests. The outputs are the following:

Table 2. Testing causality relationship between S&P 500 and Global Index of the Art Market

Hypothesis	Probability
S&P 500 does not Granger cause *Global Index of the Art Market*	0.0312
Global Index of the Art Market does not Granger cause *S&P 500*	0.8099

Source: Estimates based on the Artprice.com and S&P 500 data (see *Source* of Figure 1).

Toda-Yamamoto version of Granger causality test indicates that we can reject the assumption that "S&P500 index" does not Granger cause "Global Index of the Art Market" at 3.1% level (< 5%, standard level) and accordingly, we accept the hypothesis of causality: "S&P500 index" may be a cause for "Global Index of the Art Market". But, the reverse causality relationship may be rejected: "Global Index of the Art Market" *does not* Granger cause "S&P500 index" with a probability level of 80.99%. The causal relationships described above are also maintained if the model is only estimated for the crisis period (2007-2010). Even if it is an interesting result, however the causality test does not specify the sign of the causal relationship.

3. Exponential-Quadratic Model with Structural Breaks

To test the hypothesis that the art market is an alternative to securing (covering) financial investment in times of crisis, we have estimated the model

$$art_t = \alpha(S\&P500)_t + f(t) + e_t,$$

where we exogenously imposing two breaks (this is because Lee-Strazicich test reject the unit roots under the assumption of two structural breaks). If this hypothesis (the Art Market is an alternative for the Financial Market) is correct, then the coefficient α is negative, at the least in times of crisis (2007-2009). A weaker assumption is that α is non-significant, that is, there is no relationship between Art Market and Financial Market.

As trend function, f(t), we used an exponential-quadratic form:

$$f(t) = a \cdot \exp(t/10) + bt^2,$$

where *a* and *b* are coefficients that will be estimated through the model, along with α (in formula, we divided t to 10 only for scale reasons). This structure of the trend function was selected given the shape of the relationship between the two variables.

The outputs of the model estimation are as follows:

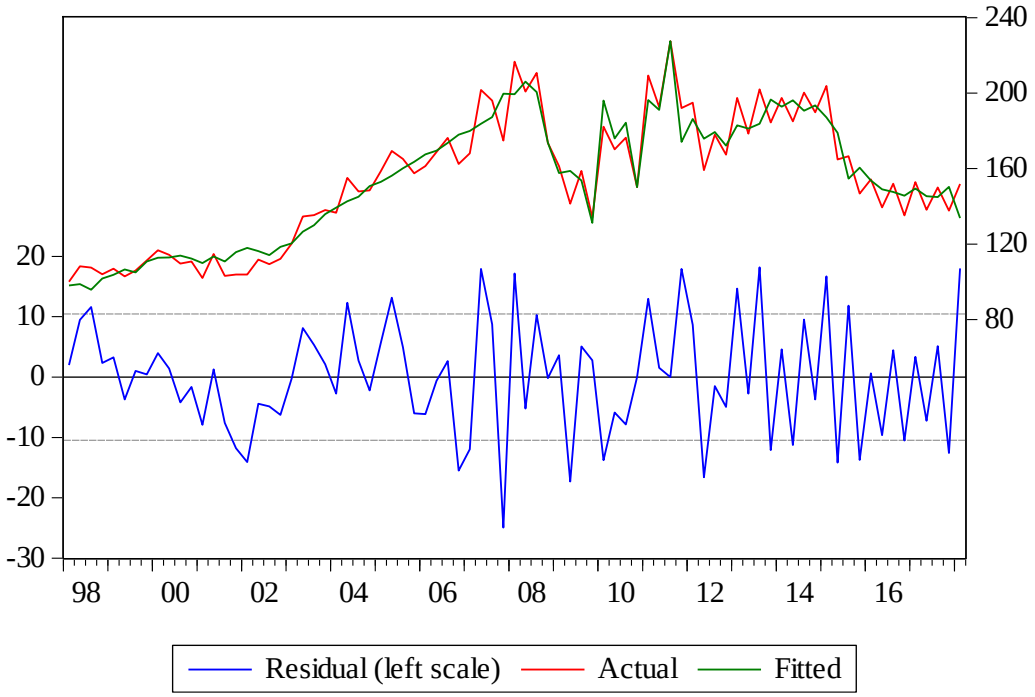
$$art_t = \begin{cases} \text{for } 1998Q1 \text{ to } 2007Q2 \\ \quad \underset{(5.851)}{70.6615} + \underset{(2.627)}{0.0261}(S\&P500)_t - \underset{(-1.756)}{1.2377}e^{t/10} + \underset{(4.848)}{0.0944}t^2 + u_t \\ \text{for } 2007Q3 \text{ to } 2009Q4 \\ \quad \underset{(-1.861)}{-786.135} + \underset{(2.086)}{0.1058}(S\&P500)_t - \underset{(-2.762)}{9.6357}e^{t/10} + \underset{(2.490)}{0.8919}t^2 + u_t \\ \text{for } 2010Q1 \text{ to } 2018(Q1) \\ \quad \underset{(9.365)}{158.7303} + \underset{(4.839)}{0.1138}(S\&P500)_t - \underset{(-2.799)}{0.0203}e^{t/10} - \underset{(-3.880)}{0.0404}t^2 + u_t \end{cases}$$

(t-statistic in parenthesis, bellow the estimators).

As estimation method, we used Least Squares with Fixed Breaks (2007Q3 and 2010Q1). Also, we have inserted into the model, as non-breaking variables, the dummy for 2010Q4 and 2011Q3.

The actual values of *Global Index of the Art Market*, the values generated by model, and the residuals are depicted in Figure 2.

Figure 2. The relationship between global index of the art market and the S&P 500 index. Econometric nonlinear (exponential-quadratic) model with Structural Breaks.



Source: Estimates based on the nonlinear (exponential-quadratic) model with Structural Breaks.

The model explains 92.1% of the art market index variation from its mean (according to R-squared) and all the coefficients are significant at the standard level of 5%. Errors are not autocorrelated (according to the Breusch-Godfrey Serial Correlation LM Test) and are not heteroscedastic (according to the White Heteroskedasticity Test). The model as a whole is significant: Prob (F-statistic = 60.432) <0.000001.

For all periods (before the crisis, in the time of crisis, and in post-crisis) the link between the dynamics of the *Global Index of the Art Market* and the evolution of the *S&P 500 index* (the coefficient α in the model) is significant and positive. The positive value of correlation signifies that the *Global Index of the Art Market* and the *S&P 500 index* evolve, as a trend, in the same way, which means that the art market has not been widely used as an alternative to the capital market, not even during the crisis.

4. Long-run Relationship between Art Market and Financial Market

If we assuming that both the short-run (VAR) dynamics and the cointegrating equations do not exhibit of intercept or linear trends, then we find a significant long-run equilibrium relationship between the *Global Index of the Art Market* and the *S&P 500 index*. For this purpose, we built a Structural Vector Error Correction (SVEC) model with 4 lags (according with the results presented in Table 1, above). In the Structural VEC Model, we imposed that all non-significant (at least at 10%) coefficients from non-structural model are zero. As well, we inserted, as exogenous in the equation of short-run dynamics, the eighth lag (two years) of the differentiated endogenous variable [namely, $d(y_{t-8})$, where *y* is the exogenous variable].

The Structural VEC Model estimates are the following:

$$d(art_t) = \ - 0.0403 \cdot (art_{t-1} - 0.0616 \cdot S\&P_{t-1}) -$$

$$– 0.0012 \cdot d(art_{t-1}) + 0.1957 \cdot d(art_{t-2}) – 0.3049 \cdot d(art_{t-3}) + 0.0902 \cdot d(art_{t-4}) +$$
$$+ 0.1829 \cdot d(art_{t-8}) + 0.0151 \cdot d(S\&P_{t-1}) + 0.0144 \cdot d(S\&P_{t-2}) + dummy + u_t.$$

To simplify the writing, we use "art" to symbolize *Global Index of the Art Market* and "S&P" for *S&P 500 index*. In above equation, *d* is the operator of differencing and u_t is the residual variable. The "dummy" stands for the dummy exogenous variables, selected by detecting the outliers in residual variable [more exactly, $d(art_{2008q1})$, $d(art_{2010q1})$, $d(art_{2011q1})$].

The SVEC model fit well the data: $R^2 = 0.8186$ and the residual variable does not contain a linear, non-linear, or chaos structural patterns. According to the BDS (Brock, et al. 1996), the residuals of SVEC model are *i.i.d.* (independent and identically distributed): the probabilities associated with null hypothesis (the errors are *i.i.d.*) are greater than 5%, whatever is the embedding dimension for 2 to 6 ($2 \leq m \leq 6$). For that matter, the minimum of those probabilities is 64.86%, suitable to the correlation dimension equal to 6 (m = 6).

Table 3. BDS independence test for residuals in SVAR model.

Dimension	BDS Statistic	Std. Error	z-Statistic	Normal Prob.	Bootstrap Prob.
2	0.000577	0.008712	0.066188	0.9472	0.8360
3	-0.007174	0.013939	-0.514700	0.6068	0.7982
4	-0.001781	0.016708	-0.106622	0.9151	0.8910
5	0.001321	0.017530	0.075329	0.9400	0.7578
6	0.003761	0.017019	0.220981	0.8251	0.6486

Source: Estimates in EViews 10, based on the SVEC model.

For the SVEC model, the cointegration coefficient, $\beta = – 0.0403$, is negative and significantly different from zero (t-Statistic = -2.729).

The long-run relationship (equilibrium) between the *Global Index of the Art Market* and the *S&P 500 index* arises in the first line of the equation:

$$art = 0.0616 \; S\&P.$$

Written with the signification of the symbols, the long-run relationship is as follows:

$$\textit{Global Index of the Art Market} = 0.0616 \; (\textit{S\&P 500 index})$$

The SVEC model outcomes show that, in the long term, there is a positive and significant relationship between the *Global Index of the Art Market* and the *S&P 500 index*, and that confirms the conclusions of the nonlinear (exponential-quadratic) econometric model with structural breaks. The coefficient of connection between the *Global Index of the Art Market* and the *S&P 500 index* (i.e. 0.0616) is close to the β values calculated through the nonlinear model with structural breaks (0.026 for the period between 1998q1 and 2007q2, 0.106 for 2007q3 - 2009q4 and 0.114 after 2010, respectively).

Conclusions

We tested the relationships between the *Artprice Global Index of the Art Market* and the *S&P 500 index*. If the Art market would be an alternative for the Financial market, then there should be a weak correlation between art market dynamics and the evolution of traditional asset classes. By applying the Toda-Yamamoto version of Granger causality test, we find that *S&P 500 index* may be a cause for *Global Index of the Art Market*, but, the inverse causality relationship can be rejected: *Global Index of the Art Market* does not *Granger cause S&P 500*. These causality relationships are verified both for the whole analysed period (1998-2018q1) and in times of financial crisis (2007-20010).

Using a non-linear (exponential-quadratic) econometric model with structural breaks, we find that, for all periods (before the crisis, in the time of crisis, and after the crisis) the link between the dynamics of the *Global Index of the Art Market* and the evolution of the *S&P 500 index* is significant and positive. The positive value of correlation means that the *Global Index of the Art Market* and the *S&P500 index* move, as a trend, in the same way, which shows that the art market has not been widely used as an alternative to the capital market, not even during the crisis.

We built, also, a Structural Vector Error Correction (SVEC) model for the purpose of analysis the long-run relationship between the *Global Index of the Art Market* and the *S&P 500 index*. The SVEC model outcomes show that, in the long-run, there is a positive relationship between the *Global Index of the Art Market* and the *S&P 500 index*, and these results confirm the conclusions of the econometric nonlinear (exponential-quadratic) model with structural breaks.

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REFLECTION OF THE CONCEPT OF SUSTAINABILITY IN TERMS OF ACCOUNTING

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Abstract: *Accounting for achieving sustainability (which also includes managerial accounting of the environment) is promoted by the followers of the theory of effective protection of the environment, for which sustainability means maintaining a balance between the activity Economic and ecological system, a fair distribution of resources and opportunities, not only between current generations, but also between present and future generations, as well as an efficient allocation of resources in time to take into account limitations of natural resources[1]. The development of a managerial accounting that incorporates the concept of sustainability is not an easy approach, as it requires the determination of constraints on economic activities, as well as the subordination of economic criteria traditional criteria based on social and ecological values[2].*

Key words: sustainability, sustainable development, environmental managerial accounting, environmental management system, accounting of sustainability

JEL classification: M41, Q01, Q56

1. Introduction

The two notions of sustainability and sustainable development received a number of definitions from experts, organisations and groups involved in the implementation of governmental concepts or departments and agencies. Thus, according to experts, sustainable development is a journey and not a destination[1], development without destroying[2] or increasing in harmony with the environment, preserving the resource base for economic well-being and planning for the future of children[3].

According to specialized organisations, sustainable development requires a healthy environment, economic prosperity and social[1] fairness, and is the accumulation of continuous economic and social development that does not affect the environment and natural[2] resources, Improving the quality of life in terms of limiting the existing capacity of eco-systems[3].

At governmental level, sustainable development is the implementation of a process that integrates the decisions of environmental, economic and social[1] considerations or the existence on the basis of the income offered by nature, not the erosion of natural capital, consumption of renewable resources within the limit of their ability to regenerate[2].

The need for a sustainable development has been shaped as a target policy both in the world economy and for nations and Companies (UNCED 1987).

Sustainability (sustainability) refers to the use of natural resources within the limit of their regenerative[1] power, and the qualitative (sustainable) growth refers to the sustainable growth of the welfare of the population and society as a whole, increasing by decreasing or maintaining constant use of natural resources at the same time as the constant decline or maintenance of pollution.

Sustainable development is the development that satisfies the needs of the present generation without compromising the ability of future generations to meet their needs[2]. The definition of sustainable development contains two key notions: the concept of need or necessity and the notion of limitations imposed by the level of technology and the ability of the environment to meet the present and future needs.

2. Systemic approach to sustainable development

Sustainable society is that society that is structured and behaves in such a way that it exists for an infinite number of generations[1]. From the perspective of Karr[2] ' a sustainable society is regarded as a system characterized by stability, the achievement of an inherent potential, capacity of self-regeneration and a minimum need for external support. Thus, both production and consumption must be sustainable.

Figure 1 presents a systemic perspective of sustainable development, which is at the intersection of social, economic and environmental components.

Figure 1. A systemic approach to sustainable development

Source: Sadler[1] (1988)

In the context of sustainable development, the ecological economy strategy must follow several main directions:

1. Resizing economic growth, taking into account a more balanced distribution of resources and the emphasis on qualitative quality of production;
2. Eliminating poverty in terms of satisfying essential needs for jobs, food, energy, water, housing and health;

[1] Sadler, B., Natural Capital and Borrowed Time: The Global Context of Sustainable Development, Victoria, B.C., Canada, Institute of the North American west

3. Preserving and enhancing natural resources, maintaining the diversity of ecosystems, overseeing the environmental impact of the economy.
4. The reorientation of the technologies and the control of their risks.
5. Ensuring the quality of economic growth;
6. Decentralisation of forms of governance, increasing participation in decision-making and linking environmental and economy decisions.

Sustainable development strategies must be permanently altered in order to adapt to continuous changes arising from the increase in understanding of the link between natural activities and ecosystems, must contain three main components : identifying priority issues, defining actions to remedy or mitigate the identified problems and ensuring effective implementation and defining the strategic objectives to be made in accordance with the political interests, economic and social.

Sustainable development implies both economic development and integration of environmental protection in national strategies, and it is necessary to define each government's own strategy on ways to ensure sustainable development. This is possible through the development of an effective legislative system, by integrating environmental protection at national policy level, by establishing integrated national accounting systems to take account of the ecological component as well.

3. Accounting for sustainability

Outlining the concepts of sustainability and sustainable development has naturally raised the question of whether businesses can provide a basis for promoting the principles related to them, the answers focusing primarily on eco-efficiency analysis.

The sustainable approach brings a new vision on the elaboration of decisions, which must integrate three dimensions: environment, society and the time horizon.(Fig. 1.3.)

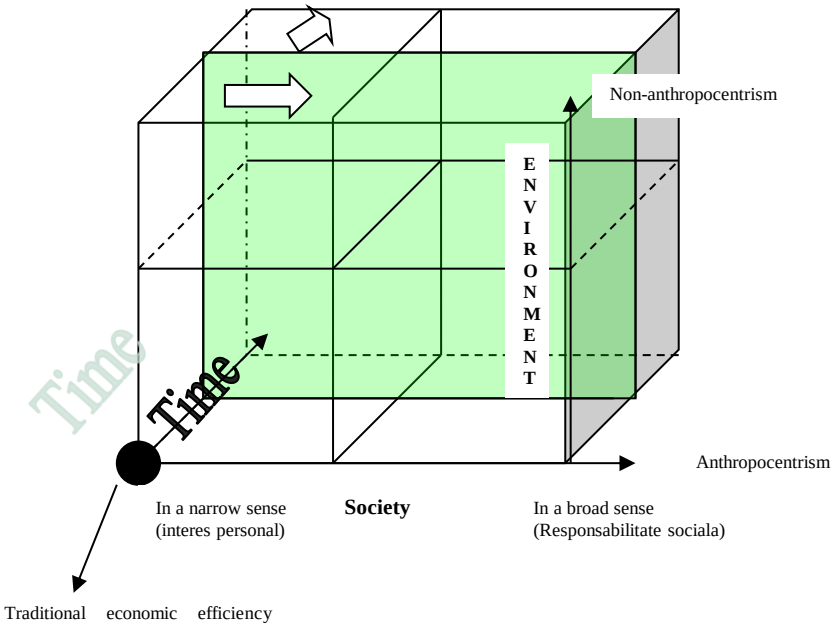

Figure 2. Socio-ecological dimensions of decision making

Source: Milne[2], 1996

[2] Milne, M., On sustainability; the environment and management accounting, Management Accounting Research, 1996, No 7, pag. 140

The traditional approach to drafting decisions focuses on short-term decisions in relation to the social area (shorter than a generation) and reported to a limited number of individuals. Sustainable development requires a long-term approach aimed at future generations, and individual values extend to the broad social approach (community, social groups), which generates social responsibility, just as the environment no longer needs Only viewed from the perspective of immediate usefulness but by its intrinsic value.

According to these dimensions, four main approaches (typologies) of environmental decisions have been developed: exploitation (environmental elements are not taken into account), conservation (taking into account environmental externalities), effective protection (naturalistic preservation) and extensive conservation.

The first and last of these approaches are at opposite poles: the exploitation approach completely ignores the environmental problems in relation to economic activity, while the extensive conservation-type approach rejects the idea that decisions about the environment should only be taken on the basis of individuals ' preferences, with rules of decision to protect the intrinsic value of nature[3].

Although totally opposite, both approaches are reflected in identical accounting treatments, i.e. not taking into account environmental elements in calculating costs. The extensive conservation approach does not allow the accounting of environmental elements, which would lead to their[3],4 trivialization, and the exploitation approach focuses only on maximizing the usefulness of activities.

The "conservation" approach uses accounting tools from a prospective perspective, such as environmental impact analysis and extensive cost-benefit analysis, which use environmental information as externalities, without integrating them into accounting.

Analyzing accounting literature on how sustainability can be reflected with the help of accounting, you can identify four completely different directions or camps[3].

So:

- The accounts must be separate from nature, ecology and sustainability because it could only provide a contamination of the precious life(Maunders and Burritt, 1991; Cooper, 1992);
- Reflecting sustainability in accounting must be done by means of environmental quotas and provisions(Canadian Institute of Authorized Accountants,1993; Federation of European Accountants ' Experts, 1993) ;
- The integration of sustainability must be done using environmental management and environmental accounting;
- Accounting and accountancy professionals must support the purpose of sustainability, but the practical way of achieving this is problematic, with new tools, methods and techniques, specially constructed to achieve this thing.

A first approach to the latter attitude was the emergence of the term of sustainable cost calculation, which encompasses the economic, social and environmental aspects of sustainable development. Also, it was proposed to divide the capital into various components with different functionalities: critical natural capital (ozone layer), Renewable natural capital (air, water, soil), and generated capital (machinery, technology and know-how)[3]. Thus, the main aspects of sustainability – the environment, social and economic components could be allocated to specific categories of capital. The development of the concept of sustainable cost calculation led to the development of a parallel accounting system that was intended to quantify in monetary terms and for a given period, the costs incurred by an organisation to bring the natural environment to the stage At the beginning of the accounting period. Such a system, however, cannot reflect the full spectrum of sustainability, but only an estimate of the variation of the environmental component of sustainability, and the reactions of

organizations towards such a system were reserved and pessimistic, mainly due to additional costs to be generated.

The first attempt to implement a sustainable cost calculation system took place in the year 1996, within a company in New Zealand, and the results were disseminated within the company's first sustainability report, published in the year 2000. This first attempt at the accounting of sustainability was considered by its authors a failure, primarily because of the results obtained which actually accounted for the measure of non-sustainability (in the absence of quantifiable benchmarks of Sustainability). The attempts of the accounting professionals to develop support tools for the development of decisions led to new methods such as the method of accounting of the costs generated by the material flows, the method of life cycle analysis, or Multi-criteria elaboration techniques, which join the expansion of classical methods such as cost-benefit analysis, or the total cost accounting method.

An analysis of how society looks at sustainable development compared to companies, shows that the multitude of activities considered sustainable by society is much lower than the multitude of activities considered sustainable by Companies, the latter must move towards a reorientation of global business strategies for the purpose of granting greater importance to environmental and social areas. This begins to be done in particular in the major corporations of the world, which are increasingly more visible to the social and environmental policies practiced and the results of their implementation.

4. Conclusions

The effective ways that can contribute to the implementation of the environmental aspects of sustainable development are: environmental management accounting, environmental impact studies and environmental management systems, regulated by the standards International in the field. Recent approaches in the area of quantification and assessment of sustainability have generated multi-dimensional models, which try to explain the links between decision-making processes and political dynamics specific to different contexts Social. Multidimensional models appear to be widely accepted with regard to the accounting approach of sustainability due to the complexity of the notion both in terms of scientific uncertainty and due to ideological diversity.[3]

Accounting for achieving sustainability (which also includes managerial accounting of the environment) is promoted by the followers of the theory of effective protection of the environment, for which sustainability means maintaining a balance between the activity Economic and ecological system, a fair distribution of resources and opportunities, not only between current generations, but also between present and future generations, as well as an efficient allocation of resources in time to take into account limitations of natural resources[4].

The development of a managerial accounting that incorporates the concept of sustainability is not an easy approach, as it requires the determination of constraints on economic activities, as well as the subordination of economic criteria Traditional criteria based on social and ecological values[5].

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COMPETITION AND ECONOMIC GROWTH. AN ECONOMETRIC ANALYSIS

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Abstract: *This paper is not about reviewing the theoretical approach (from Smith, Schumpeter and others) regarding the relationship between competition and economic growth. Its purpose is just to test the existence of a relationship between the dynamics of gross domestic product and the intensity of competition, on a worldwide sample, made of 142 countries, between 2007 and 2017. We have proved the existence of a positive and significant impact between the intensity of competition and the dynamics of gross domestic product.*

Keywords: Competition, Gross Domestic Product, Dynamic Panel Data

JEL Classification: D4, F63, C33

Introduction

Competition is considered an essential element of the efficiency of the goods market and is assessed on a scale from 1 to 7 (the highest rank). When including competition among the essential factors of competition, World Economic Forum (2017) considers the following:

> "Healthy market competition, both domestic and foreign, is important in driving market efficiency, and thus business productivity, by ensuring that the most efficient firms, producing goods demanded by the market, are those that thrive" World Economic Forum 2017. *Global Competitiveness Report 2017–2018 (GCI)*. Appendix A: Methodology and Computation of the GCI 2017–2018, p. 318, accessed on May 6, 2018, available at http://www3.weforum.org/docs/GCR2017-2018/05FullReport/The GlobalCompetitivenessReport2017%E2%80%932018.pdf).

We analyse the relationship between the dynamics of gross domestic product and the intensity of competition, by using data generated by "World Economic Forum" in the context of calculation regarding the "Global Competitiveness Index".

1. Data and methodology

1.1. Gross Domestic Product

The dynamics of gross domestic product is calculated, for each country, as a changes in volume compared to the average value for 2010 (considered to be 100%). The data is retrieved in Annex 2.

All unit root tests applied to GDP series which, as null hypothesis, assume that individual unit root process, *reject* non-stationarity in the model with individual effects and individual linear trends as exogenous variables. The common unit root is rejected by the Levin, Lin, Chu test and is not rejected by Breitung's t− ratio type test statistic. We accept the hypothesis according to which series are generated by stationary innovations around deterministic trends.

1.2. Competition

In order to assess the intensity (level) of competition, we use the data generated by "World Economic Forum" in the context of calculation regarding "Global Competitiveness Index" (data accessed in May 6, 2018, available at http://reports.weforum.org/global-competitiveness-index-2017-2018/downloads/).

In World Economic Forum valuations, the *competition* sub-pillar of competitiveness is computed as the weighted average of two constituents: *domestic competition* and *foreign competition.* The components are as follows (Table 1):

Table 1: Indicators of competition

1. Domestic competition
01 Intensity of local competition, [1 = not intense at all; 7 = extremely intense]
02 Extent of market dominance [1 = dominated by a few business groups; 7 = spread among many firms]
03 Effectiveness of anti-monopoly policy [1 = not effective at all; 7 = extremely effective]
04 Effect of taxation on incentives to invest [1 = to a great extent; 7 = not at all]
05 Total tax rate [profit tax (% of profits), labour tax and contribution (% of profits), and other taxes (% of profits)]
06 Number of procedures required to start a business [number]
07 Time required to start a business [number of days]
08 Agricultural policy costs [1 = excessively burdensome for the economy; 7 = balances well the interests of taxpayers, consumers, and producers]
2. Foreign competition
09 Prevalence of trade barriers [1 = strongly limit; 7 = do not limit at all]
10 Trade tariffs [average tariff rate, %]
11 Prevalence of foreign ownership [1 = extremely rare; 7 = extremely prevalent]
12 Business impact of rules on FDI [1 = extremely restrictive; 7 = not restrictive at all]
13 Burden of customs procedures [1 = extremely inefficient; 7 = extremely efficient]
14 Imports as a percentage of GDP [%]
Source: World Economic Forum 2017. "The Global Competitiveness Report 2017–2018". *Appendix A: Methodology and Computation of the Global Competitiveness Index 2017–2018*, p.324 and *Appendix D: Technical Notes and Sources, pp. 346-347*. Available at http://www3.weforum.org/docs/GCR2017-2018/05FullReport/TheGlobalCompetitivenessReport2017%E2%80%932018.pdf

According to the estimates, the highest level of competition is reached in Singapore, with 6.1 points out of maximum 7. The first European country in this ranking is The Netherlands (ranked the 4th, with 5.7 points), followed by Luxembourg and Ireland.

Romania is ranked the 70th (out of 137 countries) with 4.1 points, with a difference of 25.85% compared to the best performing economy (Singapore).

An excerpt from "The Global Competitiveness Index" World Economic Forum, 2017. *The Global Competitiveness Report 2017–2018* is shown in Table 2.

Table 2. Intensity of Competition

	Country	Score 1:7	Dist. from best
1	Singapore	6.1	0.00%
2	Hong Kong SAR	5.9	2.05%
3	United Arab Emirates	5.8	4.97%
4	Netherlands	5.7	5.34%
5	Luxembourg	5.7	6.38%
6	Ireland	5.6	7.79%
7	New Zealand	5.5	8.93%
8	Switzerland	5.5	9.90%
9	United States	5.4	10.04%
10	United Kingdom	5.4	10.88%
…			
13	Germany	5.3	12.66%
14	Denmark	5.3	12.86%
15	Belgium	5.3	13.13%
…			
25	Japan	5.1	16.16%
26	Czech Republic	5.0	17.09%
…			
33	Austria	4.9	18.68%
…			
40	Portugal	4.8	20.04%
41	Slovak Republic	4.8	20.73%
…			
47	Poland	4.7	22.07%
48	France	4.7	22.20%
…			
55	Spain	4.7	23.17%
…			
57	Hungary	4.6	23.71%
…			
60	Bulgaria	4.6	24.13%
…		…	…
63	China	4.5	24.85%
64	Albania	4.5	24.85%
…		…	…
69	Zambia	4.5	25.85%
70	Romania	4.5	25.85%
71	Senegal	4.5	25.88%
…		…	…
81	Italy	4.4	27.47%
…		…	…
88	Croatia	4.3	28.32%
…		…	…
93	Moldova	4.3	28.71%
94	Nigeria	4.3	28.94%
95	Russian Federation	4.3	28.95%
…		…	…
98	Serbia	4.3	29.19%
…		…	…
106	Greece	4.2	31.26%
…		…	…
134	Argentina	3.3	45.61%
135	Haiti	3.3	46.23%
136	Chad	3.2	47.22%
137	Venezuela	2.6	56.38%

Source: Data extracted from World Economic Forum, 2017. *The Global Competitiveness Report 2017–2018*. Available at http://reports.weforum.org/pdf/gci-2017-2018-scorecard/WEF_GCI_2017_2018_Scorecard_GCI.B.06.01.pdf (accessed May 6, 2018).

Romania's position compared to the main indicators on the basis of which the competitive performances of economies are estimated is presented in Table 3 and shown graphically in Figures 1 and 2.

Its European Union membership has provided a good position for Romania in the international ranking regarding *External competition* (5 points out of 7, ranked 37 out of 137 countries). This position is mainly determined by the "Commercial fees" (6.7 points out of 7, ranked 6 out of 137 countries), "The impact of the FDI rules on business" (5.3 points out of 7, ranked 25/137).

As for *Internal competition*, Romania is positioned in the second half of the international ranking (4.3 points out of 7, ranked 89/137). The lowest score is awarded for "Effect of taxation on incentives to invest". For this criterion, the score = 1 shows that taxation discourages investment, whereas 7 shows that taxation encourages investment.

Romania gets 2.9 points out of 7 and is ranked 121 out of 137 countries. Low scores are also awarded for: "Effectiveness of anti-monopoly policy " (3.4 points/7, ranked 95/137), "Intensity of local competition" (4.9 points/7, ranked 86/137) and "Extent of market dominance" (ranked 76/137, 3.6 points/7; 1 means that the market is dominated by a small number of powerful companies, whereas 7 shows the existence of a large number of companies disputing a relatively small share of the market).

Table 3. Romania's position in international ranking regarding competition (2017-2018)

Competition Index	*Romania*		*Best performance:*	
	Score	*Rank*	*Country*	*Dist. from best*
Competition	4.5	70	Singapore (6.1)	25.85%
1. Domestic competition	4.3	89	Singapore (5.8)	25.71%
01 Intensity of local competition, [1 = not intense at all; 7 = extremely intense]	4.9	86	Japan (6.2)	21.74
02 Extent of market dominance [1 = dominated by a few business groups; 7 = spread among many firms]	3.6	76	Switzerland (5.9)	39.32%
03 Effectiveness of anti-monopoly policy [1 = not effective at all; 7 = extremely effective]	3.4	95	Finland (5.7)	40.98%
04 Effect of taxation on incentives to invest [1 = to a great extent; 7 = not at all]	2.9	121	United Arab Emirates (6.1)	53.18%
05 Total tax rate [profit tax (% of profits), labour tax and contribution (% of profits), and other taxes (% of profits)]	38.4%	73	Brunei Darussalam (8.7%)	63.77%
06 Number of procedures required to start a business [number]	6 proc.	53	New Zealand (1)	70.00%
07 Time required to start a business [number of days]	12 days	74	New Zealand (1/2)	94.78%
08 Agricultural policy costs [1 = excessively burdensome for the economy; 7 = balances well the interests of taxpayers, consumers, and producers]	3.8	65	New Zealand (5.7)	33.54%
2. Foreign competition	5.0	37	Singapore (6.4)	22.63%
01 Prevalence of trade barriers [1 = strongly limit; 7 = do not limit at all]	4.6	42	Singapore (5.9)	21.35%
02 Trade tariffs [average tariff rate, %]	1.11%	6	Hong Kong (0.00%)	3.77%
03 Prevalence of foreign ownership [1 = extremely rare; 7 = extremely prevalent]	4.2	93	United Kingdom (6.1)	31.27%
04 Business impact of rules on FDI [1 = extremely restrictive; 7 = not restrictive at all]	5.3	25	Singapore (6.1)	13.92%
06 Burden of customs procedures [1 = extremely inefficient; 7 = extremely efficient]	4.2	68	Singapore (6.3)	33.90%
06 Imports as a percentage of GDP [%]	45.9%	64	Hong Kong (194%)	76.33%

Source: Data extracted from World Economic Forum, 2017. *The Global Competitiveness Report 2017–2018*. Available at:

- ✓ *Competition*: http://reports.weforum.org/pdf/gci-2017-2018-scorecard/WEF_GCI_2017_2018_Scorecard_GCI.B.06.01.pdf

- ✓ *Domestic competition*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=GCI.B.06.01.01
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- ✓ *Total tax rate*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=CORPTAXRATE
- ✓ *Number of procedures required to start a business*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=STARTBUSPROC
- ✓ *Time required to start a business*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=STARTBUSDAYS
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- ✓ *Foreign competition*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=GCI.B.06.01.02
- ✓ *Prevalence of trade barriers*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=EOSQ096
- ✓ *Trade tariffs*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=TFDUTY
- ✓ *Prevalence of foreign ownership*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=EOSQ094
- ✓ *Business impact of rules on FDI*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=EOSQ095
- ✓ *Burden of customs procedures*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=EOSQ050
- ✓ *Imports as a percentage of GDP*: http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/#series=IMPGDP

(All the series was accessed on May 2018).

Figure 1. Romania's position in international ranking regarding competition (2017-2018)
Note: Total countries: 137.
Source: Table 3.

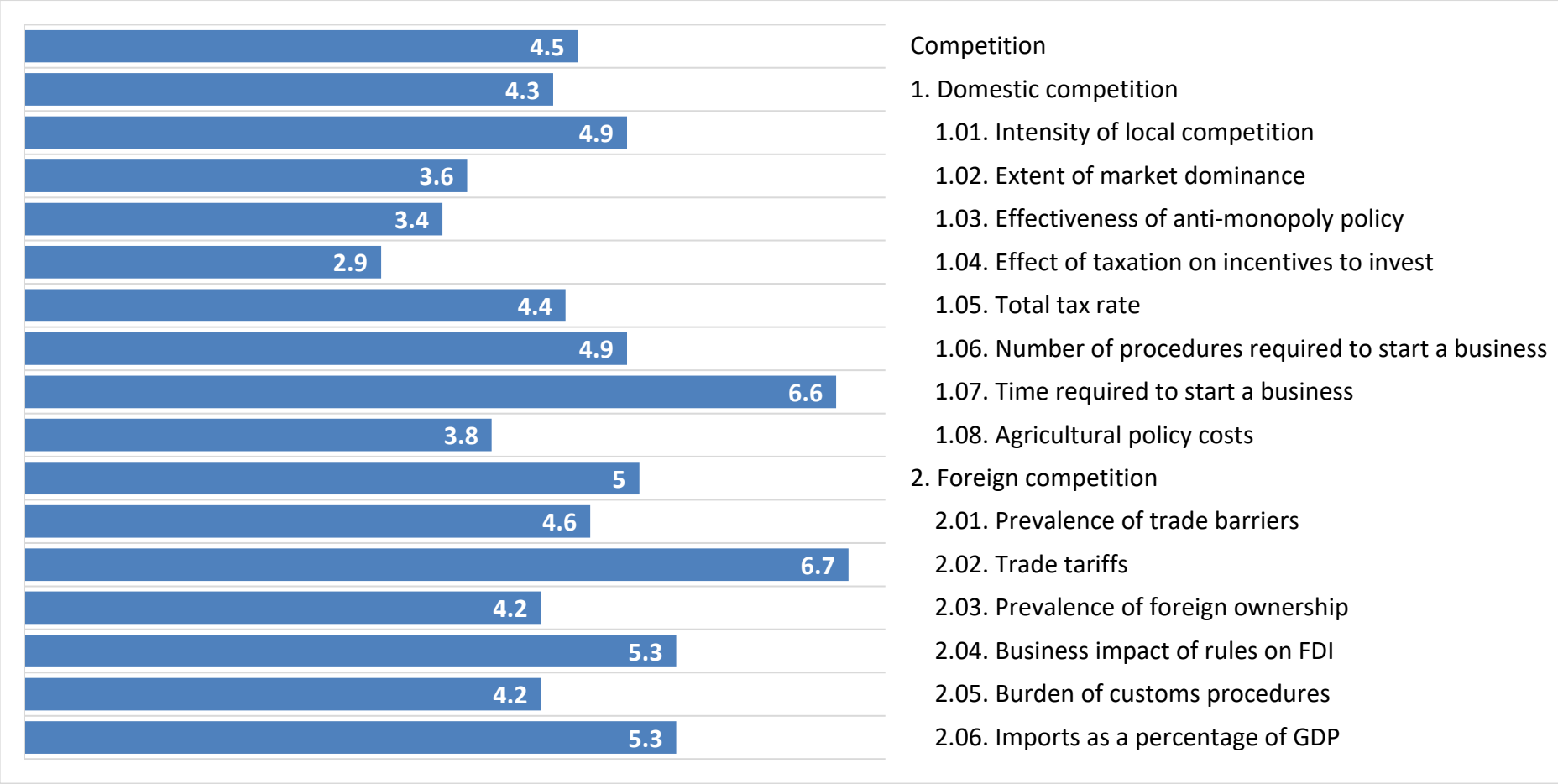

Figure 2. Romania's score in international ranking regarding competition (2017-2018)
Note: Total countries: 137. Score 1 and 7 still correspond to the worst and best possible outcomes.
Source: Table 3.

In order to use time series in econometric analysis, we shall test the nature of the Data Generating Process (DGP), i.e. "the joint probability distribution that is supposed to characterize the entire population from which the data set has been drawn" (Cízek, Härdle and Weron 2005). For this purpose, we apply unit roots panel tests for the data series that estimate the intensity of competition processes in national economies.

As per the data in Annex 2.2., for the model with individual effects, individual linear trends as exogenous variables, two out of three unit roots tests on individual series *reject* the hypothesis of non-stationarity. The common unit root is rejected by the Levin, Lin, Chu test and is not rejected by Breitung's t− ratio type test statistic. We accept the hypothesis according to which series are generated by stationary innovations around deterministic trends.

The series is normally distributed around a mean of 4.42 points (the probability of the null hypothesis in the Jarque-Bera test is 0.06, higher than the standard threshold of 0.05). The distribution normality test is shown in the Figure 3.

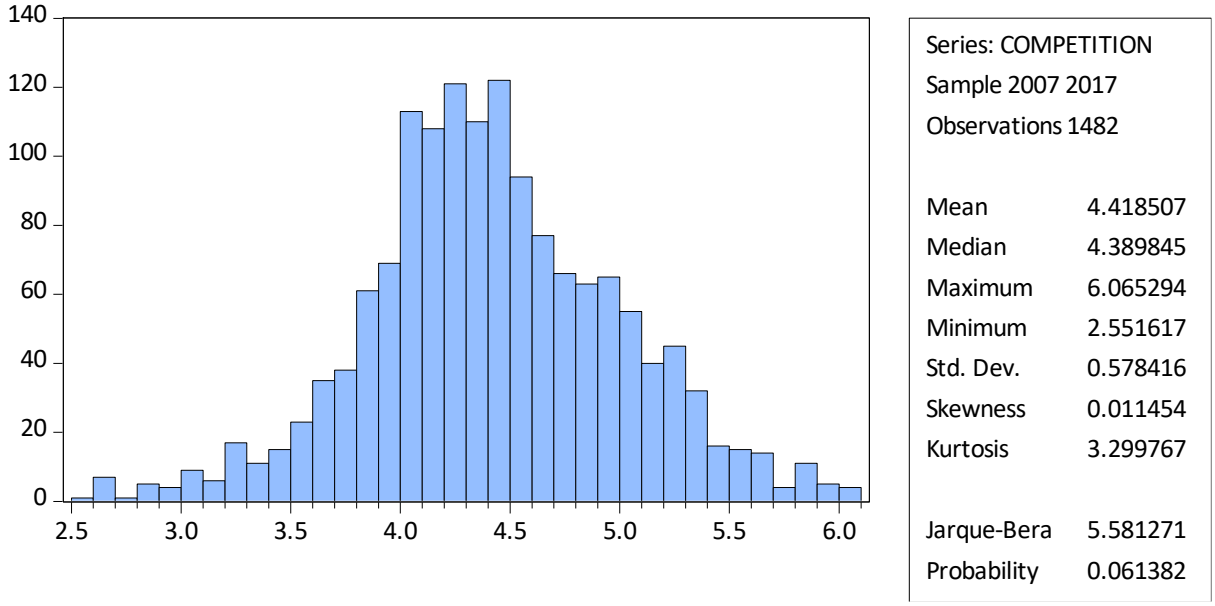

Figure 3. Jarque-Bera test for normality with the distribution of error components in panel data models (2007-2017, 130 countries) for the "competition" series.

Source: Data extracted from World Economic Forum, 2017. *The Global Competitiveness Report 2017–2018*. Available at: http://reports.weforum.org/pdf/gci-2017-2018-scorecard/WEF_GCI_2017_2018_Scorecard_GCI.B.06.01.pdf

2. Modelling the relationship between competition and gross domestic product. Panel data analysis

In order to analyse the relationship between the gross domestic product and the intensity of competition we have used dynamic panel data model (Arellano and Bond 1991), specified as follows:

$$PIB_{it} = \alpha_0 + \sum_{j=1}^{p} \alpha_j \cdot PIB_{i,t-j} + \sum_{k=0}^{q} \beta_k \cdot CONC_{i,t-k} + \gamma_i + \delta_t + e_{it} .$$

The meaning of the symbols is the following:

- i – index of sample countries (140 countries);
- t – indexes time (t = 2007, 2008, ..., 2017)
- PIB_{it} – gross domestic product of the country *i*, in year *t*;
- $CONC_{it}$ – an index of competition level of the country *i*, in year *t*;
- p – number of lags from autoregressive description;
- q – number of lags from distributed lag description;

α_0 – constant term from the regression equation;
α_j – autocorrelation coefficients of gross domestic product (*p* is the number of lags);
β – coefficient of impact:
$\beta > 0$ – suggests a direct relationship (a positive impact) between the level of competition and the dynamics of gross domestic product,
$\beta < 0$ – suggests a negative impact of the level of competition on the dynamics of gross domestic product,
$\beta = 0$ – suggests the lack of the relationship between the level of competition and the dynamics of gross domestic product,
γ_i – individual specific effect (fixed or random), which evaluates the particularities od each country;
δ_t – specific effect in time (fixed or random) in time, which evaluates the particularities of each year;
e_{it} – idiosyncratic error.

By testing various specifications of the previous relation (p, q = 1, ..., 5), we have selected the following regression equation (dynamic panel, p = 3, q = 2):

$$PIB_{it} = 0.909460 \cdot PIB_{i,t-1} - 0.198455 \cdot PIB_{i,t-2} + 0.170355 \cdot PIB_{i,t-3} + 2.916072 \cdot CONC_{i,t} + 5.527289 \cdot CONC_{i,t-1} + 2.900866 \cdot CONC_{i,t-2} + u_{it},$$

The results (EViews-10) are detailed in Annex 3. All coefficients are significantly different from zero at the threshold of 0.01. The value of the J-statistic test is 40.2999, lower than 50.9985, level corresponding to the 5% quantile from the unilateral distribution χ^2 by 36 degrees of freedom (42 – 6, namely the rank of the instruments' matrix *minus* the number of coefficients in the model). Concretely, if we reject the null hypothesis attached to that test (the over-identification restrictions for GMM are valid) the risk of error is 28.58%. At the same time, standard tests for cross-section dependence in panels (Breusch-Pagan χ^2, Pearson LM and CD Normal, Friedman χ^2, Frees Q) do not reject the hypothesis of independence: the risk of first order error is by far superior to the critical threshold of 5%.

Conclusion

Consequently, the model which explains the impact of competition on the dynamics of gross domestic product is valid from an econometric perspective. When steady-state is reached, the coefficient of impact is

$$\beta = 2.916072 + 5.527289 + 2.900866 = 11.344227$$

and the previous equation is:

$$PIB = (0.909460 - 0.198455 + 0.170355) \cdot PIB + 11.344227 \cdot CONC$$

or

$$(1 - 0.881360) \cdot PIB - 11.344227 \cdot CONC = 0$$

$$PIB - 95.618856 \cdot CONC = 0$$

Calculation suggests *a positive relation between* the gross domestic product and intensity of competition worldwide between 2007 and 2017. We do not interpret the dimension of the influence, as variables are calculated in different units of measure: growth percentages compared to 2010 – for the gross domestic product and points on a scale from 1 to 7, for the intensity of competition. Even if the dimension of time series is not very large, the consistency is assured by the cross-section dimension of panel. This allows us to state that *the previous relation demonstrates a positive impact of the level of competition on economic growth*.

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Annexes

Annex 1: Countries in panel

Symbol	*Country*	*Symbol*	*Country*	*Symbol*	*Country*
AGO	Angola	CPV	Cape Verde	IRL	Ireland
ALB	Albania	CRI	Costa Rica	IRN	Iran, Islamic Rep.
ARE	United Arab Emirates	CYP	Cyprus	ISL	Iceland
		CZE	Czech Republic	ISR	Israel
ARG	Argentina	DEU	Germany	ITA	Italy
ARM	Armenia	DNK	Denmark	JAM	Jamaica
AUS	Australia	DOM	Dominican Republic	JOR	Jordan
AUT	Austria			JPN	Japan
AZE	Azerbaijan	DZA	Algeria	KAZ	Kazakhstan
BDI	Burundi	ECU	Ecuador	KEN	Kenya
BEL	Belgium	EGY	Egypt	KGZ	Kyrgyz Republic
BEN	Benin	ESP	Spain	KHM	Cambodia
BFA	Burkina Faso	EST	Estonia	KOR	Korea, Rep.
BGD	Bangladesh	ETH	Ethiopia	KWT	Kuwait
BGR	Bulgaria	FIN	Finland	LAO	Lao PDR
BHR	Bahrain	FRA	France	LBN	Lebanon
BIH	Bosnia and Herzegovina	GAB	Gabon	LBR	Liberia
		GBR	United Kingdom	LBY	Libya
BOL	Bolivia	GEO	Georgia	LKA	Sri Lanka
BRA	Brazil	GHA	Ghana	LSO	Lesotho
BRB	Barbados	GIN	Guinea	LTU	Lithuania
BRN	Brunei Darussalam	GMB	Gambia, The	LUX	Luxembourg
BTN	Bhutan	GRC	Greece	LVA	Latvia
BWA	Botswana	GTM	Guatemala	MAR	Morocco
CAN	Canada	HKG	Hong Kong SAR	MDA	Moldova
CHE	Switzerland	HND	Honduras	MDG	Madagascar
CHL	Chile	HRV	Croatia	MEX	Mexico
CHN	China	HTI	Haiti	MKD	Macedonia, FYR
CIV	Côte d'Ivoire	HUN	Hungary	MLI	Mali
CMR	Cameroon	IDN	Indonesia	MLT	Malta
COL	Colombia	IND	India	MNE	Montenegro

Symbol	*Country*	*Symbol*	*Country*	*Symbol*	*Country*
MNG	Mongolia	PRT	Portugal	TCD	Chad
MOZ	Mozambique	PRY	Paraguay	THA	Thailand
MRT	Mauritania	QAT	Qatar	TJK	Tajikistan
MUS	Mauritius	ROU	Romania	TTO	Trinidad and Tobago
MWI	Malawi	RUS	Russian Federation		
MYS	Malaysia	RWA	Rwanda	TUN	Tunisia
NAM	Namibia	SAU	Saudi Arabia	TUR	Turkey
NGA	Nigeria	SEN	Senegal	TZA	Tanzania
NIC	Nicaragua	SGP	Singapore	UGA	Uganda
NLD	Netherlands	SLE	Sierra Leone	UKR	Ukraine
NOR	Norway	SLV	El Salvador	URY	Uruguay
NPL	Nepal	SRB	Serbia	USA	United States
NZL	New Zealand	SUR	Suriname	VEN	Venezuela
OMN	Oman	SVK	Slovak Republic	VNM	Viet Nam
PAK	Pakistan	SVN	Slovenia	YEM	Yemen
PAN	Panama	SWE	Sweden	ZAF	South Africa
PER	Peru	SWZ	Swaziland	ZMB	Zambia
PHL	Philippines	SYC	Seychelles	ZWE	Zimbabwe
POL	Poland	SYR	Syria		

Annex 2. Panel Unit Roots Tests

2.1. Panel Unit Roots Tests for Gross Domestic Product

Series: Dynamics of Gross Domestic Product(GDP, 2010=100%) – AGO, ALB, ARE, ARG, ARM, AUS, AUT, AZE, BDI, BEL, BEN, BFA, BGD, BGR, BHR, BIH, BOL, BRA, BRB, BRN, BTN, BWA, CAN, CHE, CHL, CHN, CIV, CMR, COL, CPV, CRI, CYP, CZE, DEU, DNK, DOM, DZA, ECU, EGY, ESP, EST, ETH, FIN, FRA, GAB, GBR, GEO, GHA, GIN, GMB, GRC, GTM, HKG, HND, HRV, HTI, HUN, IDN, IND, IRL, IRN, ISL, ISR, ITA, JAM, JOR, JPN, KAZ, KEN, KGZ, KHM, KOR, KWT, LAO, LBN, LBR, LBY, LKA, LSO, LTU, LUX, LVA, MAR, MDA, MDG, MEX, MKD, MLI, MLT, MNE, MNG, MOZ, MRT, MUS, MWI, MYS, NAM, NGA, NIC, NLD, NOR, NPL, NZL, OMN, PAK, PAN, PER, PHL, POL, PRT, PRY, QAT, ROU, RUS, RWA, SAU, SEN, SGP, SLE, SLV, SRB, SUR, SVK, SVN, SWE, SWZ, SYC, SYR, TCD, THA, TJK, TTO, TUN, TUR, TZA, UGA, UKR, URY, USA, VEN, VNM, YEM, ZAF, ZMB, ZWE

Sample: 2007 – 2017

Exogenous variables: Individual effects, individual linear trends

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin, Chu (t-stat)	-31.8294	0.0000	142	1246
Breitung t-stat	10.7234	1.0000	142	1104
Null: Unit root (assumes common unit root process)				
Im, Pesaran, Shin (W-stat)	-4.22663	0.0000	142	1246

ADF - Fisher (χ^2-stat)	506.213	0.0000	142	1246
PP - Fisher (χ^2-stat)	365.894	0.0007	142	1314

Source: EViews estimations based on International Monetary Fund, section "International Financial Statistics (IFS)", table "Gross Domestic Product, Real, Index" available at http://data.imf.org/regular.aspx?key=61545864 (accessed May 6, 2018). EViews calculation.

2.2. Panel Unit Roots Tests for Competition (145 countries, 2007 – 2017)

Series: Competition - AGO, ALB, ARE, ARG, ARM, AUS, AUT, AZE, BDI, BEL, BEN, BFA, BGD, BGR, BHR, BIH, BOL, BRA, BRB, BRN, BTN, BWA, CAN, CHE, CHL, CHN, CIV, CMR, COL, CPV, CRI, CYP, CZE, DEU, DNK, DOM, DZA, ECU, EGY, ESP, EST, ETH, FIN, FRA, GAB, GBR, GEO, GHA, GIN, GMB, GRC, GTM, HKG, HND, HRV, HTI, HUN, IDN, IND, IRL, IRN, ISL, ISR, ITA, JAM, JOR, JPN, KAZ, KEN, KGZ, KHM, KOR, KWT, LAO, LBN, LBR, LBY, LKA, LSO, LTU, LUX, LVA, MAR, MDA, MDG, MEX, MKD, MLI, MLT, MNE, MNG, MOZ, MRT, MUS, MWI, MYS, NAM, NGA, NIC, NLD, NOR, NPL, NZL, OMN, PAK, PAN, PER, PHL, POL, PRT, PRY, QAT, ROU, RUS, RWA, SAU, SEN, SGP, SLE, SLV, SRB, SUR, SVK, SVN, SWE, SWZ, SYC, SYR, TCD, THA, TJK, TTO, TUN, TUR, TZA, UGA, UKR, URY, USA, VEN, VNM, YEM, ZAF, ZMB, ZWE
Sample: 2007 – 2017
Exogenous variables: Individual effects, individual linear trends
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.	Cross-sections	Obs.
Null: Unit root (assumes common unit root process)				
Levin, Lin, Chu (t-stat)	-18.9427	0.0000	140	1263
Breitung t-stat	0.54410	0.7068	140	1123
Null: Unit root (assumes individual unit root process)				
Im, Pesaran, Shin (W-stat)	-1.16550	0.1219	140	1263
ADF - Fisher (χ^2-stat)	330.839	0.0198	140	1263
PP - Fisher (χ^2-stat)	375.542	0.0001	140	1308

Source: Data extracted from World Economic Forum, 2017. *The Global Competitiveness Report 2017–2018*. Available at: http://reports.weforum.org/pdf/gci-2017-2018-scorecard/WEF_GCI_2017_2018_Scorecard_GCI.B.06.01.pdf

Annex 3. Dynamic panel data model for the relationship between the gross domestic product (GDP) and the intensity of competition (140 countries, 2007-2017)

Dependent Variable: GDP
Method: Panel Generalized Method of Moments
Transformation: First Differences
Sample (adjusted): 2011 2017
Periods included: 7
Cross-sections included: 140
Total panel (unbalanced) observations: 802
White period instrument weighting matrix
White period standard errors & covariance (d.f. corrected)
Instrument specification: @DYN(PIB,-2), Constant

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.909460	0.029194	31.15240	0.0000
GDP(-2)	-0.198455	0.024642	-8.053651	0.0000
GDP(-3)	0.170355	0.017412	9.783995	0.0000
CONC	2.916072	1.047862	2.782877	0.0055
CONC(-1)	5.527289	0.953646	5.795957	0.0000
CONC(-2)	2.900866	1.117850	2.595041	0.0096

Effects specification: Cross-section fixed (first differences)

Mean dependent var	3.666584	S.D. dependent var	3.629470
S.E. of regression	3.456344	Sum squared resid	9509.268
J-statistic	40.29924	Instrument rank	42
Prob(J-statistic)	0.285792		

Source: EViews

- ✓ *Competition:* World Economic Forum 2017. *Global Competitiveness Report 2017–2018. Available at* http://reports.weforum.org/pdf/gci-2017-2018-scorecard/WEF_GCI_2017_2018_Scorecard_GCI.B.06.01.pdf (accessed in May 6, 2018)
- ✓ *GDP*: International Monetary Fund Datasets, section "International Financial Statistics (IFS) – Gross Domestic Product and Components selected indicators", table "Gross Domestic Product, Real, Index" available at http://data.imf.org/regular.aspx?key=61545864 (accessed in May 6, 2018).

THE MAIN FORMS OF MANIFESTATION OF CYBERCRIMES

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Abstract: *Cybernetic offenses have long been outside legal regulation except for the Copyright and Related Rights Act no. 8/1996 , which criminalizes software piracy, regulating only a part of this dangerous manifestation, and Law no. 16/1995 on protection of topographies of integrated circuits . Law no. 21/1999, for the prevention and sanctioning of money laundering introduced for the first time in the Romanian legislation the notion of "cybercrimes". As any social phenomenon, cybercrime represents a system with its own properties and functions, distinct in terms of quality from those of the component elements.*

Key words: cybercrime, computer attacks

JEL Classification: J24

Regulatory framework

In Romania, an important legal regulation currently applicable in the area of cybercrime is Law 161 of 04.09.2003 on certain measures for ensuring transparency and the exercise of public dignities, public functions and the business environment, prevention and sanctioning of corruption .

This law introduces 8 offenses, corresponding to the classifications and definitions presented with the analysis of the provisions of the Convention on Cybercrime, which have been grouped within Title III of the law - Preventing and Combating Cybercrime. The text was a rapid adaptation to the Romanian environment of the provisions of the Council of Europe Convention on Cybercrime and is an effective tool in the fight against this scourge.

The same facts are also provided for in the New Penal Code, most of them in Title VII, Chapter VI, except for the offense of child pornography through computer systems.

Within Law no. 161/2003 there are three categories of offenses incriminated:

- Crimes against the confidentiality and integrity of data and computer systems.
    - The offense of illegal access to a computer system ;
    - The offense of illegal interception of a computer data transmission ;
    - The offense of altering the integrity of computer data ;
    - The offense of disrupting the functioning of information systems ;
    - The offense of carrying out illegal operations with devices or software .
- Computer crimes
    - Computer aided counterfeiting fraud ;
    - Computer fraud offense.
- Child pornography through computer systems

Illegal access to a computer system

Article 42 criminalizes the act of illegal access to a computer system in a standard version (paragraph l) and two aggravated variants (paragraphs 2 and 3):

- Access, without right, to a computer system;
- Access, without right, to a computer system, in order to obtain computer data;
- Access to an information system, under paragraph (1) if the act was committed in breach of security measures.

The offense charged in Art. 42 makes clear the distinction between the three stages of access to a computer system: simple access (which is often purely accidental), access to the obtaining of information data (which is manifested most often) and access by violating security measures (which require technical knowledge and is more difficult to carry out).

Password Attacks. Password breaking in the network

To understand how hackers work for password attacks on networks, we chose Windows NT and UNIX operating systems as an example.

To retrieve passwords from a Windows NT network, a hacker must have access to at least one username and the NT implementation of the MD4 algorithm.

After copying the database (the only place where user holes and MD4 hash can be found), the hacker will perform a force attack or a dictionary attack against the password file.

Because only system administrators can access the sam directory (where Windows NT locates the password database), the only way for the hacker to find the database is either the console or a backup copy of the database (located, for example, on a repair disk). In other words, to reach the database, the hacker must have physical access to the console or a copy of the database. If the server and server backups are physically secure, the risk of attack through the password database is significantly reduced.

Password Brute Force Attack on Windows NT

When attacking a Windows NT installation, the first step of the hacker is to try a low-level password. If the Windows NT Account Lockout feature is not enabled, the hacker can try passwords until it obtains a supported network password. The password-guessing process can be automated by using a program that guesses passwords permanently, known as brute force password-cracking technique. A program that performs such attacks is widely available on the Internet. The Force Attack program will try passwords like aa, ab, ac, etc., until it tries every possible combination of characters. Finally, the hacker will get the password.

However, a brute force attack against a Windows NT network requires either the hacker to have console access to the server, or to have a copy of the password database. In the event that the hacker can run the attack by force against a static Windows NT password database, there are available several free password breaking programsthat can guess 16 characters log passwords in seven days at most.

Dictionary password attack on Windows NT

Although a brute force attack requires long-term access to the Windows NT password file, a dictionary attack on a password file can be successful if the Account Lockout feature is not enabled. However, dictionary attacks can affect an off-line copy of that password file.

Generally, a Windows NT dictionary attack either passes the words in a dictionary through the Windows NT login prompt (if Account Lockup is inactive) either takes a list of dictionary words and

encrypts them one by one using the same encryption algorithm as NT to see if encryption results in the same one-way hash value (if the hacker has an off-line copy of the password database). If the hash values are equal, the password so identified will be the user's password.

The best solutions against dictionary attacks are: systematically changing passwords, running Kane Security Analyst on a regular basis or other system parsing application for password verification.

How do hackers break Unix passwords

To discover passwords from a Unix network, a hacker must have access to the network itself, or even be able to exploit a breach in a service (such as the sendmail bounce service) to reach the /etc/passwd file. Once it reaches the password file, the hacker also needs the 8-byte Unix one-way hash. After copying the password database, the hacker will run an attack - through brute force or dictionary - on the password file.

Since the /etc/passwd file is accessible to anyone on the Unix server, the hacker can reach the password database with minimal access rights to the server or even with no rights. Shadowing password shuffling or the use of superior password security programs is almost a necessity for Unix.

Unix brute force password attack

When a hacker attacks a Unix installation, the first step is to try a low-level password. Unlike Windows NT, Unix does not block user accounts after a certain number of lost login. Because Unix is tolerant, the hacker can use a brute force attack on a server without having access to the server at all. In the event the hacker can run and attack by force against a static password database in Unix, there are free password-breaking programs that can guess 16-character passwords in up to 10 days (depending on the connection speed). After obtaining the low-level password, the hacker will use that password to access the server and copy the /etc/passwd file.

After having a copy of the /etc/passwd file, the hacker can use a brute force attack to guess passwords until it finds an accepted network password. A hacker can automate the process of finding passwords using a program that performs this continuous operation.

The best way to protect against a brute force attack is to hide the password file so that the hacker can not access the passwords themselves, but only the tokens generated by the operating system. If the hacker is kept away from the hash values of passwords, he will not be able to run the brute force program because it will not be able to compare its own hash results with the values in the file.

Unix dictionary password attacking

If a raw force attack requires long-term access to the Unix password file, a dictionary attack may have more chances of success. However, dictionary attacks will also be successful on an off-line copy of the password file.

Generally, a dictionary attack on a Unix system either submits the words in a Unix login prompt dictionary (if the hacker attempts an online attack), or uses a wordlist and applies the hash function to each word using the same algorithm encryption as Unix does, to see if encryption reaches the same value of one-way hash (if the hacker has an off-line copy of the password database). If the values are equal, that word is the user's password.

The best protection against dictionary-based attacks is to cause users to regularly change their passwords, regularly run the Security Administrator Tool for Analyzing Networks (SATAN), or another password-analyzing system analysis program.

Free access attacks occur frequently in networks that use an operating system (including Unix, VMS or Windows NT) that incorporate free access mechanisms. These mechanisms are a particularly weak point of the systems. For example, for Unix operating systems, users can create trusted host files

that include hostnames (hosts) or where a user can access the system without a password. When connecting from such a system, the user just has to use the rlogin command or other similar command, with the appropriate arguments. Thus, a hacker can gain extensive control over the system by guessing the name of a free-access system or a host-username combination. And worse, most hackers know that many Unix system administrators configure ".rhosts" files in the root directory so that users can quickly move from one host to another using the privileges of the so-called superuser. Unix system administrators are starting to realize that using ".host" files can be a costly feature. These files allow a hacker to easily get unauthorized access to the root directory.

Attacks that exploit technological weaknesses include the free access attack discussed earlier, and many more. Each important operating system has its weak points. Some are easier to access than others. On the other hand, the probability that a hacker will detect such weaknesses is quite low. For example, a recent version of the Microsoft Internet Information Server product (Windows NT Auxiliary Product) contained an error with system destruction potential. The system would have given up if the hacker had inserted into his browser a unique URL with many digits when he would have accessed that site. The URL is very long and is unique to each system. The probability that hackers exploit this defect is very low. On the other hand, the likelihood that a hacker exploits the open-access host on a Unix system, due to the ease of access and existence of this file on multiple servers, is significantly greater than the probability of exploiting this program flaw.

Attacks that exploit shared libraries use shared libraries most commonly used in Unix. A shared library is a set of common program functions that the operating system loads into a RAM file at the request of each program. Hacker often replaces programs in shared libraries with new programs that serve their own purposes, such as permission for privileged access.

Attacks by TCP (Transport Control Protocol) hijacking

Perhaps the most dangerous threat to servers connected to the Internet is TCP hijacking. Although TCP prediction of frequency numbers and TCP hijacking have many common elements, the latter procedure is avoided because the hacker has access to the network by forcing it to accept its own IP address as a credible network address rather than by repeated attempts to test you have many IP addresses until you find the right one. The underlying idea behind TCP hijacking is that the hacker acquires control of a computer connected to the target network, then disconnects the computer from the network so that the server thinks the hacker has taken its real place.

Once the hacker successfully hijacks a credible computer, it will replace the IP address of the target computer within each packet with its own address and simulate the target sequence numbers. Security experts call this process "IP simulation". A hacker simulates a credible system address on his own computer using the IP simulation process. After the hacker simulates the target computer, this will use a smart sequence number simulation to become the target of the server.

A hacker can execute a TCP hijaching attack much more simply than an IP simulation attack. TCP hijacking also allows the hacker to ignore single-password test-response systems (for example, shared secret password systems) and compromise a host with more delicate security level.

Finally, TCP hijacking attacks are more dangerous than IP cancellation because hackers gain significantly higher access after a successful TCP hijacking than after a single IP simulation attack. Hackers desire more extensive access because this way they are able to intercepti ongoing transactions rather than simulating a computer and then starting transactions.

Session hijacking is a bit more popular than IP spoofing.

One reason for this is that it allows both importing and exporting data from the system. Also, session hijacking does not require the anticipation of the frequency numbers for the startup protocol, making it easier to perform, the framework of this rudimentary computer crime technique, the intruder finds an existing connection between two computers, usually a server and a client. Then, by penetrating unprotected routers or corresponding firewalls, the intruder detects important sequence numbers (TCP/IP addresses) as part of an information exchange between computers. After entering a legitimate

user's address, the intruder hijacks his session by invalidating the user's address numbers. After hijacking the session, the host computer disconnects the legitimate user and thus the intruder gets free access to the legitimate user's files.

The protection against session hijacking is very difficult, and the detection of such hijacking is difficult as well. For anti-hijacking protection, those regions of the system from where a hijacking attack may be launched must be secured. For example, unnecessary pre-defined accounts are removed and vulnerabilities are mitigated to protect firewalls and routers from unauthorized access. Also, the use of encryption is a valuable protection against hijacking. Detection of session hijacking is virtually impossible in the absence of a message from the hijacked user because the intruder appears in the system disguised as the user who has been hijacked.

Perhaps the most dangerous threat to servers connected to the Internet is TCP hijacking. Although the TCP prediction of frequency numbers and TCP hijacking have many common elements, the latter is safe because the hacker has access to the network by forcing it to accept its own IP address as a credible network address rather than by repeated attempts to test more IP addresses until finding the right one. The underlying idea behind TCP hijacking is that the hacker acquires control of a computer connected to the target network, then disconnects the computer from the network and tricks the server into thinking the hacker has taken the place of the real host.

An interesting type of illegal access, increasingly used today, is the social engineering attacks. These have become more common and more dangerous as more and more users connect to the Internet and internal networks. A common example of social engineering is that a hacker sends emails to users (or simply use the phone) to let them know that he is the system administrator. Often, messages require users to send their password by email to the administrator, because the system is in a flaw or will be temporarily disabled. A social engineering attack is mostly based on the ignorance of computer and network users. The best recipe against these attacks is the education of users.

Practice has shown that, in the vast majority of cases, the perpetrator acts to obtain computer data, which may mean:

- visual capture of these data on the monitor;
- entry into possession of an alphanumeric print (sheet of printed paper);
- running programs or applications that manage computer data (eg database management programs in an institution, e-mail programs, etc.).

By obtaining computer data it is understood including copying them to external storage media (Floppy Disk, CD, Memory Stick, Card etc.). If there is only a copy of the data, the deed will fall under the provisions of Article 42 paragraph 2. However, if the perpetrator transfers the data to an external medium (in the case of moving or migrating data to that storage medium), the provisions of Art. 44 of the law, which refers to the "alteration of the integrity of the information tiles" will apply. Simply copying computer data from a computer's hard disk or any other storage medium to an external media device is not likely to affect the integrity of that information in any way, but transferring them may also involve deleting them from the original location.

Generally, owners, owners, or lawyers choose to protect their IT systems by standard security measures.

Protection may be either physical (isolation of the computing technique in a secured enclosure, mechanical key or metal key, manual control of the power supply etc.) or logical (by passwords, access codes or encryption).

Under paragraph 3, the perpetrator will act on the computer system targeted by forcing these protections.

At the physical level, forcing involves the decommissioning of mechanical security devices through various mechano-chemical-electric means. At the logical level, we have password attacks.

Password attacks are, historically, one of the most preferred method hackers use for online networks. In the beginning, hackers tried to enter the networks by entering a login identifier and a password. They tried a password after another until they found the right one. However, hackers realized they had the ability to write simple programs to try out passwords in the system. In general, these simple programs were running in turn each word in the dictionary in an attempt to find a password. Thus, automatic password attacks have quickly become known as dictionary-based attacks. Unix operating systems are particularly vulnerable to dictionary attacks, because Unix does not automatically exclude the user after a certain number of attempts to enter the network, unlike other operating systems that inactivate a username after a fixed number of typing of incorrect passwords. In other words, a hacker can try thousands of times to connect to a Unix system without shutting down the connection or automatically alerting the system administrator.

Some hackers have even been successful in using Unix services like Telnet or FTP to get access to publicly accessible password files. The operating system encodes passwords in such files. However, since each Unix system encodes its password file using the same algorithm (a math function), a hacker can ignore the encoding of this file using an Internet-based algorithm. This algorithm is embedded in several "burst" tools, often used in the hacker community.

From a physical point of view, the consequence is the change that the incriminated action has produced in the foreign world. Sometimes this change may involve changing a situation or state, sometimes it can materialize in a material transformation to the material object of the offense.

In practice, the consequence of the simple form of demoted access is the transition to a state of uncertainty of the computer system and / or its resources (hardware, software, etc.).

If the purpose of unauthorized access was to obtain computer data, the state of uncertainty of the computing system is doubled by the state of uncertainty of the computer data stored there or processed by it.

Violation of security measures will, however, result in an effective transformation into the material object of the offense, the security measure being, in this case, an integral part of the information system.

From the legal point of view, in terms of the consequences that the incriminated action has on the social value that is the legal object, the consequence is precisely the state of danger, of threat, to "computer domicile" or "computer space".

Conclusion

Practically, at present, easy access to information and communication technology is one of the premises for the well functioning of modern society. Cyberspace is characterized by lack of borders, dynamism and anonymity, generating both opportunities for the development of the information society based on knowledge and risks to its functioning (at individual, state and even cross-border level).

The more information based a society is, the more vulnerable it becomes, and the security of cyberspace needs to be a major concern of all the actors involved, especially at the institutional level, where the responsibility for developing and applying coherent policies in the field is concentrated.

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