Business Administration and Business Economics

The Activity Analysis of Companies within Certain Economic Sectors Based on Risk Indicators

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Abstract: The paper represents a topical subject in the economic-financial field and constitutes a particular interest to some specialists from the economic environment, because it presents a conscious and calculated assuming of the reality, evaluated equally in time and space. The practical research of this paper is materialized in a scientific approach that includes a number of 27 companies, divided equally in three economic sectors (production, construction and tourism), which has in view the obtainment of useful and perspective information, concerning the impact that risk indicators have on activities which underlie at each economic sector. The purpose of this research is developing and deepening the risk problematic, focusing on the role of relevant financial indicators, with which can be identified the optimal solutions of each analyzed company from the corresponding economic sector, allowing the formulation of some proposals and structure analysis that are intended to contribute to the development of knowledge in the domain studied. The paper itself is a matter of utmost importance, because it attempts to provide a comprehensive picture of the current stage in which the economic entities are found and responds to exigencies faced by managers in the current economic context.

Keywords: risk; risk of exploitation; financial risk; risk of bankruptcy

JEL Classification: M; M2; M21

1. Introduction

Risk can be defined informally in different ways, but the central notions are those of uncertainty about meeting goals or about potential loss, and of incomplete control over the outcomes of decisions. Risk management is the effort to understand these uncertainties in order to make better choices among goals and meet them more effectively (Malz, 2011). In other words, enterprise risk management is the process of identifying major risks that confront an organization, forecasting the significance of those risks in business processes, addressing the risks in a systematic and coordinated plan, implementing the plan, and holding key individuals responsible for managing critical risks within the scope of their responsibilities (Hampton, 2009).

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Nowadays the economic activity is dominated by risk, due to the lack of interest of the managers for knowing and understanding the elements that determine the risk which leads to the appearance of differences between companies in the same economic sector. Therefore, a manager must identify, understand and manage more efficiently the company risks, because it will allow him to reduce losses and to find opportunities for business improvement, as well taking the correct decisions.

Risk approach from the perspective of organizations must be consistent with the type of their activity and with all the characteristics of markets and environments in which they act as economic and social agents. Regardless of the activity profile, legal status, size and space in which it operates, the company is obliged permanently adapt to risky situations, that can occur in the current activity, as well as in the predicted one.

Taking into account the current economic context, there are taking place profound changes in all fields of activity and the implications are felt in the financial situation of each company. To mitigate the risks that can influence a company's activity, managers must know what are the pressures factors that may arise from the company's external environment and also the weaknesses within the internal environment of the company, in order to formulate the correct suggestions regarding their remedy.

2. Literature Review

Although in the specialized literature, risk has several acceptations for businesses carried out by economic agents (economic risk, exploitation risk, financial risk, commercial risk, investment risk etc.) the economic significance of risk is considered to be an important one, because it points out the inability of a company to adapt on time and at the lowest costs to environmental changes; in other words the economic risk expresses the volatility of the economic outcome under exploitation (Lala, 2010). Below are presented briefly three risk categories, because they are the most common risks to which it is subjected the activity of an economic agent.

A. The risk of exploitation (also called economic risk) is specific to the productive and commercial activities of a company, and represents an economic event or process (unstable and probably) that can cause a damage, a loss within an activity, operation or economic action.

In order to determine the risk of exploitation which characterizes a particular activity, the business practice uses the threshold of profitability method, which represents the point where the turnover covers the operating expenses delineated in fixed and variable costs, calculated in physical or value units, for a product or for the entire activity. The relation for calculating the threshold of profitability is:

$$CAcr = \frac{CF}{1 - \frac{CV}{CA}}$$

Where:

CAcr - Turnover to achieve the threshold of profitability; CF - Total fixed costs; CV - Total variable costs; CA - Total turnover; CV/CA - Part of variable costs in turnover.

B. The financial risk reflects the resulting variability indicators due to the changed financial structure of the company (Buglea, 2009). The financial risk can be evaluated using the threshold of profitability method, which is similar with the calculation of the exploitation threshold of profitability, but adding interest costs.

The relation for calculating the financial threshold of profitability is:

$$CAcr = \frac{CF + Chd}{1 - \frac{CV}{CA}}$$

Where:

CAcr - Turnover to achieve the threshold of profitability; CF - Total fixed costs; Chd - Interest costs; CV - Total variable costs; CA - Total turnover; CV/CA - Part of variable costs in turnover.

C. The risk of bankruptcy is closely linked to the state of solvency, reflecting the possibility that a company can not fulfill its payment obligations. In this case we can say that the company is in a financial difficulty state (Buglea, 2008).

In the present economic theory are elaborated several models which are based on the scoring method, such as: Altman; Conan-Holder; Holder, Loeb and Partier; Bailesteanu; Anghel; etc.

Within the practical research it is used the latest version of the Altman model updated and revised, presents the advantage of applicability in case of non-industrial enterprises and those that operate in countries which are under development (Matis, 2012).

The Altman scoring function, in this last version, is as follows:

$$Z = 6.56X1 + 3.26X2 + 6.72X3 + 1.05X4$$

The model variables have the following meaning:

$$X_1 = \frac{\text{Working capital}}{\text{Total assets}} \; ; \; X_2 = \frac{\text{Retained earnings}}{\text{Total assets}}$$

$$X_3 = \frac{\text{Earnings before interest and taxes}}{\text{Total assets}} \; ; \; X_4 = \frac{\text{Book value of equity}}{\text{Total liabilities}}$$

The critical intervals for this function are:

- Level I: safe zone, with very low probability of bankruptcy, practically negligible; creditworthy firms $Z > 2.6$;
- Level II: uncertain zone, firms with temporary financial difficulties, which can be remedied if the applicable strategy is suitable $1.1 < Z < 2.6$;
- Level III: risky zone, bankruptcy firms $Z < 1.1$;

3. Material and Methods

In the following case study, taking into account the current economic context, will be calculated the risk indicators (risk of exploitation, financial risk and risk of bankruptcy) and the results acquired will facilitate making the correct decisions on the settlement of existing problems, in order to improve this system.

The data to which is referred within the undertaken study belong to a representative sample of 27 companies from Timis County, Romania, and are divided equally into three economic sectors (production, construction and tourism) in order to identify the particularities of each sector separately, on a reference period of four years (2008-2011), from the risk point of view. In this case, the analyzed companies are grouped and evaluated on three sectors, namely:

- Sector 1 - Production;
- Sector 2 - Construction;
- Sector 3 - Tourism.

At the level of the case study, it is used a comparative method in order to identify differences and similarities between the results of companies, within the analyzed economic sectors.

4. Results and Discussion

Based on the data held and calculation of risk indicators (risk of exploitation, financial risk and risk of bankruptcy) using IBM SPSS Statistics 19.0.1 software, have been obtained the following results:

- For **sector 1 – Production**, the situation is as follows:
  - Risk of exploitation

Table 1. Results of the risk of exploitation in the period 2008 - 2011 for enterprises in the production sector (RON)

Production enterprise	Time span			
	2008	2009	2010	2011
P1	3648391	3960178	4425008	7716296
P2	9972396	7685570	7597277	10999803
P3	9077139	9444772	4652404	5348122
P4	14948494	21285982	17294820	16108250
P5	13313169	10419786	15575624	32956828
P6	7801670	8434026	8917440	12672132
P7	15653270	11506581	9764143	13475151
P8	11481899	8484361	5733925	8333181
P9	11749315	9827405	12023293	7015556

Source: Own compilation

Based on the threshold of profitability and safety index deviation (indicator calculated separately) results, is detached that enterprises P2, P3, P7 and P8, in the period 2008-2009 show an unstable situation, namely a high risk of exploitation; while in 2010-2011 the situation of the first two enterprises is relatively stable, whilst the last one's, are exposed to a low risk of exploitation. Based on the data in the above table, it can be noticed that enterprise P1 recorded in the period 2008-2010 a low risk of exploitation, and in the last year its situation depreciated, presenting an unstable position.

- Financial risk

Table 2. Results of financial risk in the period 2008 - 2011 for enterprises in the production sector (RON)

Production enterprise	Time span			
	2008	2009	2010	2011
P1	4062641	4297939	4641541	8026860
P2	9972396	7685570	7597277	11010272
P3	9716333	9690481	5099677	5757511
P4	16099801	22934254	18199597	16901823
P5	15857354	11445006	16343828	33720908
P6	8672708	9628089	9805045	13536713
P7	16946847	12095705	11482299	15056086
P8	11508170	8638931	5957465	8536590
P9	11931470	10150995	12198720	7280288

Source: Own compilation

Regarding the enterprises that operate in the production sector in the period 2008-2011, the situation is approximately similar (in terms of oscillation recorded values) with the risk of exploitation, but with slightly higher values due to the inclusion of interest costs. P2 recorded in all four years, financial risk values equal with the risk of exploitation, which proves a lack of interest costs. Enterprises P3 and P9 are in an unstable situation, because they are exposed to a high risk of exploitation, the entire period of time.

- Risk of bankruptcy

Table 3. Results of the risk of bankruptcy in the period 2008 - 2011 for enterprises in the production sector

Production enterprise	Time span			
	2008	**2009**	**2010**	**2011**
P1	1.45	4.94	5.09	1.46
P2	-9.91	-10.27	-7.45	-4.66
P3	-0.24	-1.41	1.21	1.53
P4	0.92	-1.27	-0.78	0.31
P5	1.65	2.12	1.95	1.76
P6	2.57	2.69	2.87	-2.02
P7	-0.69	0.42	2.61	4.28
P8	-0.59	0.59	3.57	1.9
P9	2.18	3.05	3.3	2.03

Source: Own compilation

It is remarked that between 2008 and 2011 enterprises P2 and P4 are in a risky area, namely bankruptcy. Enterprises P3, P7 and P8 are in a risky area in the first half of the range, and later, in the second half takes place an improvement of them, namely they go into a safe and uncertain area in terms of financial difficulty. Creditworthy enterprises and those who have temporary difficulty that can be remedied if proper strategy is applied are P1, P5 and P9. Also, it can be observed that in the first three years P6 is the only creditworthy enterprise whose values increases systematically from one of the other, but in 2011 is part of a strong downward evolution, which positions her in a risky area (of bankruptcy).

- For **sector 2 – Construction**, the situation is as follows:
  - Risk of exploitation

Table 4. Results of the risk of exploitation in the period 2008 - 2011 for companies in the construction sector (RON)

Construction company	Time span			
	2008	2009	2010	2011
C1	6523277	6755197	3977887	6441023
C2	8538309	7300781	6236112	7393679
C3	4134533	3672431	3181822	4032163
C4	3861643	9395876	9014112	15747140
C5	9628962	9702063	8940136	13074903
C6	8362234	8906273	15087759	18105514
C7	3743550	3677044	5809098	6471639
C8	19768099	5466875	1835571	11326775
C9	9259646	7878621	15713857	11585807

Source: Own compilation

Based on the results above and safety index deviation indicator, it can be observed that between 2008 and 2011, companies (C4 and C5) that are working in the construction sector, show a similar situation, namely in the first three years they register a low risk of exploitation, and in the last year the companies show an unstable situation, respectively a high risk of exploitation. The profitability thresholds of company C3, in the first and last year, then in the second and third year are almost equal, and the risk of exploitation is the lowest compared to other companies within the representative sample. Following the safety index deviation determined separately, C7 is the only company that registers a low risk of exploitation the entire period, which allows adaptation of the services offered to market demands.

- Financial risk

Table 5. Results of financial risk in the period 2008 - 2011 for companies in the construction sector (RON)

Construction company	Time span			
	2008	2009	2010	2011
C1	6523277	6755197	3977887	6441023
C2	8747403	7601021	6582311	7741278
C3	4250895	3863985	3339957	4122703
C4	3901640	9459876	9054533	16474454
C5	9702928	9806239	8963661	13140634
C6	8563756	9033621	15585778	18502543
C7	3743550	3677044	5813430	6477237
C8	22202271	8392324	3590674	17881478
C9	9664026	8358951	16159178	12040156

Source: Own compilation

Over the four years period of analysis, at the level of companies that activate in the construction sector, the situation is almost similar (in terms of fluctuation recorded values) with the risk of exploitation, but with slightly higher values due to the inclusion in the calculation formula of interest costs. Exception to the above mentioned is company C1 which records a similar evolution as within the risk of exploitation, because the interest costs recorded a zero value the entire range. For company C7 the situation is similar to the previous one (risk of exploitation), except for the years 2010 and 2011, because it recorded interest expense less than 2,000 RON.

- Risk of bankruptcy

Table 6. Results of the risk of bankruptcy in the period 2008 - 2011 for companies in the construction sector

Construction company	Time span			
	2008	2009	2010	2011
C1	63.11	10.97	11.03	46.40
C2	-1.09	-1.15	-2.09	-1.15
C3	3.68	1.06	4.04	3.63
C4	4.84	5.78	1.82	1.55
C5	4.42	5.90	7.26	5.89
C6	1.08	0.90	0.57	1.13
C7	6.22	7.08	4.38	4.26
C8	-3.12	2.76	2.98	2.07
C9	3.14	1.89	1.84	1.67

Source: Own compilation

Based on the available data in the above table, it is remarked that a number of three companies (C1, C5 and C7) in this economic sector, registered a very low probability of bankruptcy, practically negligible, the entire four years period. It wouldn't be recommended to overlook the values obtained by company C1 during the entire period, due to too high values recorded regarding book value of equity in comparison with total liabilities. According to the values obtained, C2 and C6 are the only companies in bankruptcy, but the latter records an improvement in the last year, placing it in an area with temporary financial difficulties. The creditworthy companies and those who have temporary difficulty that can be remedied if proper strategy is applied are C4, C8 and C9.

- For **sector 3 – Tourism**, the situation is as follows:
  - Risk of exploitation

Table 7. Results of the risk of exploitation in the period 2008 - 2011 for firms in the tourism sector (RON)

Tourism firm	Time span			
	2008	2009	2010	2011
T1	2210819	1834799	1948765	2514025
T2	3458809	3212448	2720322	3740713
T3	5484138	5104471	2934843	662404
T4	3683312	3333888	5273252	3345993
T5	15240914	8440188	5476747	5201398
T6	1289944	2594809	1144567	3283972
T7	2503995	2110188	768697	604988
T8	29244524	2696308	17897985	2540656
T9	1806613	447700	4311694	4006616

Source: Own compilation

In the representative sample of firms (T5 and T8) that are operating in the tourism sector in the period 2008-2011, can be observed highly fluctuating values of the risk of exploitation. Firm T7 registers a low risk of exploitation throughout the entire analyzed period, compared to the other firms in the same economic sector, which demonstrates the ability to easily adapt to customer requirements. Following the safety index deviation results, firms T4 and T8 registered in the first and second year a low risk of exploitation, after that in the third and fourth year appeared a high economic risk.

- Financial risk

Table 8. Results of financial risk in the period 2008 - 2011 for firms in the tourism sector (RON)

Tourism firm	Time span			
	2008	2009	2010	2011
T1	2326508	1917149	2000409	2545112
T2	3741294	3474016	2842200	3834565
T3	5572817	5268991	3104116	816599
T4	3731446	3338592	5335107	3347447
T5	15302050	8463316	5507543	5230114
T6	1289944	2968541	1489588	4121610
T7	2561699	2285542	1130561	849144
T8	32412936	4884009	20313469	11840165
T9	2055719	614155	4435906	4088776

Source: Own compilation

At the level of all firms activating in the representative sample, between 2008 and 2011 the situation is almost similar (in terms of oscillation recorded values) with the economic risk, but with slightly higher values due to the inclusion in the calculation formula of interest costs. Exception to the above mentioned is firm T6 which recorded a similar value in 2008 as within the economic risk, because interest expenses are zero. Just as in the risk of exploitation case, company T7 shows a low financial risk throughout the entire analyzed period, compared to the other firms within the same economic sector.

- Risk of bankruptcy

Table 9. Results of the risk of bankruptcy in the period 2008 - 2011 for firms in the tourism sector

Tourism firm	Time span			
	2008	2009	2010	2011
T1	208.47	38.41	38.35	123.78
T2	1.12	-0.34	-0.02	-0.08
T3	-1.49	-2.24	-6.99	-6.57
T4	10.84	12.81	2.24	6.25
T5	1.81	-0.17	0.44	0.42
T6	2.13	-3.07	-3.31	0.58
T7	0.46	-0.14	-0.35	0.99
T8	2.73	-5.17	-1.57	-5.95
T9	4.17	4.00	5.95	7.86

Source: Own compilation

In the interval 2008-2011, it is remarked that a number of three firms (T1, T4 and T9) within this economic sector, registered a very low probability of bankruptcy. It wouldn't be recommended to overlook the values obtained in all four years by firm T1, due to the small values recorded regarding earnings before interest and taxes in comparison with total assets. Starting with 2009 until the end of 2011, most firms (T2, T3, T5, T6, T7, and T8) are in bankruptcy. In 2008, some of them (T2, T5 and T6) have tried to remedy their financial difficulties through some strategies appropriate to the situation, but have not succeeded.

5. Conclusion

The entire period 2008-2011, words like "crisis", "bankruptcy", "layoffs", "reduction", "rescue plan" were often used economically, both in the private sector and the public one. Political turbulences were disastrous for the Romanian economy, that experienced an increase, but its mismanagement brought a big risk for managers and investors.

Based on the calculation above and values obtained, by comparing the results between risk indicators and as a result of poor management, of some internal dysfunctions and external factors, companies P2, P3, C2, T3, T5 and T8 are in a difficult situation, namely bankruptcy. The results obtained by the financial risk are more significant compared to the risk of exploitation, because the companies that resort to loans have to systematically support financial costs (namely interests), which means an intensification of its commitments and implicit of the risk. Any debt, regardless of its size, brings with it an amendment of results and implicitly of the financial risk. Given the direct analysis results of companies, from the economic sectors presented, based on the indicators system which express risk, the most favorable situation is found in the construction sector, followed by the production sector, and last in the tourism sector.

The undertaken analysis indicates that the companies from the three economic sectors benefit of many strong points which can be harnessed for the future activity, but face difficulties regarding recovery of receivables and stock management of raw materials, finished goods and work in progress. It is recommended to change the administration of receivables and stocks of raw materials, to outsource activities that are large consumers of financial resources to specialized firms, and to adopt production methods meant to streamline the operations. The analyzed companies should diversify their activities to the detriment of one field of activity, because in case of any difficulties appearance, profitability of others could compensate the losses registered.

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Information and Communication Technology: A Comparison of Pakistan and Sri-Lanka

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Abstract: The objective of the paper is to examine the information and communication technology sector in Pakistan and Sri-Lanka because they are among top five countries in ICT in the South Asian region. The research is helpful for decision makers to channel ICT related resources where they are required the most. ICT oriented data have been collected by International Telecommunication Union but no comparison exists between the countries included in the research. Therefore, the sources of data are ITU who has identified twenty three parameters individually; they have been rearranged under three subjects: ICT infrastructure, usage and economic impact on the economies of the countries concerned. It is found that the infrastructure of Sri-Lanka is better than Pakistan while both countries are using their resources equally. However, the economic impacts are less visible in Pakistan than its counterpart. Overall the ICT score of Sri Lanka is better than Pakistan. It suggests that policy makers in both nations have to rethink to deploy their resources to take maximum benefit as par to the international standards.

Keywords: ICT; case studies; Pakistan; Sri Lanka

JEL Classification: G14; L15

1. Introduction

ICT has the potential to improve individual productivity, profitably and work process (Kijsanayotin et. al., 2009). Direct gains are offered in productivity while indirect emerged from "trade and facilitation through lower cost, increased range of offerings and improved availability and access of information. Employment in ICT and ICT-enabled reforms and structural changes are visible. ICT offers flexibility in working hours, location, and work practices for business organizations. In addition, new business models and opportunities have been created e.g. many services are delivered from anywhere in the world to anywhere in the world." (ITU, 2010) Technology shapes knowledge, speed of change and global reach (Drori, 2010). So, it is worthwhile to look into the ICT capabilities at country level

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so that the respective countries can assess their strengths and identity their weakness to take benefit of this emerging sector in their economic endeavours. There is lot of work done on the individual countries and data are available but no comparative analysis has been made between the countries involved. Therefore, the paper is an attempt to compare the ICT capabilities of Pakistan and Sri-Lanka; it is useful for policy makers and managers to redirect their resources in order to improve their productivity. Objective is to consolidate the scattered data to make it useful for the relevant stakeholders, governments and businesses. Since the input data changes continuously that can be measured on annual basis yet future research may be conducted as soon as the new evidence is available.

The rest of the paper has been divided into five sections: literature review, ICT infrastructure of both countries involved, usage, economic impacts on the respective economies and discussion and conclusion.

2. Literature Review

The importance of information took place with the classic work of Porter and Miller in 1985; they claim that information give competitive advantage. This was the time when IBM embarked on mass production of personal computer which boosts the information possessing power of people and new field of study emerged on the horizon of the world i.e. the information technology (IT). IT offers gains in individual productivity at personal level (ITU, 2010). Kijsanayotin et al. (2009) believe improved work process and profitability at organization level. And improvements in GDP at national level (ITU, 2010). Mobile telephony enables developing countries to save investment in installing expensive infrastructure (Drori, 2010). Broadband technology is "an enabling technology in increasing investment payoffs in other sectors, transforming research and development (R&D), facilitating trade in services and globalization, and improving public services to enhance national business environments and competitiveness". (Qiang et al, 2010).

However, the potential has not been realized in South Asia despite of the fact that the region is the home of the major IT industry in the world. In addition, "The South Asia (SA) is the home of 22% of the world population but 44% of the poor; they wait for the miracles of technology to eliminate or minimize the dysfunctional impacts on their day-to-day lives" (Gunasena, 2003). It necessitates looking into the phenomenon so that its significance maybe highlighted to take appropriate measures for better application of IT for the socio-economic development of the countries involved.

3. Infrastructure

There are seven items in the infrastructure; however, data is not available for personal computers (per 100 people) for Pakistan and households with a T.V. sets (%of population) for Sri-Lanka. Therefore, they are not included in the comparison. Percentage of personal computers in Sri-Lanka is 3.7 against 3.3% of the regional average and households with TV sets percentage in Pakistan is 56% against regional average of 46%. Both countries are scoring higher in their respective areas than the regional average.

Telephone lines percentage of both the countries is less than the regional average; however, Pakistan is better than Sri-Lanka. More telephone lines have been laid down in Pakistan than its counterpart. Coverage of mobile phone networks are almost similar in both countries, nevertheless, Sri Lanka is slightly higher than Pakistan. Sri-Lanka has an edge in International Internet Bandwidth with high score of 190 against 43 in Pakistan while Pakistan is better off than other regional countries with 12 points (39%) i.e. higher bandwidth means it has bigger capacity to transmit data. Both countries score equally in e-government web-measure index. However, the regional average is lower than their ranking. Finally, Sri-Lanka is much better in Secure Internet Servers than Pakistan and the regional average. Five parameters have been compared under infrastructure; Sri-Lanka leads Pakistan in three parameters while Pakistan leads in one parameter to its counterpart. The score of one factor is equal for both nations. Therefore, it suggests that the infrastructure of Sri-Lanka is better than Pakistan (See Table 1).

Table 1. Infrastructure of Pakistan and Sri Lanka

Factor	Pakistan	Sri Lanka
Telephone lines (per 100 people)	2.7	2.5
Households with TV sets (%)	56	Data not available
Population covered by mobile phone network (%)	90	95
International Internet bandwidth	43	190
E-government web measure index	0.40	0.40
Secure Internet Servers (per 1 million people, 2009)	0.60	3.50

4. Usage of Resources

There are six factors that make up the usage of ICT resources. Mobile telephone usage is higher in Pakistan than Sri-Lanka more than double in size but both countries are still below regional average (363). The highest is in India (440) followed by Bangladesh (264) and Nepal's score is 103. The second element is the internet users where Pakistan leads both Sri-Lanka and the regional average (4.7). Nevertheless, Sri-Lanka is above the regional average. According to the recent figures Pakistan has extended the lead to 16% in 2012 (The Internet Stat, 2012).

Sri-Lanka leads Pakistan in fixed broadband subscription with a huge margin and its score is also higher than the regional average (33.1). Similarly, Sri-Lanka has a higher score (55) in mobile cellular subscription than Pakistan (53). Nevertheless, both nations lead the regional average (32.6); recent statistics is different from the above, for example, mobile subscription in Pakistan reached to about 70% in 2012 (PTA, 2012). Pakistan also leads both Lanka and the regional average in fixed Internet subscription while the score of Sri Lanka is below than the regional average. Finally, Sri Lanka got higher score than Pakistan in international voice traffic where the regional average is not available.

Table 2 Usage of resources

Factor	**Pakistan**	**Sri Lanka**
Internet voice traffic (minutes/user/month)	0.10	2.9
Mobile telephone usage (minutes/user/month)	164	69
Internet users (per 100 people)	11	5.8
Fixed broadband subscription (% of total Internet subscription)	4.5	41
Mobile cellular subscription (per 100 people)	53	55
Fixed Internet subscription (per 100 people)	2.2	1.2

5. Economic Impacts

The economic impacts have been derived from seven factors; (Table 3), Sri Lanka leads Pakistan in ICT goods export with 2% of total goods export to 0.5%. The country scores high in the regional average (1.2%). Sri-Lanka also imports minus goods (4.6% of total imports) against 5.7% of Pakistan. It shows less dependence upon others; however, more imports can be an advantage in that they enhance the existing ICT infrastructure such as number of computers, broadband devices etc. in this regard Pakistan has an edge over Sri-Lanka but for the purpose of this paper the benefits goes to the one who imports less ICT goods. Sri-Lanka is even importing less than the regional average (5.1% of total imports). Sri Lanka's net import is also lower than Pakistan that is 2.6% (4.6% - 2%); while Pakistan's net imports are 5.2% (5.7%-0.5%). Pakistan is behind in ICT services exports, 6.7% of total services exports against 16% of Sri-Lanka. Nevertheless, the regional average is much higher than Sri-Lanka that is 47.3%. it is because India's share is 50% of its total services exports, the largest in the region. Pakistan is slightly better off than Lanka in ICT expenditures, 4.49% of its GDP against 4.3% of Sri-Lanka. The regional average is however, higher than both of them i.e. 4.7%. ICT expenditure signifies the investment on the sector which boosts economic activity at national and sector levels. Pakistan also leads Sri-Lanka in telecom revenue (%of GDP);

received 2.7% while Sri-Lanka's are 1.8% (4.3%-2.5). It suggests that Sri-Lanka is spending more on ICT than Pakistan; it rapidly increases the infrastructure which enhances the contribution of the sector.

Sri-Lanka is also leading Pakistan in five factors against two where Pakistan leads its counterpart. It suggests that economic impacts are more visible in Sri-Lanka than in Pakistan. It also implies that the farmer is using its ICT resources more efficiently than the later. It may be worthwhile here to remind that Sri-Lanka's infrastructure is better than Pakistan where Sri Lanka leads in three parameters while Pakistan leads in one factor only. However, both countries are equal in usage parameters; each scores high in three parameters than the other. Let us put it together; Sri-Lanka leads in eleven factors and Pakistan in six. Thus, the ICT sector is better than Pakistan in Sri-Lanka; it corroborates that Sri-Lanka is leading seven nations of South Asia i.e. Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan and Sri-Lanka. (Iqbal, 2011)

Table 3. Economic impacts

Factor	Pakistan	Sri Lanka
ICT goods export (% of total goods export)	0.50	2
ICT goods import (% of total goods import)	5.7	4.6
ICT services export (% of total services export)	6.7	16
ICT expenditures (% total of GDP)	4.4	4.3
Telecom revenue (% total of GDP)	2.7	2.5
Mobile and fixed line subscription per employee	50	919
Telecom investment (% of revenue)	1.7	12

6. Ranking

Although we have shown the individual and group based performance of the countries but an overall measurement is required to decide which of the countries is better and why. Iqbal (2011) has ranked the South Asian countries on the basis of regional average; a score of 2 has been awarded to those parameters which are above the regional average while a score of 1 has been awarded to those values that are below the regional average. However, the method ignores the amount of strength a certain parameter owns or the intensity of weakness a given parameter suffers from. It can be addressed through measuring the performance of a parameter by performance of a country in a certain area to the regional average. It supports the value on either of the sides i.e. strong and weak. And it provides the amount of strength or weakness in a given factor. If a country is very good in an area, its goodness is measured as such whereas in the method used previously shows strong or weak no matter how much strong or how much weak. Table 4 shows the individual and total scores of both the countries.

Table 4. Comparative figures of Pakistan and Sri Lanka

Factor	Score of Pakistan	Score of Sri Lanka
Telephone lines (per 100 people)	0.87	0.81
Population covered by mobile phone network (%)	1.48	1.56
International Internet Bandwidth	1.38	6.12
E-government web measure index	1.08	1.08
Secure Internet Servers (per 1 million people, 2009)	0.46	2.69
Mobile telephone usage (minutes/user/month)	0.45	0.19
Internet users (per 100 people)	2.34	1.23
Fixed broadband subscription (% of total Internet subscription)	0.14	1.26
Mobile cellular subscription (per 100 people)	1.63	1.69
Fixed Internet subscription (per 100 people)	1.69	0.92
ICT goods export (% of total goods export)	0.45	1.67
ICT goods import (% of total goods import)	1.12	0.90
ICT services export (% of total services export)	0.14	0.34
ICT expenditures (% total of GDP)	0.94	0.92
Telecom revenue (% total of GDP)	1.29	1.19
Mobile and fixed line subscription per employee	0.09	1.63
Total	15.55	24.2

The total figure suggests that the position of Sri Lanka is better than Pakistan. However, the calculations can be augmented by including the population of the respective countries to determine permillion contributions. For example, the population of Sri Lanka is 21.5 million (CIA World Fact book, 2012) and the total score is 24.2; it gives us a ratio of 1.12; population of Pakistan is 190 million (CIA World Fact book, 2012) and the ICT score is 15.5 which give a quotient 0.08. It suggests that Sri Lanka is much better in ICT score per million than Pakistan.

7. Discussion and Conclusion

The above analysis provides useful set of information for policy and decision makers. For example, economists and planners can look at the infrastructure; compare it with other countries and regional trends in order to direct the flow of investment where it is needed. The research also points out the weak areas where improvement is required. For instance, mobile and cellular phone coverage, internet bandwidth and telephone lines network. The analysis also high lights the application of ICT resources; Pakistani users are using their mobile phones almost half of the regional average. It is an indicator for the respective government to increase the usage by introducing user friendly policies. Sri-Lankan public is using only 19% of the regional average; it is concern for the policy maker to think about the ways by which usage can be increased. Sri-Lanka owns one of the best

infrastructures in the region, e.g. 95% geographical area is covered with mobile phone network but the usage is relatively poor. Similarly, the Internet users are also low in Sri-Lanka compare to Pakistan. The Internet is a springboard for innovation and e-commerce, economic impacts show the contribution of it in the economy; both countries can evaluate the investment and return on it. If one of them is not performing well in a certain aspect than he can learn from the experience of other; the low performer can also identify the reasons for not doing well in order to improve it. On the bases of above discussion and overall analysis it may be concluded that the infrastructure of Sri-Lanka is better than Pakistan; usage is similar but the economic benefits are not visible in Pakistan. However, other socio-economic factors are contributing in demonstration of economic outcome. For instance, telecom investment is more than seven times higher in Sri-Lanka than Pakistan.

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Impact of Liquidity on Islamic Banks' Profitability: Evidence from Bangladesh

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Abstract: This study examines the impact of liquidity on Islamic banks' profitability during an 11 years period of 2001 to 2011. To explore and interpret the results the study has taken samples from five Islamic banks that have been in operation in Bangladesh on or before 2001 to till date. In order to construct the liquidity model it used four liquidity variables namely cash & due from banks to total assets (CDTA), cash & due from banks to total deposits (CDDEP), investment to total assets (INVSTA) and investment to total deposits (INVSDEP). According to adjusted R squares profitability variables return on assets (ROA), return on equity (ROE) and return on deposits (ROD) are respectively 17.1%, 4.5% and 24.6% dependent on independent variables. The statistical results suggest that CDTA is found insignificant with all profitability variables, whereas CDDEP is individually significant with all profitability variables except ROE. On the other hand INVSTA and INVSDEP are recognized significant with all three profitability variables. However, when ROE stands for an insignificant relationship with the overall liquidity model, ROA and ROD are identified significantly correlated with the similar model at 1% significant level. Unsurprisingly the findings do strengthen the specification that the impact of liquidity reflects adequate imposition on profitability that the Islamic banks in Bangladesh must abide by.

Keywords: dependency level; Islamic banking goals; liquidity ratios; profitability ratios; significance level

JEL Classification: G21

1. Introduction

Business in Islam has always been viewed as an opportunity for potentials as long as it stands on moral and ethical grounds and conforms to the Islamic code of conduct. The actual role of Islamic bank inherits in promoting and empowering the banking services and product based on Islamic principles. The main principles of Islamic banking comprise of prohibition of interest in all forms of transactions, and undertaking business and trade activities on the basis of fair and legitimate profit (Haron and Shanmugan, 1997). But according to Islamic principles, reward, i.e. profit without sharing the risks or hazards in the economic understandings is totally prohibited. Perhaps, the most significant risk of an Islamic bank is to build a sound

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liquidity management. Islamic banking has gained much popularity in Bangladesh over the last few years. There is a high demand for interest-free banking services from a segment of people in Bangladesh who have a strong desire to abide by the rules and principles set by Shariah. Along with religious requirement, economic exigencies provide a new outlook to the role of banking in promoting investment / productive activities, influencing distribution of income and adding stability to the economy. The downturn in the United States in the late part of 2008 led to a dramatic downturn in businesses and financial institutions, not only in the United States but other countries as well (Lau, 2008). It affected the world stock markets and made large financial institutions to either go bankrupt or sell off their shares to the public (Anup, 2009). But surprisingly it could not affect the Islamic banking industry as much as expected. Most banks now keep protective reserves on top of planned reserves. Excess liquidity is reported in nearly all Islamic banks (Ali and Howlader, 2005).

Due to unavailability of local capital market, Islamic banking sectors have been suffering from investing idle fund in liquid venture (Rashid and Nishat, 2009). Excess liquidity generated by Islamic banks cannot be easily shifted to conventional banks as the Islamic banks do not accept interest; while there is opportunity for exchange of excess funds among the Islamic banks on a Mudarabah / Musharakah basis. However, the scope of cooperation among this field can only be increased if their numbers are increased. So, what should be the crucial choice of an Islamic bank; whether to take fundamental choice of profit maximization or to concern more on assurance of liquidity in any banking business under Islamic principles? Possibly the answer could rise if we can have ideas on how liquidity position affects Islamic bank's profitability.

Analysis of financial statement has become very significant due to widespread interest of various parties in the financial result of a business unit. As a Muslim community, Bangladesh and its people are in greater interest for a Shariah approved banking system. The question from the people arise when there are any lacking in response to customers' demand (liquidity risk) as well as any deficiency in showing upward banks' value (profitability risk). Consequently this is a demand of time now to evaluate the impact of liquidity risk on profitability for overall Islamic banking industry in Bangladesh, as this paper attempts to find.

2. Literature Review

Banks today are under great pressure to perform- to meet the objectives of their stockholders, employees, depositors and borrowing customers, while somehow keeping government regulators satisfied that the bank's policies, loans and investments are sound (Rose, 2004-2005). At present a lot of countries around the

world having twofold banking system, as interest free banks are functioning parallel to conventional banks (Akhtar, Ali and Sadaqat, 2011).

In Islam, profit is simply a reward of taking risk. So, it should be a natural outcome of the fair play of the twin forces of demand and supply in the market (Latif, 1982). On the other hand liquidity implies availability of cash that how bank rapidly may convert its assets into cash to meet the need of short term. It is considered as life of the banks. Higher amount of the liquid assets reflect the greater liquidity of the firm (Akhter, Raza, Orangzab and Akram, 2011). The essence of liquidity management problem arises from the fact that there is a trade-off between liquidity and profitability and mismatch between demand and supply (Khan and Ahmed, 2001). While the bank has no control over the sources of fund (deposits), it can control the use of funds. To support their depositor's demand, banks need money, or in other sense the power to create money. That is why Akkas (1982) suggested that commercial banks should be compelled to keep reserves up to the full amount of their deposits, a reserve of 100 percent. Islamic principles are always in favor of non-inflationary economy. Therefore, bringing a kind of equilibrium between demand and supply for investible funds appears to be a major concern for financial intermediation (Siddiqui, 2010). But, it is to be noted that Islamic market mechanism does not support the concept of equilibrium price, rather, acts as the instrument to meet the effective demand of a consumer.[1]

Not only does Islamic banks' profitability seem less volatile than that of conventional peers, but it is also higher on average, at least in the GCC region (Hassoune, 2002). Haron (2004) said that liquidity, funds invested in Islamic securities, total expenditures and the percentage of the profit-sharing ratio between the bank and the borrower of funds are highly correlated with the level of total income received by the Islamic banks. At the same time external factors such as interest rates, market share and size of the banks produce the similar kind of effects. He also added that other determinants such as funds deposited into current accounts, total capital and reserves, the percentage of profit sharing between bank and depositors, as well as money supply also play a major role in influencing the profitability of Islamic banks. Return on assets is a good sign to determine bank's financial performance and supervisory efficiency. It shows how competent the administration is in allocating asset into net profit. The higher the ROA, the higher is the financial performance or profitability of the banks (Samad, 2004). Return on equity measures the rate of return on the bases of capital and equity capital (Akhter, Raza, Orangzab and Akram, 2011). This ratio shows how bank can create profit with shareholders' invested funds. Its increasing value indicates higher financial performance. Like ROA, ROE is also an indicator for managerial efficiency (Ika and Abdullah, 2011). Return on deposits shows percentage return

[1] The concept 'effective demand', refers to the collective demand in an economy, where there is neither surplus in production, nor the demand will go beyond out of market control.

on each currency of customer's deposit. In other words, it indicates the effectiveness of bank in converting deposit into net earnings (Rosly and Bakar, 2003). However, profitability is only part of bank performance story (Samad and Hasan, 1999).

Cash in a bank vault is the most liquid asset of a bank. Cash assets include vault cash held on bank premises, deposits the bank holds at the Central bank in its district, deposits held with other banks to compensate them for clearing checks and other interbank services, and cash items in the process of collection (Rose, 2004-2005). A higher cash-deposit ratio indicates that a bank is relatively more liquid than a bank which has lower cash-deposit ratio. Depositors' trust to bank is enhanced when a bank maintains a higher cash-deposit ratio. On the other hand an increase in loan-deposit ratio indicates that a bank is in more financial stress by making too much loan. Therefore, lower loan-deposit ratio is always favorable to higher loan-deposit ratio (Samad and Hasan, 1999). Loans-assets ratio measures the percentage of assets that are tied up in loans. The higher the ratio, the less liquid the bank will be (Samad, 2004).

While making significant progress in return on assets (ROA) and return on equity (ROE), the liquidity performance of Bank Islam Malaysia (BIMB, the single full-fledged Islamic bank in Malaysia) between 1984-89 and 1990-97 in various measures such as cash-deposit ratio, loan-deposit ratio and current ratio showed neither deterioration nor improvement (Samad and Hassan, 1999). Chowdhury and Ahmed (2009) investigated that total deposits of Islami Bank Bangladesh Ltd. was higher in comparison to some non-Islamic banks during 2002 to 2006. Saifullah (2010) argued that Islamic banks in Bangladesh are superior to Conventional banks after an overall assessment of financial performance including liquidity and profitability position. When making comparisons across firms (or over time), it is useful to control for differences in their resource base (Foster, 2002). At the same time liquidity of those resources is of paramount significance for banks (Maheshwari and Maheshwari, 2002). Akhtar, Ali and Sadaqat (2011) found positive but insignificant relationship of size of the bank and net-working capital to net assets with liquidity risk in Islamic banks. In addition return on assets (ROE) in Islamic banks is found to be positive and significant with liquidity risk at 10% significant level.

A study over determinants of Jordanian Islamic banks' profitability revealed that there are significant and positive relationship between Return on Assets and Provision for Credit Facilities + Interest in Suspense / Credit Facilities, Total Equity / Total Assets and Total Income / Total Asset of the Islamic banking, and there are significant and negative relationship between ROA and the Bank Size, Total Liabilities / Total Assets, Annual Growth Rate for Gross domestic product, Inflation Rate and Exchange Rate of the Islamic Banking. Also this study found that there are significant and positive relationship between Return on Equity and

Log TA, TL / TA, TI /TA and ERS of the Islamic banking, and there are significant and negative relationship between ROE and PRFCFI / CF, TE / TA, GDPGR and INF of the Islamic Banking (Khrawish, Siam and Khrawish, 2011).

Naceur and Goaied's (2010) investigation regarding the determinants of the Tunisian banks' performances during the period 1980–1995 showed that the principal determinants of a bank's performance are by order of importance: labor productivity, bank portfolio composition, capital productivity and bank capitalization. Athanasoglou, Delis and Staikouras (2008) examined the profitability behavior of bank-specific, industry-related and macroeconomic determinants, using an unbalanced panel dataset of South Eastern European (SEE) credit institutions over the period 1998-2002. The estimation results indicated that, with the exception of liquidity, all bank-specific determinants significantly affect bank profitability in the anticipated way.

The paper concludes with some remarks on the practicality and implements ability of the findings. Using bank level data for 80 countries in the 1988-1995 periods, a study suggested that interest margins differences and banks' profitability reflect a variety of determinants such as; bank characteristics, macroeconomic conditions, explicit and implicit bank taxation, deposit insurance regulation, overall financial structure, and several underlying legal and institutional indicators (Demirgüç-Kunt and Huizinga, 1998). Shahchera (2012) analyzed the impact of liquid asset holdings on bank profitability for a sample of Iranian banks. Applying the Generalized Method of Moment (GMM), this study analyzed the profitability of listed banks using unbalanced panel data over the period of 2002-2009. An important finding of this study is that the business cycle significantly affects bank profits. The coefficient of regulation is negative and significant. Therefore if regulators reduce the constraints imposed on banks, banks obtain profit. Liquidity is of vital importance to the daily operations of a bank. Maintenance of a sound liquidity position of the bank is necessary to protect the bank against uncertainties of its business.

Maintenance of liquidity bears both risk and return. A tradeoff between these two elements can minimize the conflict between liquidity versus profitability of a bank (Islam, 2008). As stated by Islam (2008) Koch (1992) believed that there is a short-run tradeoff between liquidity and profitability. The more liquid a bank is, the lower are its return on equity (ROE) and return on assets (ROA), all other things being equal. Therefore, statistical significance of liquidity on profitability can be a great factor for potential investors. In a nutshell the influence of Islamic banks' liquidity cannot be negligible when considering profit motive.

3. Methodology

3.1. Sample Design and Data Collection

In Bangladesh, currently seven Islamic banks are providing their services as "pure Islamic banks" and running their operations under the guidance of Islamic Shariah. Among them, five Islamic banks have been selected to investigate the impact of Islamic bank's liquidity risk on profitability over the period of 11 years during 2001 to 2011.[1] Selected Islamic banks are-

1. Islami Bank Bangladesh Limited;
2. Shahjalal Islami Bank Limited;
3. Al-Arafah Islami Bank Limited;
4. Export Import Bank of Bangladesh Limited;
5. Social Islami Bank Limited.

The data used in this study are compiled from income statements and balance sheets of selected banks from their each year annual report. The study model is tested on time series cross-sectional bank level data in the context of Bangladesh over the period 2001 to 2011. Thus, present study has been conducted taking into account a total samples of N = [5×11] 55 under each variable.

3.2. Explanatory Variables

To analyze the liquidity impact on profitability using multiple regression analysis, variables were assigned into two sections-

Dependent Variables:

1) Return on Assets = Net Income after Taxes / Total Assets
2) Return on Equity = Net Income after Taxes / Total Equity Capital Account
3) Return on Deposits = Net Income after Taxes / Total Deposits

Independent Variables:

1) Cash & Due from Banks to Total Assets = Cash & Due from Banks / Total Assets
2) Cash & Due from Banks to Total Deposits = Cash & Due from Banks / Total Deposits
3) Investment (Loans & Advances) to Total Assets = Investment / Total Assets
4) Investment (Loans & Advances) to Total Deposits = Investment / Total Deposits

[1] Other two Islamic banks have been excluded from this study as their histories are not that long as the selected banks.

3.3. Research Model and Hypotheses

The current research is being conducted to evaluate the impact of liquidity on profitability by applying multiple linear regression model which had previously been developed and applied by Demirgüç-Kunt and Huizinga (1999), Haron (2004), Athanasoglou, Delis and Staikouras (2008), Toni (2008), Naceur and Goaied (2008), Saleem and Rehman (2011), Khrawish, Siam and Khrawish (2011), Shahchera (2012) and many more in essence of their contribution to banking, economics and finance. Utilizing the similar model these preceding studies focused on assessing diverse determinants of Islamic banks' profitability. Present study used the same model but for only to strengthening on liquidity variables in order to demonstrate their impact on profitability. Current research models are as follows-

(i) $ROA_{i,t} = \alpha + \beta_1 CDTA_{i,t} + \beta_2 CDDEP_{i,t} + \beta_3 INVSTA_{i,t} + \beta_4 INVSDEP_{i,t} + €$ [Model 1]

(ii) $ROE_{i,t} = \alpha + \beta_1 CDTA_{i,t} + \beta_2 CDDEP_{i,t} + \beta_3 INVSTA_{i,t} + \beta_4 INVSDEP_{i,t} - €$ [Model 2]

(iii) $ROD_{i,t} = \alpha + \beta_1 CDTA_{i,t} + \beta_2 CDDEP_{i,t} + \beta_3 INVSTA_{i,t} + \beta_4 INVSDEP_{i,t} + €$ [Model 3]

Where,
ROA = Return on assets
ROE = Return on equity
ROD = Return on deposits
CDTA = Cash & due from banks to total assets
CDDEP = Cash & due from banks to total deposits
INVSTA = Investment (loans & advances) to total assets
INVSDEP = Investment (loans & advances) to total deposits
α = constant term
β = slopes associated with the independent (liquidity) variables
i = banks
t = time
€ = error term

To do the analysis following two hypotheses were designed:

1) There is an insignificant relationship between liquidity and profitability, i.e. H_0: $b_1 = b_2 = b_3 = b_4 = 0$ (null hypothesis)

2) There is a significant relationship between liquidity and profitability, i.e. H_a: $b_1 \neq b_2 \neq b_3 \neq b_4 \neq 0$ (alternative hypothesis)

4. Statistical Results and Analyses

The statistical analysis of secondary data has been divided into three dimensions, i.e. descriptive, correlation and regression. All the statistical tests have been performed through SPSS V15.0.

4.1. Descriptive Statistics

Table 1 shows descriptive statistics for dependent and independent variables. The analyzed statistics figures illustrate the mean, standard deviation, maximum and minimum values of Islamic banks. The statistics suggest irregular drawbacks in minimum value of ROA & ROD, even more in ROE, leading to a dramatic decrease in percentage return for overall Islamic banking industry.[1] The mean value of dependent variables imply that maximum portion of bank's income goes for shareholders, as here ROE indicates greater outcome in percentage return in comparisons to ROA or ROD. However, according to the statistics, the fraction of investment in total assets and total deposits exceeds cash & due from banks to a great extent if we take a look at their mean values.

Table 1. Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable				
ROA	-4.85	3.07	1.2060	1.05572
ROE	-176.07	38.81	15.8591	27.86636
ROD	-5.20	3.66	1.4722	1.22965
Independent Variable				
CDTA	9.94	82.12	21.4307	12.59587
CDDEP	11.62	95.43	25.3715	14.06618
INVSTA	13.33	82.51	70.2224	11.45243
INVSDEP	15.49	103.86	84.2804	15.55431

Source: Calculated value using Annual Reports of the banks issued by Dhaka Stock Exchange (2001-2011)

4.2. Correlation Matrix

The correlation coefficients are stated in Table 2. This gives information on the degree of correlation between all the dependent (profitability) and independent (liquidity) variables used in the analysis. The opportunity has been tested with the Pearson correlation coefficients test. The result indicates that the liquidity variables CDTA and CDDEP are negatively related with all selected profitability variables. On the other hand, the remaining two liquidity variables INVSTA and INVSDEP are positively related with all three profitability variables.

[1] The reason is due to an excessive foreign exchange dealing loss of Tk.884.22 million by Shahjalal Islami Bank Limited in the financial year 2004.

Table 2. Correlation Matrix of Profitability and Liquidity Variables

	ROA	ROE	ROD	CDTA	CDDEP	INVSTA	INVSDEP
ROA	1						
ROE	**.905****	1					
ROD	**.994****	**.867****	1				
CDTA	-.232	-.062	-.260	1			
CDDEP	-.206	-.048	-.226	**.993****	1		
INVSTA	.222	.037	.252	**-.945****	**-.936****	1	
INVSDEP	**.326***	.115	**.376****	**-.896****	**-.856****	**.950****	1

Pearson Correlation Coefficient
** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Source: Calculated value using Annual Reports of the banks issued by Dhaka Stock Exchange (2001-2011)

4.3. Regression Results

Tables 3, Table 4 & Table 5 report the results of regression analysis in which four independent variables are regressed by using the data of Islamic banks of Bangladesh from 2001 to 2011. The adjusted value of R squares indicate that ROA, ROE and ROD of Islamic banks of Bangladesh are respectively 17.1%, 4.5% and 24.6% dependent on independent variables, i.e. CDTA, CDDEP, INVSTA and INVSDEP. Therefore, as liquidity factors, these four variables are considered major issues to defining profitability of Islamic banks in Bangladesh over eleven years period.

Table 3. Regression Results of ROA (2001-2011)

Model 1	**Unstandardized Coefficients**		**Standardized Coefficients**		
	B	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	2.125	3.118		.681	.499
CDTA	.293	.186	3.502	1.576	.121
CDDEP	-.274	.161	-3.652	-1.699	**.096***
INVSTA	-.194	.074	-2.110	-2.630	**.011****
INVSDEP	.159	.054	2.343	2.948	**.005*****
R squared .233	F statistics 3.792	Durbin-Watson 1.635			
Adjusted R squared .171	P-value **.009*****				

*** Significant at the 1% level
** Significant at the 5% level
*Significant at the 10% level

Source: Calculated value using Annual Reports of the banks issued by Dhaka Stock Exchange (2001-2011)

Table 3 shows that CDTA and INVSDEP are positively correlated with ROA. Alternatively CDDEP and INVSTA show negative relationship with ROA. With an exception to CDTA; rest independent variables CDDEP, INVSTA and INVSDEP are significantly correlated with ROA at 10%, 5% and 1% significant level in that order. Durbin-Watson test shows that the residuals are positively correlated. At overall 1% significant level as per p-value the liquidity model [Model 1] is

significantly correlated with ROA. So the null hypothesis (H_0) is rejected and alternative hypothesis (H_a) accepted here.

Table 4. Regression Results of ROE (2001-2011)

Model 2	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	77.929	88.349		.882	.382
CDTA	7.326	5.277	3.312	1.388	.171
CDDEP	-6.960	4.571	-3.513	-1.523	.134
INVSTA	-4.796	2.096	-1.971	-2.289	**.026****
INVSDEP	3.492	1.528	1.949	2.285	**.027****
R squared	.116	F statistics	1.637	Durbin-Watson	2.024
Adjusted R squared	.045	P-value	.180		
*** Significant at the 1% level ** Significant at the 5% level * Significant at the 10% level					

Source: Calculated value using Annual Reports of the banks issued by Dhaka Stock Exchange (2001-2011)

Table 4 represents that CDTA and INVSDEP are positively correlated with ROE. At the same time CDDEP and INVSTA create negative correlation with ROE. Here, only INVSTA and INVSDEP are found significant with ROE at 5% significant level. As Durbin-Watson statistic is approximately very close to 2, therefore the residuals are uncorrelated. However, according to p-value the overall liquidity model [Model 2] is not significantly related with ROE at any formulated level. Thus the null hypothesis (H_0) is accepted for the relationship of liquidity and profitability (ROE).

Table 5. Regression Results of ROD (2001-2011)

Model 3	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	2.433	3.464		.702	.486
CDTA	.340	.207	3.480	1.642	.107
CDDEP	-.317	.179	-3.631	-1.771	**.083***
INVSTA	-.245	.082	-2.284	-2.985	**.004*****
INVSDEP	.202	.060	2.557	3.373	**.001*****
R squared	.302	F statistics	5.404	Durbin-Watson	
Adjusted R squared	.246	P-value	**.001*****	1.599	

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Source: Calculated value using Annual Reports of the banks issued by Dhaka Stock Exchange (2001-2011)

As demonstrated in Table 5 ROD has positive relation with CDTA and INVSDEP, and negative relation with CDDEP and INVSTA. Here, only insignificant variable is CDTA. CDDEP is significantly related with ROD at 10% level. At 1% significant level both liquidity variables INVSTA and INVSDEP are detected statistically significant with ROD. Durbin-Watson test indicates positive autocorrelation for the residuals. As per p-value the model [Model 3] is statistically significant with ROD at 1% significant level. As a result here the null hypothesis (H_0) is rejected and alternative hypothesis (H_a) accepted.

5. Conclusion

The current study marks the very first attempt to analyze liquidity impact on Islamic banks' profitability in Bangladesh during the period 2001 to 2011. Major parts of the study results reveal greater dependency of banks' profitability on liquidity. Specifically cash & due from banks to total assets is not significant with any profitability variables. Cash & due from banks to total deposits is found insignificant with ROE, but significant with ROA and ROD at 10% significant level. Other two independent variables investment to total assets and investment to total deposits are individually and significantly correlated with all selected profitability variables. Investment to total assets is significant with ROA and ROE at 5% significant level and with ROD at 1% significant level. On the other hand, investment to total deposits is significantly correlated with ROA and ROD at 1% significant level and with ROE at 5% significant level. The entire liquidity model is found statistically significant with ROA and ROD at 1% significant level. The reason to discover ROE less dependent and insignificant with the overall liquidity model is possibly due to that huge loss in foreign transaction by Shahjalal Islami Bank Limited in the financial year 2004. Now, according to the questions specified in introduction section, the crucial or fundamental choice of Islamic banks should compile both the highlighted issues of this study, i.e. liquidity and profitability.

When generating profit is considered to be the most fundamental concept of Islamic banking activities; the importance of liquidation is not insignificant. Without conforming proper liquidation (neither too high nor too low) Islamic banks cannot achieve their expected profit. However, adding further liquidity variable to the model may make it more or less significant with profitability. In addition, it should also be said that liquidity is not the single reason to defining Islamic banks' profitability. Therefore, in any affair, current study serves as initial movement, leaving spaces for future researches to enhance and enrich its outlook.

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How Do Ownership Features Affect Corporate Governance Disclosure ? – The Case of Banking System

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Abstract: The purpose of our empirical study is to assess the relationship between ownership' features and the level of disclosure in case of banking institutions listed on London Stock Exchange, basing on the general statement that disclosure and quality of corporate governance system are two closely related concepts - the higher the level of transparency, the better the quality corporate governance practices. The research methodology used for achieving our goal is based on econometric analysis using statistical tools - correlations for identifying the relationships and regressions for assessing them - all of these being performed using SPSS software. In this respect, we developed a disclosure index, considered structure and concentration as features for assessing ownership. The results of the performed analysis reveal significant positive influences of all features tested on the level of disclosure, thus confirming our assumptions that the higher the quality of ownership, the higher the level of disclosure. Irrespective of prior studies, which were focused on various corporate governance features, our paper comes to add value in this respect by testing only ownership. Moreover, because the banking system was little explored on this topic before, we had another chance to enrich the research literature with this empirical study.

Keywords: corporate governance; ownership; disclosure; transparency; banking system

JEL Classification: M10; G30

1 Introduction

"The corporate governance framework should ensure that timely and accurate disclosure is made on all material matters regarding the corporation, including the financial situation, performance, ownership, and governance of the company." (OECD, 2004). Starting from these provisions, disclosure and the quality of corporate governance system are more often appreciated as closely related concepts - the higher the level of transparency, the better the quality corporate governance practices. Basing on this background, we focused on corporate governance disclosure, analyzing possible influences over it coming from one dimension of corporate governance mechanism. Therefore, the objective of our paper is to identify possible associations between ownership features and the level of

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disclosure through annual reports in case of banking institutions.

Unlike prior research studies which were focused on similar goals - to test possible influences of corporate governance features like board of directors size and independence, CEO duality or various ownership' features over the level of corporate governance disclosure at companies level, our paper provides a particular approach on a specific business field, the banking one that was little explored on this topic before. Moreover, our research provides a more comprehensive approach of the most important "key-player" of corporate governance mechanism – the shareholders, considering the most important features (e.g. structure, concentration) for performing the analysis, ensuring by thus originality, which adds a plus value to our study.

Basing on this background, our paper proceeds as it follows. Firstly, we briefly reviewed prior literature concerning possible relationships between ownership characteristics and banks' level of disclosure. We continued our study by developing particular hypotheses related to possible influences of ownership features over the level of transparency about corporate governance. After explaining the research methodology used, consisting of correlation and regression analysis performed using SPSS software, we tested our hypotheses using information from sampled banks' websites. Finally, we provided our research findings and discussed their implications, closely related to previous studies focused on the same goal.

2. Literature Review and Hypotheses Development

The prior international literature provides various surveys on corporate governance disclosure, by testing the influences of various features of the board of directors, executive management, shareholders or board committees, such as size, independence, gender diversity, experience, education and so on, but their findings often appeared to be opposite and, consequently, we can not talk yet about a "unique" model of good corporate governance. Thus, we agree that its "size, composition and structure can be good or bad, depending on what you are looking for" (Gup, 2007) and, moreover, we also believe that there is an optimal corporate governance structure "which varies across firms and over time" (Dahya and Travlos, 2000).

Focusing on ownership, which is the subject of our paper, we appreciate that, from the perspective of a good corporate governance mechanism, its structure is a key issue in this respect, referring by this to the types and composition of shareholders in a corporation, researchers often "quantifying" it by using various observable measures of ownership concentration or the extent of "inside" ownership. Starting from this various opinions about its characteristics aroused along time, being often

the subject of controversial debates, the most important of these being presented as follows:

2.1. Ownership Structure

The most important way of assessing ownership structure is by considering either the proportion of ordinary shares held by senior managers (the CEO and executive directors) known as managerial ownership or by those "substantial" shareholders having more than 5% from the proportion of ordinary shares known as block-holder ownership. Anyway, there are other types of ownership considered for analysis in prior literature that proved to be related to disclosure, too, such as: institutional ownership, governmental ownership or family ownership.

According to prior evidence, most researchers expected that the level of disclosure to be negatively influenced by managerial ownership, due to an increase need for monitoring and reached to persuasive results (Gul & Leung, 2004; Ghazali & Weetman, 2006; Baek, et al., 2009; Broberg et al., 2010; Cheng & Courtenay, 2006; Arcay & Vazquez, 2005; Chau & Gray, 2010; Ho & Wong, 2001). Their expectation was mainly based on the agency theory (Jensen and Meckling, 1976) according to which a low level of director ownership will lead managers to have greater incentives to consume perquisites and less incentive to maximize job performance, providing additional information through voluntary disclosure being the alternative solution to an increase monitoring of a manager's behavior that leads to additional agency costs. On the other hand, directors' shareholding is perceived as helpful to align goals and financial incentives of board members with those of outside shareholders (Bushman et al., 2004).

On the other hand, there are other researchers who tested institutional and government ownership, leading to the conclusion that these have a positive influence over transparency, because of their openness for disclosures (Akhtaruddin and Haron, 2010; Mangena and Tauringana, 2007; Barako et al., 2006; Chau and Gray, 2002; Makhija and Patton, 2004). Thus, institutional ownership plays an important role in this respect mainly due to their usually special statute that confers them at least the following advantages: a greater incentive and ability to acquire more timely pre-disclosure information than small shareholders (Chung, et al., 2002), a better ability to interpret the information disclosed in the annual reports (Bos & Donker, 2004) and a greater voting power, making it easier to take corrective action when it is deemed necessary (Donnelly & Mulcahy, 2008). On the other hand, government ownership has been the subject of two opposite opinions as regard the level of disclosure (Ghazali & Weetman, 2006), thus appreciating it as being either higher, due to pressure to disclose additional information coming for the government, or lower, due to the separate monitoring by government itself.

Anyway, there are also prior studies that could not prove their expectations (Hassan, et al., 2008; Huafang & Jianguo, 2007; Donnelly & Mulcahy, 2008; Haniffa & Cooke, 2002; Eng & Mak, 2003).

Basing on the above mentioned arguments related to ownership structure and its influences on the level of information disclosed, as well as to prior expectations and results, we proposed the following hypotheses regarding ownership structure:

> *H1: There is a positive association between managerial ownership and the extent of voluntary disclosure.*
>
> *H2: There is a positive association between institutional banking ownership and the extent of voluntary disclosure.*

2.2. Ownership Concentration

Due to the separation of ownership and control, there is a likelihood of agency conflicts (Jensen & Meckling, 1976) and the probability to incur is higher when shares are widely held than when it is in the hands of a few (Fama and Jensen, 1983). Also, the agency costs of equity are higher where a company's shares are being held by a relatively small number of shareholders (Friedland, 2003).

Most empirical studies that have tested the correlation between *ownership concentration* and the level of disclosure reached to a negative relationship (Barako et al., 2006; Tsamenyi, et al., 2007; Haniffa & Cooke, 2002; Huafang & Jianguo, 2007; Patelli & Prencipe, 2007; Chau & Gray, 2002; Cooke, 1989), but, there are also studies that could not find any association (Arcay and Vazquez, 2005; Ghazali and Weetman, 2006; Holm & Scholer, 2010; Parsa, et al., 2007; Baek, et al., 2009; Makhija & Patton, 2004; Depoers, 2000).

Ownership concentration was appreciated as an issue of bad governance for at least two reasons, Firstly, due to the ability and motivation of large stockholders to monitor their interests directly, it is considered easier for fewer shareholders to voice an opinion to which management will be forced to listen (Shleifer & Vishny, 1997). Secondly, due to the direct access to the information by dominant owners (Cormier et al. 2010), in a concentrated ownership environment, the flow of information is affected which in turn reduces corporate transparency and increases agency costs (Fan & Wong, 2000). This may lead to increased demands for organizational information that can be used to monitor management (Gelb, 2002). On the other hand, *ownership diffusion* is appreciated as a required feature for a good corporate governance mechanism, at least from the following reasons: the impossibility of shareholders to influence company's reporting practices (Zeckhauser & Pound, 1990) and shareholders' intention to scrutinize managerial performance, thereby improving corporate governance (Coulton et al. 2003).

Consequently, as regards disclosure, if in a widely held company (ownership dispersion) its role is to signal that the managers are acting in the best interests of the principals, in a highly concentrated company (ownership concentration), it comes to annihilate the conflicts of interest between "insiders" (controlling shareholders and managers) and outside investors.

Basing both on assertions supported by the agency theory that companies with concentrated ownership do not have to rely on external disclosures to the same extent as companies with dispersed ownership, as well as on most prior empirical findings that provide evidence in this respect, we proposed the following hypothesis:

> *H3: There is a positive association between diffusion of ownership and the extent of disclosure*

3. Empirical Design and Results

The research methodology used for achieving our goal is based on econometric analysis using statistical tools - correlations for identifying possible relationships and regressions for assessing them - all of these being performed using SPSS software. In this respect, firstly, we developed a disclosure index made of three sub-indices comprising information appreciated as mandatory, recommended and voluntary to be disclosed. The analysis performed followed two steps: the first one based on a correlation test between ownership attributes and the level of disclosure using Pearson coefficient, followed by a regression analysis comprising only those attributes that proved to be significantly correlated to the level of disclosure ended with a model development expressing the relationship between ownership and transparency. Within this study, two important features of ownership have been tested – structure and concentration.

3.1. Sample Selection and Variable Measurement

In this survey we aimed to identify possible associations between ownership features and the level of disclosure through annual reports in case of banking system. For achieving our goal, we selected as a *sample* all financial institutions listed on London Stock Exchange (46 banks according to the information available for the year 2011).

Data collection was based on information provided by banks' websites, the process being divided into two parts. Firstly, we measured the level of disclosure by using a checklist developed in this respect, by using banks' annual reports for year 2010 available on their websites. Secondly, we collected data related to banks'

governance system by searching in addition through their financial statements and general information provided by their website.

Because the main purpose of our study is to identify possible associations between corporate governance dimensions and the level of disclosure, two sets of *dependent and independent variables* for performing the correlation analysis are needed.

Thus, for measuring the level of disclosure, which is *the dependent variable*, we made use of a Disclosure Index (TD) especially developed in this respect that mainly consists of three sub-indices, each of them measuring a different type of disclosure, namely: *mandatory (MD), recommended (RD) or voluntary (VD)*. These indices measure the extent of each type of disclosure, being calculated as a ratio of the total number of items disclosed to the maximum possible number obtainable for each category of disclosure.

Thus, we compiled three separate lists of disclosure, namely:

- a checklist of *mandatory disclosures* for entities listed at London Stock Exchange, based on the most recently Corporate Governance Disclosure Checklist (Delloite, 2011), considering The Listing Rules and The UK Corporate Governance Code, as well as the recently requirements supplemented by The Disclosure and Transparency Rules on Audit Committees and Corporate Governance Statements (2008), The Revised Version of the Turnbull Guidance on Internal Control (2005), The Guidance on Audit Committees (2010). This checklist comprises 44 items divided into six main categories of information related to general aspects, leadership, effectiveness, accountability, remuneration and relation with shareholders.
- a checklist of *recommended disclosures* based on OECD Principles, which propose that the corporate governance framework should ensure that timely and accurate disclosure is made on companies' "financial situation, performance, ownership and governance" (OECD, 1999). This checklist comprises 51 items divided into four categories, according to the disclosures required by the principles, as follows: rights of shareholders and key ownership functions, equitable treatment of shareholders, disclosure and transparency, responsibilities of the board.
- a checklist of *voluntary disclosure,* based on the Standard & Poor's list of 98 transparency and disclosure questions used for its study developed for Europe in 2003. This checklist comprises 88 items divided into three categories outlining ownership, company performance and boards (governance). This approach of developing the disclosure index was often used in prior studies aiming on the same goal (Mangena and Tauringana, 2007; Tsamenyi, et al., 2007; Aksu and Kosedag, 2006).

After joining the three separate checklists, a final checklist of 142 items was structured, basing on S&P's study, into 4 main categories: *general provisions (2), ownership structure and investor rights* (43), *financial transparency and information disclosure* (46), *board structure and process* (78). This was supplemented with 8 additional items used in at least one previously published study focused on the same topic and 15 own items, thus resulting a comprehensive checklist list of 167 items consisted of 31 mandatory, 54 recommended and 82 voluntary disclosures.

For developing the disclosure index each item of the checklist was scored using *binary classification*, each issue from the list being treated a dummy variable, where "1" indicates that the annual report discloses the information and '0' indicates that there is not disclosed any information about that issue.

The disclosure index was computed using an *un-weighted scoring approach* of the disclosure items, basing on the assumption that each item of information disclosure is of equal importance in the corporate information users' decision-making process. The main reason to do so is related to the subjectivity that might occur when different weights are assigned to reflect the importance of certain types of information. Our approach is supported by most prior studies aimed to develop such an index of disclosure, unlike weighted scores, which were rarely used before (Barako, et al., 2006; Cheng and Courtenay, 2006; Patelli and Prencipe, 2007).

The independent variables consisted of various features of ownership that prior studies found to have significant influences over the level of disclosure, are presented in details in Table 1.

Table 1. Independent variable description

Independent variables		Variables description	Predicted sign
Ownership concentration	O_Conc	share capital held by the majority shareholder	-
Managerial ownership	O_Manag	shares owned by shareholders being in executive positions	-
Banking institutional ownership	O_Inst.Bank	shares owned by banking institutions	+

Source: Own projection

The analysis performed followed two steps: the first one based on a correlation test between ownership attributes and the level of disclosure, followed by a regression analysis comprising only those attributes that proved to be significantly correlated to the level of disclosure.

3.2. Data Analysis and Hypotheses Test Results

For performing the correlation analysis, the first step of our analysis whose results are detailed in Table 2, we calculated Pearson coefficient that is usually used for measuring the strength of linear dependence between two variables, giving a value between "1" describing the perfect direct relationship and "-1" revealing an indirect one, "0" value meaning that there is no linear correlation between variables

Table 2. The correlation matrix between variables

		O_Conc	*O_Manag*	*O_Inst.Bank*
TD_Index	Pearson Correl	-0,555**	0,377**	0,414**
	Sig. (2-tailed)	0,000	0,010	0,004
MD_Index	Pearson Correl	-0,556**	0,301*	0,250
	Sig. (2-tailed)	0,000	0,042	0,094
RD_Index	Pearson Correl	-0,495**	0,283	0,416**
	Sig. (2-tailed)	0,000	0,057	,004
VD_Index	Pearson Correl	-0,450**	0,410**	0,395**
	Sig. (2-tailed)	0,002	0,005	0,007
	N	46	46	46

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

**Correlation is significant at the 0.05 level (2-tailed).*

Source: calculations made using SPSS software

As it can be seen, according to the sign of Pearson coefficient, *ownership concentration* (O_Conc) is the only corporate governance feature tested that has a negative influence of medium intensity and the highest probability of 99% (Sig. <0,01) over the level of transparency, for both total disclosure and all its sub-indices. As regards *ownership structure*, it proved to positively influence the corporate governance total disclosures, as well as the voluntary once. Moreover, the institutional banking ownership (O_Inst.Bank) is highly significant in case of recommended disclosures, while the mandatory once were influenced just in a low extent by the managerial ownership (O_Manag).

Because Pearson coefficients reveal that there are correlation between variables tested, the next step of our analysis was to test their significance by using the linear regression analysis, whose results are presented in Table 3.

Table 3. Linear regression analysis results

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	66,689	3,251		21,130	0,000
O_Conc	-0,249	0,056	-0,555	-4,427	0,000
R Square: 0.308	Adjusted R Square: .292		F value: 19.597	F significance: 0.000	
2 (Constant)	51,627	2,149		24,043	0,000
O_Manag	8,398	3,108	0,377	2,703	0,010
R Square: 0.142	Adjusted R Square: .123		F value: 7.304	F significance: 0.010	
3 (Constant)	51,080	2,157		23,677	0,000
O_Inst.Bank	9,217	3,051	0,414	3,021	0,004
R Square: .0172	Adjusted R Square: 0.153		F value: 9.125	F significance: 0.004	

Source: calculations made using SPSS software

By analyzing the values of Pearson's coefficient and the results of linear regression analysis performed we reached to the following conclusions

- in case of ownership concentration (O_Conc) there is a significant negative correlation of medium intensity and a probability of 99% (Sig. <0,01) between variables tested (0,555 in case of total disclosure), which is explained in 29,2% of cases, according to the linear regression results. Medium intensity associations with the same significance were identified in case of disclosure sub-indices, too, Pearson's values being between 0,450 in case of voluntary disclosures and 0,556 in case of mandatory ones. Thus, basing on assertions supported by the agency theory that companies with concentrated ownership do not have to rely on external disclosures to the same extent as companies with dispersed ownership, we hypnotizing that *"There is a negative association between ownership concentration and the extent of disclosure",* our first hypotheses (*H1)* being *accept*ed;

- in case of ownership structure, respectively *managerial ownership* (O_Manag*),* there is a significant positive correlation of medium to low intensity and a probability of 99% (Sig. <0,01) between variables tested (0,377 in case of total disclosure), which is explained in 12,3% of cases. Medium to low intensity positive associations with the same significance was identified in case of voluntary disclosure (0,410), while the probability of significance in case of mandatory disclosure was lower (just 95% (Sig. <0,05)). In case on recommended disclosure there was not found any significant correlation. Thus, basing on the premise that when leadership structures own shares, there is little incentive to provide more disclosure, since their interests are more aligned with the shareholders, we hypnotized that *"There is a positive association between managerial ownership and the extent of voluntary disclosure",* our second hypotheses *(H2)* being *accepted*;

- in case of ownership structure, respectively *banking institutional ownership* (O_Inst.Bank), there is a significant positive correlation of medium intensity and a probability of 99% (Sig. <0,01) between variables tested (0,414 in case of total disclosure), which is explained in 15,3% of cases, according to the linear regression results presented below. Medium intensity associations with the same significance were identified in case of recommended disclosure (0,416) and voluntary disclosure (0,395), while in case of mandatory disclosure there was not find any significant correlation. Thus, basing on the premise that generally institutional and government ownership have a positive influence on transparency, because of their openness for disclosures, we hypnotized that *"There is a positive association between institutional banking ownership and the extent of voluntary disclosure"* our third hypotheses *(H3)* being *accepte*d.

4. Model Development

Considering the purpose of our research – to find the most appropriate answer to our question "Do corporate governance "actors"' features affect banks' value?" – we appreciate as the best alternative to develop a model expressing all significant influences of the board, executive management and shareholders over strategies followed and performances reached by banks.

In this respect, we used multiple regression as the method of analysis and Ordinary Least Squares (OLS) as the method of estimation. For developing our models, we start for the general economic model used in prior literature focused on similar goals:

$$Y = \alpha + \beta i * F_{it} + e_{it}$$

where, Y is the dependent variable; α is constant, βi is the coefficient of the explanatory variable, F_{it} is the explanatory variable (corporate governance features in our case) and e_{it} is the error term (assumed to have zero mean and to be independent across time period).

For developing our model, firstly we had to test the significance of the relationship between dependent variables and all independent variables, where proved to exist a correlation, according to Pearson coefficient values.

Using linear regression and both "enter" and "stepwise" methods, we selected for our model just those independent variables that proved to explain better the influences over the dependent ones, considering R square coefficient values. Also, the analysis of variance performed, using Anova test, helped us measuring the strength of each relationship established.

By applying "enter" method, whose results are detailed in Table 4, we identified those independent variables that proved to explain better the influences over each

type of disclosure, but the results achieved could not allow us developing a model comprising all attributes.

Thus, only ownership concentration proved to have a significant influence over the level of disclosure, excepting the voluntary once.

Table 4. Regression analysis using "enter" method

Variables	*TD_Index*				Variables	*MD_Index*			
	Coeff.	Sig.	Toler.	VIF		Coeff.	Sig.	Toler.	VIF
(Constant)	64,282	0,000			(Constant)	80,256	0,000		
O_Conc	-0,202	0,011*	0,565	1,769	O_Conc	-0,369	0,001**	0,694	1,441
O_Manag	1,576	0,659	0,636	1,572	O_Manag	-0,314	0,950	0,694	1,441
O_Instit. Bank	2,429	0,512	0,592	1,688					
F value: 6.659	R Square: .322				F value: 9.612	R Square: 0.309			
F signif: .001	Adjusted R Square: 0.274				F signif: 0.000	Adjusted R Square: 0.277			
**) significant for p-value<0.1*					***) significant for p-value<0.05*				

Variables	*RD_Index*				Variables	*VD_Index*			
	Coeff.	Sig.	Toler.	VIF		Coeff.	Sig.	Toler.	VIF
(Constant)	71,143	0,000			(Constant)	51,754	0,000		
O_Conc	-0,229	0,023*	0,646	1,548	O_Conc	-0,101	0,150	0,565	1,769
O_Instit. Bank	5,558	0,254	0,646	1,548	O_Manag	3,719	0,255	0,636	1,572
					O_Instit. Bank	2,668	0,428	0,592	1,688
F value: 7.866	R Square: 0.268				F value: 4.690	R Square: 0.251			
F signif: 0.001	Adjusted R Square: 0.234				F signif: 0.006	Adjusted R Square: 0.197			
**) significant for p-value<0.1*									

Source: calculations made using SPSS software

Therefore, we had to made use of "stepwise" method, whose results are detailed in Table 5 that helped us selecting just those independent variables that were significant, being thus retained for our model.

Table 5. Regression analysis using "stepwise" method

TD_Index			*MD_Index*		*RD_Index*		*VD_Index*	
Variables	Coeff.	Sig.	Coeff.	Sig.	Coeff.	Sig.	Coeff.	Sig.
(Constant)		0,000		0,000		0,000		0,000
O_Conc	-0.555	0,000	-0,556	0,000	-0,495	0,000	-0,450	0,002
F value: 19.597			F value: 19.666		F value: 14.288		F value: 11.151	
F signif: 0.000			F signif: 0.000		F signif: 0.000		F signif: 0.002	
R Square: 0.308			R Square: 0.309		R Square: 0.245		R Square: 0.202	
Adj. R Square: 0.292			Adj. R Sq: 0.0293		Adj. R Sq: 0.228		Adj. R Sq: 0.184	
these models are significant for p-value<0.01								

Source: calculations made using SPSS software

For all disclosure indices we developed a model with a high probability of significance of 99% (Sig. <0,01), that can be explained in maxim 30% of cases, according to R Square values which range between 0,202 and 0,309, the only ownership attribute retained in these models being ownership concentration. In conclusion, the regression model revealing the association between ownership and the extent of disclosure is expressed by the following equation:

$$D\_Index = \alpha + \beta 1 * O\_Conc \quad (p\text{-}value < 0.01)$$

5. Findings and Conclusions

Corporate governance has become one of the most debated subject, especially in banking environment, as a consequences of the latest financial crisis that spread all over the world. The lack of transparency and disclosure was often considered as one of the major cause of the latest corporate scandals and governance failures, adversely affecting public confidence in the reliability of corporate and financial reporting, too. In fact, this crisis made from corporate governance a controversial economic concept, bringing it as well to the attention of media and academic environment. Thus, while we assisted at a "wake-up" for better corporate governance and transparency all over the world, this concept also became one of the most attractive, dynamic and challenging research subject.

Many studies focused on corporate governance mechanism analyzed its components closely related to successes reached or unavoidable failures, concluding that weak corporate governance system negatively affect firm value, while strong governance mechanism improves efficiency. Also, disclosure and the quality of corporate governance system are appreciated as closely related concepts - *the higher the level of transparency, the better the quality corporate governance practices*.

Basing on this background, our study was aimed to provide a comprehensive analysis of the relationship corporate governance – transparency in banking environment, by trying to find answers, justified throughout empirical analysis, to the following research questions *"How does ownership affect transparency in banking system?"*

The relationship between ownership and the level of disclosure was a highly debated topic of worldwide research, whose outcomes are mixed. The most important feature tested along time in prior studies was related to its dispersed vs. concentrated character, the majority results revealing a negative relationship between ownership concentration and the level of disclosure (Barako et al., 2006; Tsamenyi, et al., 2007; Haniffa & Cooke, 2002; Huafang & Jianguo, 2007; Patelli & Prencipe, 2007; Chau & Gray, 2002; Cooke, 1989). Anyway, there were also studies testing the influences of various types of shareholders, such as institutional

ownership, governmental ownership or family ownership, and whose results were mixed, but where more often their expectations could not be proved (Hassan, et al., 2008; Huafang & Jianguo, 2007; Donnelly & Mulcahy, 2008; Haniffa & Cooke, 2002; Eng & Mak, 2003).

Irrespective of prior studies, which were focused on various corporate governance features our study comes to add value to corporate governance literature by testing a single corporate governance attribute, highly explored before - *ownership*, from various perspectives, including a new one – the banking institutional structure. Moreover, because the financial system was little explored on this topic before, we had the chance to enrich the research literature with this empirical study, whose disclosure index developed ensures it as well with originality and complexity, comprising three different categories of disclosures – mandatory, recommended and voluntary. The results of the performed analysis reveal either positive relationships between ownership features tested (e.g. structure) or negative association (e.g. concentration) and the level of disclosure, but only the last one proved to be statistically significant.

Anyway, we appreciate our study as having multiple theoretical and practical implications, being a useful source of information and reflection to interested practitioners, regarding corporate governance influences over banks' transparency. Furthermore, we consider the literature review of our paper as providing an overview image of what has already been studied related to corporate governance's impact on transparency, as a useful synthesis for both research and academic environment.

Finally, being aware of our study's limitations, coming from the sample of banks, the limited number of factors and the fact that only one year data were considered for analysis, we are appreciating these as a challenge that give us outlooks for future research.

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Harmonization and Convergence – Coordinates of Accounting Globalization

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Abstract: In the last decades it shows, as a particularity, an acceleration of the internationalizations of capital and trade markets, which has emboldened globalization and, especially, the technological progress of information and communication, which has allowed economic actors to fully profit from the possibilities opened by the free markets. International accounting harmonization is opposed to the deepening of the differences between countries, offering a common denominator of understanding. Finalizing the accounting convergence process on a world scale envisions the application of an international form of accounting, of norms, principles and concepts which are unique and unitary for all participating countries, in order to thus talk of a global accounting model. Romania has made major efforts and managed to make a considerable normative progress by passing international accounting standards and harmonizing accounting, especially with regards to European directives.

Keywords: accounting harmonization; accounting convergence; European directives; accounting models; current assets

JEL Classification: G32; G33; C39

1. Introduction

Financial markets, for all countries of the world, are becoming much more integrated; the capital, both garnered and invested, tends to be very quickly internationalized, so that the globalization of financial markets generates worldwide the adoption of a unique accounting language. From an etymology standpoint, the word "accounting convergence" expresses the action of "moving towards the same point, the same purpose." (*Dicţionarul explicativ al limbii române/The Explanatory Dictionary of the Romanian Language*, p. 222)

Foreign information users, especially investors, must use clear, credible and internationally comparable financial and non-financial information for decision-making, because only under these conditions, the users trust the company, and especially with a view to keeping their investment.

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Globalization shows a segment of the process of internationalization of economic entities. Casta & Colasse (2001, p. 182) take into account the evaluation of the accounting system through a financial and economic perspective, for the relevant and credible transmission of information towards users, especially those who have financed a business: investors, shareholders and creditors.

In Europe, the process of accounting harmonization has begun in 1970 and has resulted in two directives of the European Commission: Directive IV (1978) and directive VII (1983) (Deaconu, 2004, p. 118). The characteristic of European accounting directives is that they are based on a legislative process and are not based on a conceptual framework which would assure the coherence of the norms. European accounting directives foresee many options which may be legalized through international accounting norms.

Directive IV refers to annual financial situations regarding public and private entities, and relates to: accountability of information needs of European firms, but especially the comparability of published information (Tabără, Horomnea & Mircea, 2010, p. 120). Its role can be synthesized (Ristea & Dumitru, 2005, p. 33): the directing of national legislation referring to the content, presentation and publication of financial reports related to public and private entities, as well as the accounting principles on which they are based; the establishing of minimum standards in the EU, which refers to the content and publication of financial information; the offering, through annual financial statements of an honest and credible image of the patrimony and financial position; the offering of complete information to investors regarding the economic entities they are interested in. In the content of Directive IV there is no mention of the situation of cash flows and the situation of shareholders' equity modifications. Also, it contains rules of evaluation for positions in annual financial statements, with regards to the principle of cost of purchase or of total cost (commercial). Member states may apply and choose other alternative methods with regards to evaluation. Also, this directive does not discuss the long term contract accounting or pension contract accounting.

2. The Evolution of Romanian Regulation. The Balance Format in Current Accounting Regulation

Accounting in Romania had as its main goal the offering of information towards a single user, which is the State (Fiscal Administration and Government), which has led to the development of financial statements with regulation which did not concern, mainly, professional judgment and argumentation.

In 1994, the French accounting system has been applied, with the General Account Plan. Then, accounting regulation have been elaborated, encompassed in OMFP no. 94/2001 and OMFP no. 306/2002. These normative acts regarded a blending of

international and European norms, with a focus more towards the European ones. For SMEs the simplified international norms have been applied with small insertions which regard the European accounting norms (formation expenses, the unexplained takeover of the principles of economic prevalence over judicial, materiality, the application of stock impairment accounts). If the Europeans have accepted IAS/IFRS with some degree of difficulty, especially for listed entities at the level of consolidated financial standings, in Romania the international norms have been applied at a regulation level, however, with difficulty, shedding doubt on the application of norms which are a result of a different accounting culture, majorly governed by principles.

Contradictions emerged, difficulties regarding the respecting of accounting law, fiscal regulations. Among the application difficulties of IAS/IFRS one might list (Deaconu, 2003, pp. 124-125): the application of IAS 29 "Raportarea financiară în economii hiperinflaţioniste" [Financial reporting in hiperinflationist economies] has not been imposed; the basic treatment prescribed by IAS 8 "Profitul net sau pierderea netă a perioadei, erori fundamentale şi modificări ale politicilor contabile" [Net profist or net loss of a period, fundamental errors and modifications of accounting policy] is not applied in Romania; asset depreciation was calculated vis-a-vis the normative lifespan not the useable one prescribed by the firm; difficulties relating to the understanding and application of deferred taxes; the reevaluation of tangible assets was done based on government decisions which had no correlation with the requirements of international norms; difficulties in recognizing income only in regards to capital expenditures; the situations of cash flows was not accepted as a component segment of financial standings and, furthermore, its drafting was sometimes inadequate.

Accounting regulation regarding Romanian SMEs was not in accordance with: simplicity and intelligibility, brevity, which regard the economic entity. Differentiation between small and large firms existed, namely: group-specific and account consolidation procedures, financial instruments (which include derivatives), using just value (historic account – evaluation basis), specifying cash flow situation – optional – as a component of annual financial standings of SMEs. The critical remark on Romanian accounting regulation is that (Deaconu, 2003, p. 125) the process of adopting international norms was hastened, especially since there was no favorable framework to their application, namely the legislation of the economic entity, inland revenue, practitioner mentality).

OMFP no. 1752/2005 regarding the approval of accounting regulation conforming to European directives, from 2006 looks at the Romanian accounting system from the perspective of European accounting directives (updated, in turn, in accordance with IAS/IFRS). From 1.1.2010, Contabilitatea Întreprinderii din Romania//Romanian Accounting Firm) adopts OMFP no. 3055/2009 for approving "Reglementarilor contabile conforme cu directivele europene" (accounting

regulation in accordance with European directives) which overrule OMFP no. 1752/2005, adopted on 12.31.2009.

Order 3055/2009, enforced from 1.1.2010, regards the accounting regulation in accordance with Directive IV of the European Economic Communities 78/660/CEE from 07.25.1978 regarding the annual financial standings of some types of economic entities, with ulterior updates and Directive VII of the European Economic Communities 83/349/CEE/1983 regarding consolidated accounts, with ulterior updates and addendums.

The fundamental equation of accounting balance is given by the formula: Assets – Debts = Equity (Pripoaie, 2007, p. 88), which includes the definitions of the three categories of characteristic elements and which are found within the conceptual international framework and show the synthetic reflection of the financial position of a patrimonial entity (Horomnea, 2011, p. 262).

As a justification to the accounting balance model contained in OMFP no. 3055/2009, the „current" versus „long term" distinction is presented in the following table:

Table 1. The current – long-term difference of assets and debts of a patrimonial entity

Current assets	Current debts
• are detained or realized for selling, consumption during the enterprise's normal cycle of exploitation;	• must be extinguished during the firm's normal cycle of exploitation. They are debts contained by the working capital of the firm;
• exists for realizing the firm's activities or to be realized in a maximum of 12 months from the date of the balance sheet;	• are detained for realizing the firm's activities; • have a 12 month eligibility term from the date of the balance sheet;
• are cash or cash equivalents, the utility of which does not depend on the 12 months from the date of the balance sheet.	• the patrimonial entity has no permanent right of adjournment of the maturity term of maximum 12 months after the date of the balance sheet.

Asset elements, debts which regard the aforementioned elements are non-current assets, long-term debts, with the clear mention of asset liquidity but also debt maturity. The minority interest element will be included only for the consolidation of annual financial standings, using the global integration method (Creţu, Sîrbu, Nuţă & Constandache, 2011, p. 89).

Currently, the Romanian accounting system may be considered, taking into account certain variables of the environment with an influence on different balances of an accounting system (Deaconu & Groşanu, 2004, p. 8).

Table 2. A reflection on the Romanian accounting system

Variable	Romanian accounting system
financing possibilities	varied: investors, banks, state, other creditors
legislation	Rigid legislation
political and economic relations with other countries	U.E. Countries, USA
Inflation rate	medium
Business diversity, management development, education level	medium
Culture Individualism Risk	low low strong

The Romanian accounting model corresponds to a hybrid model, with an inclination towards the judicial side, in the context of the current accounting regulation (the blending of international norms with European ones) but also current accounting practice. The model does not satisfy the informational necessities of foreign investors, but is rather inclined to satisfy the requirements of fiscal authorities (taxes and obligations) and the evaluation of the firm's activity in the context of the state's macroeconomic policy. Banks represent a financing resource and encourage accounting practices, however carefully.

For the application of a complete convergence, an independence of accounting norms from fiscal ones must exist, at a regulation and practice level and particularizing of international/European norms to the economic and financial realities of Romanian companies.

The norm-makers in Romania have presented the conformity of Romanian accounting with European directives and especially the putting into practice of the provisions of European directives imposing the necessity of ensuring a correct implementation in all activity sectors. Romanian authorities ask for their implementation and, for this purpose, a professional training program is undergone, for the understanding, analysis and use of overarching accounting information for all users, with the implication of professional institutions and authorities.

3. The Drafting and Presentation of Financial Position Standing in Accordance with IAS 1

With regards to financial standing, IAS 1 the presentation of financial standings brings to the forefront a situation with the same name, which actually represents, the balance regulated by IFRS. Thus, the requirements for the drafting and presenting of the financial standing situation regard:

A. policies for the current/non-current classification;
B. policies regarding minimal structure;
C. policies regarding developed structure;
D. policies of sub-classification and presentation of information in the balance sheet;
E. policies regarding the presentation of information referring to the financial standing in footnotes. (Lungu, 2007, p. 324)

A. The current/non-current Distinction represents the basic criteria for the presentation of elements in the financial standing at the end of the period. In certain cases, such as financial institutions, the presenting basis according to liquidity criteria (which is that assets and debts are presented in ascending or descending order of liquidity) offers more credible and relevant information than the basis of presentation given by the current/non-current criteria (which is that assets are presented in ascending or descending order of eligibility). The nature of operations undertaken within the firm must be established, and based on that, the current/non-current or liquidity criteria will be adopted, with the mention that the former constitutes an exception. The new version of the standard also includes the possibility of a mixed presentation, based on both criteria: current/non-current as well as liquidity.

Regardless of the adopted criteria, the differentiation in the classification of presented elements is circumscribed to the 12 month period from the date of the drafting of the financial standing. IAS 1 Financial situation presentation mentions the following referring to the current/non-current distinction:

- inventory or trade receivables are classified as current assets, even if they are not envisioned to be realized within 12 months of the drafting date of the financial position standing. If there is inventory or receivables which will not be realized in the mentioned period, then their value must be distinctively presented, such mentions being useful, for example, in the case of inventory for which the rotation cycle is of long-term;

- current assets include those assets initially detained for selling, as well as the current part of non-current assets. In case there are restrictions on the transfer of securities or when their market is less liquid, then their inclusion in non-current assets is more appropriate. When an entity is owed sums from affiliated parts, they must be included with current assets, only when there is both an intention as well as the possibility of including the proceeds in the next financial year. Financial assets generated following visible loans of entities for the affiliated parties, will be included in the category of current assets. If it is observed that the affiliated party cannot pay the respective sum, then the elements related to the aforementioned loans will be included under long-term assets;

- cash or cash equivalents the utility of which is not restricted must be included in the category of short-term assets, and those that are restricted must be classified as non-current;

- commercial debts, debts towards employees and other debts generated by exploitation are included in the category of short-term debts, even if they cannot be paid in the following financial year;

- also in the category of current debt we find financial debt classified as detained for the purpose of selling according to IAS 39, overdrafts, the current part of long term financial debts, dividends, income tax and other non-commercial obligations which are envisioned to be paid in a shorter period than that of a financial year;

- the category of debts shorter than one year includes debts which must be paid in 12 months from the date of the financial standing, even if the original term had surpassed the time period of a financial year and therefore, a long term refinancing or staggered payment plan was closed after the date of the financial standing at the end of the period but before the date of publishing authorization;

- also classified as long-term are debts which have been subjected to a refinancing agreement or those that the firm postponed for at least one financial year even if they have been previously classified as current debts.

- on-demand payment debts following the infraction of obligatory agreements are included in the short-term debts category when the agreement with the creditor of not asking for debt payment came after the drafting date of the financial standing, according to IAS 10 Events ulterior to the date of the balance. If the creditor allows the debtor an adjournment period longer than a year, for the honoring of obligations, then the obligation is classified as long-term;

- the presentation of assets and debts according to the current/non-current distinction does not impose the inclusion of assets/debts regarding income tax in the current asset category.

B. Policies regarding the minimal structure of the Financial Standing bring to the foreground obligatory elements that must be presented, without prescribing their order. According to IAS 1 there is no prescribed format for the document but it must include:

- Tangible assets;
- Land investment;
- Intangible assets;
- financial assets with the exception of those under points e), h) and i);
- Financial investment accounted using the equity method;
- Biologic assets;
- Stocks;

- Trade and similar receivables;
- Cash and cash equivalents;
- Commercial and other types of debts;
- Supplying;
- Financial debts;
- Current debts and fiscal assets, as defined in IAS 12 Income tax;
- Postponed debts and fiscal assets, as defined in IAS 12 Income tax;
- Minority interests presented under capital;
- Issued capital and reserves ascribable to investors in the mother-firm;
- The total of assets classified as held for selling and assets and debts corresponding to operations which are interrupted, according to IFRS 5 Non-current assets held for selling and interrupted operations.

In the Annex of the New Version of IAS 1 the Presentation of Financial Standings we do not see new models of financial standings proposed. Thus, IASB allows more freedom to those who draft accounting reporting and synthesis documents. Therefore, there is no imposed order of presentation, but only certain obligatory elements which must be included in the financial standing. In conclusion, any presentation order and form ensures conformity to the aforementioned standard, so long as they optimize the relevance and credibility of related information.

C. Policies Regarding the Developed structure of the Financial Position Standing ask that the mandatory elements which must be presented according to the minimal structure imposed by IAS 1 be accompanied by other line-elements and subtotals imposed by the nature, quantum or function of the elements or the nature of the activity and the transactions undertaken by the entity, with the purpose that the final presentation be relevant to users in the understanding of the financial standing of the firm.

Even if they have not been imposed at an international level, certain formats for financial standings must have a rigorous and precise structure, in order to present the economic-financial information as clearly as possible. Even if the policies regarding the detailed structure imply to a greater extend professional reasoning, they offer at the same time guidance for firm management. Professional reasoning regarding the developed presentation of elements from the financial standing of the firm has as its base three criteria presented in IAS 1:

- the nature and liquidity of assets;
- the function of assets within the entity;
- the quantum, nature and time-limit of debts.

The nature of assets influences the classification in tangible assets, intangible assets, financial, stock, receivables, liquid assets or detailing this classification through separate reporting of elements such as commercial fund, land, equipment,

commercial receivables, financial and fiscal receivables, etc., and liquidity ensures the offering of information regarding the possibility of asset transformation into liquidity, in time. The function of assets induces detailed classifications of elements specific to the firm's activity. For example, a firm that produces certain goods must offer detailed information of prime good stocks, finite product stocks or those currently undergoing execution, while a financial firm details information which regard financial assets which it has it its portfolio.

For debts, the same provisions above apply, with a mention that they must be detailed also according to their value. Because debts are significant from a value standpoint, they may have major implications on the continuity of activity, and must be presented distinctly, in order to answer to relevance and credibility characteristics.

D. The information sub-classification and presentation policies refer to the necessity of detailing some line-elements from the minimal or developed structure of the financial standing. These details can be presented either in the financial standing or in the annotations, based on the firm's profile of activity. Thus IASB imposes that entities present the sub-classification of line-elements in a manner corresponding to the firm's activity, taking into account:

- the requirements of international standards of financial reporting;
- the quantum, nature and function of implied sums;
- the criteria which form the basis of professional reasoning.

E. IAS 1 demands, as well, specific sub-classifications, either in the financial standings, or in annotations for non-current assets, receivables, stocks, supply and capital. The policies specified in IAS 1 referring to the presentation of information are accompanied by the requirements which appear at the end of each standard referring to:

- presentation details;
- implications generated by modification of the elements during the period;
- Implications generated by transactions, events or re-treatment realized by the entity.

A particularity of revising the standard is the requirement of presenting in annotations the information regarding the sum of dividends towards owners, proposed or declared before the accounting synthesis and report documents are authorized for publishing, but unknown as distributions towards investors for the current period.

IAS 1 does not prescribe the form of financial standing, it only demands the presentation of financial-accounting information regarding assets, debts, and capital, for two successive fiscal years: the current one, compared to the last one. Under these conditions, one can first present short-term assets and then long-term

assets or vice-versa, followed by short-term debts, long-term debts and capital or vice-versa.

The standard suggests, without imposing, the presentation of two important indicators, as follows:

- a presentation of net assets through the formula: Total assets – total debt = equity;
- a presentation of long-term financing, following: Total assets – Current debt = non-current debt + equity.

This balance model in which assets and debts are classified as current and non-current comes to meet economic-financial analysis of the firm from the point of view of its liquidity and solvency.

Those who see the advantages of adopting IAS/IFRS show that this process is an opportunity for firms to optimize the manner in which: it evaluates and measures internal performance; communicates with the exterior regarding more information, faster and with a higher periodicity; and, finally, obtain a competitive advantage, a higher value for stockholders, answering, thus, the demands of the market.

According to an inquiry done by Mazars – international audit and expertise organization – of 425 European firms from 6 countries, the application of IAS/IFRS is a means of development of the European capital market. This is the opinion of 75% of the listed firms questioned and of 55% of the unlisted firms which desire to apply the norms. The process regards 5 million European firms (7000 listed firms of the EU, branches of EU firms, unlisted groups which emit negotiable bonds on an EU regulated market, branches of European unlisted groups in countries in which the use of IAS/IFRS is authorized or imposed).

4. Conclusion

One may conclude that the advantages of adopting international norms may be listed as follows: they favor the construction of a unified capital market regulated by a European stock market organism (based on common accounting norms); a better compatibility of financial information is ensured in the European space. The disappearance of certain national accounting anomalies, such as the treatment of pension commitments or leasing accounting, is beneficial; analysts and investors will have more information with regards to business units (sub-units, branches) so that poor performance of some of these units will no longer be able to be hidden. This will force managers to invest resources in more profitable sectors or to more quickly improve the performance of weak links; the consolidation of results will be done on branches and activities, so that the performance of firms on geographic areas and activity sectors will be known; the increase of transparency in accounting

information will lead to new business opportunities because the cost of attracting capital will be reduced by increasing the trust of investors in financial reports and, consequently, the reduction of the risk premium they ask for; firms will be able to enter capital markets across the world without difficulties or expenditures for converting the set of financial documents; the exchange rate will be improved. This, first of all, because the value of a firm is determined by the cash flows it is capable of generating and should not be influenced by the accounting principles which stand as the basis of financial reports, or, common accounting principles being known, the accounting results will be immediately corrected in order to be transformed into cash flows. On the other hand, improving the exchange rate is also the consequence of the fact that performance previsions and cash flows of enterprises will be more secure, considering the increase in detail and transparency of the reports; some European firms and their analysts, which are represented on international asset markets, are familiar with US GAAP and UK GAAP and know, thus, the accounting principles related to communication with capital markets (considering the Anglo-Saxon source of inspiration of international norms); information and accounting service providers will obtain, in turn, benefits. Accountants because they will be trained in the explanation, implementation and application of new norms and information specialists because, to apply the norms, firms will have to change their software programing (for example, in order to take into account for assets the principle of just value, useful life-span, residual value and for stocks, net realizable value, which takes into account different expenditures, including transport).

Concerning disadvantages, one may conclude, that among the more significant ones is: for financial analyses one needs at least two years of historical data regarding pro-forma accounts which attract supplemental costs for firms. They must be compared with the risk premium which will be attributed by investors to a firm that would present significantly different costs from what it previously presented and which would only present one year pro-forma; IASB must finalize the text of certain norms, and, on the other hand IAS/IFRS is continuously changing (new concepts appear, existent standards are replaced or modified). A certain reticence, on the part of financial institutions which are directly interested in IAS/IFRS norms because they are considerably affected but which are worried by the evolution of their content and even by the uncertainty which looms over their drafting and adopting. This instability attracts some national/firm systems towards the selective adoption of some of the norms or concepts, considered to have a greater stability; some IAS/IFRS cannot be easily accepted in countries or sectors in which the respective problems are treated radically different. This is the case in Great Britain, for example, regarding the accounting of pension costs. Or, banking sector firms, financial services, energy and insurance would find difficulty particularly with IAS 39 regarding financial instruments; for the implementation of norms the appeal to external experts is necessary (especially accountants and

financial experts) but also others who offer solutions to firms regarding internal organizing procedures, communication, personnel training, IT systems diagnosis. All of this expertise attracts significant costs for the company; introduction of just value may introduce higher volatility in evaluating assets. It will have, first and foremost, an effect on financial instruments, mergers and acquisitions, tangible assets, pension obligations; new norms present interpretation risks, some accusing even a risk of "manipulation" of financial situations; another critique refers to the complexity of the norms, with inherent difficulties in comprehension and application; some difficulty may thus occur in the application of unique norms, so long as a greater diversity of sectors and activity profiles is observed; the proximity of the new norms to Anglo-Saxon concepts raises concern especially for Latin countries, because putting them into practice may give rise to vast interpretations than in these countries, in which the presentation and accounting rules are codified in a regulated manner; in this context, one may also mention certain difficulties observed by unlisted companies which apply or may apply the norms due to them belonging to a listed group or their implantation abroad. They see the adoption of the new norms as an expensive and long-lasting process which, considering they accuse limited means at their disposal and the weak impact of publishing the accounts following the new norms (taking into account that these firms do not communicate with the capital market, but, at most, with clients and suppliers).

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The Non-Financial Reporting: Goal and Perspective in the Romanian Society of the Third Millennium

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Abstract: More often, we realize that we do not live for ourselves, that the saying "seize the day" should be revised in the light of the implications of our own actions for the others and the responsibility and each one's responsibility come from the individual social consciousness, especially from the collective social consciousness. Our research is based on this background, it is a research focused on highlighting the existing climate at the national level (and here we refer to the actions of the state), at the level of business communities (the role of non-governmental organizations in promoting non-financial reporting) and at the level of the economic entities (their level to perceive and understand the new emerging needs and information requirements of the users of reported information). We aim to highlight the concerns of these actors to legislate, to propose and become responsible for the current and future state of the Romanian society. The results factually confirm that things do not stand still and that changes related to the non-financial reporting practice in Romania come to support the development presented in the international environment, both as result, and especially as part of it.

Keywords: non-financial reporting; social responsibility; regulation; non-financial information; accounting

JEL Classification: M14; M41

1. Introduction

Whether we like it or not, we are all born on this planet, being part of the great human family, and each one of us has the same right to live in a clean environment and to be healthy, while having the mission to leave behind him a legacy untainted by his actions. In this context, the business community acknowledges and accepts gradually the need to implement a social and environmental policy. For example, the environmental protection is no longer considered an area reserved exclusively

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for government and community, but rather a common responsibility of several interest groups: companies, financial institutions, managers, creditors, contractors, customers and the public. Civil society requires in turn to be consulted by industry actors and organizations are more often asked to make public their standards of ethical conduct and the financial statements or the market values. Certain industrial sectors are particularly sensitive to public opinion, in a world where communication is global and instantaneous (Nohria, 2010).

The financial consequences, the environmental responsibilities and the risk of destroying a company's reputation are good reasons to adopt standards of ethical responsibility and environmental protection in each company. Global Reporting Initiative (GRI) is one of the most known body who promotes the expansion of the entities' social responsibility. According to Brown et al. (2009), GRI was created taking into account the U.S. financial reporting system FASB, which has sought to expand it in terms of depth (global), purpose (social, economic and environmental performance indicators), flexibility (descriptive and quantitative indicators) and in terms of public interest (industry, financial sector, accounting profession, civil society, NGOs working on human rights and environment and other stakeholders).

Jianu (2012) militates for the idea that social responsibility reporting should be integrated into the financial statements, because the management as an accounting science has the ability to adapt to changes and to provide useful and relevant information about the social and the environmental. In this context, another type of reporting was born: integrated reporting. Eccles and Krzus (2010) consider that integrated reporting adds tremendous value to the company and all of its stakeholders, including shareholders, and also ultimately contributes to a sustainable society. Another reason for using social responsibility is to provide the desired information for decision making to the actors in the economic entity's life. The increase of the importance of social and environmental factors determined many entities to voluntarily provide such information (Ligteringen & Arbex, 2010).

Our approach will focus on highlighting the issues that contribute to form an image of the level reached by the non-financial reporting in Romania; from the regulated issues (identified in the national legislation) to levels of responsibility and social and environmental involvement (specific to the initiatives adopted by the non-governmental bodies) until private practices of reporting (highlights the perception of economic entities to ensure the transparency and credibility of the information presented). The structure of this paper will further present the research methodology, highlight the issues previously mentioned on non-financial reporting, and it will conclude with discussions on the non-financial reporting environment in Romania and with an attempt to design a possible evolution of this need – the non-financial reporting.

2. The Research Methodology

To report financial and accounting information is a very current issue in the theory and practice of accounting. Speaking about the goals of financial reporting, it appears as inevitable the discussion about the accounting systems of reference – the Continental accounting system and the Anglo-Saxon accounting system. Romania, a Latin country, based on Roman law system, has an orientation in the accounting theory and practice (at least in terms of normalization) of continental origin. Thus, it appears the need for insights into the steps taken by governmental bodies regarding financial reporting regulations, practically a quantitative and qualitative analysis of the texts and papers that form the lawlike luggage of the accounting normalization in our country, hoping to discover the issues related to non-financial reporting.

The perspective towards something new and the globalization of markets, especially the financial one, have brought for the economic operators the need of belonging to the common reference systems, the need of comparability and the need to be together with others. This made possible the application at the level of economic entities, in addition to national and international regulations and to the international reference system (IAS/IFRS).

The civil society is more than ever responsible and it is launching actions for the interest of both the state and the economic agents in carrying out activities placed in a less dominant logic of the dictum "profit at any cost". Here is the key to sustainable repositioning, here is the foundation of building a responsible society, practically here is the essence of non-financial reporting. The economic operators begin to see the social responsibility with new eyes, begin to approach their local communities (basically behaving as a part of them), are effective on the environmental protection and make all these concerns known for a better management of potential sources of investment.

3. The Institutional Regulation of Accounting in Romania and the Non-Financial Reporting

3.1. The Ministry of Finance

The accounting activity in Romania is regulated by the Order no. 3055/2009 issued by Minister of Finance, for the approval of accounting regulations in accordance with the European directives and the Accounting Law no. 82/1991 republished. If Law. 82/1991 is a document regulating the organization of the accounting activity, Order no. 3055/2009 regulates the financial reporting in Romania and therefore it will be our main source of information. The first part of this order is dedicated to the application of "Accounting Regulations in accordance with Directive IV of the European Economic Communities." Thus, in paragraph (5), Art. 305, Section 10

"The Content of the Managers' Report", Chapter II "The Format and Content of Annual Financial Statements" states that: *"The extent to which it is necessary to understand the development of the entity, its performance or financial position, the analysis includes financial indicators when appropriate,* ***key non-financial indicators*** *of performance, relevant to specific activities, including information about environmental issues and employees."*

At letter k) of point (1) of Art. 307 in the same Section appears information on corporate governance, point (2) strengthening the aspect of corporate governance: *"Also, an entity whose securities are admitted to trading on a regulated market, as it is defined in the legislation regarding the capital market, it will include in the same section related to corporate governance a statement which shall include at least the following information:*

a) a reference to:

- *the corporate governance code that applies to the entity and/or corporate governance code which the entity has decided to apply voluntarily. The entity shall indicate provisions which are publicly available and/or;*
- *all relevant information on corporate governance practices applied in addition to the requirements of national legislation. In this case, the entity shall make publicly available its corporate governance practices;*

b) the extent to which, according to the national legislation, the entity is distant from the code of corporate governance that applies to it or that it chose to apply, an explanation of it regarding the parts of code that it does not apply and the reasons for not applying them;"

In Note 8 "Information on employees and members of administrative, management and supervision bodies" of Section 5 "Examples to Illustrate the Explanatory Notes to the Annual Financial Statements" chapter VI "The Structure of Annual Financial Statements" shall be mentioned:

a) indemnities given to the members of the administrative, management and supervision bodies;
b) contractual obligations relating to the payment of pensions to former members of the administrative, management and supervision bodies, indicating the total amount of commitments for each category;
c) the amount of advances and loans to members of administrative, management and supervision bodies during the year:
   - *the interest rate;*
   - *the main provisions of the loan;*
   - *the repayment by that date;*
   - *future obligations such as guarantees assumed by the entity on their behalf.*

d) employees:

- *average number, the breakdown for each category;*
- *wages paid or payable for the year;*
- *expenses for social security;*
- *other expenses for pension contributions.*

3.2. The National Securities Commission

And since we talk about institutional regulation, it should be noted that at the level of the capital market in Romania, the activity is conducted by the Bucharest Stock Exchange (BSE) and carefully monitored by the National Securities Commission (Rom. CNVM). Law no. 297/2004 on capital market regulates this domain of activity. Sections from Chapter V "The transparency of issuers" of Title VI "Issuers" call into question many aspects of non-financial reporting (Section 1 *"Obligations of companies whose shares are admitted to trading on a regulated market*"; Section 2 "*Obligations of companies whose bonds are admitted to trading on a regulated market*"; Section 3*"Obligations of public authorities and international bodies that issue securities").* In Chapter VI "Special provisions regarding companies admitted to trading" of the same Title, there are many aspects related to corporate governance, in addition to those covered by Law 31/1990 "Companies Law" republished. Corporate governance issues raised by the two legal texts show that things are moving, that non-financial information has its role in assessing the performance and activities of the economic entities and that Romania is on the good track in terms of the alignment to the latest practices in the domain of non-financial reporting.

3.3. The Bucharest Stock Exchange

Also Regulation no. 6/2009 of BSE "regarding the exercise of certain rights of shareholders in general meetings of companies" comes, as evidenced by its title, to strengthen the position and the rights of shareholders. The regulation implements provisions of Directive 2007/36/EC on the exercise of certain rights of shareholders in listed companies. When referring to BSE, from its strategy on corporate governance, it is envisaged in the *"Guidelines for implementing the corporate governance code" (March 2010)* in the Recommendation no.25 it is stated: *"The company makes continuous and periodic reports on financial statements and other relevant information on the activity of the company",* basically leaving the gate open to non-financial information. Recommendation no. 36 states: "The company disseminates information on its corporate governance policy, implicitly to apply the recommendations/not to apply this code, according to the principle "Apply or Explain". The compliance statement on Corporate Governance Code that each listed entity must complete, presents the following request: "Does the issuer perform activities on Social and Environmental Responsibility of the Company?"

In the Corporate Governance Code of BSE, in Art.1 - Structures of Corporate Governance, under the auspices of principle no.1 *"Issuers will adopt clear and transparent structures of corporate governance that will be adequately disclosed to the general public",* we find Recommendation no.3 *"In the Annual Report, Issuers will provide a chapter on corporate governance in which it will be described all relevant events related to corporate governance, registered during the previous financial year. If the company will not implement totally or partially one or more of the recommendations contained in this Code, it will explain its decision in Chapter GC of the Report or annually, as well as in the statement or "apply or explain".* This is an extremely important aspect because the non-financial reporting gains the importance it deserves. In the same document, but in Article 7 *"Transparency, Financial Reporting, Internal Control and Risk Management",* under the auspices of principles no.12 *"The structures of Corporate Governance established by Issuers must ensure an adequate and continuous periodic report on all important events concerning the Issuer, including its financial statement, performance, ownership and management"* and no. 13 *"The Board of Directors will adopt strict rules, meant to protect the interests of the society, in areas of financial reporting, internal control and risk management", we find Recommendation no.25 "Issuers will prepare and disseminate relevant periodic and continuous information, in accordance with the highest standards of financial reporting – International Financial Reporting Standards (IFRS) - and other reporting standards, i.e. environmental, social and management (ESG - Environment, Social and Governance). Information will be disseminated both in Romanian and in English, as international language in finance".*

Article 10 – *The Social Responsibility of the Issuer*, under the auspices of principle 18 "The structures of corporate governance must know and recognize the legal rights of any interested third party - the stakeholders - and to encourage the cooperation between the Issuer and these ones in order to create prosperity, jobs and to ensure sustainability of a solid company, from a financial point of view". We find Recommendation no.37: "The issuers will make all efforts to integrate into their operational activities and in their interaction with the interested third party - *the stakeholders* - some economic, social and environmental concerns" and Recommendation no. 38: "The issuers will supervise the increase of the employees' level of involvement, their representatives and trade unions, and interested people outside the company - creditors, consumers and investors – in the development and implementation of practices of social responsibility of the company".

BSE and the corporate social responsibility – the code of conduct of BSE

Bucharest Stock Exchange has embraced the spirit of corporate responsibility in its strategy to meet the challenges of the educational, social and cultural sector. Social responsibility is an important part of the philosophy of Bucharest Stock Exchange,

and extending this belief to the level of each company and institution in Romania, we believe that we shall, in addition to the continuous improvement of products and services, get involved with the sense of responsibility in solving the problems of the community and to act responsibly towards the society in which we operate. BSE has prioritized its corporate responsibility policy in three areas regarding education, talent support and volunteering.

In the spirit of promoting and enhancing the sense of social responsibility, the Bucharest Stock Exchange has set the following objectives:

- the development, among employees and management, of a culture of social responsibility to the company and brand, on the one hand, and to the problems around us, on the other hand, and the creation of a sense of social responsibility among participants to market;
- the expansion and strengthening of the CSR BSE program at the level of BSE Group;
- the development of medium and long term partnerships for the purpose of running corporate programs in the directions provided in the social responsibility policy.

4. The Non-Financial Reporting, a Current Concern for the Civil Society- Social Initiatives to Ensure and Strengthen a Sustainable Environment

4.1. The Green Revolution Association

Founded in March 2009, it is the first non-governmental organization of urban ecology in Romania. Green Revolution promotes and implements green measures underlying the construction of an eco-city: urban design, spatial planning, local policy reform and control of the activities with environmental impact. The goal of this association is to build a sustainable and healthy community from a social perspective which generates economically viable solutions. Green Revolution promotes and supports:

- Legislative environmental projects;
- The adoption of an environmentally responsible behaviour by authorities, private and state companies;
- The protection and expansion of green areas inside and outside the cities;
- The decrease in consumption of energy and raw materials;
- Environmental education and respect for the environment;
- Separate collection of packaging waste;
- Ecologic and economic solutions and means of transport;

- Use of bicycles as alternative means of transportation, making track systems for cyclists;
- Organic products, healthy food;
- Eco solutions and equipment intended for mass consumption;
- Green buildings.

In two years of existence, the Green Revolution Association showed that the imagination, energy and enthusiasm of a young team have been able to develop local and national projects: the campaigns Capital grows Green, Green Parliament and Law 132 - Public Institutions collect selectively, the proposal of the Barbecue Law, the top of environmentally responsible companies in Romania - Green Business Index, the conferences Romania on the road to Copenhagen, Romania and the climate change and Romania between Copenhagen and Cancun, the multi-annual projects of bike-sharing La Pedale, I'Velo, StudentObike, bikes with tie or Law 132/2010.

4.2. Green Business Index (GBI)

The companies' barometer of responsibility towards environment in Romania, GBI, is a project that monitors the green initiatives of the Romanian business sector. In its third edition, Green Business Index is the only free tool to evaluate the companies' responsibility towards environment in Romania. It also provides assistance and training to improve their environmental performance. The project is based on environmental performance indicators that are internationally recognized: ISO 14031, ISO 26000, ISO 16001 and it is developed with the support of a team of senior experts. Green Business Index is supported by strategic partners, with relevant expertise in environmental protection and in sustainable development: The Institute of National Economy, Faculty of Transport (Bucharest Polytechnic University).

Depending on the two largest sectors of the Romanian economy: industry/manufacturing and services/trade, GBI evaluates the environmental responsibility of companies in the following areas of analysis: sustainable development, environmental impact, sustainable transport, the use of resources, the state of buildings, green purchasing and the management of waste. GBI has a triple functionality. On the one hand, it is designed for companies as support and training tool for improving environmental performance. On the other hand, for authorities, its role is to encourage environmental protection by law, on macro and microeconomic level. And for media and public, GBI is a means of sustainability reporting in the business of our country.

The 2011 Edition of the GBI revealed that the incorporation of sustainable development in the policies and processes of a company involves the refinement of

management systems, practices and procedures. To ensure that the Sustainable Development Strategy is implemented, managers must conduct a constant monitoring of environmental performance. According to art. 94 (1) letter d) of OUG no.195/2005 on environmental protection, the operating companies with significant environmental impact are required to organize their own structures that are specialized for the protection of the environment. According to Green Business Index survey, 67% of surveyed companies said that under the law, they must have a Sustainable Development Strategy and support staff for environmental management, safety and occupational health and they comply with their duties in this respect. Only 8% of the companies included in the GBI this year said they had already implemented a Sustainable Development Strategy, although they are not legally required to do so. All on their own initiative, 15% of surveyed companies plan to implement such a Strategy. The remaining 10% of surveyed companies are not required to have a Sustainable Development Strategy and they did not express their intention to implement such a plan.

4.3. Forum for International Communications Foundation - The CSR Romania Programme

CSR Romania is a long term programme which aims to promote the concept of corporate social responsibility and all that it means: good business practices, ethical standards that function as landmark in relations between companies and society, ethical responsibilities of managers and shareholders towards communities, consumers and environment. The CSR Romania Programme started in March 2006. In October 2006, the programme expanded with the launch of the section "Ethics and Business Communication." The programme involves the organization of debates which aim to bring face to face Romanian and foreign managers and specialists to identify the ethical issues in the Romanian business environment.

This non-governmental organization has conducted a research in the business environment in Romania with the aim to see the opinions of business people regarding two of the most controversial issues in the CSR domain: the transparency in policies of corporate responsibility and the credibility of companies that carry out social programs. We will present the idea in which our research was conceived and carried out, emphasizing the quantitative approach, in order to be able to appreciate a certain level of non-financial reporting among economic entities. The criteria that define transparency are found in 19 questions. The questions addressed issues of social and environmental audits (social auditing and areas covered by the audits), social reporting (publication of reports, their credibility, target groups in the report), the code of ethics (the existence of the code of ethics, its publication), social investments (evaluation and publication of evaluation results, the evaluation methods used, the areas of social investment, investment target groups). The survey

was conducted from February 19 to March 2. The study was conducted online, on 250 business representatives involved in CSR. The research had two stages, the first one was quantitative and the second one was qualitative; the latter analysed the answers to a set of questions for the respondents to the survey.

55 businessmen answered the questionnaire, the response rate was 22%. 61% of respondents say that their companies are not socially audited and do not publish social reports. According to the results, 24% of companies are socially audited. Multinational companies prevail among socially audited companies. The companies which are not socially audited operate in the industries of alcoholic beverages, banking, pharmaceuticals, software, telecommunications, energy. Almost half of unaudited companies are multinational companies. It is to note that, although they deal with CSR, 14.8% of businessmen say they do not know if the companies where they work are socially audited. In a significant percentage, 37% of respondents say that their companies publish social reports. However, most of these companies do not have social reports published on sites. Among respondents, 16.7% of businessmen have not heard of Romanian companies that report socially, 11% say that the social reports of companies are not credible, and 53.7% say that they find credible the social reports. Businessmen consider that the main issues that must be taken into account by a social audit are related, in order of importance, to the relations with local communities (77.8%), rights and working conditions of employees (74%), consumers (66.7%) and the environment (66.7%). Respondents argue that recycling, the decrease in energy consumption and the prevention of water and soil contamination are the main environmental issues that their company should be concerned about.

In a large proportion, 76%, businessmen say that their companies have ethical codes. Also, the main ways in which organizations promote their ethical code are: internal communication channels (74%), training (46%) and corporate web-site (43%). According to the research, ethical codes are addressed primarily to employees and unions (81%), corporate customers (46%) and shareholders (41%). 87% of respondents say that their company invests socially. In an even higher percentage, 93%, businessmen believe that the organizations for which they work should invest in community issues. In contrast, 35% of respondents admit that their company does not evaluate social investment programs. The main methods for evaluating social investments are, in order of importance, the invested budget (70%), newspaper articles (55.6%) and reports of NGO partners in social projects (48%). The areas of social investment preferred by companies are: training and professional development opportunities for employees (94%), education (70%), working conditions for employees (69%), culture and art (63%). Finally, the social investment areas preferred by employees are: training and professional development opportunities for employees (69%), education (69%) and working conditions for employees (63%) “.

This study shows that things start to happen, that there is concern from the economic entities' side, that we have models and that there is concern from someone (the civil society) to monitor the activity of the economic entities.

5. The Non-Financial Reporting - The Link that Makes Possible: The Complete Report at the Level of Economic Entities

In this part of our research we aim to illustrate the non-financial reporting state reached by the economic entities in Romania, by following the reports published on their websites and by highlighting the issues that concern us. We will try to outline whether the measures imposed by the law brought into question in the first part generates results, or whether the economic entities act to fulfil these new dimensions of reporting and how they do it. Thus, we accessed the websites of some of the most representative and popular economic entities that operate in Romania.

5.1. Coca-Cola

Worldwide, the Coca-Cola Hellenic Group is recognized for the way it reports its economic, social and environmental performances. Its CSR reports include information about the activities in Romania and they are available on the Group's website. Since 2003, these reports are in accordance with the GRI (Global Reporting Initiative) standard. In 2005, Coca-Cola Hellenic joined the UN Global Compact, pledging to respect the 10 principles of the organization. Since then, the quality of its reports has been recognized by UNGC, every year, by their inclusion in the list of Notable COPs (Communication on Progress). Since 2000, the company was listed in the FTSE4Good index, and since 2008 in the Dow Jones Sustainability Index. In Romania, as well as internationally, the company promotes social responsibility by investing in 4 directions: work (the employees' improvement), market (the consumers' health), community and environment (the conservation and protection of water resources, energy and climate protection, the recovery and recycling of packaging).

5.2. BCR - Romanian Commercial Bank

For BCR, long-term investments are important in areas that directly contribute to a healthy development of the community. Therefore, the bank develops community projects especially in areas such as Education (especially financial education), Entrepreneurship and the Social. Also, secondarily, the bank is also involved in areas such as Culture, Media and Sport. BCR's CSR initiatives are coordinated by the Department of Community Relations. It also runs the analysis and selection

process of sponsorship applications coming from outside. BCR is trying to put its employees' volunteering in the centre of all CSR initiatives. The ambition of the bank is to turn each colleague into a messenger of BCR's involvement in community life. Every year, hundreds of the bank's volunteers deliver financial education in schools, provide entrepreneurial advice for students (e.g. "START! Business"), are involved in planting activities (e.g. "The BCR orchard") or contribute with various donations to programs for the benefit of disadvantaged people (e.g. "The food bank"). A major objective of the BCR is to help young people understand the principles of a healthy management of both money which they have at present and especially the one that they will earn in the future, as responsible adults. Among the most popular programs of the bank in financial education, there are: "My Finances" (addressed to high school students) or "The School of Money" (addressed to the public). BCR is part of the international financial group Erste Group, whose majority shareholder is ERSTE Foundation. Therefore, social solidarity is part of the core values of the bank's business model. Every year, BCR is involved in dozens of charitable projects to help some disadvantaged groups. Among others, BCR is a strategic partner of the NGO Save the Children Romania, and more than 2,500 disadvantaged children in educational centres of the organization benefit from the financial support. Another well-known example is the educational project "BCR Hopes". A report BCR - Good CSR 2009, produced as part of the Good CSR 2009 regional programme, organized by Braun & Partners agency. The BCR Report was awarded the prize for the best short report of Romania, at the Good CSR Gala, held in November 2009, in Budapest.

5.3. Dacia Groupe Renault

Dacia was founded in 1966, in Colibasi, Arges county, being the brand around which the automotive industry in Romania was created and developed. Since the beginning, there were close ties of cooperation between Dacia and Renault, the French manufacturer being at the origin of the automotive industry in Romania. On July 2, 1999, Dacia becomes the brand of Renault Group by signing the privatization contract of the company. With an investment of 489 million euro, the factory in Pitesti is now at the highest European standards, with working methods applied in the Renault Group factories. Dacia is in pursuit of sustainable development, which refers to 3 dimensions: economic, environmental and social. *"We started to rebuild and sustain the economic dimension: in 2005, with over 170,000 produced and ordered vehicles and with a turnover of 1.2 billion euros, Dacia was again a profitable company and an important vector of the economic development. Our environmental concerns have resulted in bringing the factory in Pitesti at the appropriate level of quality and in obtaining the ISO 14001 certification. Regarding the social domain, we did not want to focus our actions*

within the company, but we decided to make Dacia a society open to the outside, to interfere in matters of Romanian society and to help solving them".

And we stop here, not because we treated the subject substantially, but because we consider that we provided enough light traces about a beginning (an extremely shy one), but still a bright one, if we think at the power of example. We need examples, we need results, we need a readjustment of the individual conscience in the interest of the contemporary society, its values and goals.

6. Conclusions

We wanted to emphasize and we think we managed that reporting, at the level of the economic entities in Romania, is in a new era, the era of completing the financial information with non-financial information, the era of completing the Conceptual Framework of financial reporting with the Corporate Governance Framework, the era in which the concern and responsibility of the companies for profit is translated as Corporate Social Responsibility.

The three steps presented in our approach reveal the existence of regulations that enable the non-financial reporting, the careful monitoring of non-governmental bodies, of responsible practices and actions undertaken and reported by the economic entities, and even more each economic entity develops and reports according to rules and ideas which they individualize and rank in the landscape of the economic, social and business environment. Emulation is specific to business sector. Therefore, we tried to illustrate as varied as possible (from the institutional regulation to the actions taken by the economic entities, all under the close supervision of civil society through non-governmental organizations) in order to give a correct image of the area of non-financial reporting in Romania.

Beyond the ethical arguments, the report of non-financial aspects (the socially responsible behavior of the economic entities) has become a major competitive advantage. The adoption of CSR practices will increase as companies will understand their importance in order to reach the objectives of business. Thus, the present study, without claiming to be complete, is a reference point, which certainly will improve over time, based on the feedback provided by the local market and by international developments.

It is interesting to emphasize that the law like aspect of the regulation of non-financial reporting in Romania is not meant to limit the companies' own possibilities, as it has been very obvious in the three cases presented (Coca-Cola, BCR and Dacia). The commercial entities are able to achieve this reporting according to their own visions, in agreement with the information needs expressed by various categories of users of the information reported.

7. Acknowledgements

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Structural Analysis of Human Resources within a Company

Cornelia Tureac[1]

Abstract: The study analyzes the issues of human resources within a company, namely commercial services and service delivery. Although the technical progress has reduced substantially the human presence in some production processes, at any stage of development of mankind it was not noticed any economic process that can dispense the human contribution. The used method of analysis is the structural one. It highlights certain features of the labor force of a company. The economic and financial analysis involves dividing the labor force of a company after its occupation.

Keywords: human resources; services; economic and financial analysis; labor force

JEL Classification: E44; F16

1. Introduction

The essential objective of job analysis is to determine the duties of a job within an organization and in the manpower, in terms of dexterities (skills), knowledge, abilities and experience to successfully accomplish the tasks; the job analysis provides data for developing the job description and the specifications of the job. It is also the basis for: defining the job, job redesigning, recruitment, selection, orientation, training, career counseling, performance evaluation and compensation (salary). The evolution of jobs during 2006 - 2012 is as follows:

Table 1. The number of jobs in the 2006 - 2012

Compartment	2006	2007	2008	2009	2010	2011	2012
Management	3	3	3	3	3	3	3
Supply	9	10	13	15	26	29	33
Financial-Accounting	4	4	5	10	14	15	17
Sales	19	32	38	55	80	85	98
Total	**35**	**49**	**59**	**83**	**123**	**131**	**151**

Source: www.firme.info: Human Resources Department SC x SRL

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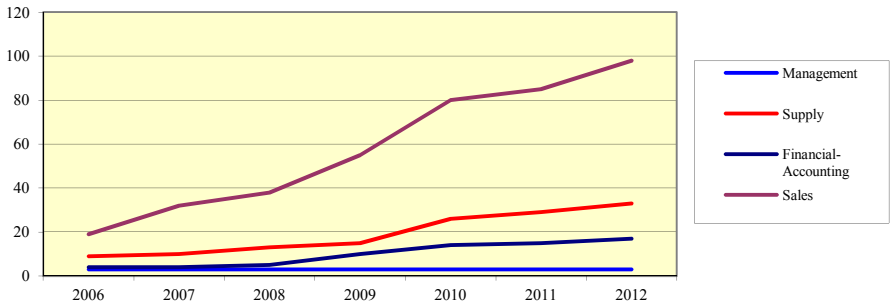


Graphic 1. The evolution of the number of jobs in 2006 – 2012

Source: www.firme.info: Human Resources Department SC x SRL

In the analyzed period the number of jobs increased by an average of 18 jobs per year due to the investments made in the opening of new outlets and in the diversification of construction activities of cold storages.

2. Method of Analysis

As method of performed analysis we used structural analysis on levels of structure positions, organizational, rates method by calculating the share of different categories of staff in the company's total staff.

3. Results and Discussion

Workforce available to an economic agent is evidenced by the number of staff employed, an indicator which can be determined at some point or for a period of time. The number of personnel at a time represents the effect of employees and it is aimed at the beginning and the end of the period. It characterizes the human potential that it is available to the unit and it is considered as an indicator of stock.

4. Structure Analysis of Jobs

Table 2. The number of jobs in 2012

Compartment	2012			
	Total	Higher education	Secondary education	comprehensive school
Management	4	4	-	-
Supply	33	7	15	11
Financial-Accounting	16	2	14	-
Sales	98	-	85	13
Total	151	13	114	24

Source: www.firme.info: Human Resources Department SC X SRL

There is a continuous increase in personnel during the analyzed period. Achieving the objectives related to the basis activity of the company, in terms of economic efficiency, or it is conditioned by the insurance of the company with the necessary workforce, in number and in structure. The personnel movement is characterized by a system of indicators:

1) Indicators of labor mobility:
a) indicators of the labor force movement:
- the average coefficient input of staff;
- the average coefficient of the outputs of staff;
- the average coefficient of the total movement.

b) indicators of labor force fluctuation.

2) Indicators of labor force stability.

Staff input coefficient (ci)

$Ci = \frac{I}{Np}$, where:

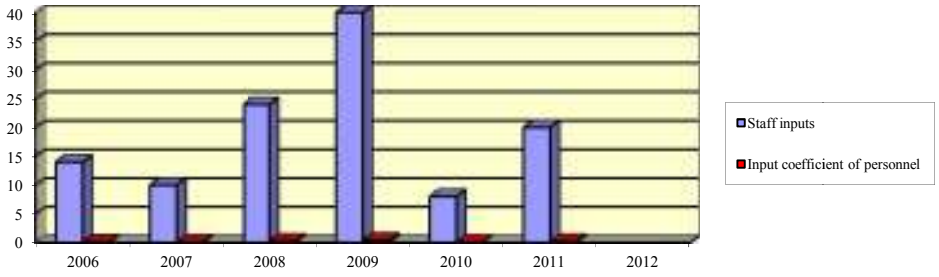
I = input

Np = average number of personnel (90.1)

Table 3. The analysis of the coefficient of the personnel inputs

Year	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012
Staff inputs	14	10	24	40	8	20
Input coefficient of personnel	0,15	0,11	0,26	0,44	0,08	0,22

Source: Analyzed by the author according to the data: www.firme.info: Human Resources Department SC x SRL



Graphic 2. The evolution of staff inputs coeficient

Source: Analyzed by the author according to the data: www.firme.info: Human Resources Department SC x SRL

From this figure it can be noticed that in the years 2009-2010 there were employed more people. Employment rate in 2011-2012 was resumed as the investments made by the company required additional personnel. In this period there were opened new outlets in Vaslui and Huşi.

The Coefficient of the output personnel (ce)

$Ce = \frac{E}{Np}$, where:

E = output

Np = average number of personnel

In the analyzed period review we do not have personnel outputs.

Total movements coefficient (cm)

$Cm = \frac{I + E}{Np}$ where:

I + E = inputs + outputs

Np = average number of personnel

This coefficient has the same coefficient values as the personnel entries. There were outflows of personnel.

The coefficient of staff fluctuation (cf)

$$Cf = \frac{En}{Np}$$ where:

En = total staff outputs for unjustified reasons

Np = the average number of staff

In the analyzed period we have no staff outputs.

The analysis on the basis of these indicators is performed in the dynamics from one period to another, for at least 3 to 5 years. Such an analysis highlights the increasing or decreasing trends of the phenomenon of staff movement. Between the labor force movement and fluctuation there is a clear distinction:

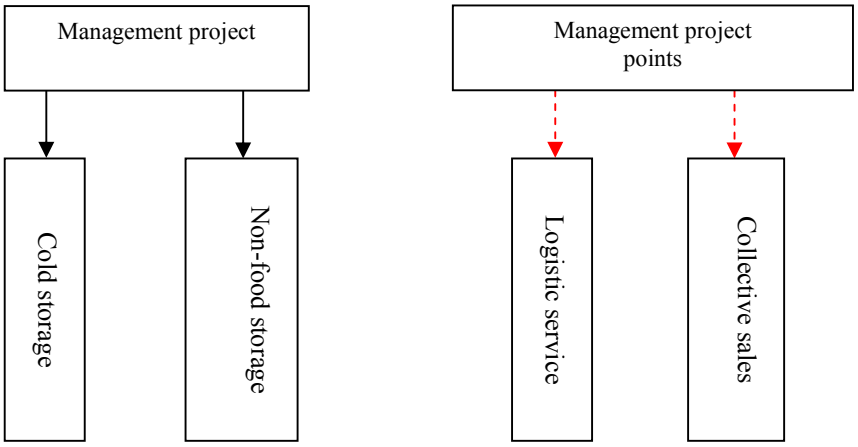
Movement = is the mobility of an enterprise during a period, from the point of view of inputs and outputs in terms of normal reasons: transfer, illness, retirement, death, disability.

Fluctuation = is an abnormal phenomenon that refers to labor force outflows without the approval of the management of the company, or the termination of the labor contract as a result of a violation of the labor contract.

5. The Analysis of the Organizational Chart

Human resources (HR) in the SC x SRL represents the department which starts with determining the correct number of trained people, in well-established positions at the right moments. The organizational company since 2006 has known a development and a transformation due to the activity diversification of commercial services and due to the opening of new outlets. Thus the implemented method since the opening of the company was leading through projects which presupposed a close collaboration between the departments. The form of organizational structure is of individual type.

Figure 1. Individual type 1 Organization in SC x SRL



Source: Adapted by author according to (Radu, 1995)

Table 4. The structure human resources in the SC x SRL in 2012

Training	Total	Men			Women		
		Higher education	Secondary Education	Comprehensive school	Higher education	Secondary Education	Comprehensive school
Manager	1	1					
Economic Director	1	1					
Commercial Director	1	1					
Experts in the science of commodities	18	3	13		1	1	
Data validation Operator	10	1				9	
Management accounting	4				4		

Storage keepers	21	1	4			16	
Salesmen	53		22			31	
Drivers	18		18				
Unqualified workers-manipulator	24			21			3
Total	**151**	**8**	**57**	**21**	**5**	**57**	**3**

Source: Processed by the author according to www.firme.info: Human Resources Department SC x SRL

6. Structural Analysis of Human Resources

Such an analysis is necessary to highlight certain features of the labor force of a company. The economic and financial analysis involves dividing the labor force of a company according to its occupation.

In this sense there is the following grouping of the staff:

1. Staff:
   a) direct-productive;
   b) indirect-productive.
2. Economic trained personnel;
3. Management and administrative staff;
4. General service personnel: guards.

Such an analysis, in relation to the occupation of the personnel highlights the needs skilled employment or dismissal of personnel. From the structural point of view, the human potential in a society can be grouped on other criteria such as:

1. by age:
   a) under 25 years;
   b) between 26-35 years;
   c) between 36-45 years;
   d) between 46-55 years;
   e) over 55.
2. by the seniority in the society:
   a) less than 1 year;
   b) 2-5 years;
   c) between 5-10 years.
3. According to the gender:
   a) men;

b) female.

4. According to training:

a) workers (skilled, unskilled)
b) specialist staff (with secondary or higher education);
c) administrative-technical staff (with secondary or higher education);
d) management staff.

5. According to the functions of the company:

a) research - development;
b) production;
c) marketing;
d) staff;
e) financial-accounting function.

As analysis methods there were used the rates, by calculating the share of different categories of staff in the company's total staff.

In the SC x SRL, in structural terms, the staff can be grouped at the end of 2012:

1. by age:

a) between 20 -34 years - 44%; 57 people
b) between 35-49 years - 56% 84 people

2. according to the gender:

a) Men - 86 people
b) Women - 65 people.

3. According to the training:

a) higher education – 13 people
b) secondary education -114 people
c) comprehensive school - 24 people

7. Conclusions

According to the data provided by the human resources department, it appears that the company has qualified, young staff. Due to the opening of new outlets, the staff is predominantly male, especially in unskilled occupations where physical force is required (manipulators). The society is considering the age experience, training and retention of new employees through bonuses and rewards. Redesigning represents a solution to solving the situation taking into consideration the main structural and functional parameters of the overall management and the major components (organizational, decision-making, information and methodological). Through

redesigning, it ensures both flexibility of management system and an increase in its capacity to receive, maintain and apply the new, generated for change.

By management redesigning we can implement a new management system that allows a greater freedom of decision-making of the management at the level of the considered organization, assuming that it acts as a specialist and that the freedom will not damage the organization, it is a much more motivating system; a system which enables a rapid adaptation to the market changes, so a flexible system, that is exactly what the company needs.

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The Training Process of Civil Servants Employees in Ministry of Economic Development in Kosovo: Effect of Training through the Prism of Participants and Interpretation of Employee Questionnaire Survey

Florina Mehaj-Kosumi[1]

Abstract: The Institutions of Public Administration in the Republic of Kosovo are relatively new institutions. This Paper addresses the need for a more carefully specified training process for the civil servant employees of the Ministry of Economic Development [MED]. The paper has assessed the trainings provided during the period 2005-2011, focusing on the effects and results for increase of skills and knowledge of trained employees. Despite the large number of training topics it has never been clear how effective they were, what knowledge and skills the employees gained through these trainings and whether they have increased their skills and applied in their workplace. This study was conducted to improve the performance of MED employees and to design trainings that enable employees to gain new skills and knowledge. During the research activities, especially from the first survey conducted with MED officials it was noticed that there was a discrepancy between the organized training courses and shown results at work by the trained officers. It is recommended to design an effective evaluation process on training. MED, has not issued any report on how effective the previous training have been, what new skills and knowledge an employee has applied at his/her workplace. This lack not only faded the whole process of trainings, but it demotivated employees on taking seriously the training process

Keywords: Training; Civil Servant; Ministry of Economic Development

JEL Classification: G18; F00

1. Introduction

In parallel with the recruitment process there is also a need for training employees in order to accomplish their duties and responsibilities in more efficient way. The Law on Civil Service of Republic of Kosovo is the basic law for employees in the public sector which states that the civil service should be composed of professional employees, who would be politically independent, and be included in the system based on merit. The Law on Civil Service "sets the rules for the overall management and organization of a politically neutral and impartial Civil Service, the rules on the admission to the Civil Service, working conditions, the rights and

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obligations of staff, personal conduct, career progression and professional development of Civil Servants".[1] Article 35, defines rules and obligations for the Civil Servant's Capacity Building where it states that "all Civil Servants are eligible for and also required to upgrade and enhance their professional capacity through training in the Civil Service. Civil Servants may also be authorized to attend, outside the Civil Service, specialized educational programs, for their professional development, as long as relevant for the Civil Service of Kosovo." Another issue that is worth to emphasize, which is also related with the training process, is the evaluation of the performance of the civil servants. This assessment, according to article 33, defines that the Performance Appraisal of the Kosovo CSL shall be conducted periodically at the end of each year, and the purpose of it is "to enhance work performance and to ensure the gradual improvement of the professional capacity and quality of administrative services". The results of performance appraisal shall be used to identify training needs of each civil servant employee and their eligibility for career advancement.

2. The Training Process of Civil Servants Employees in MED From 2005-2011

There is no central planning for developing a training program or co-ordination of training activities for MED, despite the fact that training and capacity building is one of the main challenges and permanent tasks of the Ministry of Economic Development. Training and professional education is developed and implemented on department levels and sometimes on individual levels. As all civil servants in the Ministries of the Government of Republic of Kosovo, MED employees too can participate in a broad range of training courses on topics related to administration. An Executive Agency is established within the Ministry of Public Administration (MPA) and its aim is to support Kosovo Public Administration through staff training in the field of good governance, management, administration, legislation, human resources, budget and finance, information technology and municipal issues. The MPA determines development policies of Kosovo Civil Service. KIPA, on the other hand, develops and implements training policies for KCS. The largest number of civil servant employees trained from 2005 until 2011 is during 2009, which expressed in percentage is 44%, while the lowest number of trained civil servants employees is in the first year of the Ministry's existence in 2005, which expressed in percentage is 22%.[2]

Below are presented training courses on different fields held from 2005 through 2011. They are summarized in eight different fields (general management, legislation and administration, human resources, budget and finance, EU and

[1] Law No. 03/L-149 On the Civil Service of Republic of Kosovo.
[2] Personnel civil service database in MED.

human rights, English language, IT, professional trainings). Training topics during the period from 2005 up to 2011 were mainly on general management issues about 32%, while training topics on professional or specialized sectors as on energy or mining sectors were not sufficient, there were only 14% of overall trainings held during these years.

2.1. Why were Trainings Conducted?

The most important resources of the public administration are its employees, as it is a case with all organizations, and the key to their successful functioning depends on the results of activities and outputs of the employees. "The public administration is grounded in a strong desire to serve the public and solve its problems"(Starling, 1986, p. 7). Since its establishment, the management of MED is focused on training and developing its employees in order to accomplish the goals of Ministry. As it was noticed from the analysis of the training process from 2005 through 2011, MED management provided its employees with general trainings needs such as General Management and Administration, Information Technology, English Language, Finance, etc., which were designed and implemented mostly from KIPA.

The Ministry itself did not have any training program, designed according to the needs of employees. The Ministry trained its civil servant employees mainly according to KIPA's plan that existed for the whole Kosovo Public Administration and also by ad- hoc trainings that were offered to the employees through consultancy. So, MED did not have its training program for its employees and training topics were not in accordance to employees' needs. Also, training topics were not important and in accordance with policies of the Ministry. In the first year of the existence of the Ministry trainings offered in General Management and Administration were welcomed but, over time the offered training programs were not sufficient to employees. As a result each employee is faced every day towards new era, that of new technology and broader knowledge. So, the training needs rise from day to day because there was a need for progress, competition and training development for every employee.

In order to be successful in achieving its strategies, mission and goal, MED needs to develop various trainings that recognizes, supports, and promotes learning within the Ministry. This training development is very important, both for the ministry and for employees as well, because it impacts their performance and motivation. The Law on Kosovo Civil Service defines trainings as a right and obligation for civil servants and emphasizes the link between their performance and training. So, under this law, "Civil servants are entitled and obliged to increase their professional skills through training in the Civil Service. Results of performance appraisals should be used, inter alia, to determine individual or group

training needs of civil servants."[1] Civil Servants employee shall be eligible to access training, which is relevant to their function and represents an advancement of their professional and/or academic career. The target is to build up the capacities of MED civil servants through qualitative trainings. Building up a powerful, accountable and professionalized public administration according to international standards is one of the Ministry's needs.

2.2. Who Financed Trainings and How Much Budget was Spent?

The budget is important because through it the ministry implements its policy development. "Budgets can be a rich source of information on government programs, employment and performance, among other things"(Mussel, 2008, p. 2). The process of budgeting is always difficult. There are more demands from departments of the Ministry than those that can Ministry approve. Ministry approves only those projects that are necessary and fully justified and enables the Ministry to achieve its goal. The Ministry's budget demands are always larger than government's opportunity to receive and to finance them. Despite difficulties and dissatisfaction of all parties, the best budget is considered the budget which is allocated for the realization of basic programs development policies of our ministry. MED's budget is divided into different categories. There is a category for salaries and wages, capital investments, subsidies, utilities and for goods and services. Within the category of goods and services there is a sub-category for educational and training services. The table 2-2 presents allocated budget for educational and training services through past six years. The overall budget of the Ministry was approximately 2 million Euros per year, while for the educational and training services has been allocated only 2%.[2] All trainings delivered by KIPA were financed from the budget of the Republic of Kosovo, which is allocated from Government for KIPA Institution under MPA to provide and implement training courses for all civil servant employees of the Republic of Kosovo, in the central and local level.

3. Effect of Training through the Prism of Participants And Interpretation of Employee Questionnaire Survey

In order to understand the impact of the past trainings, strengths and weaknesses, a survey was conducted with the civil servants of the MED. The method used is a questionnaire method. A questionnaire composed of six parts has been designed. The first part deals with background information of employee and the current

[1] Law No. 03/L-149 On the Civil Service of Republic of Kosovo, Article 35.
[2] Database of the Budget and finance division in MED.

position held. The second part deals with employee opinion on overall job satisfaction at MED. The third part of the questionnaire deals with MED management, especially with the treatment of employees at the Ministry. Through the questionnaire we also learn about the level of communication and teamwork building at the Ministry. A particular attention in the questionnaire was given to the past training process and the employees' recommendation for future trainings. The questionnaire has been sent by email to 119 MED employees out of whom 56 have positively responded to. The highest percentage of respondents fall in the professional level 68%, followed by managerial level with 27% and the lowest percentage is in administrative level 5%.

3.1. Job Satisfaction

The second part of the employee questionnaire deals with job satisfaction of employees. The employee overall satisfaction in MED, where 64% of respondents answered to be satisfied with their work. The percentage of 64% of satisfied employees is an important indicator to how satisfied are the employees with their work. Only 4% claim not to be satisfied. To the question which aspect of their job was the most challenging and enjoyable, respondents answered that the professional one is more so. About 77% answered that the professional part was the most challenging and enjoyable part of their job.

3.2. MED Management

The third part of the questionnaire deals with MED Management, where 37% of respondents agreed on fair treatment.

3.3. Communication and Teamwork

The questions of the fourth part of the questionnaire address the communication and teamwork relations of the employees at the Ministry and with given support for the application of the gained knowledge at the workplace. The respondents answer about their view for communication process in the Ministry. 34% agree that is a good communication, 29% strongly agree, while 30% were neutral and 7% disagree about it.

3.4. Past Trainings

The fifth part of the questionnaire is one of the two most important parts. In this part there are questions that directly deal with the past trainings of employees. Participants of the trainings responded to these questions on the benefits and

weaknesses of the trainings and the opportunities for applying the gained knowledge at their workplace, so we will treat each separately.

Only 4 % of respondents answered negatively to the first question of this part, more precisely, the trainings they attended did not enable them to perform better. The question had to do with the assessment by respondents of any benefit from the trainings, not implying the approval of the training they attended. The respondent answers to find out whether attended trainings enabled employees to perform better.

3.5. Recommendations for Future Trainings

In the last section of the questionnaire questions related to the duration of trainings and participants recommendations about the future trainings are included. This section is one of the second important sections of the questionnaire, which directly affects the essence of this capstone project; it will be treated separately one by one.

The duration of trainings is treated in the first two questions of Section F. The seventy seven (77%) percent of trainings lasted 2-4 days per year and fifty two (52%) percent of respondents think that the duration of trainings has been sufficient. A large number of participants, about forty eight (48%) percent of respondents think that the training they received was not sufficient.

About seventy nine (79 %) percent of respondents would prefer a training program that closely linked to the work they do at the Ministry.

Attended trainings are valuable, but not as much as for employees concrete work and those respondents want trainings that directly relate to their work.

The majority of the respondents have recommended training topics related to their work or an issue related to their department. So, most of them have required a specific training topic related close to their work at the Ministry. But some responses appear to be general training needs, such as training for English Language etc.

By reviewing the proposed topics for future trainings, we notice that very few topics are proposed by more than one official. The major change of topics can be understood as the tendency of officials to completely specific training for jobs that they do in the Ministry. Each job position requires some specific skills, thus gaining those skills requires specific training, with specific topics, that are not similar with other specific topics of other job positions. An illustrative example is the officers' demand for training in the field of software application. A large number of officers have required software training, but each application is different from another, based on the needs of their job position.

Officials are not sure that the length of training 2-4 days per year is enough for the work they do, so, most of them prefer a more specialized training for the work they do. Therefore, a more specific training for their work and their preferred topics are mainly closely related topics with the work they do in the Ministry.

4. Conclusion

To summarize the research, based on the analysis in this project of the MED past training programs and policies, of detail trainings courses for the period 2005-2011, surveys done with civil servant employees in MED, and directors of all departments of the ministry, detailed findings and recommendations are presented.

- Within the Strategic Development Plan of MED, a special attention should be given to the employee training process. This would create a policy base for future approaches for trainings and would eliminate the current ad hoc practices. In this direction a significant progress has been made by drafting the Strategic Development Plan of MED for period 2011-20014, in which training is considered but no special measures have been indicated. The ministry should clearly define its employees training needs and must see the training issue as a continuous process.

- The Ministry must draft an operational plan or a detailed plan for trainings in compliance with MED Strategic Development Plan. The plan should be draft annual to foresee training topics in detail, estimate the training budget, its participants, time and place of training.

- MED should set a mechanism for assessing the effectiveness of the training programs. First, at the end of the each training, the employee should compile a brief report about followed trainings in which he/she will emphasize what performance improvement will be generated and what knowledge and skills will be gained. Second, MED should also draft an annual report on evaluation of training programs which should be compiled by directors of departments and the general secretary of the ministry. The report should emphasize training policies and their concrete effects which derive from direct results of trained officials.

- For the purpose of exact determination of training topics and actual employee training needs MED must classify types of trainings into three groups: (1) General trainings which should be organized as a result of changes in laws that impact Ministry area of responsibility, (2). Systematic trainings or vocational trainings, dealing with a limited number of sectors, example European law that coincides with the MED area of responsibility] and (3) Specific trainings for a specific sector that requires specific expertise, such as trainings for the field of ICT, energy and mining. In its annual operational plan MED should include all trainings for each training category but a particular attention must be given to specific trainings because the employees' needs are specific for their work.

• MED should have the main role in setting each training agenda. This means that before any specific training, directors of departments should have the main role for preparations of trainings in compliance with annual training plan, including the appointment of adequate officer, time, and duration of training period.

• MED should create more favorable working environment for its trained employees in order to apply their gained knowledge and skills through trainings in their workplace. Also, the ministry should find methods and ways to motivate those officers which as a result of the followed training would achieve better job performance. Motivation could include finance rewards, appreciation certificates, or create more suitable condition for career advancement. This will drive MED towards a creation of a sustainable continuous learning environment.

• MED should create a database for employee trainings as a separate database for all held training and future trainings. Creation of this database enables that policy makers of the annual operational plan see and review past held trainings and the need for future trainings.

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Macroeconomics and Monetary Economics

Issues Regarding the Conducting of the Euro Area Monetary Policy during the European Debt Crisis

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Abstract: This article provides for the identification of the present challenges faced by the monetary policy of the European Central Bank, given that the sovereign debt crisis has complicated the pursuing of its primary objective of the maintaining the price stability. This research is a part of a larger framework, being a continuation of some previous works related to the issue of the sustainable functioning of a currency area. Based on the research of the international monetary institutions documents, we have presented "the route" of the financial shock and also the challenges facing the European Central Bank monetary policy in the current period and in the short-term perspective. The results reveal that the current crisis has been maintained and enhanced by the conflict occurrence between the "no bail out" clause provided in the Maastricht Treaty, and the "too big to fail" principle applied to the sovereign debt of the European countries. This discrepancy has undermined the confidence in the euro project at a level where the conventional channels of the monetary transmission mechanism do not work efficiently. This topical subject could be a reference for the academic research regarding the European monetary integration process and its new challenges.

Keywords: financial shock; interbank market; unconventional measures; European Central Bank policy

JEL Classification: E44; E52; H63

1. Introduction

The route of the initial shock that triggered the financial crisis of 2007 has been steered and amplified by both the financial factors (the increasing of the funding cost for the financial sector, and hence for the households and non-financial corporations; the general decrease of the asset prices with an impact on the net wealth), and non-financial factors (the pervasive decline of the economic activity which has affected the consumers'confidence and has given rise to a prudential behaviour).

In this time of crisis, the European Central Bank (ECB) monetary policy is facing with a number of challenges related to the maintaining the price stability and to the fostering the lending activity of the economy, given the uncertain environment with

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prudent investors and given the profoundly damaged fiscal sustainability for some Eurozone Member States.

2. The Interbank Market: The Spreading Stage of the Financial Shocks

In the Euro Area, the global financial shock has been most visibly reflected in the rising the gap between the different types of the interbank interest rates. Thus, in autumn 2008, the interbank market has quickly shown the engender of the Lehman Brothers bankruptcy shock[1] by rising sharply the spreads between the monetary policy interest rates and the short-term interbank interest rates: EURIBOR and OIS (overnight index swap rates). Those latter have sharply increased at the historic levels (see Figure 1).

During this period, the demand for liquidity to banks became very volatile, increasing the preference for ensuring long-term liquidity and severely affecting the redistribution of funds in the interbank market (Cecioni, Ferrero & Secchi, 2011).

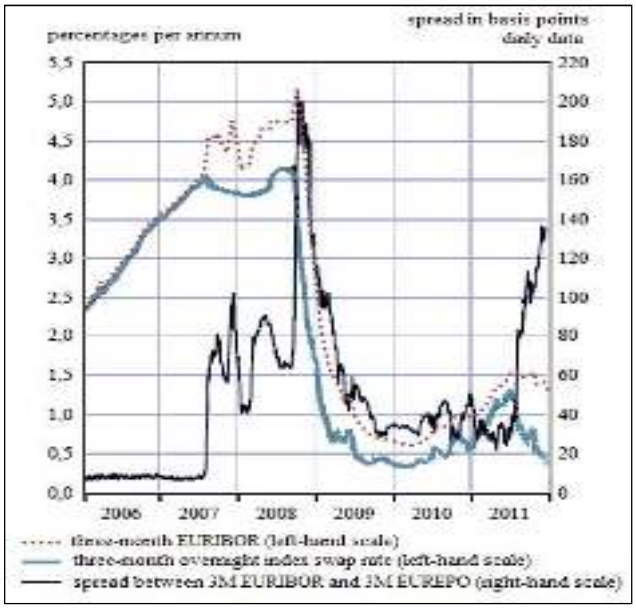

Figure 1. The financial shocks in the interbank market

Source: European Central Bank, Annual Report 2011

[1] The disruptions exhibited in the interbank market are generally an accurate signal for the evaluation of the financial shock intensity. The initial shock, in August 2007, a specific and a local one (the "subprime" shock), has also been strongly reflected in the interbank market.

The increasing of spread between the secured interest rate (the three–month overnight index swap rate) and the unsecured interest rate (the three-month EURIBOR rate) signals the propagation of the shock in the interbank market. Generally, the disturbances developed in the interbank market represent a fairly accurate indicator for assessing the financial shock intensity. Hence, the initial shock of august 2007, the "subprime" shock, has been also strongly reflected in the interbank market (see Figure 2).

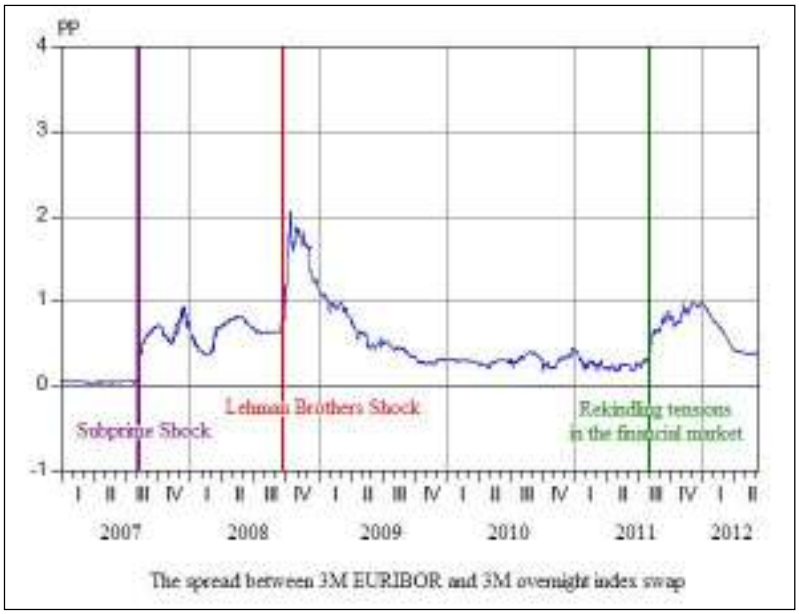

Figure 2. The signalling of the financial shock propagation in the interbank market

Source: Collignon, Esposito, Cui (2012)

The transmission of the Lehman Brothers shock has deepened the financial crisis already started in 2007 and in response to this shock, the ECB has intervened extensively in the money market by reducing the monetary policy key interest rates and by expanding the area of application for the unconventional measures. As it is shown in the Figure 3, the ECB has significantly decreased the official interest rates between October 2008 and May 2009.

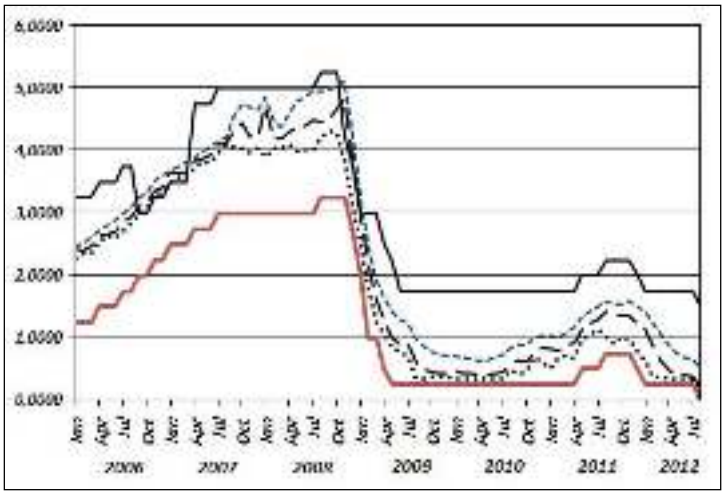

Figure 3. The development of the interbank interest rate(%)
Source: Statistical Data, ECB

In normal times, when the interbank market operate in a functional manner, the signal of change in short term interest rates cause changes in expectations and portfolio balance, which further influence other interest rates, longer term and thus eventually send in the real economy (through the two channels - the credit channel and the borrowing channel). In times of financial market turbulence and uncertainty, the interbank market is "locked" by the arising of liquidity problems so that solvent banks may have difficulties to borrow. In this case, signals using conventional tools of monetary policy are no longer effective.

The asymmetric information, specific to the financial market, underlies of the problems in the interbank market. There are three sources that can cause problems in the interbank market (Freixas et al., 2000): the uncertainty related to the banks' solvency (the interbank market has access to only the incomplete information); the cautious behaviour of the interbank market players in times of crisis; the liquidity on the interbank market could evaporate because of the prudential behaviour of banks (a bank refuses to lend the other bank when it cannot be reliable that it will be able to cover its own liquidity shortage by borrowing from other banks). These expectations could become self-fulfilling and to prevent such a circumstance, the interbank market must be controlled by a credible institution, as a lender of last resort – features that a central bank should have.

3. Current Challenges for the Monetary Policy

The "freezing" of the interbank market in eurozone has subsequently influenced the developments of the longer-term interest rates, including those of the sovereign bonds issued by the eurozone's countries. The distrust manifested by investors regarding the ability of some European countries to pay their debts, has fuelled the risk aversion, entailing a fragmentation of the Euro Area financial markets, highlighted by the increasing interest rate differentials. During the periods when the government bonds are considered "risk-free" securities and liquid instruments, the yields on the government bonds influence significantly the conduct of monetary policy transmission to the real economy. The changes of monetary policy interest rates (both current interest rate and expected interest rate) are conveyed on the interest rates for sovereign bonds.

Since the end of 2008, the relation between the monetary policy impulse through the interest rate channel and the yield for sovereign bonds has been altered by the effects of the Lehman Brothers shock, given that the financial market behaves in a procyclic manner. Therefore, some sovereign bonds (those issued by the governments of "vulnerable" economies) have begun to be affected by high and volatile risk premium. In these circumstances, the monetary policy has no longer the main responsibility for "establishing" the developments of government bonds yields, thus disturbing the signal conveyed to the real economy.

Since 2009, it has been observed a close relationship between the evolution of the bank credit risk and the evolution of the sovereign risk, and this feature represents a major impediment in eliminating the crisis effects in the Euro Area. On the one side, the rising of sovereign risk harms the bank credit risk through the banks' exposure to the government debt. This generates the deleveraging pressure, with massive sales which could bring financial "disorders". On the other side, the "weak" banks increase the government burden. These two effects reinforce each other and create a vicious circle. For banks, increasing their own credit risk makes more difficult their refunding. In short, the unsecured funding is affected by the increased of the bank risk perception, while the secured funding is undermined by the deterioration of collaterals. Such a perception represents a significant barrier in guaranteeing loans to the real economy. Since in the Euro Area, the credit institutions are the main funding source, the credit flow towards the private sector might be jeopardized. With no room for reducing short-term interest rate (which is near zero), and in order to address and to mitigate these distortions created in the different segments of the financial markets, with repercussion on the real economy, many central banks have appealed to different unconventional measures.

3.1. The Unconventional Monetary Policy Channels

Cecioni, Ferrero, Secchi (2011) display the way the unconventional monetary policy measures work, showing that they are transmitted through two channels to the economy: the signalling channel and the portfolio-balance channel. Below, we present shortly both channels described by these authors.

The signalling channel is activated through the communications made by the central bank aiming at informing the public about its intentions concerning the future developments of short-term interest rates, the purchase of financial assets, or the implementation of other measures in order to eliminate market dysfunctions. An effective functioning of this channel is based on a high credibility of the central bank, allowing to rebuild the confidence in financial markets and to influence the public expectations about the policy decisions, and the development of long-term interest rates. These communications are considered unconventional monetary policy tools when they communicate information that go beyond the central bank usual practice.

The portfolio-balance channel is enabled through the specific operations of a central bank: securities purchase, liquidity injections, asset swaps. Such operations modify the size and the structure of the balance sheet of both the central bank and the private sector. The central bank is the only economic agent that can lead to large scale such specific operations, because it has the power regarding the provision of monetary base. An effective functioning of this channel is based on the imperfect substitutability among private sector's balance sheet items. The specific operations held through this channel aimed at influencing prices in some "dysfunctional" segments of financial market, or alleviating the financial frictions exerted on the funding conditions. During a financial crisis, the creditors might prefer to provide funds only for short- time periods, increasing the risk for a collapse of credit availability. In this case, the central bank can enhance the liquidity provisions to credit institutions in order to accommodate the increased demand for precautionary reasons. When there are tensions generated by the liquidity mismatch between the asset and the liability side of private banks, the central bank can decide to provide liquidity for longer terms, thus sustaining the amount of credit offered to the economy and reducing term spreads.

Cecioni, Ferrero, Secchi (2011) remark that a too prolonged exploit of these unconventional measures might generate market distortions.

Bernanke and Reinhart (2004) have shown that there are three strategies of monetary policy to stimulate the economy when the monetary policy interest rate has reached or is close to its minimum level (0), namely:

- ensuring investors that short-term interest rates will be kept at low levels in the future;

- changing the relative supply of securities market by changing the composition of the central bank balance sheet;
- increasing the size of the central bank balance sheet beyond the level corresponding to zero interest rate monetary policy. This strategy is one of the *quantitative easing* (QE). The manner of its implementation is different from country to country, depending on the specific interactions between the banking system and the monetary authority and the primary targets of monetary policy. Such measures have been reflected in the balance sheet of these central banks, which have substantially increased (see Figure 4).

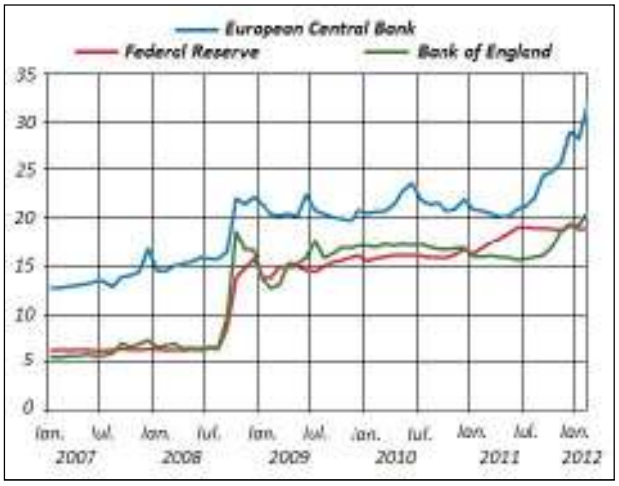

Figure 4. The evolution of the central bank's balance-sheet (% of GDP)

Source: IMF, 2012

In USA and UK, the central banks (Federal Reserve and Bank of England) have applied the QE strategy by purchasing financial assets in order to influence the long-term interest rates, especially those of government bonds. At the European level, such a policy has meant an extended refinancing operations conducted by central banks of the Eurosystem which provides liquidity lending in large quantities loans at fixed interest rates.

The difference between the policy of Bank of England, or Fed, and the policy of the European Central Bank is primarily an institutional one: while for the Bank of England or Fed, the decision of purchasing government bonds is a directly one, because there is a single monetary policy, but also a single fiscal policy (the government's policy), for the ECB such a decision is more difficult, because it should take into account more governments.

3.2. Unconventional Measures applied by the European Central Bank

During the crisis, the ECB has implemented measures that have not distorted the overall monetary policy strategy, but they were completed it. It was noticed a complementary relationship between the unconventional measures and the interest rate policy in times of financial crisis.

In October 2008, because the financial turmoil has triggered significant disruption and liquidity shortages in different financial market segments, the ECB decided to conduct its refinancing operations with fixed rates and full allotment (ECB, 2009). The purpose of these operations was to support the availability of credit to the private sector and to eliminate tensions and disruptions in the interbank market.

In spring 2010, the Governing Council decided to implement a program to purchase the government and private debt securities issued by euro area countries (*Securities Markets Programme*). This decision was taken, besides others, in the context of the increasing uncertainty of investors with respect to the sustainability of public finances in some euro area countries, in order to address the disturbances manifested in the government bond markets of such countries and to eliminate the risk of contagion to other bond issuers. Through this program, it has been pursued the restoring of an adequate functioning of the monetary policy transmission mechanism, addressing the malfunctioning of some financial market segments (the government and private debt securities markets). The purchasing operation of such assets has not injected the extra-liquidity in the financial markets, because it has been sterilised through the weekly collection of fixed-term deposits from the banking sector (ECB, 2011). The purchase of these securities has been significant until the beginning of the 2011. Between February and July 2011, these interventions have been very limited.

In the second half of 2011, the tensions in financial markets have increased significantly In order to counter the risk of impairing the monetary transmission mechanism, the ECB decided to apply unconventional monetary policy measures during August-December 2011[1]. Thus, in august 2011 the Governing Council announced that it would start again actively to implement the SMP in order to eliminate both the increased risk for a malfunctioning of government debt markets and the tensions running on other markets. The ECB also decided to expand the field of assets accepted as eligible collateral for its refinancing operations, through the *Covered Bond Purchase Programme*. The covered bonds are an important category of assets for financing the banks and the economies of the Euro Area. The application of unconventional measures aimed at: reducing the maturity in the money market; easing funding conditions for credit institutions and companies; encouraging the credit institutions to maintain or to expand lending activity to

[1] For a more detailed presentation, see *ECB Annual Report 2011*, pp. 14-16.

firms and households; and improving the liquidity in the important segments of private debt securities market.

The study conducted by Cecioni, Ferrero and Secchi (2011) argues that the unconventional monetary policy measures have supported financial intermediation by providing liquidity to the solvent banks and by restoring the confidence among the market players, helping to maintain the viability of the banking system and of the important financial market segments. However, the authors underline there is considerable uncertainty concerning the quantification of the unconventional monetary policy effectiveness.

The significant increase in the ECB's balance sheet due to its interventions made to absorb the shocks from the financial markets (in the context of the reducing space for maneuver the interest rates and applying unconventional measures) involves certain risks related to the monetary policy conducting in the next stage. Caruana (2011) states out the inflationary pressure risk, the financial instability risk, the risk of potential financial market distortions and the risk of the conflicts created with the authorities managing the government debt. Therefore, the risks related to the price and financial stability for the next period should be closely monitored, and the best way through which monetary policy can support this process is the formation of low inflationary expectations of the private sector. But this is only a necessary condition, and not a sufficient one, since the monetary policy must be supported in this direction by the other macroeconomic policies.

4. Conclusions

The transmission of the Lehman Brothers shock has deepened the financial crisis already started in 2007 and it was firstly reflected in the interbank market. The European Central Bank has entered in a new phase for conducting its monetary policy. It has intervened extensively in the money market by reducing the monetary policy key interest rates at the lowest levels and by expanding the area of application for the unconventional measures.

The challenges of the European Central Bank have emerged in the context of the increasing uncertainty in the financial regarding the ability of some European countries to pay their debts. This situation has fuelled the risk aversion, and the increasing of interest rates on the sovereign debt, affecting the public and the private sector. The sovereign debt crisis effects denote a strong relationship occurrence between the public sector debt and the private debt, between the bank credit risk and the sovereign credit risk, encumbering the monetary policy tasks.

Another challenge for the monetary policy emerged from the fragmentation of the Euro Area financial markets, highlighted by the increasing interest rate differentials. Such a case demonstrates that the membership of a currency area does

not automatically guarantee a smoothly distribution of risk. Investors will always make the difference between countries depending on the economic and political position of each one. Even if the currency area is a well defined institutional entity, the economies of that system are also well defined entities. This situation creates a conflict between the local and the global (the monetary union) management – another challenge for the common monetary policy and generally, for the governance of the eurozone.

The crisis of sovereign debt in the Euro Area was maintained and amplified by the existence of the conflict between two principles of macroeconomic policies: the "no bail out" clause and the "too big to fail" principle applied to sovereign debt of the European countries. This conflict has actually undermined the confidence in the euro project at a level where the conventional channels of the monetary policy do not work effectively.

The conduct of monetary policy in the current crisis is a difficult task, also because its primary objective, the price stability, cannot be considered a sufficient condition for the financial stability.

The European Central Bank can best contribute to the financial stability by a firmly anchoring of the inflation expectations at low levels and by providing liquidity needs of the financial system, but the monetary policy must be supported in this direction by the other macroeconomic policies. Besides the central bank, each sector of the economy, the government, the financial institutions, and the private sector should assume their responsibilities for this general objective.

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Saving Euro by Dividing Europe in Multiple OCAs

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Abstract: On the aftermath of the global credit crunch was made clear that the Euro countries debt crisis shows that the EMU is far from being an Optimal Currency Area (OCA) under its current form. The countries accepted bailouts from their counterparts and international organizations in order to prevent the Eurozone collapse spreading the crisis further. Can the breakup to multiple areas help as Tootel (1990) suggested? Three possible sets of OCA scenarios are analyzed along with the demolition scenario. The breakup of the Eurozone to two currencies consisting possible OCAs along with a second one adding all the EU members and a third one applying in small regions. The scenarios are analyzed by using eleven equally weighted optimum area criteria to make Eurozone a single or a set of sustainable OCAs. These type and extension scenarios are presented for the first time for EU countries finding possible sets of independent country groups. The results show that the asymmetries lead to the crisis persist in a possible two or more "euros" area and this scenario cost is higher than union dissolution's. Europe cannot become in its current form a set of OCAs under any circumstances.

Keywords: Asymmetries; OCA; monetary policy; dissolution scenarios

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1. Introduction

The current debt crisis in the Eurozone has made clear that the current form of EMU is far from being an Optimal Currency Area (OCA). Possible national market problems transferred through financial contagion channels to other countries as asymmetric shocks. The economic development is also asymmetric. Countries which share the same currency have different economic, social, political and legal framework, but they have to share the same monetary policy. The countries had also the obligation to bailout their weaker counterparts acting as lenders of last resort for them in order to maintain the union increasing their exposure to the initial financial infection. The loss of economic independence, the asymmetric shocks through contagion and the bailout obligation are the major disadvantages of EMU participation (Cohen, 2003).

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The current scheme cannot last for long. There is no union withdraw process and if a country capable of forming an independent monetary policy wants to abandon the union or bankrupt the other countries will (or they should) lead union to dissolution because the costs related to the maintenance of a broken monetary scheme are high(Blanchard, 2006). A possible dissolution scenario is analyzed along with the multiple OCA's scenario and a second set of scenarios adding more European countries to a new extended Eurozone. This analysis goes beyond the present literature because until now it was limited to exist and working monetary unions and not proposed ones. After analyzing the characteristics of a possible OCA using the Mangas (1997) criteria I am presenting a set of 11 variables to make quantification on each country's characteristics. The voluntarily breakup of the union in new free floating currencies consisting of countries having common characteristics is presented.

The paper is structured as follows: The next part is presenting the disadvantages of European monetary union. The third part provides the dissolution scenario. OCA requisitions, the relative data set and scenarios are presented on the forth part. On the final section I conclude based on data results criticizing the three scenarios and I propose incentives on possible further research.

2. Monetary Union's Problems and Disadvantages

When the common European currency introduced back in 1999, the monetary union plausible advantages were overestimated while potential disadvantages were put aside. Since 1999 progress has been made. Intra-trade within EU has been stimulated because of the non-tariff and single market policy. Factor mobility has also been increased despite the limitations put by older members to their newer counterparts (countries accessed union after 2003). The price transparency is another advantage linked to the common currency creating benefits for business and consumers. Transaction costs which can appear in different ways (commissions and buying and selling prices spreads) eliminated within the zone (De Grauwe and Moesen, 2009). Despite its obvious advantages Eurozone is debated for its disadvantages. Some of them have been known and expected since its foundation. Despite early literature (Gros and Thygesen, 1998) and (Pszezolka, 2004) which emphasized on temporary negative effect of transaction costs this problem seems to be less important than the others. The most interesting fact has to do with disadvantages which weren't expected on their current extension. The problems are so severe nowadays leaving the existence of Eurozone under question (Masson, 2011).

The major expected disadvantage is the loss of monetary and national macroeconomic policy autonomy. The introduction of a common central bank which handles the interest rate of Euro along with the single currency without

capital controls. Countries cannot determine their own monetary policy and inflation rate. The trade-off between unemployment and inflation is unable. The countries have to put their inflation in to the line with the lower inflation rate. Regional disparities are also present. Some union countries gain while others lose. Regional policies have fallen out of favor because of the political manipulation, economic adjustments delay and insufficient industries funding. Finally the exchange policy instrument was also lost, this loss wouldn't matter if they had only fiscal policy but the problem of external balance is also present. Whether the zone could have a balanced external trade, they experienced countries having surpluses and others having deficits (De Grauwe, 2003).

The debt crisis showed the disadvantages of the monetary union which they weren't projected. Asymmetric shocks which had to be avoided for the counties of the monetary union were present because some countries were infected in the first stage of crisis (PIG debt problem) and within the union the problem amplified by contagion exposing initially not infected countries to credit risk transforming crisis to symmetric within the zone. (Costa Fernandes & Mota, 2011)

Another unpredicted disadvantage has to do with the role of internal "lender of last resort" which countries were called to play recently. Countries having better economic results are forced from their political decision of bailing out weaker economies exposing themselves to other countries credit risk doubting whether they would receive their loans on the maturity dates or not. The lack of central policy or in other words political union among the European countries was a problem recognized even before the EMU creation. (Schinasi and Texeira, 2006) The Europeans hoped that the monetary union would lead to an extended political bonds creation. But, individual economic policies acts were actions against the mutual monetary policy.

The Eurogroup where the political decisions related to Euro are unofficially but substantially taken, lost its confidence among the European citizens of being capable to plan and imply strong monetary policy. A future risk has to do with their exposure to weaker countries default. If a country within the zone cannot meet its repayments its lenders and reintroducing a national currency they will lose their funds and they will be forced to introduce immediately national currencies to avoid part of the dissolution later costs. As shown the disadvantages from the current scheme are many and difficult to solve. With its current form EMU cannot last for long. In the next part we are about to see the dissolution scenario where a country is selecting to introduce a national currency in order to gain from a possible autonomous monetary policy, the effect of its decision to the other monetary union countries and the effects on their monetary policy change.(Robichaud, 2011).

3. Eurozone Dissolution Scenario

A monetary union has never been made to be broken. But under unlucky political or economic circumstances none of the modern monetary unions has remained untouched and only microstates bonded to larger neighbor's currency monetary union and the CFA zone are still in operation for more than 50 years. The reason behind the long term existence has to do with the high cost of independent monetary policy. If a country cannot afford it could leave its monetary policy guided by the larger country or the union common central bank.

It would order to find the reasons of breakup excluding the cases of previous political disintegration (Former USSR, Yugoslavia and Czechoslovakia respectively) (Fidrmuc and Horvath, 1998) bonding or dollarization (many cases in Central and South America). In this case though we can presume that this dissolution scenario refers to the voluntary participation unions such as Eurozone. With exception of high political risk incentives to secede are developed because of inefficiencies due to integration.

A country in order to leave the EMU will face a large depreciation of its currency followed by exports decline, transition costs and political and economic risk rise. (Blanchard, 2006) But it will leave if its cost of national currency reintroduction is lower than the maintained cost of being a part of a monetary union in the long term. Leaving a monetary zone cannot be a single side decision and unions don't have a smooth and volunteer leaving process by their creation, only temporary solutions can be proposed. (Fuchs and Lippi, 2005) We exclude the parallel circulation of both national and common currency which cannot last for long due to Gresham's law (Mundell, 1988). On the other hand we propose three plausible scenarios: the voluntarily withdraw of a country from the union, the dissolution and the reintroducing of national currencies. The remaining countries to the zone will also have strong incentives to leave the zone immediately because there is a possibility to avoid the majority of the high broken zone maintenance cost and gain from the strong motive of autonomous monetary policy profits.

The point where a monetary union dissolute is also an important issue. When a country leaves a scheme if its size can work as a monetary policy individual the scheme breaks down. Comparisons cannot be made between EMU and Latin Monetary Union which can be considered more as a fixed rates club. There wasn't common currency and one central bank. Monetary discipline was also absent. Thus there was no single currency or central bank for a long time to abandon and the members' commitment was loose the consequences from the national currencies mint didn't have negative effects on members economies.(Bae and Bailey, 2011).

The possible devaluation long-term positive effects in competitiveness are the major motive that the breaking country has to leave the monetary union. The reintroducing national currency costs are high and a possible decision has to be

taken by monetary authorities is analyzed in various categories of cost acting as barriers for a possible exit. (Fuchs & Lippi, 2005)

An initial effect of the reintroducing announcement is the rise of risk and interest rates on countries' debt, not only for the abandoning country but for the whole zone. This is a penalty for the leaving country, but also for the others that let the union broke. Credit ratings will lower increasing the pressure on the now independent central bank to raise interest rates and further devaluation.

Internal economic problems also occur. To regain its competitiveness a country should reduce, according to an earlier work (Blanchard, 2006) referring to the case of Portugal as a possible leaving country, a 25% wage reduction as to be made. Further reduction to the wages will follow possible trade flows from abroad. Because of its inconvenience, due to unfair manipulating monetary issues failing to maintain the previous commitment of monetary union will imply a tariff to their exports to the breaking country. In order to maintain its competitiveness country must transfer this tariff to its workers as a wage reduction. This compensatory tariff can be also followed by unfair monetary exchange rate policy to attract FDI or restrictions to their citizen's freedom.

Political disintegration is another major consequence of the economic and monetary independence. An abandoning country, something that is no provision in the European Union, obviously didn't estimate the profits from the political integration. The other members won't easy participate to discussions for common foreign policy and a European Army creation. Through this process weaker countries are excluded from the European Union decisions and in a later stage from the Union itself. This would have also a major effect on their international trade position against these countries and the European Union because all participants will lose EU membership and its benefits. This will lead to higher country risk added interest cost.

Reintroducing new currency also involves technical and legal obstacles. Some of those are associated with the initial competitiveness depreciation itself. In order to be effective the currency introduction should be followed by debt and savings redenomination inside the country otherwise it will lead to financial distress and bankruptcies. All money working equipment (ATMs, Payment machines, airport handlers etc.) must be reprogrammed; notes and coins have to be minted and placed all over the country. A short period of double circulation is also important for the smoothest possible transition, raising further costs.

In any case more measures will be needed to keep people from massive withdraws, and bank runs to foreign banks. A "corralito" limit to bank withdrawals can be an immediate remedy but it cannot be a long term measure. The bond issues cannot be easy accepted by international markets having a junk rating status and interest rates will rise further. Redenomination of the foreign debt is also plausible out of favor

of the positioned investors who will have great loss of the country's inconvenience. If they law suit the country in the European court of justice they will receive remedy because the court won't be favor against braking country.

The other members will have to pay the increased cost occurred by the country's retirement. Unless their action is coordinated and rapid they will have to pay a short term cost which is 50% devaluation and further devaluation in the long term, the possible share of the leaving country to the ECB, the possible bailouts given will be under question and the loss from the possible independent monetary policy. If the remaining countries coordinate their action of introducing national currencies they will keep their political sustainability keeping their competitiveness and wages level and they won't have to bail out their joint central bank. Markets will be probably positive in a possible common action looking to the future of the countries. People are also favorite to their national currencies and the political decision may be easier. The sunk cost which cannot be avoided in any case consists of the credit risk lowering costs compared to the zone maintenance and the loss of debt repayments plus technical cost (Boonstra, 2010).

In any case this scenario seems to have large cost for all the countries but the cost for the leaving country will be unbearable. In real life a country won't easy let voluntarily the union to dissolute and the others will decide to abandon the union when the exposure to possible delayed or lost debt repayments will be already high.

4. OCA Scenarios

Making Eurozone an OCA in the long term has been the ultimate goal since its foundation. Possible multiple breakup to a set of more than one OCAs (Tootel 1990) could be more operative and effective. A more realistic target is the implement of a common interest system allowing countries to participate in the financial markets equally with the implementation of an interest equalization tax within the zone as a presumption of the short term effective monetary policy along with specific and customized in each country's needs to eliminate regional disparities transforming zone to an OCA. These scenarios of multiple OCAs and interest equalization tax implementation are analyzed in the present sector.

In a similar work (Monga, 1997) author listed 19 relevant criteria for a successful currency union in Francophone Africa. The level of freedom in certain sectors of the economy is crucial for creating or maintaining monetary unions. More freedom means larger flexibility for the referring country making it keen to accept needed transformations to be a part of an OCA. The OCA countries levels have to be equal. I made transformations to the original variables in order to transform them to meet my current research criteria. I have deployed the latest (2012) dataset from Heritage foundation for economic freedom scores (Business, Trade, Fiscal,

Government spending, investment, fiscal, property rights, Freedom from corruption and labor freedom), political risk from Euromoney country and credit rating from international agencies respectively consisting an 11 variables dataset. In (Monga, 1997) the measure is ordinal and based on estimates. Integer values range from -2 (heavy disadvantage or incentive) to +2 (strong advantage) using zero (0) if the effect is neutral. The variables have the same weight and added to make a final index.

In contrast to the referred one (Monga, 1997) I used quantitive data provided by referred sources using as population the specific scores for each series calculating its average and standard deviation omitting zero (0). The methodology choice has to do with the fact that asymmetries are present. I use these descriptive measures to give each country a score for each variable. The higher deviation means higher asymmetry. Thus, the effective grouping to two has to be made on the basis of higher asymmetries of the population average. The constructing of the indices is following the deviation ordination pattern. If the value is smaller than one standard deviation from the mean I note it as a heavy disadvantage (-2), from one standard deviation to mean (not included) is a minus one (-1), from mean to one standard deviation (not included) variable is a plus one (+1) and finally if the value is more than one standard deviation it takes a plus two (+2). Countries with positive final index can be counted as possible candidates for an OCA scheme and negative final index means that the country has to make possible transformations in order to improve its score or its candidate to format another OCA with other low final index countries. The results are shown on the following table.

The results show that 10 countries (Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Ireland, Luxemburg and Netherlands) have positive final index showing that their scores are close and are primary candidates for an OCA. The other 7 countries have negative score (Greece, Italy, Malta, Portugal, Slovak Republic, Slovenia and Spain) which means that they cannot be members of an OCA with their current scores and have to make transformations to join a common area. In a possible multiple currency areas scenario these two groups seem to consist the initial group of the two new Euros. A “hard” one based on positive score countries and a “soft” one based on negative score countries. Possible advantages of this scheme are obvious. The control of the monetary policy is more flexible for a participating country than the larger union. Political cost seems to be lower than the dissolution’s scenario. The regional asymmetries are expected to be smaller because countries scores and characteristics are closer. The markets will be easier to accept this division and transition costs will be lower.

The creation of multiple currency areas has some fundamental presumptions. Initially the countries consisting a new monetary zone must accept that the two currencies will free float between them. Otherwise the scheme substantially doesn’t change and its problems remain. Additionally there is no OCA if the participating

countries don't share the same borders because the trade volume isn't so high among the zone countries.

In current scenario Cyprus and Slovak republic don't border with the other participants and they have to be excluded facing the cost of an abandoning country facing a major disadvantage for the scenario The results of the 9 countries "Hard Euro" and 6 countries "Soft Euro" are shown below:

Table 1.

Country Name	Business Freedom	Trade Freedom	Fiscal Freedom	Gov't Spending	Monetary Freedom	Investment Freedom	Financial Freedom	Property Rights	Freedom from Corruption	Labor Freedom	Gov't Expenditure % of GDP	pol. Risk	credit rating	Final Index
Austria	-2	1	-1	1	1	1	1	2	1	2	-1	1	1	8
Belgium	1	1	-1	1	1	1	1	1	1	1	-2	1	1	10
Cyprus	-1	-1	2	-1	1	-1	1	1	-1	2	1	1	-1	1
Estonia	-1	1	2	-2	-1	2	2	1	-1	1	2	1	-1	5
Finland	1	1	1	1	-1	1	1	2	2	-1	-2	1	1	11
France	1	-2	-1	2	1	-2	1	1	1	-1	-2	1	1	1
Germany	1	1	-1	1	1	1	-1	2	1	-1	1	1	1	9
Greece	-1	-2	1	2	1	2	1	-2	-2	-1	1	-2	-2	-14
Ireland	1	1	1	-1	-1	2	1	2	1	1	1	-1	-1	9
Italy	-1	1	-1	1	1	-1	1	-2	-1	-1	-1	-1	-1	-6
Luxembourg	-1	1	1	-2	1	2	2	2	1	-1	2	2	1	11
Malta	-2	1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-11
Netherlands	1	1	-1	1	1	2	2	1	2	1	-1	1	1	11
Portugal	-1	1	-1	-2	1	-1	-1	-2	-1	-1	-1	-2	-1	-8
Slovak Republic	-2	1	2	-2	-1	-1	1	-2	-2	1	2	-1	-1	-5
Slovenia	1	1	1	-1	-1	1	-2	-2	-1	-1	1	1	-1	-5
Spain	-1	1	-1	-1	1	1	2	-1	-1	-1	1	-1	-1	-1

Table 2. "Hard" Euro scenario

	Business Freedom	Trade Freedom	Fiscal Freedom	Gov't Spending	Monetary Freedom	Investment Freedom	Financial Freedom	Property Rights	Freedom from Corruption	Labor Freedom	Gov't Expenditure % of GDP	pol. Risk	credit rating	Final Index
Austria	-2	1	-1	-1	1	-1	-1	1	1	2	-1	1	1	1
Belgium	1	1	-2	-1	1	-1	-1	-2	-1	1	-1	-1	-1	-7
Estonia	-1	1	2	2	-2	1	1	-2	-2	-1	2	-2	-2	-3
Finland	2	1	1	-1	-1	1	1	1	2	-2	-1	1	1	6
France	1	-2	-1	-2	2	-2	-1	-1	-2	-1	-2	-1	1	-11
Germany	1	1	-1	1	2	1	-2	1	1	-2	1	1	1	6
Ireland	1	1	1	1	-1	1	-2	1	1	2	1	-2	-2	3
Luxembourg	-2	1	1	2	-1	1	1	1	1	-1	2	2	1	9
Netherlands	-1	1	-1	-1	1	1	1	1	2	1	-1	1	1	6

Table 3. "Soft" Euro scenario

Country	Business Freedom	Trade Freedom	Fiscal Freedom	Gov't Spending	Monetary Freedom	Investment Freedom	Financial Freedom	Property Rights	Labor Freedom	pol. Risk	credit rating	Final Index
Greece	-1	-2	2	-1	-1	-2	-1	-2	1	-2	-2	-10
Italy	-1	1	-2	-2	1	1	-1	-2	-1	-1	-1	-7
Malta	-2	1	1	1	-2	1	-1	1	2	1	1	6
Portugal	1	1	-1	-1	2	-1	-1	1	-2	-1	1	-2
Slovenia	2	1	1	1	-1	-1	-2	-1	-1	2	1	0
Spain	-1	1	-1	2	2	2	2	1	1	1	2	13

Table 4. All EU scenario

NAME	Property Rights	Freedom from Corruption	Fiscal Freedom	Gov't Spending	Business Freedom	Labor Freedom	Trade Freedom	Investment Freedom	Financial Freedom	Political Risk	Credit Rating	Overall score
Austria	0	0	-1	-1	-1	1	0	0	0	0	0	-2
CzechRepublic	0	-1	0	0	-1	1	0	-1	0	0	0	-2
Estonia	0	0	0	0	0	0	0	0	0	0	0	0
Finland	0	1	0	-2	1	-1	0	0	0	1	1	1
Germany	0	0	0	0	1	-1	0	0	-1	0	1	0
Iceland	0	0	0	0	1	0	1	-1	-1	-1	-1	-2
Ireland	0	0	0	0	1	1	0	0	0	-1	-1	0
Latvia	-1	-1	0	0	0	0	0	0	-2	-1	-1	-6
Lithuania	0	-1	1	0	0	0	0	0	0	1	-1	0
Luxembourg	0	0	0	1	0	-1	0	1	0	0	1	2
Netherlands	0	0	-1	0	0	0	0	0	0	0	1	0
Slovakia	-1	-1	0	1	-1	0	0	0	0	0	0	-2

As we can see the asymmetries were smoothened but they didn't eliminate. In the "Hard Euro" France, Belgium and Estonia and in the "Soft Euro" Greece, Italy and Portugal seem to be week. The problems didn't solve and in fact the dissolution is still extremely plausible and the total cost of this scenario is larger compared to national currencies introduction.

Another possible innovative OCA scenario has to do with the creation of multiple OCAs adding future Euro participants. Countries that will adopt Euro in the next years could be a fruitful addition for the creation of one or more OCAs. Using the same 11 variables on the index creation we added all the 2003-2007 expansion non euro members (Bulgaria, Czech Republic, Hungary, Latvia, Lithuania, Poland and Romania respectively) plus the two joining members of the EU (Croatia and Iceland). The change is the use of zero because some countries are not currently members of Eurozone and their participation can be a political choice. The results for all 27 countries are shown to the following table:

The results show that twelve countries now have positive scores (Austria, Czech Rep, Estonia, Finland, Germany Iceland, Ireland Latvia, Lithuania, Luxemburg, Netherlands and Slovakia), two countries have scored zero (Malta and Spain) and

thirteen countries scored negative (Belgium, Bulgaria, Croatia, Cyprus, France Greece, Hungary , Italy, Poland, Portugal, Romania and Slovenia). On the same motive we make a set of two OCAs. The results are shown to the following table.

Table 5. All EU scenario "Hard" Euro

NAME	Property Rights	Freedom from Corruption	Fiscal Freedom	Gov't Spending	Business Freedom	Labor Freedom	Trade Freedom	Investment Freedom	Financial Freedom	Poltical Risk	Credit Rating	Overall score
Belgium	1	1	-1	-1	2	1	0	1	0	1	1	6
Bulgaria	-1	-1	1	1	0	1	0	-1	0	0	0	0
Croatia	-1	0	0	0	-2	0	0	0	0	0	0	-3
Cyprus	0	0	1	0	0	0	-1	0	0	0	0	0
France	1	1	-1	-1	0	0	-1	-1	0	1	1	0
Greece	0	-1	0	-1	0	-1	-1	-1	0	-2	-2	-9
Hungary	0	0	0	0	0	0	0	0	0	0	0	0
Italy	0	-1	0	0	0	0	0	0	0	0	0	-1
Malta	0	0	0	0	-1	0	0	0	0	1	0	0
Portugal	0	0	0	0	0	-1	0	0	0	0	0	-1
Romania	-1	-1	1	1	-1	0	0	1	-1	0	0	-1
Slovenia	0	0	0	0	0	0	0	0	-1	0	0	-1
Spain	0	0	0	0	0	0	0	1	0	0	0	1

We also see that the asymmetries remain in the extended model. The same problems are still present. More developed countries will benefit from a possible union and the weakest countries will still have to carry the costs of a possible monetary union. The size of these possible OCAs is large and it could be the reason for the existence of the asymmetries.

A final OCA scenario could be a set of regional unions that seems to be easier to coordinate. We choose to present three possible scenarios. A Balkan monetary union with the exception of the Euro's weak link Greece, a union consisting of Visegrad and Baltics in a common region and finally a scenario using Visegrad itself. The results are shown to the following set of tables.

Table 6. All EU scenario "Soft" Euro

NAME	Property Rights	Freedom from Corruption	Fiscal Freedom	Gov't Spending	Business Freedom	Labor Freedom	Monetary Freedom	Trade Freedom	Investment Freedom	Financial Freedom	Political Risk	Credit Rating	Overall score
CzechRepublic	0	-1	0	0	0	1	0	0	0	0	0	1	1
Estonia	1	2	0	0	0	-1	0	0	1	0	1	1	5
Hungary	0	0	0	0	1	0	-1	0	0	0	-1	-1	-2
Latvia	-1	0	0	0	0	0	0	0	-1	-1	-1	0	-4
Lithuania	0	0	1	0	1	0	0	0	0	0	0	0	2
Poland	0	0	0	0	-1	0	0	0	-1	0	0	0	-2
Slovakia	-1	0	0	1	1	0	1	0	0	0	0	0	2

Table 7. Balkan monetary union

NAME	Property Rights	Freedom from Corruption	Fiscal Freedom	Gov't Spending	Business Freedom	Labor Freedom	Monetary Freedom	Trade Freedom	Investment Freedom	Financial Freedom	Political Risk	Credit Rating	Overall Score
Bulgaria	-1	-1	1	0	0	1	0	-2	0	0	0	-2	-4
Croatia	0	0	0	0	-1	0	0	0	0	0	0	-1	-2
Cyprus	1	1	0	0	1	0	-2	0	1	0	-1	1	2
Italy	0	0	-1	-1	0	-1	0	0	0	0	1	-2	-4
Malta	1	0	0	0	0	0	0	0	0	1	1	3	6
Romania	0	0	0	1	0	0	0	1	-1	-1	-1	-1	-2
Slovenia	0	1	0	-1	1	-1	0	0	-1	0	0	-1	-2

Table 8. Visegrad and Baltics

NAME	Property Rights	Freedom from Corruption	Fiscal Freedom	Gov't Spending	Business Freedom	Labor Freedom	Monetary Freedom	Trade Freedom	Investment Freedom	Financial Freedom	Political Risk	Credit Rating	Overall Score
CzechRepublic	0	0	0	0	0	1	0	0	0	1	0	1	3
Hungary	0	0	0	-1	1	0	-1	0	0	0	-1	-1	-3
Poland	0	1	-1	0	-1	0	0	0	1	-1	0	0	-1
Slovakia	-1	-1	1	1	-1	-1	1	0	0	0	0	0	-1

Table 9. Visegrad scenario

NAME	Property Rights	Freedom from Corruption	Fisca Freedom	Gov't Spending	Business Freedom	Labor Freedom	Trade Freedom	Investment Freedom	Financial Freedom	Political Risk	Credit Rating	Overall score
Austria	1	1	-1	-1	0	1	0	0	0	1	0	2
Belgium	0	0	-1	-1	1	0	0	0	0	0	0	-1
Bulgaria	-2	-1	1	1	0	1	0	-1	0	0	0	-1
Croatia	-1	-1	0	1	-1	0	0	0	0	0	0	-2
Cyprus	0	0	0	0	0	0	-2	0	0	0	0	-2
CzechRep	0	0	0	0	-1	1	0	0	1	0	0	1
Estonia	0	0	0	0	0	0	0	1	1	0	0	2
Finland	1	1	0	-1	1	-1	0	0	1	1	1	4
France	0	0	-1	-1	0	0	-2	-1	0	0	1	-4
Germany	1	1	0	0	1	-1	0	0	-1	1	1	3
Greece	-1	-1	0	-1	0	-1	-2	0	0	-2	-2	-10
Hungary	0	0	0	0	0	0	1	-1	0	-1	0	-1
Iceland	1	1	0	0	1	0	1	1	0	0	0	5
Ireland	1	1	0	0	1	1	0	0	0	0	0	4
Italy	-1	-1	-1	0	0	-1	0	0	0	0	0	-4
Latvia	-1	0	1	0	0	0	0	0	1	0	0	1
Lithuania	0	0	1	0	0	0	0	0	1	1	0	3
Luxembo	1	1	0	1	0	-1	0	1	0	1	1	5
Malta	0	0	0	0	0	0	0	0	0	0	0	0
Netherlan	1	1	-1	0	0	0	0	1	1	1	1	5
Poland	0	0	0	0	-1	0	0	-1	0	0	0	-2
Portugal	0	0	0	0	0	-1	0	0	-1	-1	0	-3
Romania	-1	-1	1	1	0	0	0	0	0	-1	0	-1
Slovakia	-1	0	1	1	0	0	0	0	0	0	0	1
Slovenia	0	0	0	0	0	-1	0	0	-1	0	0	-2
Spain	0	0	0	0	0	0	0	0	0	0	0	0

The results still show the asymmetries that follow all the OCA scenarios in Europe. Nobody can claim that even smaller regions can consist under Tootel's (1990) hypothesis that we can make many (4-5 probably) small regional monetary unions in Europe the solution is obviously not the division of countries to regions or multiple monetary unions.

5. Conclusions

The present work has presented three sets of possible scenarios related to transformations for the EMU future to smaller areas that can smooth the asymmetries. Present debt crisis is testing the durability and long prosperity of the union. It was on the decision dead-end under this pressure as a motive for reform and crucial decisions having to do with the possible maintenance of the monetary union. The dissolution or breakup cost seems to be extremely high for all the participating countries and the problems doesn't seem to be solved by a breakup into multiple OCAs of any size hiding a possible future dissolution of the smaller unions cost.

The first decision that it has to be made is an opportunity cost choice. Countries want to pay the cost of possible dissolution or EU and EMU maintenance? Political decisions related to liberation reforms and transformations and the change of the economic environment seem to be critical for the long term sustainability but the time for the implication of a tighter union under the present turbulence seems to be inadequate. Further sustainability based solutions have to be developed in contrast to the dissolution scenarios for Eurozone and furthermore for European Union itself.

A single OCA is preferable for all the countries and in a possible work authors can develop a long term forecast analysis for the possible time of creation under the existing or future EU form. Until then the Eurozone countries have to be saved from the possible costs of dissolution in any form.

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Mathematical and Quantative Methods

The Reduction of Quadratic Forms to the Normal Form with Applications for Production Functions

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Abstract: The article treats the reduction of quadratic forms to the normal form by Gauss's method taking in discussing various determinants whose behavior will determine its nature. Applications of this method are illustrated for the most common production functions: Cobb-Douglas and CES.

Keywords: quadratic form; production function; Cobb-Douglas; CES

JEL Classification: E17; E27

1. Introduction

Let consider the quadratic form: $H:\mathbf{R}^n\to\mathbf{R}$, $H(x)=\sum_{i,j=1}^{n}a_{ij}x_ix_j \quad \forall x=(x_1,...,x_n)\in\mathbf{R}^n$.

The quadratic form H is called positive definite if $H(x)>0 \ \forall x\neq 0$, negative definite if $H(x)<0 \ \forall x\neq 0$, positive semi-definite if $H(x)\geq 0 \ \forall x\in R^n$ and $\exists x_0\in R^n-\{0\}$ such that $H(x_0)=0$, negative semi-definite if $H(x)\leq 0 \ \forall x\in R^n$ and $\exists x_0\in R^n-\{0\}$ such that $H(x_0)=0$, semi-definite if $\exists x_1,x_2\in R^n$ such that $H(x_1)H(x_2)<0$.

It is known that if a quadratic form is positive (negative) (semi) definite in a basis then it retains that character in any other basis.

We say that the quadratic form H has the normal form if there is a basis B of $\mathbf{R}^n$ where $H(x)=\sum_{i=1}^{m}b_iy_i^2 \quad \forall x_B=(y_1,...,y_n)$, $m\leq n$.

It follows from the above that, being given the normal form of H (whatever the process by which this is achieved), H is positive definite if and only if $b_i>0$, $\forall i=$

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$\overline{1,n}$, negative definite if and only if $b_i<0$, $\forall i=\overline{1,n}$, positive semi-definite if and only if $m<n$ and $b_i>0$, $\forall i=\overline{1,m}$, negative semi-definite if and only if $m<n$ and $b_i<0$, $\forall i=\overline{1,m}$, semi-definite if and only if $\exists i\neq j=\overline{1,n}$ such that $b_i>0$, $b_j<0$.

Relative to bringing a quadratic form to the normal expression are essentially three big methods.

Jacobi's Method

Considering the matrix associated to the quadratic form $[H]=\left(a_{ij}\right)_{i,j=\overline{1,n}}\in M_n(\mathbf{R})$, let $\Delta_i=\begin{vmatrix} a_{11} & \cdots & a_{1i} \\ \cdots & \cdots & \cdots \\ a_{i1} & \cdots & a_{ii} \end{vmatrix}$, $i=\overline{1,n}$ - the principal diagonal determinants.

If $\Delta_i\neq 0$ $\forall i=\overline{1,n}$ then there is a basis $B=\{f_1,...,f_n\}$ obtained from the canonical basis through a triangular matrix, such that the normal expression of H is: $H(x)=\frac{1}{\Delta_1}y_1^2+\frac{\Delta_1}{\Delta_2}y_2^2+...+\frac{\Delta_{n-1}}{\Delta_n}y_n^2$.

The method is limited by the fact that the determinants obtained from the first i rows and columns must be non-zero. If $\exists i=\overline{1,n}$ such that $\Delta_k\neq 0$ $\forall k=\overline{1,i-1}$ (considering $\Delta_0=1$ we can assume that the condition is always satisfied) and $\Delta_i=0$, then it will investigate all determinants of the form: $\Delta_{i-1,p}=\begin{vmatrix} a_{11} & ... & a_{1\,i-1} & a_{1p} \\ ... & ... & ... & ... \\ a_{i-1\,1} & ... & a_{i-1\,i-1} & a_{i-1\,p} \\ a_{p1} & ... & a_{p\,i-1} & a_{pp} \end{vmatrix}$ with $p>i$. If such a determinant is non-null, then after the change of variables (which is basically a renumbering of variables):

$$\begin{cases} y_k=x_k,\ k=\overline{1,n},\ k\neq i,p \\ y_i=x_p \\ y_p=x_i \end{cases}$$ the condition that $\Delta_i\neq 0$ is satisfied.

From the Jacobi's method is obtained that if $\Delta_i>0$ $\forall i=\overline{1,n}$ then H is positive definite, and if
$(-1)^i\Delta_i>0$ $\forall i=\overline{1,n}$ then H is negative definite.

The essential drawback of Jacobi's method is that all determinants Δ_i must be non-null (regardless of any renumbering). The method also does not specify the nature

of quadratic form when $\exists i=\overline{1,n}$ such that $\Delta_k=0$ $\forall k=\overline{1,n}$, $k\geq i$ (obviously after possible renumbering).

The Eigenvalues Method

Considering the associated matrix of H, let the characteristic polynomial $P(\lambda)=\det(A-\lambda I_n)$. It is shown that: $P(\lambda)=(-1)^n(\lambda^n-\delta_1\lambda^{n-1}+\delta_2\lambda^{n-2}-...+(-1)^n\delta_n)$ where δ_k is the sum of diagonal minors of order k of the matrix A.

Considering the characteristic equation: $P(\lambda)=0$, its roots are called the eigenvalues of the matrix A. For an eigenvalue λ, the vector $v\in\mathbf{R}^n$ such that: $Av=\lambda v$ is called eigenvector corresponding to λ.

It is shown that the eigenvalues of a symmetric matrix are real. Considering the basis B consisting of eigenvectors corresponding to the eigenvalues $\lambda_1,...,\lambda_n$ we get:

$[H]_B=\begin{pmatrix} \lambda_1 & ... & 0 \\ ... & ... & ... \\ 0 & ... & \lambda_n \end{pmatrix}$ from where: $H(x)=\lambda_1 y_1^2+\lambda_2 y_2^2+...+\lambda_n y_n^2$.

The eigenvalues method appears, at first sight, much better to determine the nature of quadratic form in the sense that H is positive definite if and only if $\lambda_i>0$, $\forall i=\overline{1,n}$, negative definite if and only if $\lambda_i<0$, $\forall i=\overline{1,n}$, positive semi-definite if and only if $m<n$ and $\lambda_i>0$, $\forall i=\overline{1,m}$ (therefore there are also null eigenvalues, but those non-null are strictly positive), negative semi-definite if and only if $m<n$ and $b_i<0$, $\forall i=\overline{1,m}$ (therefore there are also null eigenvalues, but those non-null are strictly negative), semi-definite if and only if $\exists i\neq j=\overline{1,n}$ such that $\lambda_i>0$, $\lambda_j<0$ (so there are at least two eigenvalues of sign contrary).

This method presents also a key deficiency, consisting in the difficulty of solving the characteristic equation (of n-th degree).

The Gauss Method

The Gauss method identifies the terms of the form $a_{ii}x_i^2$ and builds a perfect square that contains all occurrences of the variable x_i. The process is continued on the remaining quadratic form. If there is no term of the form $a_{ii}x_i^2$, then it identifies a mixed term: $a_{ij}x_ix_j$ with $a_{ij}\neq 0$. If no such term appears, the process ends. If so, it is considered a change of variable of the form: $x_i=y_i+y_j$, $x_j=y_i-y_j$ obtaining new square terms and the process continues as above.

2. Preliminary Results

Be a square symmetric matrix $A=\begin{pmatrix} a_{11} & ... & a_{1n} \\ ... & ... & ... \\ a_{n1} & ... & a_{nn} \end{pmatrix} \in M_n(\mathbf{R})$.

Let note, as above, $\Delta_k=\begin{vmatrix} a_{11} & \cdots & a_{1k} \\ \cdots & \cdots & \cdots \\ a_{k1} & \cdots & a_{kk} \end{vmatrix}$, $k=\overline{1,n}$ - the prinicipal diagonal determinants and define the appropriate determination of Δ_k board with the row i and the column j as: $\Delta_{k,ij}=\begin{vmatrix} a_{11} & ... & a_{1k} & a_{1j} \\ ... & ... & ... & ... \\ a_{k1} & ... & a_{kk} & a_{kj} \\ a_{i1} & ... & a_{ik} & a_{ij} \end{vmatrix}$.

It is noted that, due to the symmetry of the matrix A, we have: $\Delta_{k,ij}=\Delta_{k,ji}$. We also consider that: $\Delta_{0,ij}=a_{ij}$. We will note below:

- $\Delta_{k,\alpha\beta\gamma}=\begin{vmatrix} a_{11} & ... & a_{1k} & \alpha_1 \\ ... & ... & ... & ... \\ a_{k1} & ... & a_{kk} & \alpha_k \\ \beta_1 & ... & \beta_k & \gamma \end{vmatrix}$ where $\alpha=(\alpha_1,...,\alpha_k)^t$, $\beta=(\beta_1,...,\beta_k)^t \in \mathbf{R}^k$, $\gamma \in \mathbf{R}$
- $\Delta_{k,\alpha\delta\beta\varepsilon\gamma\mu\eta\lambda}=\begin{vmatrix} a_{11} & ... & a_{1k} & \alpha_1 & \delta_1 \\ ... & ... & ... & ... & ... \\ a_{k1} & ... & a_{kk} & \alpha_k & \delta_k \\ \beta_1 & ... & \beta_k & \gamma & \mu \\ \varepsilon_1 & ... & \varepsilon_k & \eta & \lambda \end{vmatrix}$ where $\alpha=(\alpha_1,...,\alpha_k)^t$, $\delta=(\delta_1,...,\delta_k)^t$, $\beta=(\beta_1,...,\beta_k)^t$, $\varepsilon=(\varepsilon_1,...,\varepsilon_k)^t \in \mathbf{R}^k$, $\gamma,\mu,\eta,\lambda \in \mathbf{R}$
- Γ_{pq} the minor of a_{pq} from the matrix $\begin{pmatrix} a_{11} & ... & a_{1k} \\ ... & ... & ... \\ a_{k1} & ... & a_{kk} \end{pmatrix}$
- $\Gamma_{pq,rs}$ the determinant of the matrix $\begin{pmatrix} a_{11} & ... & a_{1k} \\ ... & ... & ... \\ a_{k1} & ... & a_{kk} \end{pmatrix}$ obtained by deleting the rows p and q and the columns r and s. For k=2 we define $\Gamma_{pq,rs}=1$.

It is noted that due to symmetry, we have: $\Delta_{k,\alpha\beta\gamma}=\Delta_{k,\beta\alpha\gamma}$ and $\Delta_{k,\beta\varepsilon\alpha\delta\gamma\eta\mu\lambda}$.
The proofs of the following two lemmas are absolutely trivial, following the Laplace development of appropriate determinants.

Lemma 2.1

$$\Delta_{k,\alpha\beta\gamma}=\sum_{r,s=1}^{k}(-1)^{r+s+1}\alpha_r\beta_s\Gamma_{rs}+\gamma\Delta_k$$

Lemma 2.2

$$\Delta_{k,\alpha\delta\beta\varepsilon\gamma\mu\eta\lambda}=\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}+\sum_{p,s=1}^{k}(-1)^{p+s}\left(\varepsilon_s\begin{vmatrix}\alpha_p & \delta_p\\ \gamma & \mu\end{vmatrix}-\beta_s\begin{vmatrix}\alpha_p & \delta_p\\ \eta & \lambda\end{vmatrix}\right)\Gamma_{ps}+\begin{vmatrix}\gamma & \mu\\ \eta & \lambda\end{vmatrix}\Delta_k$$

Lemma 2.3

Be the vectors $\alpha=(\alpha_1,...,\alpha_k)^t$, $\beta=(\beta_1,...,\beta_k)^t$, $\delta=(\delta_1,...,\delta_k)^t$, $\varepsilon=(\varepsilon_1,...,\varepsilon_k)^t\in\mathbf{R}^k$ and $\gamma,\mu,\eta,\lambda\in\mathbf{R}$. Then:

$\Delta_{k,\alpha\beta\gamma}\Delta_{k,\delta\varepsilon\lambda}-\Delta_{k,\alpha\varepsilon\mu}\Delta_{k,\beta\delta\eta}-\Delta_k\Delta_{k,\alpha\delta\beta\varepsilon\gamma\mu\eta\lambda}=$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\left(\Gamma_{pr}\Gamma_{qs}-\Gamma_{ps}\Gamma_{qr}-\Gamma_{pq,rs}\Delta_k\right)$$

Proof

From lemmas 2.1 and 2.2 it follows:

$\Delta_{k,\alpha\beta\gamma}\Delta_{k,\delta\varepsilon\lambda}-\Delta_{k,\alpha\varepsilon\mu}\Delta_{k,\beta\delta\eta}-\Delta_k\Delta_{k,\alpha\delta\beta\varepsilon\gamma\mu\eta\lambda}=$

$$\left(\sum_{u,v=1}^{k}(-1)^{u+v+1}\alpha_u\beta_v\Gamma_{uv}+\gamma\Delta_k\right)\left(\sum_{r,s=1}^{k}(-1)^{r+s+1}\delta_r\varepsilon_s\Gamma_{rs}+\lambda\Delta_k\right)-$$

$$\left(\sum_{u,v=1}^{k}(-1)^{u+r+1}\alpha_u\varepsilon_v\Gamma_{uv}+\mu\Delta_k\right)\left(\sum_{r,s=1}^{k}(-1)^{r+s+1}\beta_s\delta_r\Gamma_{rs}+\eta\Delta_k\right)-$$

$$\Delta_k\left(\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}+\sum_{p,s=1}^{k}(-1)^{p+s}\left(\varepsilon_s\begin{vmatrix}\alpha_p & \delta_p\\ \gamma & \mu\end{vmatrix}-\beta_s\begin{vmatrix}\alpha_p & \delta_p\\ \eta & \lambda\end{vmatrix}\right)\Gamma_{ps}+\begin{vmatrix}\gamma & \mu\\ \eta & \lambda\end{vmatrix}\Delta_k\right)=$$

$$\sum_{r,s,u,v=1}^{k}(-1)^{r+s+u+v}\alpha_u\delta_r(\beta_v\varepsilon_s-\beta_s\varepsilon_v)\Gamma_{rs}\Gamma_{uv}+\Delta_k\sum_{r,s=1}^{k}(-1)^{r+s+1}(\gamma\delta_r\varepsilon_s+\lambda\alpha_r\beta_s-\mu\beta_r\delta_s-\eta\alpha_s\varepsilon_r)\Gamma_{rs}-$$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Delta_k\Gamma_{pq,rs}-\sum_{p,s=1}^{k}(-1)^{p+s}\varepsilon_s\begin{vmatrix}\alpha_p & \delta_p\\ \gamma & \mu\end{vmatrix}\Delta_k\Gamma_{ps}+\sum_{p,s=1}^{k}(-1)^{p+s}\beta_s\begin{vmatrix}\alpha_p & \delta_p\\ \eta & \lambda\end{vmatrix}\Delta_k\Gamma_{ps}=$$

$$\sum_{r,s,u,v=1}^{k}(-1)^{r+s+u+v}\alpha_u\delta_r(\beta_v\varepsilon_s-\beta_s\varepsilon_v)\Gamma_{rs}\Gamma_{uv}-\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}\Delta_k+$$

$$\Delta_k\sum_{p,s=1}^{k}(-1)^{p+s}\left(\beta_s\begin{vmatrix}\alpha_p & \delta_p\\ \eta & \lambda\end{vmatrix}-\varepsilon_s\begin{vmatrix}\alpha_p & \delta_p\\ \gamma & \mu\end{vmatrix}-\gamma\delta_p\varepsilon_s-\lambda\alpha_p\beta_s+\mu\beta_s\delta_p+\eta\alpha_p\varepsilon_s\right)\Gamma_{ps}=$$

$$\sum_{p,q,r,s=1}^{k}(-1)^{p+q+r+s}\alpha_p\delta_q\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pr}\Gamma_{qs}-\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}\Delta_k=$$

$$\sum_{\substack{p,q,r,s=1\\p<q}}^{k}(-1)^{p+q+r+s}\alpha_p\delta_q\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pr}\Gamma_{qs}+\sum_{\substack{p,q,r,s=1\\p>q}}^{k}(-1)^{p+q+r+s}\alpha_p\delta_q\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pr}\Gamma_{qs}+$$

$$\sum_{p,r,s=1}^{k}(-1)^{r+s}\alpha_p\delta_p\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pr}\Gamma_{ps}-\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}\Delta_k=$$

$$\sum_{\substack{p,q,r,s=1\\p<q}}^{k}(-1)^{p+q+r+s}\alpha_p\delta_q\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pr}\Gamma_{qs}+\sum_{\substack{p,q,r,s=1\\q>p}}^{k}(-1)^{p+q+r+s}\alpha_q\delta_p\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{qr}\Gamma_{ps}+$$

$$\sum_{\substack{p,r,s=1\\r<s}}^{k}(-1)^{r+s}\alpha_p\delta_p\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pr}\Gamma_{ps}+\sum_{\substack{p,r,s=1\\r>s}}^{k}(-1)^{r+s}\alpha_p\delta_p\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pr}\Gamma_{ps}-$$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}\Delta_k=$$

$$\sum_{\substack{p,q,r,s=1\\p<q}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\left(\alpha_p\delta_q\Gamma_{pr}\Gamma_{qs}+\alpha_q\delta_p\Gamma_{qr}\Gamma_{ps}\right)+\sum_{\substack{p,r,s=1\\r<s}}^{k}(-1)^{r+s}\alpha_p\delta_p\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pr}\Gamma_{ps}+$$

$$\sum_{\substack{p,r,s=1\\s>r}}^{k}(-1)^{r+s}\alpha_p\delta_p\begin{vmatrix}\beta_s & \beta_r\\ \varepsilon_s & \varepsilon_r\end{vmatrix}\Gamma_{ps}\Gamma_{pr}-\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}\Delta_k=$$

$$\sum_{\substack{p,q,r,s=1\\p<q}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\left(\alpha_p\delta_q\Gamma_{pr}\Gamma_{qs}+\alpha_q\delta_p\Gamma_{qr}\Gamma_{ps}\right)-\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}\Delta_k=$$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\left(\alpha_p\delta_q\Gamma_{pr}\Gamma_{qs}+\alpha_q\delta_p\Gamma_{qr}\Gamma_{ps}\right)+\sum_{\substack{p,q,r,s=1\\p<q\\r>s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\left(\alpha_p\delta_q\Gamma_{pr}\Gamma_{qs}+\alpha_q\delta_p\Gamma_{qr}\Gamma_{ps}\right)-$$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}\Delta_k=$$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\left(\alpha_p\delta_q\Gamma_{pr}\Gamma_{qs}+\alpha_q\delta_p\Gamma_{qr}\Gamma_{ps}\right)+\sum_{\substack{p,q,r,s=1\\p<q\\s>r}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_s & \beta_r\\ \varepsilon_s & \varepsilon_r\end{vmatrix}\left(\alpha_p\delta_q\Gamma_{ps}\Gamma_{qr}+\alpha_q\delta_p\Gamma_{qs}\Gamma_{pr}\right)-$$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}\Delta_k=$$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\left(\alpha_p\delta_q\Gamma_{pr}\Gamma_{qs}+\alpha_q\delta_p\Gamma_{qr}\Gamma_{ps}-\alpha_p\delta_q\Gamma_{ps}\Gamma_{qr}-\alpha_q\delta_p\Gamma_{qs}\Gamma_{pr}\right)-$$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}\Delta_k=$$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\left(\Gamma_{pr}\Gamma_{qs}-\Gamma_{ps}\Gamma_{qr}\right)-\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\Gamma_{pq,rs}\Delta_k=$$

$$\sum_{\substack{p,q,r,s=1\\p<q\\r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\left(\Gamma_{pr}\Gamma_{qs}-\Gamma_{ps}\Gamma_{qr}-\Gamma_{pq,rs}\Delta_k\right)$$

Corollary 2.1

Be the vectors $\alpha=(\alpha_1,...,\alpha_k)^t$, $\delta=(\delta_1,...,\delta_k)^t$, $\varepsilon=(\varepsilon_1,...,\varepsilon_k)^t\in\mathbf{R}^k$ and $\gamma,\mu,\eta,\lambda\in\mathbf{R}$. Then:

$\Delta_{k,\delta\varepsilon\lambda}\Delta_{k,\alpha\alpha\gamma}-\Delta_{k,\alpha\varepsilon\eta}\Delta_{k,\delta\alpha\mu}-\Delta_k\Delta_{k,\alpha\delta\alpha\varepsilon\gamma\mu\eta\lambda}=$

$$\sum_{\substack{p,s,q,r=1\\p<q\\r<s}}^{k}(-1)^{p+s+q+r}\begin{vmatrix}\alpha_r & \alpha_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\begin{vmatrix}\alpha_p & \alpha_q\\ \delta_p & \delta_q\end{vmatrix}\left(\Gamma_{qs}\Gamma_{pr}-\Gamma_{ps}\Gamma_{qr}-\Gamma_{pq,rs}\Delta_k\right)$$

Proof

It follows from Lemma 2.3 for $\beta=\alpha$.

Lemma 2.4

$\Gamma_{qs}\Gamma_{pr} - \Gamma_{ps}\Gamma_{qr} - \Gamma_{pq,rs}\Delta_k = 0$, p<q, r<s, p,q,r,s=$\overline{1,k}$, $\forall k \geq 2$.

Proof

Let P(k): $\Gamma_{qs}\Gamma_{pr} - \Gamma_{ps}\Gamma_{qr} - \Gamma_{pq,rs}\Delta_k = 0$, p<q, r<s, p,q,r,s=$\overline{1,k}$.

For k=2, let $\Delta_2 = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}$ - symmetrical. We have: $\Gamma_{22}\Gamma_{11} - \Gamma_{12}\Gamma_{21} - \Gamma_{12,12}\Delta_2$ $= a_{11}a_{22} - a_{12}^2 -$
$(a_{11}a_{22} - a_{12}^2) = 0$.

For k=3, let $\Delta_3 = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$ - symmetrical. We have 9 variants:

- p=1, q=2, r=1, s=2;
- p=1, q=3, r=1, s=2;
- p=2, q=3, r=1, s=2;
- p=1, q=2, r=1, s=3;
- p=1, q=3, r=1, s=3;
- p=2, q=3, r=1, s=3;
- p=1, q=2, r=2, s=3;
- p=1, q=3, r=2, s=3;
- p=2, q=3, r=2, s=3

We will proof the equality for on variant, for the others doing analogously.

Let, for example: p=1, q=2, r=1, s=3. Then:

$$\Gamma_{23}\Gamma_{11} - \Gamma_{13}\Gamma_{21} - \Gamma_{12,13}\Delta_3 =$$

$$(a_{11}a_{23} - a_{12}a_{13})(a_{22}a_{33} - a_{23}^2) - (a_{12}a_{23} - a_{22}a_{13})(a_{12}a_{33} - a_{13}a_{23}) -$$
$$a_{23}(a_{11}a_{22}a_{33} + 2a_{12}a_{23}a_{13} - a_{13}^2a_{22} - a_{23}^2a_{11} - a_{12}^2a_{33}) =$$

$$a_{11}a_{22}a_{23}a_{33} - a_{11}a_{23}^3 - a_{12}a_{13}a_{22}a_{33} + a_{12}a_{13}a_{23}^2 - a_{12}^2a_{23}a_{33} + a_{12}a_{13}a_{23}^2 + a_{12}a_{13}a_{22}a_{33} - a_{13}^2a_{22}a_{23} -$$
$$a_{11}a_{22}a_{23}a_{33} - 2a_{12}a_{13}a_{23}^2 + a_{13}^2a_{22}a_{23} + a_{11}a_{23}^3 + a_{12}^2a_{23}a_{33} = 0$$

Therefore, P(3) is true. Assuming P(i) true $\forall i=\overline{3,k}$, let P(k+1): $\Gamma_{qs}\Gamma_{pr}-\Gamma_{ps}\Gamma_{qr}-\Gamma_{pq,rs}\Delta_{k+1}=0$, p<q, r<s, p,q,r,s=$\overline{1,k+1}$.

Let $\delta_{k-1}=\Gamma_{pq,rs}$ obtained from Δ_{k+1} by removing the rows p and q and the columns r and s.

Considering in Lemma 2.3: α=the column r, δ= the column s, β=the row p, ε= the row q of Δ_{k+1}, $\gamma=a_{pr}$, $\mu=a_{ps}$, $\eta=a_{qr}$, $\lambda=a_{qs}$ it follows first:

- $\delta_{k-1,\alpha\delta\beta\varepsilon\gamma\mu\eta\lambda}=(-1)^{r+s+p+q}\Delta_{k+1}$
- $\delta_{k-1,\alpha\beta\gamma}=(-1)^{r+p}\Gamma_{sq}$
- $\delta_{k-1,\delta\varepsilon\lambda}=(-1)^{s+q}\Gamma_{rp}$
- $\delta_{k-1,\alpha\varepsilon\mu}=(-1)^{r+q}\Gamma_{ps}$
- $\delta_{k-1,\beta\delta\eta}=(-1)^{p+s}\Gamma_{qr}$

From Lemma 2.3, it follows:

$(-1)^{r+s+p+q}\left(\Gamma_{qs}\Gamma_{pr}-\Gamma_{ps}\Gamma_{qr}-\Gamma_{pq,rs}\Delta_{k+1}\right)=\delta_{k-1,\alpha\beta\gamma}\delta_{k-1,\delta\varepsilon\lambda}-\delta_{k-1,\alpha\varepsilon\mu}\delta_{k-1,\beta\delta\eta}-\delta_{k-1}\,\delta_{k-1,\alpha\delta\beta\varepsilon\gamma\mu\eta\lambda}=$

$\sum_{\substack{p,q,r,s=1\\ p<q\\ r<s}}^{k}(-1)^{p+q+r+s}\begin{vmatrix}\beta_r & \beta_s\\ \varepsilon_r & \varepsilon_s\end{vmatrix}\begin{vmatrix}\alpha_p & \delta_p\\ \alpha_q & \delta_q\end{vmatrix}\left(\gamma_{pr}\gamma_{qs}-\gamma_{ps}\gamma_{qr}-\gamma_{pq,rs}\delta_{k-1}\right)=0$ from the induction hypothesis (where γ_{ij} are appropriates minors of δ_{k-1}.

Corollary 2.2

Be the vectors $\alpha=(\alpha_1,...,\alpha_k)^t$, $\beta=(\beta_1,...,\beta_k)^t$, $\delta=(\delta_1,...,\delta_k)^t$, $\varepsilon=(\varepsilon_1,...,\varepsilon_k)^t\in\mathbf{R}^k$ and $\gamma,\mu,\eta,\lambda\in\mathbf{R}$, k≥2. Then: $\Delta_{k,\alpha\beta\gamma}\Delta_{k,\delta\varepsilon\lambda}-\Delta_{k,\alpha\varepsilon\mu}\Delta_{k,\beta\delta\eta}-\Delta_k\,\Delta_{k,\alpha\delta\beta\varepsilon\gamma\mu\eta\lambda}=0$.

Proof

It follows from lemmas 2.3 and 2.4.

Lemma 2.5

$\Delta_{k,ij}\Delta_{k+1}-\Delta_{k,k+1\,i}\Delta_{k,k+1\,j}=\Delta_k\Delta_{k+1,ij}\ \ \forall i,j\geq k+2\ \forall k\geq 2$.

Proof

For k=1 we will prove directly.

We have therefore:

$$\Delta_{k,ij}\Delta_{k+1}-\Delta_{k,k+1i}\Delta_{k,k+1j}-\Delta_k\Delta_{k+1,ij}=$$

$$\begin{vmatrix}a_{11} & a_{1j}\\ a_{i1} & a_{ij}\end{vmatrix}\begin{vmatrix}a_{11} & a_{12}\\ a_{21} & a_{22}\end{vmatrix}-\begin{vmatrix}a_{11} & a_{1i}\\ a_{21} & a_{2i}\end{vmatrix}\begin{vmatrix}a_{11} & a_{1j}\\ a_{21} & a_{2j}\end{vmatrix}-a_{11}\begin{vmatrix}a_{11} & a_{12} & a_{1j}\\ a_{21} & a_{22} & a_{2j}\\ a_{i1} & a_{i2} & a_{ij}\end{vmatrix}=$$

$$\left(a_{11}a_{ij}-a_{1i}a_{1j}\right)\left(a_{11}a_{22}-a_{12}^2\right)-\left(a_{11}a_{2i}-a_{1i}a_{12}\right)\left(a_{11}a_{2j}-a_{1j}a_{12}\right)-$$
$$a_{11}\left(a_{11}a_{22}a_{ij}+a_{12}a_{2i}a_{1j}+a_{12}a_{1i}a_{2j}-a_{1j}a_{22}a_{1i}-a_{11}a_{2i}a_{2j}-a_{12}^2a_{ij}\right)=$$

$$a_{11}^2a_{22}a_{ij}-a_{11}a_{12}^2a_{ij}-a_{11}a_{22}a_{1i}a_{1j}+a_{12}^2a_{1i}a_{1j}-a_{11}^2a_{2i}a_{2j}+a_{11}a_{12}a_{2i}a_{1j}+a_{11}a_{12}a_{2j}a_{1i}-a_{12}^2a_{1i}a_{1j}-$$
$$a_{11}^2a_{22}a_{ij}-a_{11}a_{12}a_{2i}a_{1j}-a_{11}a_{12}a_{1i}a_{2j}+a_{11}a_{1j}a_{22}a_{1i}+a_{11}^2a_{2i}a_{2j}+a_{11}a_{12}^2a_{ij}=0$$

From corollary 2.1, for $\alpha=\left(a_{1\,k+1},...,\alpha_{k\,k+1}\right)^t$, $\delta=\left(a_{1j},...,a_{kj}\right)^t$, $\varepsilon=\left(a_{i1},...,a_{ik}\right)^t\in\mathbf{R}^k$, $\gamma=a_{k+1\,k+1}$, $\mu=a_{k+1\,j}$,

$\eta=a_{i\,k+1}$, $\lambda=a_{ij}$ we have:

$$\Delta_{k,ij}\Delta_{k+1}-\Delta_{k,k+1i}\Delta_{k,k+1j}-\Delta_k\Delta_{k+1,ij}=$$
$$\sum_{\substack{p,s,q,r=1\\ p<q\\ r<s}}^{k}(-1)^{p+s+q+r}\begin{vmatrix}a_{r\,k+1} & a_{s\,k+1}\\ a_{ir} & a_{is}\end{vmatrix}\begin{vmatrix}a_{p\,k+1} & a_{q\,k+1}\\ a_{pj} & a_{qj}\end{vmatrix}\left(\Gamma_{qs}\Gamma_{pr}-\Gamma_{ps}\Gamma_{qr}-\Gamma_{pq,rs}\Delta_k\right).$$

From Lemma 2.4, we have $\Gamma_{qs}\Gamma_{pr}-\Gamma_{ps}\Gamma_{qr}-\Gamma_{pq,rs}\Delta_k=0$, p<q, r<s, p,q,r,s=$\overline{1,k}$, $\forall k\geq 2$.

It follows therefore: $\Delta_{k,ij}\Delta_{k+1}-\Delta_{k,k+1i}\Delta_{k,k+1j}-\Delta_k\Delta_{k+1,ij}=0$.

3. A New Approach of the Gauss Method

Suppose, first, that (after a possible renumbering) $a_{11}\neq 0$. We have:

$$H(x)= a_{11}x_1^2 + 2x_1\sum_{j=2}^{n}a_{1j}x_j + \sum_{i,j=2}^{n}a_{ij}x_ix_j =$$

$$a_{11}\left[x_1^2 + 2x_1\sum_{j=2}^{n}\frac{a_{1j}}{a_{11}}x_j + \left(\sum_{j=2}^{n}\frac{a_{1j}}{a_{11}}x_j\right)^2\right] - a_{11}\left(\sum_{j=2}^{n}\frac{a_{1j}}{a_{11}}x_j\right)^2 + \sum_{i,j=2}^{n}a_{ij}x_ix_j =$$

$$\frac{1}{a_{11}}\left(a_{11}x_1 + \sum_{j=2}^{n}a_{1j}x_j\right)^2 - \frac{1}{a_{11}}\sum_{i,j=2}^{n}a_{1i}a_{1j}x_ix_j + \sum_{i,j=2}^{n}a_{ij}x_ix_j =$$

$$\frac{1}{a_{11}}y_1^2 + \frac{1}{a_{11}}\sum_{i,j=2}^{n}\left(a_{11}a_{ij} - a_{1i}a_{1j}\right)x_ix_j$$

where we performed the change of variables: $y_1= a_{11}x_1 + \sum_{j=2}^{n}a_{1j}x_j$ the others remaining the same.

From the above it follows that if $\Delta_1\neq 0$ then: $H(x)=\frac{1}{\Delta_1}y_1^2 + \frac{1}{\Delta_1}\sum_{i,j=2}^{n}\Delta_{1,ij}x_ix_j$.

Let P(k): $H(x)=\frac{1}{\Delta_1}y_1^2 + \frac{1}{\Delta_1\Delta_2}y_2^2 + ... + \frac{1}{\Delta_{k-1}\Delta_k}y_k^2 + \frac{1}{\Delta_k}\sum_{i,j=k+1}^{n}\Delta_{k,ij}x_ix_j$, $\Delta_i\neq 0\ \forall i=\overline{1,k}$

Since P(1) is true, suppose P(k) true. If $\exists i=\overline{k+1,n}$ such that: $\Delta_{k,ii}\neq 0$ then, after a possible renumbering, we assume: $\Delta_{k,k+1\ k+1}=\Delta_{k+1}\neq 0$.

Considering $H'(x) = \frac{1}{\Delta_k}\sum_{i,j=k+1}^{n}\Delta_{k,ij}x_ix_j$, we get:

$$H'(x) = \frac{1}{\Delta_k}\left(\Delta_{k+1}x_{k+1}^2 + 2x_{k+1}\sum_{i=k+2}^{n}\Delta_{k,k+1\,i}x_i + \sum_{i,j=k+2}^{n}\Delta_{k,ij}x_ix_j\right) =$$

$$\frac{\Delta_{k+1}}{\Delta_k}\left(x_{k+1}^2 + 2x_{k+1}\sum_{i=k+2}^{n}\frac{\Delta_{k,k+1\,i}}{\Delta_{k+1}}x_i + \sum_{i,j=k+2}^{n}\frac{\Delta_{k,ij}}{\Delta_{k+1}}x_ix_j\right) =$$

$$\frac{\Delta_{k+1}}{\Delta_k}\left(x_{k+1}^2 + 2x_{k+1}\sum_{i=k+2}^{n}\frac{\Delta_{k,k+1\,i}}{\Delta_{k+1}}x_i + \left(\sum_{i=k+2}^{n}\frac{\Delta_{k,k+1\,i}}{\Delta_{k+1}}x_i\right)^2 - \sum_{i,j=k+2}^{n}\frac{\Delta_{k,k+1\,i}}{\Delta_{k+1}}\frac{\Delta_{k,k+1\,j}}{\Delta_{k+1}}x_ix_j + \sum_{i,j=k+2}^{n}\frac{\Delta_{k,ij}}{\Delta_{k+1}}x_ix_j\right)$$

=

$$\frac{\Delta_{k+1}}{\Delta_k}\left(\left(x_{k+1}+\sum_{i=k+2}^{n}\frac{\Delta_{k,k+1i}}{\Delta_{k+1}}x_i\right)^2+\sum_{i,j=k+2}^{n}\left(\frac{\Delta_{k,ij}}{\Delta_{k+1}}-\frac{\Delta_{k,k+1i}}{\Delta_{k+1}}\frac{\Delta_{k,k+1j}}{\Delta_{k+1}}\right)x_ix_j\right)=$$

$$\frac{1}{\Delta_k\Delta_{k+1}}\left(\left(\Delta_{k+1}x_{k+1}+\sum_{i=k+2}^{n}\Delta_{k,k+1i}x_i\right)^2+\sum_{i,j=k+2}^{n}\left(\Delta_{k,ij}\Delta_{k+1}-\Delta_{k,k+1i}\Delta_{k,k+1j}\right)x_ix_j\right)=$$

$$\frac{1}{\Delta_k\Delta_{k+1}}y_{k+1}^2+\frac{1}{\Delta_{k+1}}\sum_{i,j=k+2}^{n}\frac{\Delta_{k,ij}\Delta_{k+1}-\Delta_{k,k+1i}\Delta_{k,k+1j}}{\Delta_k}x_ix_j$$

where we performed the change of variable: $y_{k+1}=\Delta_{k+1}x_{k+1}+\sum_{i=k+2}^{n}\Delta_{k,k+1i}x_i$.

From Lemma 5, $\Delta_{k,ij}\Delta_{k+1}-\Delta_{k,k+1i}\Delta_{k,k+1j}=\Delta_k\Delta_{k+1,ij}$ $\forall i,j\geq k+2$ $\forall k\geq 2$ therefore:

$$H'(x)=\frac{1}{\Delta_k\Delta_{k+1}}y_{k+1}^2+\frac{1}{\Delta_{k+1}}\sum_{i,j=k+2}^{n}\Delta_{k+1,ij}x_ix_j\ .$$

Therefore:

$$H(x)=\frac{1}{\Delta_1}y_1^2+\frac{1}{\Delta_1\Delta_2}y_2^2+\ldots+\frac{1}{\Delta_k\Delta_{k+1}}y_{k+1}^2+\frac{1}{\Delta_{k+1}}\sum_{i,j=k+2}^{n}\Delta_{k+1,ij}x_ix_j$$

and P(k+1) is also true.

Suppose now that $\Delta_1,\ldots,\Delta_k\neq 0$ and all $\Delta_{k,ii}=0$ $\forall i=\overline{k+1,n}$.

We have therefore: $H(x)=\frac{1}{\Delta_1}y_1^2+\frac{1}{\Delta_1\Delta_2}y_2^2+\ldots+\frac{1}{\Delta_{k-1}\Delta_k}y_k^2+\frac{1}{\Delta_k}\sum_{i,j=k+1}^{n}\Delta_{k,ij}x_ix_j$.

We have now two cases:

1. If $\Delta_{k,ij}=0$ $\forall i,j=\overline{k+1,n}$ then the algorithm ends and the normal form of H is:

$$H(x)=\frac{1}{\Delta_1}y_1^2+\frac{1}{\Delta_1\Delta_2}y_2^2+\ldots+\frac{1}{\Delta_{k-1}\Delta_k}y_k^2$$

Considering the matrix of changing of the canonical basis to a new basis: $M_{B_cB}=S^{-1}$ where:

$$S=\begin{pmatrix} \Delta_1 & \Delta_{0,12} & \dots & \Delta_{0,1k} & \Delta_{0,1\,k+1} & \dots & \Delta_{0,1n} \\ 0 & \Delta_2 & \dots & \Delta_{1,2k} & \Delta_{1,2\,k+1} & \dots & \Delta_{1,2n} \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & \Delta_k & \Delta_{k-1,k\,k+1} & \dots & \Delta_{k-1,kn} \\ 0 & 0 & \dots & 0 & 1 & \dots & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & 0 & 0 & \dots & 1 \end{pmatrix}$$

we have: $x=M_{B_cB}\,y$ from where $H(x)=x^t[H]_{B_c}\,x=y^tM_{B_cB}^t[H]_{B_c}M_{B_cB}y=y^t[H]_B\,y$

In the new basis:

$$[H]_B=\begin{pmatrix} \frac{1}{\Delta_1} & 0 & \dots & 0 & 0 & \dots & 0 \\ 0 & \frac{1}{\Delta_1\Delta_2} & \dots & 0 & 0 & \dots & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & \frac{1}{\Delta_{k-1}\Delta_k} & 0 & \dots & 0 \\ 0 & 0 & \dots & 0 & 0 & \dots & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & 0 & 0 & \dots & 0 \end{pmatrix}$$

2. If $\exists p\neq q$ such that $\Delta_{k,pq}\neq 0, k\leq n-2$, let the transformation: $\begin{cases} z_p=\dfrac{2(\delta x_p+\beta x_q)}{\alpha\delta+\beta\gamma} \\ z_q=\dfrac{2(\gamma x_p-\alpha x_q)}{\alpha\delta+\beta\gamma} \end{cases}$ with $\alpha\delta+\beta\gamma\neq 0$, $\alpha\gamma\neq 0$, $\beta\delta\neq 0$. We have therefore: $x_p=\dfrac{\alpha z_p+\beta z_q}{2}$ and $x_q=\dfrac{\gamma z_p-\delta z_q}{2}$.

After replacing, the term $\Delta_{k,pq}x_px_q$ becomes:

$\Delta_{k,pq}\dfrac{\alpha z_p+\beta z_q}{2}\dfrac{\gamma z_p-\delta z_q}{2}=\dfrac{\Delta_{k,pq}}{4}\left(\alpha\gamma z_p^2-\beta\delta z_q^2-(\alpha\delta-\beta\gamma)z_pz_q\right)$ and thus proceed as above.

We assume (again after a possible renumbering) that: $\Delta_{k,k+1\ k+2}\neq 0$ therefore: $x_{k+1}=\frac{\alpha z_{k+1}+\beta z_{k+2}}{2}$ and $x_{k+2}=\frac{\gamma z_{k+1}-\delta z_{k+2}}{2}$. For the form: $H'(x)=\sum_{i,j=k+1}^{n}\Delta_{k,ij}x_i x_j$ it follows:

$$H'(x)=2\Delta_{k,k+1k+2}x_{k+1}x_{k+2}+2\sum_{j=k+3}^{n}\Delta_{k,k+1\,j}x_{k+1}x_j+2\sum_{j=k+3}^{n}\Delta_{k,k+2\,j}x_{k+2}x_j+\sum_{i,j=k+3}^{n}\Delta_{k,ij}x_i x_j=$$

$$2\frac{\Delta_{k,k+1k+2}}{4}\left(\alpha\gamma z_{k+1}^2-\beta\delta z_{k+2}^2-(\alpha\delta-\beta\gamma)z_{k+1}z_{k+2}\right)+2\sum_{j=k+3}^{n}\Delta_{k,k+1\,j}\frac{\alpha z_{k+1}+\beta z_{k+2}}{2}x_j+$$

$$2\sum_{j=k+3}^{n}\Delta_{k,k+2\,j}\frac{\gamma z_{k+1}-\delta z_{k+2}}{2}x_j+\sum_{i,j=k+3}^{n}\Delta_{k,ij}x_i x_j=$$

$$\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}z_{k+1}^2-\beta\delta\frac{\Delta_{k,k+1k+2}}{2}z_{k+2}^2-(\alpha\delta-\beta\gamma)\frac{\Delta_{k,k+1k+2}}{2}z_{k+1}z_{k+2}+$$

$$\sum_{j=k+3}^{n}\alpha\Delta_{k,k+1\,j}z_{k+1}x_j+\sum_{j=k+3}^{n}\beta\Delta_{k,k+1\,j}z_{k+2}x_j+\sum_{j=k+3}^{n}\gamma\Delta_{k,k+2\,j}z_{k+1}x_j-\sum_{j=k+3}^{n}\delta\Delta_{k,k+2\,j}z_{k+2}x_j+\sum_{i,j=k+3}^{n}\Delta_{k,ij}x_i x_j$$

Proceeding as above, it follows:

$$H'(x)=\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}z_{k+1}^2+z_{k+1}\left(-(\alpha\delta-\beta\gamma)\frac{\Delta_{k,k+1k+2}}{2}z_{k+2}+\sum_{j=k+3}^{n}\gamma\Delta_{k,k+2\,j}x_j+\sum_{j=k+3}^{n}\alpha\Delta_{k,k+1\,j}x_j\right)-$$

$$\beta\delta\frac{\Delta_{k,k+1k+2}}{2}z_{k+2}^2+\sum_{j=k+3}^{n}\beta\Delta_{k,k+1\,j}z_{k+2}x_j-\sum_{j=k+3}^{n}\delta\Delta_{k,k+2\,j}z_{k+2}x_j+\sum_{i,j=k+3}^{n}\Delta_{k,ij}x_i x_j=$$

$$\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}\left[z_{k+1}+\frac{1}{\alpha\gamma\Delta_{k,k+1k+2}}\left(-(\alpha\delta-\beta\gamma)\frac{\Delta_{k,k+1k+2}}{2}z_{k+2}+\sum_{j=k+3}^{n}\gamma\Delta_{k,k+2\,j}x_j+\sum_{j=k+3}^{n}\alpha\Delta_{k,k+1\,j}x_j\right)\right]^2-$$

$$\frac{1}{2\alpha\gamma\Delta_{k,k+1k+2}}\left(-(\alpha\delta-\beta\gamma)\frac{\Delta_{k,k+1k+2}}{2}z_{k+2}+\sum_{j=k+3}^{n}\gamma\Delta_{k,k+2\,j}x_j+\sum_{j=k+3}^{n}\alpha\Delta_{k,k+1\,j}x_j\right)^2-\beta\delta\frac{\Delta_{k,k+1k+2}}{2}z_{k+2}^2+$$

$$\sum_{j=k+3}^{n}\beta\Delta_{k,k+1\,j}z_{k+2}x_j-\sum_{j=k+3}^{n}\delta\Delta_{k,k+2\,j}z_{k+2}x_j+\sum_{i,j=k+3}^{n}\Delta_{k,ij}x_i x_j$$

With the variable transformation:

$$y_{k+1}=$$

$$z_{k+1}+\frac{1}{\alpha\gamma\Delta_{k,k+1k+2}}\left(-(\alpha\delta-\beta\gamma)\frac{\Delta_{k,k+1k+2}}{2}z_{k+2}+\sum_{j=k+3}^{n}\gamma\Delta_{k,k+2\,j}x_j+\sum_{j=k+3}^{n}\alpha\Delta_{k,k+1\,j}x_j\right)$$

we get:

$$H'(x)=\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}y_{k+1}^2-\frac{1}{2\alpha\gamma\Delta_{k,k+1k+2}}\left(-(\alpha\delta-\beta\gamma)\frac{\Delta_{k,k+1k+2}}{2}z_{k+2}+\sum_{j=k+3}^{n}\gamma\Delta_{k,k+2j}x_j+\sum_{j=k+3}^{n}\alpha\Delta_{k,k+1j}x_j\right)^2-$$

$$\beta\delta\frac{\Delta_{k,k+1k+2}}{2}z_{k+2}^2+\sum_{j=k+3}^{n}\beta\Delta_{k,k+1j}z_{k+2}x_j-\sum_{j=k+3}^{n}\delta\Delta_{k,k+2j}z_{k+2}x_j+\sum_{i,j=k+3}^{n}\Delta_{k,ij}x_ix_j=$$

$$\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}y_{k+1}^2-(\alpha\delta-\beta\gamma)^2\frac{\Delta_{k,k+1k+2}}{8\alpha\gamma}z_{k+2}^2-\frac{\gamma}{2\alpha\Delta_{k,k+1k+2}}\sum_{i,j=k+3}^{n}\Delta_{k,k+2i}\Delta_{k,k+2j}x_ix_j-$$

$$\frac{\alpha}{2\gamma\Delta_{k,k+1k+2}}\sum_{i,j=k+3}^{n}\Delta_{k,k+1i}\Delta_{k,k+1j}x_ix_j+(\alpha\delta-\beta\gamma)\frac{1}{2\alpha}\sum_{j=k+3}^{n}\Delta_{k,k+2j}x_jz_{k+2}+(\alpha\delta-\beta\gamma)\frac{1}{2\gamma}\sum_{j=k+3}^{n}\Delta_{k,k+1j}x_jz_{k+2}-$$

$$\frac{1}{\Delta_{k,k+1k+2}}\sum_{i,j=k+3}^{n}\Delta_{k,k+1i}\Delta_{k,k+2j}x_ix_j-\beta\delta\frac{\Delta_{k,k+1k+2}}{2}z_{k+2}^2+\sum_{j=k+3}^{n}\beta\Delta_{k,k+1j}z_{k+2}x_j-\sum_{j=k+3}^{n}\delta\Delta_{k,k+2j}z_{k+2}x_j+$$

$$\sum_{i,j=k+3}^{n}\Delta_{k,ij}x_ix_j=$$

$$\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}y_{k+1}^2-(\alpha\delta+\beta\gamma)^2\frac{\Delta_{k,k+1k+2}}{8\alpha\gamma}z_{k+2}^2+\frac{\alpha\delta+\beta\gamma}{2\alpha\gamma}\sum_{j=k+3}^{n}(\alpha\Delta_{k,k+1j}-\gamma\Delta_{k,k+2j})x_jz_{k+2}+$$

$$\frac{1}{2\alpha\gamma\Delta_{k,k+1k+2}}\sum_{i,j=k+3}^{n}(2\alpha\gamma\Delta_{k,ij}\Delta_{k,k+1k+2}-\gamma^2\Delta_{k,k+2i}\Delta_{k,k+2j}-\alpha^2\Delta_{k,k+1i}\Delta_{k,k+1j}-2\alpha\gamma\Delta_{k,k+1i}\Delta_{k,k+2j})x_ix_j=$$

$$\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}y_{k+1}^2-(\alpha\delta+\beta\gamma)^2\frac{\Delta_{k,k+1k+2}}{8\alpha\gamma}\left(z_{k+2}-\frac{2}{(\alpha\delta+\beta\gamma)\Delta_{k,k+1k+2}}\sum_{j=k+3}^{n}(\alpha\Delta_{k,k+1j}-\gamma\Delta_{k,k+2j})x_j\right)^2+$$

$$\frac{1}{2\alpha\gamma\Delta_{k,k+1k+2}}\left(\sum_{j=k+3}^{n}(\alpha\Delta_{k,k+1j}-\gamma\Delta_{k,k+2j})x_j\right)^2+$$

$$\frac{1}{2\alpha\gamma\Delta_{k,k+1k+2}}\sum_{i,j=k+3}^{n}(2\alpha\gamma\Delta_{k,ij}\Delta_{k,k+1k+2}-\gamma^2\Delta_{k,k+2i}\Delta_{k,k+2j}-\alpha^2\Delta_{k,k+1i}\Delta_{k,k+1j}-2\alpha\gamma\Delta_{k,k+1i}\Delta_{k,k+2j})x_ix_j$$

Also, with the variable transformation:

$$y_{k+2}=z_{k+2}-\frac{2}{(\alpha\delta+\beta\gamma)\Delta_{k,k+1k+2}}\sum_{j=k+3}^{n}(\alpha\Delta_{k,k+1j}-\gamma\Delta_{k,k+2j})x_j$$

it follows:

$$\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}y_{k+1}^2-(\alpha\delta+\beta\gamma)^2\frac{\Delta_{k,k+1k+2}}{8\alpha\gamma}y_{k+2}^2+$$

$$\frac{1}{2\Delta_{k,k+1k+2}}\sum_{i,j=k+3}^{n}(2\Delta_{k,ij}\Delta_{k,k+1k+2}-3\Delta_{k,k+1i}\Delta_{k,k+2j}-\Delta_{k,k+2i}\Delta_{k,k+1j})x_ix_j=$$

$$\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}y_{k+1}^2-(\alpha\delta+\beta\gamma)^2\frac{\Delta_{k,k+1k+2}}{8\alpha\gamma}y_{k+2}^2+\frac{1}{\Delta_{k,k+1k+2}}\sum_{i,j=k+3}^{n}(\Delta_{k,ij}\Delta_{k,k+1k+2}-2\Delta_{k,k+1i}\Delta_{k,k+2j})x_ix_j$$

=

$$\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}y_{k+1}^2-(\alpha\delta+\beta\gamma)^2\frac{\Delta_{k,k+1k+2}}{8\alpha\gamma}y_{k+2}^2+$$

$$\frac{2}{\Delta_{k,k+1k+2}}\left(\sum_{\substack{i,j=k+3\\ i<j}}^{n}\left(\Delta_{k,ij}\Delta_{k,k+1k+2}-\Delta_{k,k+1i}\Delta_{k,k+2j}-\Delta_{k,k+1j}\Delta_{k,k+2i}\right)x_ix_j-2\sum_{i=k+3}^{n}\Delta_{k,k+1i}\Delta_{k,k+2i}x_i^2\right)=$$

$$\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2}y_{k+1}^2-(\alpha\delta+\beta\gamma)^2\frac{\Delta_{k,k+1k+2}}{8\alpha\gamma}y_{k+2}^2+$$

$$\frac{2}{\Delta_{k,k+1k+2}}\sum_{\substack{i,j=k+3\\ i\le j}}^{n}\left(\Delta_{k,ij}\Delta_{k,k+1k+2}-\Delta_{k,k+1i}\Delta_{k,k+2j}-\Delta_{k,k+1j}\Delta_{k,k+2i}\right)x_ix_j$$

The form H becomes therefore:

$$H(x)=\frac{1}{\Delta_1}y_1^2+\frac{1}{\Delta_1\Delta_2}y_2^2+\ldots+\frac{1}{\Delta_{k-1}\Delta_k}y_k^2+\alpha\gamma\frac{\Delta_{k,k+1k+2}}{2\Delta_k}y_{k+1}^2-(\alpha\delta+\beta\gamma)^2\frac{\Delta_{k,k+1k+2}}{8\alpha\gamma\Delta_k}y_{k+2}^2+$$

$$\frac{1}{\Delta_k\Delta_{k,k+1k+2}}\sum_{i,j=k+3}^{n}\left(\Delta_{k,ij}\Delta_{k,k+1k+2}-2\Delta_{k,k+1i}\Delta_{k,k+2j}\right)x_ix_j$$

In particular, for $\alpha=\beta=\gamma=\delta=\sqrt{2\text{sign}(\Delta_k)\Delta_k}$ it follows:

$$H(x)=\frac{1}{\Delta_1}y_1^2+\frac{1}{\Delta_1\Delta_2}y_2^2+\ldots+\frac{1}{\Delta_{k-1}\Delta_k}y_k^2+\text{sign}(\Delta_k)\Delta_{k,k+1k+2}y_{k+1}^2-\text{sign}(\Delta_k)\Delta_{k,k+1k+2}y_{k+2}^2+$$

$$\frac{1}{\Delta_k\Delta_{k,k+1k+2}}\sum_{i,j=k+3}^{n}\left(\Delta_{k,ij}\Delta_{k,k+1k+2}-2\Delta_{k,k+1i}\Delta_{k,k+2j}\right)x_ix_j$$

As:

$$\begin{cases}z_{k+1}=\dfrac{1}{\sqrt{2\text{sign}(\Delta_k)\Delta_k}}x_{k+1}+\dfrac{1}{\sqrt{2\text{sign}(\Delta_k)\Delta_k}}x_{k+2}\\ z_{k+2}=\dfrac{1}{\sqrt{2\text{sign}(\Delta_k)\Delta_k}}x_{k+1}-\dfrac{1}{\sqrt{2\text{sign}(\Delta_k)\Delta_k}}x_{k+2}\end{cases}$$

it follows:

$y_{k+1}=$

$$\frac{1}{\sqrt{2\text{sign}(\Delta_k)\Delta_k}}x_{k+1}+\frac{1}{\sqrt{2\text{sign}(\Delta_k)\Delta_k}}x_{k+2}+\frac{1}{\sqrt{2\text{sign}(\Delta_k)\Delta_k\Delta_{k,k+1k+2}}}\sum_{j=k+3}^{n}\left(\Delta_{k,k+2j}+\Delta_{k,k+1j}\right)x_j$$

$$y_{k+2}=\frac{1}{\sqrt{2\text{sign}(\Delta_k)\Delta_k}}x_{k+1}-\frac{1}{\sqrt{2\text{sign}(\Delta_k)\Delta_k}}x_{k+2}+\frac{1}{\sqrt{2\text{sign}(\Delta_k)\Delta_k\Delta_{k,k+1k+2}}}\sum_{j=k+3}^{n}\left(\Delta_{k,k+2j}-\Delta_{k,k+1j}\right)x_j$$

Considering the matrix of changing of the canonical basis to a new basis: $M_{B_cB}=S^{-1}$ where:

S=

$$\begin{pmatrix}
\Delta_1 & \Delta_{0,12} & \dots & \Delta_{0,1k} & \Delta_{0,1k+1} & \Delta_{0,1k+2} & \Delta_{0,1k+3} & \dots & \Delta_{0,1n} \\
0 & \Delta_2 & \dots & \Delta_{1,2k} & \Delta_{1,2k+1} & \Delta_{1,2k+2} & \Delta_{1,2k+3} & \dots & \Delta_{1,2n} \\
\dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\
0 & 0 & \dots & \Delta_k & \Delta_{k-1,kk+1} & \Delta_{k-1,kk+2} & \Delta_{k-1,kk+3} & \dots & \Delta_{k-1,kn} \\
0 & 0 & \dots & 0 & \frac{1}{\sqrt{2\operatorname{sign}(\Delta_k)\Delta_k}} & \frac{1}{\sqrt{2\operatorname{sign}(\Delta_k)\Delta_k}} & \frac{\Delta_{k,k+2k+3}+\Delta_{k,k+1k+3}}{\sqrt{2\operatorname{sign}(\Delta_k)\Delta_k\Delta_{k,k+1k+2}}} & \dots & \frac{\Delta_{k,k+2n}+\Delta_{k,k+1n}}{\sqrt{2\operatorname{sign}(\Delta_k)\Delta_k\Delta_{k,k+1k+2}}} \\
0 & 0 & \dots & 0 & \frac{1}{\sqrt{2\operatorname{sign}(\Delta_k)\Delta_k}} & -\frac{1}{\sqrt{2\operatorname{sign}(\Delta_k)\Delta_k}} & \frac{\Delta_{k,k+2k+3}-\Delta_{k,k+1k+3}}{\sqrt{2\operatorname{sign}(\Delta_k)\Delta_k\Delta_{k,k+1k+2}}} & \dots & \frac{\Delta_{k,k+2n}-\Delta_{k,k+1n}}{\sqrt{2\operatorname{sign}(\Delta_k)\Delta_k\Delta_{k,k+1k+2}}} \\
0 & 0 & \dots & 0 & 0 & 0 & b_{k+3k+3} & \dots & b_{k+3n} \\
\dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\
0 & 0 & \dots & 0 & 0 & 0 & b_{nk+3} & \dots & b_{nn}
\end{pmatrix}$$

we have: $x=M_{B_cB}y$ from where $H(x)=x^t[H]_{B_c}x=y^tM_{B_cB}^t[H]_{B_c}M_{B_cB}y=y^t[H]_By$.

In the new basis:

$[H]_B=$

$$\begin{pmatrix}
\frac{1}{\Delta_1} & 0 & \dots & 0 & 0 & 0 & 0 & \dots & 0 \\
0 & \frac{1}{\Delta_1\Delta_2} & \dots & 0 & 0 & 0 & 0 & \dots & 0 \\
\dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\
0 & 0 & \dots & \frac{1}{\Delta_{k-1}\Delta_k} & 0 & 0 & 0 & \dots & 0 \\
0 & 0 & \dots & 0 & \operatorname{sign}(\Delta_k)\Delta_{k,k+1k+2} & 0 & 0 & \dots & 0 \\
0 & 0 & \dots & 0 & 0 & -\operatorname{sign}(\Delta_k)\Delta_{k,k+1k+2} & 0 & \dots & 0 \\
0 & 0 & \dots & 0 & 0 & 0 & c_{k+3k+3} & \dots & c_{k+3n} \\
\dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\
0 & 0 & \dots & 0 & 0 & 0 & c_{nk+3} & \dots & c_{nn}
\end{pmatrix}$$

where $c_{ij}=\frac{\Delta_{k,ij}\Delta_{k,k+1k+2}-2\Delta_{k,k+1i}\Delta_{k,k+2j}}{\Delta_k\Delta_{k,k+1k+2}}$, $i,j=\overline{k+3,n}$.

After these considerations, we can formulate the following theorem:

Theorem 3.1

Given the quadratic form $H:\mathbf{R}^n\to\mathbf{R}$, $H(x)=\sum_{i,j=1}^{n}a_{ij}x_ix_j$ $\forall x=(x_1,...,x_n)\in\mathbf{R}^n$ we have:

1. If $\Delta_1,...,\Delta_n\neq 0$ then the normal form of H is:

$$H(x)=\frac{1}{\Delta_1}y_1^2+\frac{1}{\Delta_1\Delta_2}y_2^2+...+\frac{1}{\Delta_{n-1}\Delta_n}y_n^2$$

where: $y_k=\Delta_k x_k+\sum_{i=k+1}^{n}\Delta_{k-1,ki}x_i$, $k=\overline{1,n}$, $\Delta_0=1$.

2. If $\Delta_1,...,\Delta_k\neq 0$, $\Delta_{k,ij}=0$ $\forall i,j=\overline{k+1,n}$ then the normal form of H is:

$$H(x)=\frac{1}{\Delta_1}y_1^2+\frac{1}{\Delta_1\Delta_2}y_2^2+...+\frac{1}{\Delta_{k-1}\Delta_k}y_k^2$$

where: $y_k=\Delta_k x_k+\sum_{i=k+1}^{n}\Delta_{k-1,ki}x_i$, $k=\overline{1,n}$, $\Delta_0=1$.

3. If $\Delta_1,...,\Delta_k\neq 0$, $\Delta_{k,ii}=0$ $\forall i=\overline{k+1,n}$ and $\exists i\neq j=\overline{k+1,n}$ such that $\Delta_{k,ij}\neq 0$ then the normal form of H is:

$$H(x)=\frac{1}{\Delta_1}y_1^2+\frac{1}{\Delta_1\Delta_2}y_2^2+...+\frac{1}{\Delta_{k-1}\Delta_k}y_k^2+\operatorname{sign}(\Delta_k)\Delta_{k,ij}y_i^2-\operatorname{sign}(\Delta_k)\Delta_{k,ij}y_j^2+H'_n(x')$$
$$, \; x'=(x_{k+3},...,x_n)$$

where $y_p=\Delta_p x_p+\sum_{i=p+1}^{n}\Delta_{p-1,pi}x_i$, $p=\overline{1,k}$, $\Delta_0=1$,

$$y_{k+1}=z_{k+1}+\frac{1}{\sqrt{2\operatorname{sign}(\Delta_k)\Delta_k}\Delta_{k,k+1k+2}}\sum_{j=k+3}^{n}(\Delta_{k,k+2j}+\Delta_{k,k+1j})x_j\,,$$

$$y_{k+2}=z_{k+2}+\frac{1}{\sqrt{2\operatorname{sign}(\Delta_k)\Delta_k}\Delta_{k,k+1k+2}}\sum_{j=k+3}^{n}(\Delta_{k,k+2j}-\Delta_{k,k+1j})x_j$$

and H'_n is the normal form of

$$H'(x)=\frac{1}{\Delta_k\Delta_{k,k+1k+2}}\sum_{i,j=k+3}^{n}(\Delta_{k,ij}\Delta_{k,k+1k+2}-2\Delta_{k,k+1i}\Delta_{k,k+2j})x_ix_j\,.$$

Corollary 3.1

Given the quadratic form $H:\mathbf{R}^n\to\mathbf{R}$, $H(x)=\sum_{i,j=1}^{n}a_{ij}x_ix_j$ $\forall x=(x_1,...,x_n)\in\mathbf{R}^n$ it follows (after a possible renumbering):

1. The quadratic form is positive definite if and only if: $\Delta_1,...,\Delta_n>0$;
2. The quadratic form is negative definite if and only if: $(-1)^k\Delta_k>0$ $\forall k=\overline{1,n}$;
3. The quadratic form is positive semi-definite if and only if: $\exists k=\overline{1,n}$ such that: $\Delta_1,...,\Delta_k>0$ and $\Delta_{k,ij}=0$ $\forall i,j=\overline{k+1,n}$;
4. The quadratic form is negative semi-definite if and only if: $\exists k=\overline{1,n}$ such that: $(-1)^i\Delta_i>0$, $i=\overline{1,k}$ and $\Delta_{k,ij}=0$ $\forall i,j=\overline{k+1,n}$;
5. The quadratic form is semi-definite if and only if:

a. $\Delta_1,...,\Delta_n\neq0$, but do not meet 1 or 2;

b. $\exists k=\overline{1,n}$ such that $\Delta_1,...,\Delta_k\neq0$ not meeting 1 or 2 and $\forall i,j=\overline{k+1,n}$: $\Delta_{k,ij}=0$;

c. $\exists k=\overline{1,n}$ such that $\Delta_1,...,\Delta_k\neq0$, $\Delta_{k,ii}=0$ $\forall i=\overline{k+1,n}$ and $\exists i,j=\overline{k+1,n}$ such that $\Delta_{k,ij}\neq0$.

We ask now the question what happens to the coefficient C_{ij} of x_ix_j from H'_n.

We have $C_{ij}=\Delta_{k,ij}\Delta_{k,k+1\,k+2}-2\Delta_{k,k+1\,i}\Delta_{k,k+2\,j}$.

How $C_{ij}=C_{ji}$ it follows: $\Delta_{k,k+1\,i}\Delta_{k,k+2\,j}=\Delta_{k,k+1\,j}\Delta_{k,k+2\,i}$.

Noting δ_{ij} the determinant obtaind by board Δ_k with the columns k+2 and j and the rows k+1 and i, from corollary 2, it follows:

(1) $\Delta_{k,ij}\Delta_{k,k+2\,k+1}-\Delta_{k,i\,k+1}\Delta_{k,j\,k+2}=\Delta_k\delta_{ij}$ $\forall i\geq k+2,\ j\geq k+3$

In particular, for i=j, we have:

(2) $\Delta_{k,ii}\Delta_{k,k+2\,k+1}-\Delta_{k,i\,k+1}\Delta_{k,i\,k+2}=\Delta_k\delta_{ii}$ $\forall i\geq k+3$

How $\Delta_{k,ii}=0$, it follows:

(3) $\Delta_{k,i\,k+1}\Delta_{k,i\,k+2}=-\Delta_k\delta_{ii}$

From Lemma 5:

(4) $\Delta_{k,ij}\Delta_{k+1}-\Delta_{k,k+1\,i}\Delta_{k,k+1\,j}=\Delta_k\Delta_{k+1,ij}$ $\forall i,j\geq k+2$ $\forall k\geq2$

How $\Delta_{k+1}=\Delta_{k,k+1\,k+1}=0$, we get from (4):

(5) $\Delta_{k,k+1\,i}\Delta_{k,k+1\,j}=-\Delta_k\Delta_{k+1,ij}$

In particular, for i=j:

(6) $\Delta^2_{k,k+1\,i}=-\Delta_k\Delta_{k+1,ii}$

For i=k+2 în (6):

(7) $\Delta^2_{k,k+1\,k+2}=-\Delta_k\Delta_{k+1,k+2\,k+2}=-\Delta_k\Delta_{k+2}$

therefore implicitly $\Delta_{k+2}\neq 0$.

From (5), for j=k+2:

(8) $\Delta_{k,k+1\,i}\Delta_{k,k+1\,k+2}=-\Delta_k\Delta_{k+1,k+2\,i}$

We have now, from (3) and (5):

(9) $\Delta_{k,k+1\,i}\Delta_{k,k+2\,j}\Delta^2_{k,k+1\,j}=\Delta^2_k\Delta_{k+1,ij}\delta_{jj}$

From (6) and (9):

$\Delta_{k,k+1\,i}\Delta_{k,k+2\,j}\Delta_{k+1,jj}=-\Delta_k\Delta_{k+1,ij}\delta_{jj}$

therefore:

(10) $\Delta_{k,k+1\,i}\Delta_{k,k+2\,j}=-\dfrac{\Delta_k\Delta_{k+1,ij}\delta_{jj}}{\Delta_{k+1,jj}}$ if $\Delta_{k+1,jj}\neq 0$

If $\Delta_{k+1,jj}=0$ then, from (6) it follows: $\Delta_{k,k+1\,j}=0$, and from (5) it follows: $\Delta_{k+1,ij}=0$. Also, from (3) it follows: $\delta_{jj}=0$.

Therefore, if $\Delta_{k+1,jj}\neq 0$ then:

$C_{ij}=\Delta_{k,ij}\Delta_{k,k+1\,k+2}-2\Delta_{k,k+1\,i}\Delta_{k,k+2\,j}=\dfrac{\Delta_{k,ij}\Delta_{k+1,jj}\Delta_{k,k+1\,k+2}+2\Delta_k\Delta_{k+1,ij}\delta_{jj}}{\Delta_{k+1,jj}}$ and, in particular: $C_{jj}=2\Delta_k\delta_{jj}$

and if $\Delta_{k+1,jj}=0$ then: $C_{ij}=\Delta_{k,ij}\Delta_{k,k+1\,k+2}$ and, in particular: $C_{jj}=0$.

Therefore:

$$H'(x)=\frac{1}{\Delta_k\Delta_{k,k+1\,k+2}}\sum_{i,j=k+3}^{n}\left(\Delta_{k,ij}\Delta_{k,k+1\,k+2}-2\Delta_{k,k+1\,i}\Delta_{k,k+2\,j}\right)x_i x_j=$$

$$\frac{1}{\Delta_k\Delta_{k,k+1\,k+2}}\left(\sum_{\substack{i,j=k+3\\ \Delta_{k+1,jj}\neq 0}}^{n}\frac{\Delta_{k,ij}\Delta_{k+1,jj}\Delta_{k,k+1\,k+2}+2\Delta_k\Delta_{k+1,ij}\delta_{jj}}{\Delta_{k+1,jj}}x_ix_j+\sum_{\substack{i,j=k+3\\ \Delta_{k+1,jj}=0}}^{n}\Delta_{k,ij}\Delta_{k,k+1\,k+2}x_ix_j\right)$$

=

$$\frac{2}{\Delta_k\Delta_{k,k+1\,k+2}}\left(\sum_{i,j=k+3}^{n}\Delta_{k,ij}\Delta_{k,k+1\,k+2}x_ix_j+\sum_{\substack{i,j=k+3\\ \Delta_{k+1,jj}\neq 0}}^{n}\frac{\Delta_k\Delta_{k+1,ij}\delta_{jj}}{\Delta_{k+1,jj}}x_ix_j\right)=$$

$$2\left(\frac{1}{\Delta_k}\sum_{i,j=k+3}^{n}\Delta_{k,ij}x_ix_j+\frac{1}{\Delta_{k,k+1\,k+2}}\sum_{\substack{i,j=k+3\\ \Delta_{k+1,jj}\neq 0}}^{n}\frac{\Delta_{k+1,ij}\delta_{jj}}{\Delta_{k+1,jj}}x_ix_j\right)$$

4. Bordered Matrices

Let the bordered matrix: $H_B=\begin{pmatrix}0 & b_1 & b_2 & \dots & b_n\\ b_1 & a_{11} & a_{12} & \dots & a_{1n}\\ b_2 & a_{21} & a_{22} & \dots & a_{2n}\\ \dots & \dots & \dots & \dots & \dots\\ b_n & a_{n1} & a_{n2} & \dots & a_{nn}\end{pmatrix}$ and $\Delta_k^B=$

$\begin{pmatrix}0 & b_1 & b_2 & \dots & b_k\\ b_1 & a_{11} & a_{12} & \dots & a_{1k}\\ b_2 & a_{21} & a_{22} & \dots & a_{2k}\\ \dots & \dots & \dots & \dots & \dots\\ b_k & a_{k1} & a_{k2} & \dots & a_{kk}\end{pmatrix}$, $k=\overline{1,n}$.

From Lemma 2.1, we have: $\Delta_k^B=\sum_{r,s=1}^{k}(-1)^{r+s+1}b_rb_s\Gamma_{rs}$ where Γ_{rs} is the appropriate minor of a_{ij} from the matrix of $H(x)=\sum_{i,j=1}^{n}a_{ij}x_ix_j$.

Let consider the quadratic form: $H_k^B(b) = -\sum_{r,s=1}^{k}(-1)^{r+s}\Gamma_{rs}b_r b_s$ and $\Delta_k^{Bb} = \begin{vmatrix} \Gamma_{11} & \dots & (-1)^{k+1}\Gamma_{1k} \\ \dots & \dots & \dots \\ (-1)^{k+1}\Gamma_{k1} & \dots & \Gamma_{kk} \end{vmatrix}$.

Since $\begin{pmatrix} a_{11} & \dots & a_{1k} \\ \dots & \dots & \dots \\ a_{k1} & \dots & a_{kk} \end{pmatrix}\begin{pmatrix} \Gamma_{11} & \dots & (-1)^{k+1}\Gamma_{1k} \\ \dots & \dots & \dots \\ (-1)^{k+1}\Gamma_{k1} & \dots & \Gamma_{kk} \end{pmatrix} = \Delta_k I_k$ it follows: $\Delta_k \Delta_k^{Bb} = \Delta_k^k$ from where: $\Delta_k^{Bb} = \Delta_k^{k-1}$ if $\Delta_k \neq 0$.

If $\Delta_1,\dots,\Delta_k \neq 0$ then $\exists P \in M_k(\mathbf{R})$, invertible, such that:

$$P^t\begin{pmatrix} a_{11} & \dots & a_{1k} \\ \dots & \dots & \dots \\ a_{k1} & \dots & a_{kk} \end{pmatrix}P = \begin{pmatrix} \frac{1}{\Delta_1} & 0 & \dots & 0 \\ 0 & \frac{1}{\Delta_1\Delta_2} & \dots & 0 \\ \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & \frac{1}{\Delta_{k-1}\Delta_k} \end{pmatrix}$$

We obtain after few computations:

$$P^{-1}\begin{pmatrix} \Gamma_{11} & \dots & (-1)^{k+1}\Gamma_{1k} \\ \dots & \dots & \dots \\ (-1)^{k+1}\Gamma_{k1} & \dots & \Gamma_{kk} \end{pmatrix}\left(P^{-1}\right)^t = \Delta_k\begin{pmatrix} \Delta_1 & 0 & \dots & 0 \\ 0 & \Delta_1\Delta_2 & \dots & 0 \\ \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & \Delta_{k-1}\Delta_k \end{pmatrix}$$

Therefore, for $\Delta_1,\dots,\Delta_k \neq 0$ the normal form of $H_k^B(b)$ is:

$$H_k^B(b) = -\Delta_k\left(\Delta_1 c_1^2 + \Delta_1\Delta_2 c_2^2 + \dots + \Delta_{k-1}\Delta_k c_k^2\right)$$

where $c=(c_1,\dots,c_k)$ are the coordinates of b in the new basis.

As a result of these relations, it follows that if: $\Delta_1,\dots,\Delta_k > 0$ then: $\Delta_k^B < 0$. If $(-1)^i\Delta_i > 0$ $\forall i = \overline{1,k}$ then: $\text{sign}(\Delta_k^B) = \text{sign}(\Delta_k)$ therefore $(-1)^k\Delta_k^B > 0$.

Analogously the things happen if $\Delta_1,...,\Delta_p \neq 0$ and $\Delta_{p,ij}=0\ \forall i,j=\overline{p+1,k}$. In this case, the normal form of $H_k^B(b)$ is:

$$H^B(b)=-\Delta_p\left(\Delta_1 c_1^2+\Delta_1\Delta_2 c_2^2+...+\Delta_{p-1}\Delta_p c_p^2\right)$$

where $c=(c_1,...,c_k)$ are the coordinates of b in the new basis.

As a result of these relations, it follows that if: $\Delta_1,...,\Delta_p>0$ and $\Delta_{p,ij}=0\ \forall i,j=\overline{p+1,k}$ then: $\Delta_k^B \leq 0$. If $(-1)^i\Delta_i>0\ \forall i=\overline{1,p}$ then: $\text{sign}(\Delta_k^B)=\text{sign}(\Delta_k)$ therefore $(-1)^k\Delta_k^B \geq 0$.

If H is semi-definite, the problem is more complicated. So, in the case of expression $\Delta_k^B=\sum_{r,s=1}^{k}(-1)^{r+s+1}b_r b_s \Gamma_{rs}$ if Δ_k^B is semi-definite then $\exists b', b'' \in \mathbf{R}^k$ such that $\Delta_k^B(b')>0$, $\Delta_k^B(b'')<0$. Difficult issue arises where for another determinant Δ_s^B, $s\neq k$, which signs depending on the values of b is not strictly determined, the values $b', b'' \in \mathbf{R}^k$ are not necessarily the same as in the case of Δ_k^B.

5. The Convexity of the Functions

We present in this section some of the remarkable results of concavity or quasi-concavity of functions.

Definition 5.1 A subset $D\subset\mathbf{R}^n$ is called convex if $\forall x,y\in D\ \forall\lambda\in[0,1]\Rightarrow\lambda x+(1-\lambda)y\in D$.

From definition, it follows that D is convex if and only if for any two points $x,y\in D$, the segment $[x,y]\subset D$.

Definition 5.2 A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$ is called **convex** if $\forall x,y\in D\ \forall\lambda\in[0,1]$ follows
$f(\lambda x+(1-\lambda)y)\leq\lambda f(x)+(1-\lambda)f(y)$.

Definition 5.3 A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$ is called **concave** if $\forall x,y\in D\ \forall\lambda\in[0,1]$ follows
$f(\lambda x+(1-\lambda)y)\geq\lambda f(x)+(1-\lambda)f(y)$.

From the definitions, it follows that a function is convex (concave) if and only if for any segment $[x,y]\subset D$ the values of the restriction function is under (above) or on the chord determined by the values of the function on the extremities of its.

Definition 5.4 A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$ is called **strictly convex** if $\forall x,y\in D$ $\forall\lambda\in(0,1)$ follows

$f(\lambda x+(1-\lambda)y)<\lambda f(x)+(1-\lambda)f(y)$.

Definition 5.5 A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$ is called **strictly concave** if $\forall x,y\in D$ $\forall\lambda\in(0,1)$ follows

$f(\lambda x+(1-\lambda)y)>\lambda f(x)+(1-\lambda)f(y)$.

From these definitions, it follows that a function is strictly convex (concave) if and only if for any segment $[x,y]\subset D$ the values of the restriction function is under (above) the chord determined by the values of the function on the extremities of its.

Definition 5.6 A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is called **quasiconvex** if $\forall x,y\in D$ $\forall\lambda\in[0,1]$ then: $f(\lambda x+(1-\lambda)y)\leq\max(f(x),f(y))$.

Definition 5.7 A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is called **quasiconcave** if $\forall x,y\in D$ $\forall\lambda\in[0,1]$ then: $f(\lambda x+(1-\lambda)y)\geq\min(f(x),f(y))$.

From the definitions, it follows that a function is quasiconvex (quasiconcave) if and only if for any segment $[x,y]\subset D$ the values of the restriction function is under (above) the maximum (minimum) level registered by the function at the ends.

Definition 5.8 A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is called **strictly quasiconvex** if $\forall x\neq y\in D$ $\forall\lambda\in(0,1)$ then: $f(\lambda x+(1-\lambda)y)<\max(f(x),f(y))$.

Definition 5.9 A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is called **strictly quasiconcave** if $\forall x\neq y\in D$ $\forall\lambda\in(0,1)$ then: $f(\lambda x+(1-\lambda)y)>\min(f(x),f(y))$.

From the definitions, it follows that a function is strictly quasiconvex (quasiconcave) if and only if for any segment $[x,y]\subset D$ the values of the restriction function is strictly under (above) the maximum (minimum) level registered by the function at the ends.

Theorem 5.1 If A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is quasiconvex (quasiconcave, convex, concave) then –f is quasiconcave (quasiconvex, concave, convex).

After this theorem, where not explicitly stated, we state the results only for concave functions, ie quasi-concave.

Theorem 5.2 A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is quasiconcave (quasiconvex) if and only if

$f^{-1}[a,\infty)$ ($f^{-1}(-\infty,a]$) is convex $\forall a\in\mathbf{R}$.

Theorem 5.3 If a function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is concave then it is quasiconcave.

Remark 5.1 A function quasiconcave is not necessarily concave.

Theorem 5.4 If a function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is quasiconcave then αf is quasiconcave $\forall\alpha\geq 0$.

Theorem 5.5 If the functions $f_k:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, $k=\overline{1,m}$, are quasiconvex then $\forall p_i\geq 0$, $i=\overline{1,m}$ the function $f=\max(p_1f_1,...,p_mf_m)$ is also quasiconvex.

Theorem 5.6 If the functions $f_k:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, $k=\overline{1,m}$, are quasiconcave then $\forall p_i\geq 0$, $i=\overline{1,m}$ the function $f=\min(p_1f_1,...,p_mf_m)$ is also quasiconcave.

Theorem 5.7 If the function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is quasiconvex (quasiconcave), and $g:\mathbf{R}\to\mathbf{R}$ is increasing, the function $g\circ f:D\to\mathbf{R}$ is quasiconvex (quasiconcave).

Theorem 5.8 If the function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is of class $C^1(D)$ then it is concave (strictly concave) if and only if:

$$f(x)-f(y)\leq(<)\sum_{i=1}^{n}\frac{\partial f}{\partial x_i}(y)\left(x_i-y_i\right)\ \forall x,y\in D$$

Theorem 5.9 If the function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is of class $C^1(D)$ then it is convex (strictly convex) if and only if:

$$f(x)-f(y)\geq(>)\sum_{i=1}^{n}\frac{\partial f}{\partial x_i}(y)\left(x_i-y_i\right)\ \forall x,y\in D$$

Theorem 5.10 If the function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is of class $C^1(D)$ then it is quasiconcave (strictly quasiconcave) if and only if:

$$f(x)\geq f(y)\Rightarrow\sum_{i=1}^{n}\frac{\partial f}{\partial x_i}(y)\left(x_i-y_i\right)\geq(>)0\ \forall x,y\in D$$

Theorem 5.11 If the function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, is of class $C^1(D)$ then it is quasiconvex (strictly quasiconvex) if and only if:

$$f(x)\geq f(y)\Rightarrow\sum_{i=1}^{n}\frac{\partial f}{\partial x_i}(x)\left(x_i-y_i\right)\geq(>)0\ \forall x,y\in D$$

Definition 5.6 A function $f:D\subset\mathbf{R}^n\to\mathbf{R}$, D – convex, $f\in C^1(D)$ is called **pseudoconvex** if it is quasiconcave and $f(x)>f(y)\ \Rightarrow\sum_{i=1}^{n}\frac{\partial f}{\partial x_i}(y)\left(x_i-y_i\right)>0$ $\forall x,y\in D$.

Definition 5.7 A function f:D⊂$\mathbf{R}^n$→$\mathbf{R}$, D – convex, f∈C^1(D) is called **pseudo-concave** if it is quasiconvex and f(x)>f(y) $\Rightarrow \sum_{i=1}^{n}\frac{\partial f}{\partial x_i}(x)(x_i-y_i)>0$ ∀x,y∈D.

Suppose, in what follows, that f:D⊂$\mathbf{R}^n$→$\mathbf{R}$, D – convex, is of class C^2(D).

Let x_0∈D. From Taylor series expansion:

$$f(x)=f(x_0)+\sum_{i=1}^{n}\frac{\partial f}{\partial x_i}(x_0)(x_i-x_{0i})+\frac{1}{2}\sum_{i,j=1}^{n}\frac{\partial^2 f}{\partial x_i\partial x_j}(x_0+\alpha(x-x_0))(x_i-x_{0i})(x_j-x_{0j})$$

, α∈(0,1)

or otherwise, for $x=x_0+h$:

$$f(x_0+h)=f(x_0)+\sum_{i=1}^{n}\frac{\partial f}{\partial x_i}(x_0)h_i+\frac{1}{2}\sum_{i,j=1}^{n}\frac{\partial^2 f}{\partial x_i\partial x_j}(x_0+\alpha h)h_ih_j\text{ , }\alpha\in(0,1)$$

We can write this:

$$f(x_0+h)-f(x_0)-\sum_{i=1}^{n}\frac{\partial f}{\partial x_i}(x_0)h_i=\frac{1}{2}\sum_{i,j=1}^{n}\frac{\partial^2 f}{\partial x_i\partial x_j}(x_0+\alpha h)h_ih_j\text{ , }\alpha\in(0,1)$$

From Theorem 5.8 it follows that f is concave (strictly concave) if and only if $\sum_{i,j=1}^{n}\frac{\partial^2 f}{\partial x_i\partial x_j}(x_0+\alpha h)h_ih_j\le 0$ (<0).

Like a conclusion, if d^2f is negative semi-definite then f is concave.

Conversely, if f is concave, suppose that d^2f is not negative-semi-definite. In this case, ∃x'∈D such that: $\sum_{i,j=1}^{n}\frac{\partial^2 f}{\partial x_i\partial x_j}(x')h_ih_j>0$. Because the function f is of class C^2(D) it follows that ∃V∈V(x') such that: $\sum_{i,j=1}^{n}\frac{\partial^2 f}{\partial x_i\partial x_j}(x)h_ih_j>0$ ∀x∈V. Let r>0 such that the n-sphere of center x' and radius r: B(x',r)={x∈$\mathbf{R}^n$| $\|x-x'\|<r$ }⊂V. Let now x∈B(x',r) and h=x-x'. We have:

$$f(x)-f(x')-\sum_{i=1}^{n}\frac{\partial f}{\partial x_i}(x')h_i=\frac{1}{2}\sum_{i,j=1}^{n}\frac{\partial^2 f}{\partial x_i\partial x_j}(x'+\alpha h)h_ih_j\text{ , }\alpha\in(0,1)$$

Because $\|x'+\alpha h - x'\| = \|\alpha h\| = |\alpha|\|h\| < \|h\| = \|x - x'\| < r$ it follows $\sum_{i,j=1}^{n} \frac{\partial^2 f}{\partial x_i \partial x_j}(x'+\alpha h)h_i h_j > 0$ therefore: $f(x) - f(x') - \sum_{i=1}^{n} \frac{\partial f}{\partial x_i}(x')h_i > 0$ which contradicts the fact that the function is concave.

The proof is analogous in the case of convexity. Therefore:

Theorem 5.12 If the function $f:D\subset \mathbf{R}^n \to \mathbf{R}$, D – convex, is of class $C^2(D)$ then it is concave (convex) if and only if d^2f is negative (positive) semi-definite.

Suppose now that d^2f is negative definite. In this case, we have: $\sum_{i,j=1}^{n} \frac{\partial^2 f}{\partial x_i \partial x_j}(x_0 + \alpha h)h_i h_j < 0,\ \alpha \in (0,1)$ therefore: $f(x_0 + h) - f(x_0) - \sum_{i=1}^{n} \frac{\partial f}{\partial x_i}(x_0)h_i < 0$. Therefore, the function is strictly concave. Analogously is shown for strictly convex functions.

Theorem 5.13 If the function $f:D\subset \mathbf{R}^n \to \mathbf{R}$, D – convex, is of class $C^2(D)$ then if d^2f is negative (positive) definite, the function is strictly concave (strictly convex).

The reciprocal question is: if f is strictly concave then d^2f is defined negatively? The answer is unfortunately negative, meaning that d^2f is negative semi-definite.

Now consider a function $f:D\subset \mathbf{R}_+^n \to \mathbf{R}$, D – convex, $f\in C^2(D)$, the bordered hessian matrix:

$$H^B(f) = \begin{pmatrix} 0 & \frac{\partial f}{\partial x_1} & \frac{\partial f}{\partial x_2} & \dots & \frac{\partial f}{\partial x_n} \\ \frac{\partial f}{\partial x_1} & \frac{\partial^2 f}{\partial x_1^2} & \frac{\partial^2 f}{\partial x_1 \partial x_2} & \dots & \frac{\partial^2 f}{\partial x_1 \partial x_n} \\ \frac{\partial f}{\partial x_2} & \frac{\partial^2 f}{\partial x_2 \partial x_1} & \frac{\partial^2 f}{\partial x_2^2} & \dots & \frac{\partial^2 f}{\partial x_2 \partial x_n} \\ \dots & \dots & \dots & \dots & \dots \\ \frac{\partial f}{\partial x_n} & \frac{\partial^2 f}{\partial x_n \partial x_1} & \frac{\partial^2 f}{\partial x_n \partial x_2} & \dots & \frac{\partial^2 f}{\partial x_n^2} \end{pmatrix}$$

and the bordered principal diagonal determinants:

$$\Delta_k^B=\begin{vmatrix} 0 & \frac{\partial f}{\partial x_1} & \frac{\partial f}{\partial x_2} & \dots & \frac{\partial f}{\partial x_k} \\ \frac{\partial f}{\partial x_1} & \frac{\partial^2 f}{\partial x_1^2} & \frac{\partial^2 f}{\partial x_1 \partial x_2} & \dots & \frac{\partial^2 f}{\partial x_1 \partial x_k} \\ \frac{\partial f}{\partial x_2} & \frac{\partial^2 f}{\partial x_2 \partial x_1} & \frac{\partial^2 f}{\partial x_2^2} & \dots & \frac{\partial^2 f}{\partial x_2 \partial x_k} \\ \dots & \dots & \dots & \dots & \dots \\ \frac{\partial f}{\partial x_k} & \frac{\partial^2 f}{\partial x_k \partial x_1} & \frac{\partial^2 f}{\partial x_k \partial x_2} & \dots & \frac{\partial^2 f}{\partial x_k^2} \end{vmatrix}, k=\overline{1,n}$$

Theorem 5.14 If the function $f:D\subset \mathbf{R}_+^n \to \mathbf{R}$, D – convex, $f\in C^2(D)$ is quasiconcave then: $\Delta_1^B \le 0,\ \Delta_2^B \ge 0,\ \Delta_3^B \le 0,...$ (*the determinants signs being alternate*).

Theorem 5.15 In order that the function $f:D\subset \mathbf{R}_+^n \to \mathbf{R}$, D – convex, $f\in C^2(D)$ be quasiconcave is sufficient that: $\Delta_1^B <0,\ \Delta_2^B >0,\ \Delta_3^B <0,...$ (*the determinants signs being alternate*).

Theorem 5.16 If the function $f:D\subset \mathbf{R}_+^n \to \mathbf{R}$, D – convex, $f\in C^2(D)$ is quasiconvex then: $\Delta_1^B \le 0,\ \Delta_2^B \le 0,\ \Delta_3^B \le 0,...,\ \Delta_n^B \le 0$.

Theorem 5.17 In order that the function $f:D\subset \mathbf{R}_+^n \to \mathbf{R}$, D – convex, $f\in C^2(D)$ be quasiconvex is sufficient that: $\Delta_1^B <0,\ \Delta_2^B <0,\ \Delta_3^B <0,...,\ \Delta_n^B <0$.

Remark 5.2 From Section 3, we have seen that if f is concave (convex, strictly concave, strictly convex) then $(-1)^k\Delta_k \ge 0$ ($\Delta_k \ge 0$, $(-1)^k\Delta_k >0$, $\Delta_k >0$). From Section 4, it follows that the function is quasiconcave (quasiconvex, strictly quasiconcave, strictly quasiconvex).

6. The Convexity Analysis of Production Functions

6.1. The Cobb-Douglas Function

The Cobb-Douglas function has the following expression:

$$f:D\subset \mathbf{R}_+^n-\{0\}\to \mathbf{R}_+,\ (x_1,...,x_n)\to f(x_1,...,x_n)=Ax_1^{\alpha_1}...x_n^{\alpha_n}\in \mathbf{R}_+\ \forall (x_1,...,x_n)\in D,\ A\in \mathbf{R}_+,$$
$$\alpha_1,...,\alpha_n>0$$

Computing the partial derivatives of first and second order, we get:

$$f'_{x_i}=\alpha_i Ax_1^{\alpha_1}...x_i^{\alpha_i-1}...x_n^{\alpha_n}=\frac{\alpha_i f}{x_i}\ \forall i=\overline{1,n}$$

$$f''_{x_i x_j} = \alpha_i \alpha_j A x_1^{\alpha_1} \ldots x_i^{\alpha_i - 1} \ldots x_j^{\alpha_j - 1} \ldots x_n^{\alpha_n} = \frac{\alpha_i \alpha_j f}{x_i x_j} \quad \forall i \neq j = \overline{1,n}$$

$$f''_{x_i x_i} = \alpha_i (\alpha_i - 1) A x_1^{\alpha_1} \ldots x_i^{\alpha_i - 2} \ldots x_n^{\alpha_n} = \frac{\alpha_i (\alpha_i - 1) f}{x_i^2} \quad \forall i = \overline{1,n}$$

The Hessian matrix is:

$$H_f = \begin{pmatrix} \frac{\alpha_1(\alpha_1 - 1)f}{x_1^2} & \ldots & \frac{\alpha_1 \alpha_n f}{x_1 x_n} \\ \ldots & \ldots & \ldots \\ \frac{\alpha_1 \alpha_n f}{x_1 x_n} & \ldots & \frac{\alpha_n(\alpha_n - 1)f}{x_n^2} \end{pmatrix}$$

We have now:

$$\Delta_k = (-1)^k A^k x_1^{k\alpha_1 - 2} \ldots x_k^{k\alpha_k - 2} \prod_{i=1}^{k} \alpha_i \left(1 - \sum_{i=1}^{k} \alpha_i\right), \; k = \overline{1,n}.$$

$$\Delta_{k,ij} = (-1)^k \alpha_i \alpha_j \left(\prod_{i=1}^{k} \alpha_i\right) A^{k+1} x_1^{(k+1)\alpha_1 - 2} \ldots x_i^{(k+1)\alpha_i - 3} \ldots x_j^{(k+1)\alpha_j - 3} \ldots x_k^{(k+1)\alpha_k - 2}, \quad k = \overline{1,n}, \quad i \neq j,$$

$i,j \geq k+1$

We note first that $\Delta_{k,ij} \neq 0$, $k = \overline{1,n}$, $i \neq j$, $i,j \geq k+1$.

Because $\alpha_i > 0$, $i = \overline{1,n}$ it follows: $\operatorname{sign}(\Delta_k) = \operatorname{sign}(-1)^k \left(1 - \sum_{i=1}^{k} \alpha_i\right)$.

We get therefore that:

- $\operatorname{sign}(-1)^k \left(1 - \sum_{i=1}^{k} \alpha_i\right) > 0$, $k = \overline{1,n}$ implies that f is strictly convex. We have however, for k=1: $1-\alpha_1 < 0$, and for k=2: $1-\alpha_1-\alpha_2 > 0$ therefore: $\alpha_1 > 1$, $\alpha_1 + \alpha_2 < 1$ which conflicts with $\alpha_i > 0$, $i = \overline{1,n}$. Therefore, the Cobb-Douglas function cannot be strictly convex.

- $\operatorname{sign}\left(1 - \sum_{i=1}^{k} \alpha_i\right) > 0$, $k = \overline{1,n}$ implies that f is strictly concave;

• $\exists k=\overline{1,n}$ (after a possible renumbering), k=even such that: $1-\sum_{i=1}^{k}\alpha_i<0$ or $\exists k,p=\overline{1,n}$, k,p=odd such that $1-\sum_{i=1}^{k}\alpha_i<0$ and $1-\sum_{i=1}^{p}\alpha_i>0$ then f has a saddle point;

• $\exists k=\overline{1,n}$ (after a possible renumbering) such that: $1-\sum_{i=1}^{p}\alpha_i\neq 0\ \forall p=\overline{1,k}$, but $1-\sum_{i=1}^{s}\alpha_i=0\ \forall s=\overline{k+1,n}$ (this thing, because the fact that $\alpha_i>0$ cannot occur only for $1-\sum_{i=1}^{n}\alpha_i=0$) then:

○ if $\operatorname{sign}(-1)^k\left(1-\sum_{i=1}^{k}\alpha_i\right)>0$, $k=\overline{1,n-1}$ implies the fact that f is convex. In this case, for k=1: $1-\alpha_1<0$ therefore $\alpha_1>1$, the equality $\sum_{i=1}^{n}\alpha_i=1$ cannot occur;

○ if $\operatorname{sign}\left(1-\sum_{i=1}^{k}\alpha_i\right)>0$, $k=\overline{1,n-1}$ implies the fact that f is concave.

In particular, for the Cobb-Douglas function: $f(x_1,...,x_n)=Ax_1^{\alpha_1}x_2^{\alpha_2}$, $\alpha_1,\alpha_2>0$, we have:

• $\alpha_1+\alpha_2<1$ implies the fact that f is strictly concave;

• $\alpha_1+\alpha_2>1$ implies the fact that f has saddle points, therefore it is not convex and not concave;

• $\alpha_1+\alpha_2=1$ implies the fact that f is concave.

6.2. The CES Function

The CES function has the following expression:

$$f:D\subset \mathbf{R}_+^n-\{0\}\to\mathbf{R}_+,\ (x_1,...,x_n)\to f(x_1,...,x_n)=\alpha\left(\sum_{i=1}^{n}\beta_i x_i^{\rho}\right)^{\frac{1}{\rho}}\in\mathbf{R}_+\ \forall(x_1,...,x_n)\in D,$$

$$\alpha,\beta_1...,\beta_n>0,\ \rho\neq 0,1,\ \sum_{i=1}^{n}\beta_i=1$$

Computing the partial derivatives of first and second order, we get:

$$f'_{x_i} = \alpha\beta_i x_i^{\rho-1}\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^{\frac{1}{\rho}-1} = \frac{\beta_i x_i^{\rho-1} f}{\sum_{k=1}^{n}\beta_k x_k^{\rho}} \quad \forall i=\overline{1,n}$$

$$f''_{x_i x_j} = \alpha\beta_i\beta_j(1-\rho)x_i^{\rho-1}x_j^{\rho-1}\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^{\frac{1}{\rho}-2} = -\frac{\beta_i\beta_j(\rho-1)x_i^{\rho-1}x_j^{\rho-1}f}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} \quad \forall i\neq j=\overline{1,n}$$

$$f''_{x_i x_i} = \alpha\beta_i(\rho-1)x_i^{\rho-2}\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^{\frac{1}{\rho}-2}\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}-\beta_i x_i^{\rho}\right) = \frac{\beta_i(\rho-1)x_i^{\rho-2}\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}-\beta_i x_i^{\rho}\right)f}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} \quad \forall i=\overline{1,n}$$

The Hessian matrix is:

$$H_f=\begin{pmatrix} \frac{\beta_1(\rho-1)x_1^{\rho-2}\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}-\beta_1 x_1^{\rho}\right)f}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^2} & -\frac{\beta_1\beta_2(\rho-1)x_1^{\rho-1}x_2^{\rho-1}f}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^2} & \dots & -\frac{\beta_1\beta_n(\rho-1)x_1^{\rho-1}x_n^{\rho-1}f}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^2} \\ -\frac{\beta_1\beta_2(\rho-1)x_1^{\rho-1}x_2^{\rho-1}f}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^2} & \frac{\beta_2(\rho-1)x_2^{\rho-2}\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}-\beta_2 x_2^{\rho}\right)f}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^2} & \dots & -\frac{\beta_2\beta_n(\rho-1)x_2^{\rho-1}x_n^{\rho-1}f}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^2} \\ \dots & \dots & \dots & \dots \\ -\frac{\beta_1\beta_n(\rho-1)x_1^{\rho-1}x_n^{\rho-1}f}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^2} & -\frac{\beta_2\beta_n(\rho-1)x_2^{\rho-1}x_n^{\rho-1}f}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^2} & \dots & \frac{\beta_n(\rho-1)x_n^{\rho-2}\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}-\beta_n x_n^{\rho}\right)f}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^2} \end{pmatrix}$$

We have now:

$\Delta_k=\frac{f^k(\rho-1)^k\prod_{s=1}^{k}\beta_s\prod_{s=1}^{k}x_s^{\rho-2}\sum_{s=k+1}^{n}\beta_s x_s^{\rho}}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^{k+1}}$, $k=\overline{1,n}$ (where the last sum in the numerator is 0 for k=n)

$$\Delta_{k,ij} = -\frac{\beta_i\beta_j\prod_{s=1}^{k}\beta_s(\rho-1)^{k+1}\left(\prod_{s=1}^{k}x_i\right)^{\rho-2}x_i^{\rho-1}x_j^{\rho-1}f^{k+1}}{\left(\sum_{s=1}^{n}\beta_s x_s^{\rho}\right)^{k+2}} \neq 0,\ k=\overline{1,n},\ i\neq j,\ i,j\geq k+1$$

If $\rho>1$ then $\Delta_k>0$, $k=\overline{1,n-1}$ and $\Delta_n=0$. In this case, the function is convex (non strictly).

If $\rho<1$ then $(-1)^k\Delta_k>0$ and $\Delta_n=0$, the function being concave (non strictly).

7. The Analysis of Quasi-Concavity of Production Functions

7.1. The Cobb-Douglas Function

Let the bordered Hessian matrix:

$$H^B(f)=\begin{pmatrix} 0 & \frac{\alpha_1 f}{x_1} & \frac{\alpha_2 f}{x_2} & \dots & \frac{\alpha_n f}{x_n} \\ \frac{\alpha_1 f}{x_1} & \frac{\alpha_1(\alpha_1-1)f}{x_1^2} & \frac{\alpha_1\alpha_2 f}{x_1x_2} & \dots & \frac{\alpha_1\alpha_n f}{x_1x_n} \\ \frac{\alpha_2 f}{x_2} & \frac{\alpha_1\alpha_2 f}{x_1x_2} & \frac{\alpha_2(\alpha_2-1)f}{x_2^2} & \dots & \frac{\alpha_2\alpha_n f}{x_2x_n} \\ \dots & \dots & \dots & \dots & \dots \\ \frac{\alpha_n f}{x_n} & \frac{\alpha_1\alpha_n f}{x_1x_n} & \frac{\alpha_2\alpha_n f}{x_2x_n} & \dots & \frac{\alpha_n(\alpha_n-1)f}{x_n^2} \end{pmatrix}$$

We have: $\Delta_k^B=(-1)^k f^{k+1}\dfrac{\prod_{i=1}^{k}\alpha_i\sum_{i=1}^{k}\alpha_i}{\left(\prod_{i=1}^{k}x_i\right)^2}$, $k=\overline{1,n}$. Because $(-1)^k\text{sign}(\Delta_k^B)>0$ it follows that the function is strictly quasiconcave. From Section 6, we have seen that for some values of α_i, $i=\overline{1,n}$ the function has allow saddle points, therefore it was not concave and not convex. On the other hand, we have seen now that the function is strictly quasiconcave.

7.2. The CES function

Let the bordered Hessian matrix:

$$H^B(f)=\begin{pmatrix} 0 & \frac{\beta_1 x_1^{\rho-1}}{\sum_{k=1}^{n}\beta_k x_k^{\rho}} & \frac{\beta_2 x_2^{\rho-1}}{\sum_{k=1}^{n}\beta_k x_k^{\rho}} & \dots & \frac{\beta_n x_n^{\rho-1}}{\sum_{k=1}^{n}\beta_k x_k^{\rho}} \\ \frac{\beta_1 x_1^{\rho-1}}{\sum_{k=1}^{n}\beta_k x_k^{\rho}} & \frac{\beta_1(\rho-1)x_1^{\rho-2}\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}-\beta_1 x_1^{\rho}\right)}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} & -\frac{\beta_1\beta_2(\rho-1)x_1^{\rho-1}x_2^{\rho-1}}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} & \dots & -\frac{\beta_1\beta_n(\rho-1)x_1^{\rho-1}x_n^{\rho-1}}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} \\ \frac{\beta_2 x_2^{\rho-1}}{\sum_{k=1}^{n}\beta_k x_k^{\rho}} & -\frac{\beta_1\beta_2(\rho-1)x_1^{\rho-1}x_2^{\rho-1}}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} & \frac{\beta_2(\rho-1)x_2^{\rho-2}\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}-\beta_2 x_2^{\rho}\right)}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} & \dots & -\frac{\beta_2\beta_n(\rho-1)x_2^{\rho-1}x_n^{\rho-1}}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} \\ \dots & \dots & \dots & \dots & \dots \\ \frac{\beta_n x_n^{\rho-1}}{\sum_{k=1}^{n}\beta_k x_k^{\rho}} & -\frac{\beta_1\beta_n(\rho-1)x_1^{\rho-1}x_n^{\rho-1}}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} & -\frac{\beta_2\beta_n(\rho-1)x_2^{\rho-1}x_n^{\rho-1}}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} & \dots & \frac{\beta_n(\rho-1)x_n^{\rho-2}\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}-\beta_n x_n^{\rho}\right)}{\left(\sum_{k=1}^{n}\beta_k x_k^{\rho}\right)^2} \end{pmatrix}$$

We have: $\Delta_k^B = -\frac{(\rho-1)^{k-1}\left(\prod_{i=1}^{k}\beta_i\right)\prod_{i=1}^{k}x_i^{\rho-2}f^{k+1}}{E^{k+1}}$, $k=\overline{1,n}$.

If $\rho<1$ then $(-1)^k \text{sign}(\Delta_k^B)>0$ therefore the function is quasiconcave.

If $\rho>1$ then $\text{sign}(\Delta_k^B)<0$ therefore the function is quasiconvex.

8. Conclusions

The above analysis reveals several aspects. On the one hand, the Gauss method of reducing a quadratic form to the normal form using determinants (unlike classical algorithm) gives clues to its nature without necessarily having to actually obtain the normal form. On the other hand, makes a strong link with the theory of bordered matrices, the matrix remaining after removal behavior board determines, in some cases, the behavior of the original matrix. The production function analysis reveals that, despite the fact that they are not necessarily concave or strictly concave, they are quasi-concave and so satisfying the uniqueness of extreme points with linear constraints.

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How to Improve the SPF Forecasts?

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Abstract: Many researchers are interested in making predictions for macroeconomic variables, but few of them studied the accuracy of their forecasts. The problem is essential, especially in crisis periods, because from many forecasts made for the same indicator only one or few are the most accurate. In this research, some alternative forecasts for the annual rate of change for the HICP for EU were developed. Their accuracy was evaluated and compared with the accuracy of SPF predictions. All the proposed predictions for January 2010-May 2012 (those based on a random walk developed for 1997-2009, combined forecasts, the median and the mean of forecasts, predictions based on different econometric models that take into account the previous SPF forecasts) were not more accurate than the naïve forecasts or SPF ones. A considerably improvement of the accuracy was gotten for predictions based on mean error of SPF expectations for 1997-2009 and the previous registered value. This empirical strategy of building more accurate forecasts was better than the classical theoretical approaches from literature, but it is still less accurate than the naïve forecasts that could be made for UE inflation rate. So, the forecasts based on a simple econometric model as the random walk from the naïve approach are the most accurate, conclusion that is in accordance with the latest researches in literature and with one of the essential condition in forecasting theory.

Keywords: forecasts accuracy; combined forecasts; naïve forecasts; SPF

JEL Classification: C54; E37

1. Introduction

In addition to economic analysis, the elaboration of forecasts is an essential aspect that conducts the way of developing the activity al macroeconomic level. But any forecast must be accompanied by macroeconomic explanations of its performance. The purpose of this evaluation is related to different aspects: the improvement of the model on which the forecast was based, adjustment of gouverment policies, the planning of results. Basically, performance evaluation in this context refers directly to the degree of trust confered to the prediction. Although the literature on forecasting methods and techniques used in describing the evolution of an economic phenomenon is particularly rich, surprisingly, few researchers have dealt with the methods used to improve the measurement of forecast uncertainty. The

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aspect is important, because the macroeconomic predictions must not be easily accepted, taking into account the negative consequences of macroeconomic forecasts failures, consequences that affect the state policies. The decisions of economic policy are based on these forecasts. Hence, there is an evident interest of improving their performance.

In literature there are 3 directions in evaluating the performance of macroeconomic forecasts: accuracy, bias and efficiency.A large number of articles have considered the problem of comparing the accuracy measures, contributions in the field are related of names like: Leith and Tanner-1990, Makridakis- 1993, Yokum and Armstrong-1995, Tashman-2000, Makridakis and Hibon-2000, Koehler, Martin and Witt -2002, Hyndman -2006 and Witt -2002, Hyndman-2006. Meese and Rogoff's paper, "Empirical exchange rate models of the seventies", remains the starting point for many researches on the comparing of accuracy and bias. Recently, (Dovern & Weisser, 2011) examines in the same article, "Accuracy, unbiasedness and efficiency of professional macroeconomic forecasts: An empirical comparison for the G7" the three criteria using the empirical data from the G7 economies.

2. Forecasts Accuracy in Literature

Forecast accuracy is a large chapter in the literature related to the evaluation of forecasts uncertainty. There are two methods used in comparing the prediction quality: vertical methods (e.g., mean squared error) and horizontal methods (such as distance in time). An exhaustive presentation of the problem taking into account all the achievements in literature is impossible, but will outline some important conclusions.

In literature, there are several traditional ways of measurement, which can be ranked according to the dependence or independence of measurement scale. A complete classification is made by RJ Hyndman and AB Koehler (2005) in their reference study in the field, "Another Look at Measures of Forecast Accuracy"

Hyndman and Koehler introduce in this class of errors "Mean Absolute Scaled Error " (MASE) in order to compare the accuracy of forecasts of more time series.

Other authors, like Fildes R. and Steckler H. (2000) use another criterion to classify accuracy measures. If we consider, the predicted value after k periods from the origin time t, then the error at future time (t+k) is: Indicators used to evaluate the forecast accuracy can be classified according to their usage. Thus, the forecast accuracy measurement can be done independently or by comparison with another forecast.

A. Independent measures of accuracy

In this case, it is usually used a loss function, but we can also choose the distance criterion proposed by Granger and Jeon for evaluating forecasts based on economic models. The most used indicators are:

a) Mean Square Error (MSE)

b) Root Mean Squared Error (RMSE)

c) Generalized Forecast Error Second Moment (GFESM)

d) Mean Absolute Percentage Error (MAPE)

e) Symmetric Median Absolute Percent Error (SMAPE)

f) Mean error (ME)

g) Mean absolute error (MAE).

In practice, the most used measures of forecast error are:

- Root Mean Squared Error (RMSE) $RMSE = \sqrt{\frac{1}{n}\sum_{j=1}^{n} e_X^2(T_0 + j, k)}$
- Mean error (ME) $ME = \frac{1}{n}\sum_{j=1}^{n} e_X(T_0 + j, k)$

The sign of indicator value provides important information: if it has a positive value, then the current value of the variable was underestimated, which means expected average values too small. A negative value of the indicator shows expected values too high on average.

- Mean absolute error (MAE) $MAE = \frac{1}{n}\sum_{j=1}^{n} \left| e_X(T_0 + j, k) \right|$

These measures of accuracy have some disadvantages. For example, RMSE is affected by outliers. Armstrong and Collopy stresses that these measures are not independent of the unit of measurement, unless if they are expressed as percentage. Fair, Jenkins, Diebold and Baillie show that these measures include average errors with different degrees of variability. The purpose of using these indicators is related to the characterization of distribution errors. Clements and Hendry have proposed a generalized version of the RMSE based on errors intercorrelation, when at least two series of macroeconomic data are used. If we have two forecasts with the same mean absolute error, RMSE penalizes the one with the biggest errors.

B. Measures for the evaluation of the relative accuracy of forecasts

Relative accuracy measures are related to the comparison of the forecast with a forecast of reference, found in the literature as the 'benchmark forecast' or 'naive forecast. However, it remains a subjective step to choose the forecast used for comparison Problems may occur in this case are related to these aspects: the existence of outliers or inappropriate choice of models used for predictions and the emergence of shocks. A first measure of relative accuracy is Theil's U statistic, which uses as reference forecast the last observed value recorded in the data series. Collopy and Armstrong have proposed instead of U a new similar indicator (RAE). Thompson improved MSE indicator, suggesting a statistically determined MSE-log mean squared error ratio.

A common practice is to compare the forecast errors with those based on a random-walk. "Naïve model" method assumes that the variable value in the next period is equal to the one recorded at actual moment. U-Theil proposed the calculation of U, that takes into account both changes in the negative and the positive sense of an indicator: $U = \sqrt{\frac{\sum (X_{t+k} - \hat{X}_t(k))^2}{\sum X_{t+k}^2}}$.

U Theil's statistic is calculated in two variants by the Australian Tresorery in order to evaluate the forecasts accuracy.

The following notations are used:

a- the registered results

p- the predicted results

t- reference time

e- the error (e=a-p)

n- number of time periods

$$U_1 = \frac{\sqrt{\sum_{t=1}^{n} (a_t - p_t)^2}}{\sqrt{\sum_{t=1}^{n} a_t^2} + \sqrt{\sum_{t=1}^{n} p_t^2}}$$

The more closer of zero is, the forecasts accuracy is higher.

$$U_2 = \sqrt{\frac{\sum_{t=1}^{n-1}\left(\frac{p_{t+1}-a_{t+1}}{a_t}\right)^2}{\sum_{t=1}^{n-1}\left(\frac{a_{t+1}-a_t}{a_t}\right)^2}}$$

If =1=> there are not differences in terms of accuracy between the two forecasts to compare

If <1=> the forecast to compare has a higher degree of accuracy than the naive one

If >1=> the forecast to compare has a lower degree of accuracy than the naive one

Hyndman and Koehler proposed scale errors based on the mean absolute error of a naive forecasting method. MAE serves therefore, as denominator. Using this method, it is generated the one-step-ahead forecast. Scale error is defined as: and mean absolute scale error as: MASE= mean | |.

Naive forecast values are considered to be the current ones recorded during the previous period. MASE is used both to compare forecast methods applied to a given set of data and also to compare the accuracy of several series. If the scale error is less than 1, the compared forecast is better than the reference one (naïve forecast).

One of the business objectives in forecasting was empirical validation. Famous results have been registered by Makridakis and Hibon, who lead research groups around the world to make comparisons between different methods of forecasting. In literature the results are known as “M-competition”. Ex-ante forecast errors for 21 methods were compared with predictions based on 1001 economic series. Accuracy criteria used in the M competition were: central tendency error (APE median), MSE, which gives more weight to larger error, MAPE, which is the basic measure. This is the measure recommended in reference books in forecast accuracy domain, written by Hanke and Reitsch or Bowerman, O'Connell and Koehler.

Armstrong and Collopy use MdRAE, MdAPE and GMRAE, the last two measures being also recommended by Fildes, that also uses GRMSE (geometric mean squared relative error). In M3 competition, Makridakis and Hibon recommended MdRAE, sMAPE and sMdAPE.

Recent studies target accuracy analysis using as comparison criterion different models used in making predictions or the analysis of forecasted values for the same macroeconomic indicators registered in several countries.

Ericsson NR (1992) shows that the parameters stability and mean square error of prediction are two key measures in evaluation of forecast accuracy, but they are not sufficient and it is necessary the introduction of a new statistical test.

Considering the AR (1) process, which is represented as y t = βy t-1 + u t, Hoque A., Magnus JR and Pesaran B. (1988) show that for small values of β the prediction mean square error is a decreasing function in comparison with the number of forecast periods.

Granger CWJ şi Jeon Y. CWJ Granger and Y. Jeon (2003) consider four models for U.S. inflation: a univariate model, a model based on an indicator used to measure inflation, a univariate model based on the two previous models and a bivariate model. Applying the mean square error criterion, the best prediction made is the one based on an autoregressive model of order 1 (AR (1)). Applying distance-time method, the best model is the one based on an indicator used to measure the inflation.

Ledolter J. (2006) compares the mean square error of ex-post and ex ante forecasts of regression models with transfer function with the mean square error of univariate models that ignore the covariance and show superiority of predictions based on transfer functions.

T. Teräsvirta, van Dijk D., Medeiros MC (2005) examine the accuracy of forecasts based on linear autoregressive models, autoregressive with smooth transition (STAR) and neural networks (neural network-NN) time series for 47 months of the macroeconomic variables of G7 economies. For each model is used a dynamic specification and it is showed that STAR models generate better forecasts than linear autoregressive ones. Neural networks over long horizon forecast generated better predictions than the models using an approach from private to general.

U. Heilemann and Stekler H. (2007) explain why macroeconomic forecast accuracy in the last 50 years in G7 has not improved. The first explanation refers to the critic brought to macroeconometrics models and to forecasting models, and the second one is related to the unrealistic expectations of forecast accuracy. Problemes related to the forecasts bias, data quality, the forecast process, predicted indicators, the relationship between forecast accuracy and forecast horizon are analyzed.

Ruth K. (2008), using the empirical studies, obtained forecasts with a higher degree of accuracy for European macroeconomic variables by combining specific sub-groups predictions in comparison with forecasts based on a single model for the whole Union.

Gorr WL (2009) showed that the univariate method of prediction is suitable for normal conditions of forecasting while using conventional measures for accuracy, but multivariate models are recommended for predicting exceptional conditions when ROC curve is used to measure accuracy.

Dovern J. and J. Weisser (2011) uses a broad set of individual forecasts to analyze four macroeconomic variables in G7 countries. Analyzing accuracy, bias and

forecasts efficiency, resulted large discrepancies between countries and also in the the same country for different variables. In general, the forecasts are biased and only a fraction of GDP forecasts are closer to the results registered in reality.

In Netherlands, experts make predictions starting from the macroeconomic model used by the Netherlands Bureau for Economic Policy Analysis (CPB). For the period 1997-2008 was reconstructed the model of the experts macroeconomic variables evolution and it was compared with the base model. The conclusions of Franses PH, Kranendonk HC & Lanser D. (2011) were that the CPB model forecasts are in general biased and with a higher degree of accuracy.

Many studies in literature refer to the combining of two methods based on the same model (such as e.g. bayesian mediation model), but French and Insura point out that a combination between model predictions and expert assessments has not been proposed yet.

3. Assessing the Forecasts Accuracy

The monthly data for the annual rate of change for the HICP is published by Eurostat and the predictions are made by SPF (Survey of Professional Forecasters) for January 2010- May 2012.

The monthly data for the annual rate of change for the HICP is not stationary, being necessary to differentiate the data. The stationarized data series for January 1997- December 2009 follows a random walk process: $\Delta ir_t = 0{,}339 \cdot \Delta ir_{t-1} + \varepsilon_t$. Starting from this econometric model, the predictions for January 2010- May 2012 are made.

We refer to the most used combination approaches used in order to improve the forecasts accuracy:

- optimal combination (OPT), with weak results according to Timmermann (2006);
- equal-weights-scheme (EW);
- inverse MSE weighting scheme (INV).

Bates and Granger (1969) considered two predictions p1;t and p2;t, for the same variable Xt, derived h periods ago. If the forecasts are unbiased, the error is calculated as: $e_{i,t} = X_{i,t} - p_{i,t}$. The errors follow a normal distribution of parameters 0 and σ_i^2. If ρ is the correlation between the errors, then their covariance is $\sigma_{12} = \rho \cdot \sigma_1 \cdot \sigma_2$. The linear combination of the two predictions is a weighted average: $c_t = m \cdot p_{1t} + (1-m) \cdot p_{2t}$ .The error of the combined forecast is:

$e_{c,t} = m \cdot e_{1t} + (1-m) \cdot e_{2t}$ .The mean of the combined forecast is zero and the variance is:

$\sigma_c^2 = m^2 \cdot \sigma_1^2 + (1-m)^2 \cdot \sigma_{2t}^2 + 2 \cdot m \cdot (1-m) \cdot \sigma_{12}$. By minimizing the error variance, the optimal value for m is determined (m_{opt}):

$m_{opt} = \frac{\sigma_2^2 - \sigma_{12}}{\sigma_1^2 + \sigma_2^2 - 2 \cdot \sigma_{12}}$ .The individual forecasts are inversely weighted to their relative mean squared forecast error (MSE) resulting INV. In this case, the inverse weight (m_{inv}) is: $m_{inv} = \frac{\sigma_2^2}{\sigma_1^2 + \sigma_2^2}$. Equally weighted combined forecasts (EW) are gotten when the same weights are given to all models.

Table 1. Indicators of forecasts accuracy (January 2010- May 2012)

Accuracy indicators	Predictions based on random walk	SPF predictions	Combined forecasts (OPT scheme)	Combined forecasts (INV scheme)	Combined forecasts (EW scheme)	Mean of the forecasts	Median of the forecasts	Forecasts based on M1
RMSE	0,634	0,204	0,231	0,271	0,221	0,281	0,231	0,833
ME	-0,521	-0,018	-0,113	-0,171	-0,094	-0,183	-0,113	-0,617
MAE	0,534	0,157	0,172	0,204	0,165	0,214	0,172	0,702
MAPE	0,223	0,065	0,070	0,082	0,067	0,087	0,070	0,247
U1	0,129	0,038	0,044	0,052	0,042	0,054	0,044	0,178
U2	3,195	1,068	1,226	1,426	1,177	1,477	1,226	2,948

Accuracy indicators	Forecasts based on M2
RMSE	0,422
ME	0,332
MAE	0,362
MAPE	0,154
U1	0,074
U2	1,946

Source: processing of data provided by Eurostat and SPF

The SPF forecasts are the best ones, because of the low values for all accuracy indicators. All the predictions are overestimated, the ME values being negative. In

average the SPF errors differ with 6,5% from the registered values. All the mentioned predictions are not better than the naïve ones, because of the values greater than 1 for U2 statistics. The median of forecasts is equal to the optimal combined prediction on the entire forecasting horizon.

We can build new forecasts starting from a regression model that explains the registered values of the rate of change using the SPF values. The regression uses time series from 1997-2010 to make predictions for 2010- May 2012. Two valid regression models were selected: M1 and M2.

EFFECTIV = 2.127022766 - 0.05534008024*SPF

EFFECTIV = 1.689861546 + 0.6027484692*(1/SPF)

The new forecasts are gotten starting from these regression models and knowing the SPF values.

Another interesting strategy is, according to Bratu (2012) to build new predictions considering that these have as MPE, the mean percentage error, or other accuracy indicator registered for 1997-2009. We used the MPE of SPF predictions or of forecasts based on the AR(1) model. We can replace MPE with the other indicators (ME, MAE, RMSE).

$$MPE = \frac{X_{t+1} - X_t}{X_t} \Rightarrow \frac{X_{t+1}}{X_t} - 1 = MPE \Rightarrow X_{t+1} = (MPE + 1) \cdot X_t$$

$$ME = X_{t+1} - X_t \Rightarrow X_{t+1} = ME + X_t$$

$$MAE1 = X_{t+1} - X_t \Rightarrow X_{t+1} = MAE1 + X_t$$

$$MAE2 = -X_{t+1} + X_t \Rightarrow X_{t+1} = -MAE2 + X_t$$

$$RMSE^2 = X_{t+1} - X_t \Rightarrow X_{t+1} = RMSE^2 + X_t$$

Table 2. Accuracy indicators for predictions of annual change of HICP (1997-2009)

	ME	**MAE**	**RMSE**	**MPE**
SPF forecasts	-0,021	0,403	0,518	-0,023

To build the predictions for 2010-May 2012 we take into account the accuracy indicator for 1997-2009 and the previous SPF forecasted value, but all the predictions have a lower degree of accuracy than SPF forecasts and the random walk. All the new predictions are overestimated with a rather high degree of accuracy, because of the negative values of ME.

We can also use the variant when we take into account the previous effective value and the accuracy indicator. In this case, we have an improvement of SPF forecasts according to all accuracy indicators for the predictions based on ME and the previous registered value for the annual

change of price index. However, these predictions are not better than the naïve forecasts.

Table 3 Accuracy indicators for forecasts based on a historical accuracy indicator

Accuracy indicators	Forecasts based on ME and SPF previous predictions	Forecasts based on MAE1 and SPF previous predictions	Forecasts based on MAE2 and SPF previous predictions	Forecasts based on RMSE and SPF previous predictions	Forecasts based on MPE and SPF previous predictions	SPF predictions
RMSE	0,787	0,508	1,119	0,577	0,799	0,204
ME	-0,638	-0,215	-1,020	-0,348	-0,664	-0,018
MAE	0,649	0,424	1,020	0,471	0,668	0,157
MAPE	0,275	0,178	0,424	0,199	0,282	0,065
U1	0,163	0,097	0,250	0,113	0,167	0,038
U2	4,067	2,701	5,548	3,078	4,089	1,068

A rather low degree of accuracy was registered for predictions based on MPE and the previous predicted value of SPF. All the new forecasts, excepting those based on MAE1, are overestimated.

4. Conclusions

The accuracy indicators of ex-post forecasts gives us a hint about the way we will chose to build better forecasts, according to the indicator we want to have the lowest value. In this study, the accuracy of SPF forecasts for monthly annual rate of change for HICP was evaluated and some strategies to improve the accuracy were proposed. It seems that the classical approaches from literature didn't improve the accuracy, but the empirical strategy proposed by Bratu (2012) for USA gave good results for EU. So, we have an improvement of SPF forecasts according to all accuracy indicators for the predictions based on ME and the previous registered value for the annual change of HICP.

In conclusion, macroeconomic forecasts evaluation is necessary to inform the public about the way in which SPF or other institution predicted the economic phenomenon. Further, the public will chose a certain strategy to improve the SPF predictions, according to historical approaches.

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APPENDIX 1

Combined forecasts based on random walk process and SPF predictions on the forecasting horizon 2010-May 2012

Month	Combined forecasts (%) (OPT scheme)	Combined forecasts (%) (INV scheme)	Combined forecasts (%) (EW scheme)	Mean of the forecasts (%)	Median of the forecasts (%)	Forecasts based on M1	Forecasts based on M2
ian.10	1,450	1,314	1,492	1,285	1,450	2,099	1,991
feb.10	1,605	1,504	1,636	1,483	1,605	2,077	2,232
mar.10	1,332	1,271	1,351	1,257	1,332	2,077	2,232
apr.10	1,912	1,754	1,962	1,719	1,912	2,083	2,172
mai.10	2,034	1,972	2,053	1,958	2,034	2,039	2,654
iun.10	2,006	1,948	2,024	1,936	2,006	2,039	2,654
iul.10	1,807	1,792	1,812	1,789	1,807	2,033	2,714
aug.10	2,042	1,965	2,066	1,948	2,042	2,044	2,594
sep.10	1,916	1,885	1,926	1,879	1,916	2,033	2,714
oct.10	2,251	2,158	2,280	2,138	2,251	2,039	2,654
nov.10	2,225	2,179	2,239	2,169	2,225	2,022	2,835
dec.10	2,225	2,179	2,239	2,169	2,225	2,022	2,835
ian.11	2,660	2,552	2,694	2,528	2,660	2,022	2,835
feb.11	2,606	2,548	2,624	2,536	2,606	2,005	3,016
mar.11	2,842	2,765	2,866	2,748	2,842	2,000	3,076
apr.11	3,023	2,935	3,051	2,915	3,023	1,994	3,136
mai.11	3,242	3,165	3,266	3,148	3,242	1,978	3,317
iun.11	3,097	3,055	3,111	3,046	3,097	1,972	3,377
iul.11	2,997	2,955	3,011	2,946	2,997	1,978	3,317
aug.11	2,807	2,792	2,812	2,789	2,807	1,978	3,317
sep.11	2,952	2,902	2,968	2,891	2,952	1,983	3,257
oct.11	3,232	3,128	3,265	3,105	3,232	1,989	3,197
nov.11	3,352	3,302	3,368	3,291	3,352	1,961	3,498
dec.11	3,216	3,185	3,226	3,179	3,216	1,961	3,498
ian.12	2,917	2,929	2,914	2,932	2,917	1,961	3,498
feb.12	2,835	2,816	2,841	2,812	2,835	1,978	3,317
mar.12	2,862	2,839	2,870	2,834	2,862	1,978	3,317
apr.12	2,844	2,809	2,854	2,801	2,844	1,983	3,257
mai.12	2,645	2,653	2,642	2,654	2,645	1,978	3,317

Source: Own calculations using Excel

On Homogeneous Functions

Catalin Angelo Ioan[1]

Abstract: The paper investigates some aspects of the behavior of homogeneous functions. After determining the degree of homogeneity of partial derivatives of a homogeneous function, it is determined their general form in the case of integer degree of homogeneity and they are defined in 0. It also generalizes the Euler relation for homogeneous functions to the higher order partial derivatives. Finally, it is determined a necessary condition for concavity of these functions.

Keywords: production functions; convexity; concavity; homogenous functions

JEL Classification: E17; E27

1. Introduction

The production functions are fundamental in the theory of producer behavior. One of the basic requirements that needs to be satisfied is that of homogeneity, meaning that an increase in inputs will result in an increase in the below sense of its production. We will propose in what following, to determine some of their fundamental properties, many of them very useful for economic research, but not only.

2. Some Facts about Homogenous Functions

Definition 2.1 A non-constant function $\Psi:D\subset\mathbf{R}^n\to\mathbf{R}$ is said to be homogenous of degree $\alpha\neq0$ if $\Psi(\lambda x)=\lambda^{\alpha}\Psi(x)$ for any $\lambda>0$, $\lambda\neq1$, $x\in D$ such that $\lambda x\in D$.

Theorem 2.1 Let $\Psi:D\subset\mathbf{R}^n\to\mathbf{R}$ a homogenous function of degree $\alpha\in\mathbf{R}$. If $0\in D$ then $\Psi(0)=0$.

Proof. For x=0 we have: $\Psi(0)=\lambda^{\alpha}\Psi(0)$ therefore $(\lambda^{\alpha}-1)\Psi(0)=0$. Because $\lambda\neq1$, $\alpha\neq0$, we have $\Psi(0)=0$.

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Remark 2.1 If the relationship $\Psi(\lambda x)=\lambda^{\alpha}\Psi(x)$ holds for $\alpha=0$, and the function Ψ is continous in $0\in D$, then: $\Psi(\lambda x)=\Psi(x)\ \forall x\in D$, hence, by passing to limit after $\lambda\to 0$ we obtain: $\Psi(x)=\Psi(0)=$constant.

Lemma 2.1 Let $\Psi:D\subset\mathbf{R}^n\to\mathbf{R}$ a homogenous function of degree α. Then $\frac{\partial\Psi}{\partial x_i}$ is homogenous of degree α-1 $\forall i=\overline{1,n}$.

Proof. We have in an arbitrary point $\left(x_1^0,...,x_n^0\right)\in D$:

$$\frac{\partial\Psi}{\partial x_i}\left(x_1^0,...,x_n^0\right)=\lim_{t\to 0}\frac{\Psi\left(x_1^0,...,x_i^0+t,...,x_n^0\right)-\Psi\left(x_1^0,...,x_i^0,...,x_n^0\right)}{t}$$

But:

$$\frac{\partial\Psi}{\partial x_i}\left(\lambda x_1^0,...,\lambda x_n^0\right)=\lim_{t\to 0}\frac{\Psi\left(\lambda x_1^0,...,\lambda x_i^0+t,...,\lambda x_n^0\right)-\Psi\left(\lambda x_1^0,...,\lambda x_i^0,...,\lambda x_n^0\right)}{t}=$$

$$\lim_{t\to 0}\frac{\Psi\left(\lambda x_1^0,...,\lambda x_i^0+\lambda t,...,\lambda x_n^0\right)-\Psi\left(\lambda x_1^0,...,\lambda x_i^0,...,\lambda x_n^0\right)}{\lambda t}=$$

$$\lim_{t\to 0}\frac{\lambda^{\alpha}\Psi\left(x_1^0,...,x_i^0+t,...,x_n^0\right)-\lambda^{\alpha}\Psi\left(x_1^0,...,x_i^0,...,x_n^0\right)}{\lambda t}=$$

$$\lambda^{\alpha-1}\lim_{t\to 0}\frac{\Psi\left(x_1^0,...,x_i^0+t,...,x_n^0\right)-\Psi\left(x_1^0,...,x_i^0,...,x_n^0\right)}{t}=\lambda^{\alpha-1}\frac{\partial\Psi}{\partial x_i}\left(x_1^0,...,x_n^0\right).$$

Corollary 2.1 Let $\Psi:D\subset\mathbf{R}^n\to\mathbf{R}$ a homogenous function of degree α and of class $C^k(D)$. Then $\frac{\partial^k\Psi}{\partial x_{i_1}...\partial x_{i_k}}$ is homogenous of degree α-k $\forall i_1,...,i_k=\overline{1,n}$, $k\geq 1$.

Theorem 2.2 Let $\Psi:D\subset\mathbf{R}^n\to\mathbf{R}$ a non-constant function, homogenous of degree $\alpha\notin\mathbf{Z}$, $0\in D$, $\Psi\in C^{\infty}(D^*)$. Then $\exists k\geq 1\ \exists i_1,...,i_k=\overline{1,n}$ such that $\frac{\partial^k\Psi}{\partial x_{i_1}...\partial x_{i_k}}$ is not defined in 0.

Proof. Suppose that all the partial derivatives of Ψ are defined in 0. Because Ψ is homogenous of degree α, follows that $\frac{\partial^k\Psi}{\partial x_{i_1}...\partial x_{i_k}}$ is homogenous of degree α-k

$\forall i_1,...,i_k=\overline{1,n}$, $k\geq 1$ and therefore, from the theorem 1 follows: $\frac{\partial^k \Psi}{\partial x_{i_1}...\partial x_{i_k}}(0)=0$.

Developing in Taylor series around to $0\in D$, follows:

$$\Psi(x)=\Psi(0)+\sum_{k=1}^{\infty}\sum_{i_1,...,i_j=1}^{n}\frac{\partial^k \Psi}{\partial x_{i_1}...\partial x_{i_k}}(0)x_{i_1}...x_{i_k}=0 \text{ – contradiction.}$$

Theorem 2.3 Let $\Psi:D\subset \mathbf{R}^n\to\mathbf{R}$ a non-constant function, homogenous of degree $\alpha\in\mathbf{Z}$, $0\in D$, $\Psi\in C^{\infty}(D)$. Then $\Psi=\sum_{\substack{\beta_1,...,\beta_n=0\\ \beta_1+...+\beta_n=\alpha}}^{\alpha} c_{\beta_1...\beta_n}x_1^{\beta_1}...x_n^{\beta_n}$.

Proof. From statement, follows that all the partial derivatives of Ψ are defined in 0. Because Ψ is homogenous of degree α follows that $\frac{\partial^k \Psi}{\partial x_{i_1}...\partial x_{i_k}}$ is homogenous of degree α-k $\forall i_1,...,i_k=\overline{1,n}$, $k\geq 1$. For $k=\alpha$ we have from remark 2.1: $\frac{\partial^\alpha \Psi}{\partial x_{i_1}...\partial x_{i_\alpha}}=C_{i_1...i_\alpha}$=constant $\forall i_1,...,i_\alpha=\overline{1,n}$. For $i_1=...=i_\alpha=p=\overline{1,n}$ we get: $\frac{\partial^\alpha \Psi}{\partial x_p^\alpha}=C_p$ where, by successive integrations with brespect to x_p follows: $\Psi=\sum_{u=0}^{\alpha}A_{u,p}\left(x_1,...,\hat{x}_p,...,x_n\right)x_p^u$ where $A_{u,p}$ are arbitrary functions. For $i_\alpha\neq i_1=...=i_{\alpha-1}=p=\overline{1,n}$ follows: $\frac{\partial^\alpha \Psi}{\partial x_p^{\alpha-1}\partial x_{i_\alpha}}=C_{p,i_\alpha}$. We obtain now:

$$\alpha!\frac{\partial A_{\alpha,p}\left(x_1,...,\hat{x}_p,...,x_n\right)}{\partial x_{i_\alpha}}x_p+(\alpha-1)!\frac{\partial A_{\alpha-1,p}\left(x_1,...,\hat{x}_p,...,x_n\right)}{\partial x_{i_\alpha}}=C_{p,i_\alpha}$$

therefore: $\frac{\partial A_{\alpha,p}\left(x_1,...,\hat{x}_p,...,x_n\right)}{\partial x_{i_\alpha}}=0$ $\forall i_\alpha\neq p$ therefore: $A_{\alpha,p}\left(x_1,...,\hat{x}_p,...,x_n\right)=a_p$=const.

From $(\alpha-1)!\frac{\partial A_{\alpha-1,p}\left(x_1,...,\hat{x}_p,...,x_n\right)}{\partial x_{i_\alpha}}=C_{p,i_\alpha}$ follows, analogously:

$A_{\alpha-1,p}\left(x_1,...,\hat{x}_p,...,x_n\right)=\sum_{\substack{i=1\\ i\neq p}}^{n} b_{ip}x_i$. If we continue:

$A_{\alpha-2,p}\left(x_1,...,\hat{x}_p,...,x_n\right)=\sum_{\substack{i,j=1\\ i,j\neq p}}^{n} c_{ip}x_i x_j$ etc.

Finally: $\Psi=\sum_{\substack{\beta_1,...,\beta_n=0\\ \beta_1+...+\beta_n=\alpha}}^{\alpha} c_{\beta_1...\beta_n}x_1^{\beta_1}...x_n^{\beta_n}$.

Lemma 2.2 Let $\Psi:D\subset\mathbf{R}^n\to\mathbf{R}_+^*$ a homogenous function of degree α and $\Phi=\ln\Psi$. Then $\frac{\partial\Phi}{\partial x_i}$ is homogenous of degree -1.

Proof. We have: $\Phi(\lambda x_1,...,\lambda x_n)=\ln\Psi(\lambda x_1,...,\lambda x_n)=\alpha\ln\lambda+\ln\Psi(x_1,...,x_n)=\alpha\ln\lambda+\Phi(x_1,...,x_n)$

The partial derivatives in a point $\left(x_1^0,...,x_n^0\right)\in D$ are:

$$\frac{\partial\Phi}{\partial x_i}\left(x_1^0,...,x_n^0\right)=\lim_{t\to0}\frac{\Phi\left(x_1^0,...,x_i^0+t,...,x_n^0\right)-\Phi\left(x_1^0,...,x_i^0,...,x_n^0\right)}{t}$$

$$\frac{\partial\Phi}{\partial x_i}\left(\lambda x_1^0,...,\lambda x_n^0\right)=\lim_{t\to0}\frac{\Phi\left(\lambda x_1^0,...,\lambda x_i^0+t,...,\lambda x_n^0\right)-\Phi\left(\lambda x_1^0,...,\lambda x_i^0,...,\lambda x_n^0\right)}{t}=$$

$$\lim_{t\to0}\frac{\Phi\left(\lambda x_1^0,...,\lambda x_i^0+\lambda t,...,\lambda x_n^0\right)-\Phi\left(\lambda x_1^0,...,\lambda x_i^0,...,\lambda x_n^0\right)}{\lambda t}=$$

$$\lim_{t\to0}\frac{\alpha\ln\lambda+\Phi\left(x_1^0,...,x_i^0+t,...,x_n^0\right)-\alpha\ln\lambda-\Phi\left(x_1^0,...,x_i^0,...,x_n^0\right)}{\lambda t}=$$

$$\frac{1}{\lambda}\lim_{t\to0}\frac{\Phi\left(x_1^0,...,x_i^0+t,...,x_n^0\right)-\Phi\left(x_1^0,...,x_i^0,...,x_n^0\right)}{t}=\frac{1}{\lambda}\frac{\partial\Phi}{\partial x_i}\left(x_1^0,...,x_n^0\right).$$

Theorem 2.4 Let $\Psi:D\subset\mathbf{R}^n\to\mathbf{R}$ a C^2-differentiable function on an open subset D, $\Psi(0)=0$. The following statements are equivalent:

1. $\exists f:I\to\mathbf{R}$, $I\subset\mathbf{R}$, $f(\lambda)\neq0$ $\forall\lambda\in I$ such that: $\Psi(\lambda x)=f(\lambda)\Psi(x)$ $\forall x\in D$ $\forall\lambda\in I$;

2. $\exists\alpha\in\mathbf{R}$ such that: $\sum_{j=1}^{n}x_j\frac{\partial\Psi}{\partial x_j}=\alpha\Psi$;

3. $\exists\alpha\in\mathbf{R}$ such that: $\sum_{i=1}^{n} x_i \frac{\partial^2\Psi}{\partial x_i \partial x_j} = (\alpha-1)\frac{\partial\Psi}{\partial x_j}$, $j=\overline{1,n}$;

4. $\exists\alpha\in\mathbf{R}$ $\exists k\geq 1$ such that: $\frac{\partial^k\Psi}{\partial x_{i_1}...\partial x_{i_k}}(0)=0$ and $\sum_{i=1}^{n} x_i \frac{\partial^{k+1}\Psi}{\partial x_i \partial x_{i_1}...\partial x_{i_k}} = (\alpha-k)\frac{\partial^k\Psi}{\partial x_{i_1}...\partial x_{i_k}}$, $i_1,...,i_k=\overline{1,n}$.

Proof. 1)⇒2) If $\Psi(\lambda x)=f(\lambda)\Psi(x)$ $\forall x\in D$ $\forall\lambda\in I$ then, differentiating with λ: $\sum_{j=1}^{n} x_j \frac{\partial\Psi}{\partial x_j}(\lambda x) = f'(\lambda)\Psi(x)$ $\forall x\in D$ $\forall\lambda\in I$. For $\lambda=1$ we have: $\sum_{j=1}^{n} x_j \frac{\partial\Psi}{\partial x_j}(x) = f'(1)\Psi(x)$ and 2) follows for $\alpha= f'(1)$.

2)⇒1) From $\sum_{j=1}^{n} x_j \frac{\partial\Psi}{\partial x_j} = \alpha\Psi$ we have: $\sum_{j=1}^{n} \lambda x_j \frac{\partial\Psi}{\partial x_j}(\lambda x) = \alpha\Psi(\lambda x)$ or: $\lambda\frac{d\Psi(\lambda x)}{d\lambda} = \alpha\Psi(\lambda x)$. But this is equivalent with: $\frac{d\Psi(\lambda x)}{\Psi(\lambda x)} = \alpha\frac{d\lambda}{\lambda}$ from where: $\Psi(\lambda x)=\lambda^\alpha C(x)$. For $\lambda=1$ we have: $\Psi(x)=C(x)$ therefore: $\Psi(\lambda x)=\lambda^\alpha\Psi(x)$ and 1) follows for $f(\lambda)=\lambda^\alpha$.

2)⇒3) If $\sum_{j=1}^{n} x_j \frac{\partial\Psi}{\partial x_j} = \alpha\Psi$ then differentiating with x_i, we have: $\sum_{j=1}^{n} x_j \frac{\partial^2\Psi}{\partial x_i \partial x_j} + \frac{\partial\Psi}{\partial x_i} = \alpha\frac{\partial\Psi}{\partial x_i}$ from where: $\sum_{j=1}^{n} x_j \frac{\partial^2\Psi}{\partial x_i \partial x_j} = (\alpha-1)\frac{\partial\Psi}{\partial x_i}$.

3)⇒2) From $\sum_{i=1}^{n} x_i \frac{\partial^2\Psi}{\partial x_i \partial x_j} = (\alpha-1)\frac{\partial\Psi}{\partial x_j}$ integrating with respect to x_j we have:

$$\sum_{\substack{i=1\\ i\neq j}}^{n} x_i\left(\frac{\partial\Psi}{\partial x_i} + \Phi_i(x_1,...,\hat{x}_j,...,x_n)\right) + \int x_j \frac{\partial\left(\frac{\partial\Psi}{\partial x_j} + \Phi_j(x_1,...,\hat{x}_j,...,x_n)\right)}{\partial x_j} dx_j = (\alpha-1)\left[\Psi + \Lambda(x_1,...,\hat{x}_j,...,x_n)\right]$$

where Φ_i and Λ are arbitrary functions.

Integrating through parts:

$$\sum_{\substack{i=1\\ i\neq j}}^{n} x_i\left(\frac{\partial\Psi}{\partial x_i}+\Phi_i(x_1,...,\hat{x}_j,...,x_n)\right)+x_j\left(\frac{\partial\Psi}{\partial x_j}+\Phi_j(x_1,...,\hat{x}_j,...,x_n)\right)-$$

$$\int\left(\frac{\partial\Psi}{\partial x_j}+\Phi_j(x_1,...,\hat{x}_j,...,x_n)\right)dx_j=(\alpha-1)\left(\Psi+\Lambda(x_1,...,\hat{x}_j,...,x_n)\right)$$

Further:

$$\sum_{\substack{i=1\\ i\neq j}}^{n} x_i\left(\frac{\partial\Psi}{\partial x_i}+\Phi_i(x_1,...,\hat{x}_j,...,x_n)\right)+x_j\left(\frac{\partial\Psi}{\partial x_j}+\Phi_j(x_1,...,\hat{x}_j,...,x_n)\right)-$$

$$\Psi-\Theta(x_1,...,\hat{x}_j,...,x_n)-\Phi_j(x_1,...,\hat{x}_j,...,x_n)x_j=(\alpha-1)\left(\Psi+\Lambda(x_1,...,\hat{x}_j,...,x_n)\right)$$

where Θ is an arbitrary function. We have therefore, finally:

$$\sum_{i=1}^{n} x_i\frac{\partial\Psi}{\partial x_i}-\alpha\Psi=(\alpha-1)\Lambda(x_1,...,\hat{x}_j,...,x_n)+\Theta(x_1,...,\hat{x}_j,...,x_n)-\sum_{\substack{i=1\\ i\neq j}}^{n} x_i\Phi_i(x_1,...,\hat{x}_j,...,x_n)$$

Because the right side does not depend from x_j and x_j was arbitrary chosen, we have that: $\sum_{i=1}^{n} x_i\frac{\partial\Psi}{\partial x_i}-\alpha\Psi=\beta$=constant or: $\sum_{i=1}^{n} x_i\frac{\partial\Psi}{\partial x_i}=\alpha\Psi+\beta$. Because $\Psi(0)=0$ we have: $\beta=0$ and the relation becomes: $\sum_{i=1}^{n} x_i\frac{\partial\Psi}{\partial x_i}=\alpha\Psi$.

3)⇒4) Let P(k): $\exists\alpha\in\mathbf{R}$ such that: $\sum_{i=1}^{n} x_i\frac{\partial^{k+1}\Psi}{\partial x_i\partial x_{i_1}...\partial x_{i_k}}=(\alpha-k)\frac{\partial^k\Psi}{\partial x_{i_1}...\partial x_{i_k}}$, $i_1,...,i_k=\overline{1,n}$, $k\geq 1$. From 3) follows that P(1) is true. Suppose that P(k) is true.

Differentiating with respect to $x_{i_{k+1}}$ we have:

$$\sum_{i=1}^{n} x_i\frac{\partial^{k+2}\Psi}{\partial x_i\partial x_{i_1}...\partial x_{i_k}\partial x_{i_{k+1}}}+\frac{\partial^{k+1}\Psi}{\partial x_{i_1}...\partial x_{i_k}\partial x_{i_{k+1}}}=(\alpha-k)\frac{\partial^{k+1}\Psi}{\partial x_{i_1}...\partial x_{i_k}\partial x_{i_{k+1}}}$$

of where:

$$\sum_{i=1}^{n} x_i\frac{\partial^{k+2}\Psi}{\partial x_i\partial x_{i_1}...\partial x_{i_k}\partial x_{i_{k+1}}}=(\alpha-k-1)\frac{\partial^{k+1}\Psi}{\partial x_{i_1}...\partial x_{i_k}\partial x_{i_{k+1}}}$$

therefore P(k+1) is true.

4)⇒3) Suppose that: $\sum_{i=1}^{n} x_i \frac{\partial^{k+2}\Psi}{\partial x_i \partial x_{i_1}...\partial x_{i_{k+1}}} = (\alpha - k - 1)\frac{\partial^{k+1}\Psi}{\partial x_{i_1}...\partial x_{i_k}\partial x_{i_{k+1}}}$, $i_1,...,i_{k+1} = \overline{1,n}$, $k \geq 1$. Integrating with respect to $x_{i_{k+1}}$ we have:

$$\sum_{\substack{i=1 \\ i\neq i_{k+1}}}^{n} x_i\left(\frac{\partial^{k+1}\Psi}{\partial x_i \partial x_{i_1}...\partial x_{i_k}} + \Phi_i(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right) +$$

$$\int x_{i_{k+1}} \frac{\partial\left(\frac{\partial^{k+1}\Psi}{\partial x_{i_1}...\partial x_{i_{k+1}}} + \Phi_{i_{k+1}}(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right)}{\partial x_{i_{k+1}}} dx_{i_{k+1}} = (\alpha - k - 1)\left(\frac{\partial^{k}\Psi}{\partial x_{i_1}...\partial x_{i_k}} + \Lambda(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right)$$

where $\Phi_{i_{k+1}}$ and Λ has arbitrary functions. Integrating through parts:

$$\sum_{\substack{i=1 \\ i\neq i_{k+1}}}^{n} x_i\left(\frac{\partial^{k+1}\Psi}{\partial x_i \partial x_{i_1}...\partial x_{i_k}} + \Phi_i(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right) + x_{i_{k+1}}\left(\frac{\partial^{k+1}\Psi}{\partial x_{i_1}...\partial x_{i_{k+1}}} + \Phi_{i_{k+1}}(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right) -$$

$$\int\left(\frac{\partial^{k+1}\Psi}{\partial x_{i_1}...\partial x_{i_{k+1}}} + \Phi_{i_{k+1}}(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right)dx_{i_{k+1}} = (\alpha - k - 1)\left(\frac{\partial^{k}\Psi}{\partial x_{i_1}...\partial x_{i_k}} + \Lambda(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right)$$

Further:

$$\sum_{\substack{i=1 \\ i\neq i_{k+1}}}^{n} x_i\left(\frac{\partial^{k+1}\Psi}{\partial x_i \partial x_{i_1}...\partial x_{i_k}} + \Phi_i(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right) + x_{i_{k+1}}\left(\frac{\partial^{k+1}\Psi}{\partial x_{i_1}...\partial x_{i_{k+1}}} + \Phi_{i_{k+1}}(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right) -$$

$$\left(\frac{\partial^{k}\Psi}{\partial x_{i_1}...\partial x_{i_k}} + \Theta(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right) - \Phi_{i_{k+1}}(x_1,...,\hat{x}_{i_{k+1}},...,x_n)x_{i_{k+1}} =$$

$$(\alpha - k - 1)\left(\frac{\partial^{k}\Psi}{\partial x_{i_1}...\partial x_{i_k}} + \Lambda(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right)$$

where Θ has an arbitrary function. We have therefore, finally:

$$\sum_{i=1}^{n} x_i \frac{\partial^{k+1}\Psi}{\partial x_i \partial x_{i_1}...\partial x_{i_k}} - (\alpha - k)\frac{\partial^{k}\Psi}{\partial x_{i_1}...\partial x_{i_k}} =$$

$$(\alpha - k - 1)\Lambda(x_1,...,\hat{x}_{i_{k+1}},...,x_n) + \Theta(x_1,...,\hat{x}_{i_{k+1}},...,x_n) - \sum_{\substack{i=1 \\ i\neq i_{k+1}}}^{n} x_i\left(\Phi_i(x_1,...,\hat{x}_{i_{k+1}},...,x_n)\right)$$

Because the right side does not depend from $x_{i_{k+1}}$ and $x_{i_{k+1}}$ was arbitrary chosen, we have that: $\sum_{i=1}^{n} x_i \frac{\partial^{k+1}\Psi}{\partial x_i \partial x_{i_1}...\partial x_{i_k}} - (\alpha - k)\frac{\partial^k \Psi}{\partial x_{i_1}...\partial x_{i_k}} = \beta = \text{constant}$ or:

$\sum_{i=1}^{n} x_i \frac{\partial^{k+1}\Psi}{\partial x_i \partial x_{i_1}...\partial x_{i_k}} = (\alpha - k)\frac{\partial^k \Psi}{\partial x_{i_1}...\partial x_{i_k}} + \beta$. Because $\frac{\partial^k \Psi}{\partial x_{i_1}...\partial x_{i_k}}(0) = 0$ we have: $\beta = 0$ and the relation becomes: $\sum_{i=1}^{n} x_i \frac{\partial^{k+1}\Psi}{\partial x_i \partial x_{i_1}...\partial x_{i_k}} = (\alpha - k)\frac{\partial^k \Psi}{\partial x_{i_1}...\partial x_{i_k}}$. From induction after k we will find that 3) holds. **Q.E.D.**

Corollary 2.2 Let $\Psi: D \subset \mathbf{R}^n \to \mathbf{R}$ a homogenous function of degree α, of class $C^k(D)$, $\Psi(0)=0$. If $\exists k \geq 1$ such that: $\frac{\partial^{k-1}\Psi}{\partial x_{i_1}...\partial x_{i_{k-1}}}(0) = 0$ then:

$$\sum_{i_1,...,i_k=1}^{n} \frac{\partial^k \Psi}{\partial x_{i_1}...\partial x_{i_k}} x_{i_1}...x_{i_k} = (\alpha - k + 1)(\alpha - k + 2)...\alpha U$$

Proof. From Theorem 2.4 $\sum_{i_1=1}^{n} x_{i_1} \frac{\partial^k \Psi}{\partial x_{i_1} \partial x_{i_2}...\partial x_{i_k}} = (\alpha - k + 1)\frac{\partial^{k-1}\Psi}{\partial x_{i_2}...\partial x_{i_k}}$, $i_2,...,i_k = \overline{1,n}$

Multiplying with $x_{i_2},..., x_{i_k}$ and summing after $x_{i_2},..., x_{i_k}$ we obtain:

$$\sum_{i_1,...,i_k=1}^{n} \frac{\partial^k \Psi}{\partial x_{i_1}...\partial x_{i_k}} x_{i_1}...x_{i_k} = (\alpha - k + 1) \sum_{i_2,...,i_k=1}^{n} \frac{\partial^{k-1}\Psi}{\partial x_{i_2}...\partial x_{i_k}} x_{i_2}...x_{i_k}$$

Through induction, follows:

$$\sum_{i_1,...,i_k=1}^{n} \frac{\partial^k \Psi}{\partial x_{i_1}...\partial x_{i_k}} x_{i_1}...x_{i_k} = (\alpha - k + 1)(\alpha - k + 2)...\alpha U .$$

Corollary 2.3 Let $\Psi: D \subset \mathbf{R}^n \to \mathbf{R}$ a homogenous function of degree 1 and of class $C^k(D)$, $\Psi(0)=0$. Then: $\det\left(\frac{\partial^2 \Psi}{\partial x_i \partial x_j}\right) = 0$.

Proof. From the theorem, we have that for a homogenous function of degree 1 for which in addition $\Psi(0)=0$ we have that $\sum_{j=1}^{n} x_j \frac{\partial \Psi}{\partial x_j}=\Psi$ and $\sum_{i=1}^{n} x_i \frac{\partial^2 \Psi}{\partial x_i \partial x_j}=0$, $j=\overline{1,n}$.

Because the equality holds for any $x_1,...,x_n$ we find that: $\det\left(\frac{\partial^2 \Psi}{\partial x_i \partial x_j}\right)=0$.

3. The Concavity of the Functions

We will present in this section some of the remarkable results of concavity of functions.

Definition 3.1 A subset $D\subset \mathbf{R}^n$ is called convex if $\forall x,y\in D\ \forall \lambda\in[0,1]\Rightarrow \lambda x+(1-\lambda)y\in D$.

Definition 3.2 A function $\Psi:D\subset \mathbf{R}^n\to \mathbf{R}$ is called **convex** if $\forall x,y\in D\ \forall \lambda\in[0,1]$ follows
$\Psi(\lambda x+(1-\lambda)y)\leq \lambda\Psi(x)+(1-\lambda)\Psi(y)$.

Definition 3.3 A function $\Psi:D\subset \mathbf{R}^n\to \mathbf{R}$ is called **concave** if $\forall x,y\in D\ \forall \lambda\in[0,1]$ follows
$\Psi(\lambda x+(1-\lambda)y)\geq \lambda\Psi(x)+(1-\lambda)\Psi(y)$.

Definition 3.4 A function $f:D\subset \mathbf{R}^n\to \mathbf{R}$ is called **strictly convex** if $\forall x,y\in D$ $\forall \lambda\in(0,1)$ follows $f(\lambda x+(1-\lambda)y)<\lambda f(x)+(1-\lambda)f(y)$.

Definition 3.5 A function $f:D\subset \mathbf{R}^n\to \mathbf{R}$ is called **strictly concave** if $\forall x,y\in D$ $\forall \lambda\in(0,1)$ follows $f(\lambda x+(1-\lambda)y)>\lambda f(x)+(1-\lambda)f(y)$.

Suppose now that $\Psi:D\subset \mathbf{R}^n\to \mathbf{R}_+$, $0\in D$, $\Psi(0)=0$, is homogenous of degree α and convex. From the definition 3.2, for $y=0$ follows: $\Psi(\lambda x)\leq\lambda\Psi(x)$ $\forall x\in D$. From the homogenity of the function, follows: $(\lambda^{\alpha}-\lambda)\Psi(x)\leq 0$ $\forall \lambda\in(0,1)$ $\forall x\in D$. Since $\Psi(x)\geq 0$ we obtain: $\lambda^{\alpha}\leq\lambda$ $\forall \lambda\in(0,1)$. The function $g(t)=\lambda^t$ being decreasing we obtain $\alpha\geq 1$. Analogously, if the function Ψ is concave then: $\alpha\leq 1$. In the case of strictly convexity we will have, analogously: $\alpha>1$, and of strictly concavity: $\alpha<1$.

Theorem 3.1 Let $\Psi:D\subset \mathbf{R}^n\to \mathbf{R}_+$, $0\in D$, $\Psi(0)=0$, homogenous of degree α. Then:

1. If $\alpha<1$ then the function Ψ cannot be convex;
2. If $\alpha>1$ then the function Ψ cannot be concave;
3. If $\alpha\leq 1$ then the function Ψ cannot be strictly convex;
4. If $\alpha\geq 1$ then the function Ψ cannot be strictly concave.

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Financial, Public and Regional Economics

Strategic Management of Transport Infrastructure Development in Albania

Fioralba Vela[1]

Abstract: In recent years Albania is facing a lot of challenges in developing infrastructure. In this paper the author tend to give some important recommendations for strategy design and implementation according to the need of respecting European standards and integration in developing transport infrastructure in Albania. In reality, the government has to consider many factors when making fiscal policy decisions, especially those related to public infrastructure investment. First, with a limited budget, it should use the money efficiently, keeping in mind the macroeconomic objectives of economic growth. Secondly, budget allocation, is jointly determined with the Parliament during budget formulation. This paper therefore provides a brief description of the current condition of transport infrastructure development in Albania followed by a definition of the problem and a description of the policies that the government has adopted. It concludes with identifying the major remaining issues and problems in infrastructure development in Albania and some valuable recomandations.

Key words: transportation; strategic management; Albania

JEL Classification: R42

1. Introduction

1.1. Transport Infrastructure as Public Goods

One reason why infrastructure is not properly provided by private economic activities is that it has characteristics of public goods in the sense used in economics. Ordinary goods are usually consumed by one consumer, and not simultaneously consumed by many consumers. The consumption of such goods can also be prohibited to those who do not pay (exclusion principle). Public goods are defined in economics as goods that do not fulfill these two conditions.

The optimum allocation of economic resources such as labor and capital is not achieved if public goods exist. Goods provided to one person can also be consumed by others and consequently each individual does not reveal his or her own demand.

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Furthermore, since consumers that do not pay the price cannot be excluded, there is a problem. In other words, since the amount needed by the society as a whole cannot be clearly defined and it is not possible to charge prices, private enterprises have no incentives to provide public goods.

Another case where infrastructure cannot be adequately provided by private economic activities is that externality effect is so large that the project is not viable unless careful consideration is given to this externality effect. It is well known that there are two kinds of externality: negative externality and positive externality.

Problems of environmental degradation such as air pollution and noise are typical examples of negative externalities. On the other hand, positive external effects include developmental benefits arising from the improved transport infrastructure. In both cases, an appropriate amount of supply cannot be obtained if we rely solely upon the market. Such shortfalls in supply occur particularly in transport infrastructure (there is an over-supply of goods causing pollution in the case of environmental pollution). This is because a firm cannot make profit, in principle, unless the benefits provided to parties other than the firm can be reclaimed.

Shortfalls in the supply of transport infrastructure are also caused by uncertainties and incomplete information. For example, in the case of large-scale projects in which huge capital investments are needed, private businesses are unable to make investment decisions, even if the investment could be repaid over 30 to 40 years. The uncertainty is so large during such period, that is, the risks firms assume are too large. In such case, there would be no shortage in financing if information about the future were complete and perfect. However, long-term financial markets cannot be perfect. For this reason public intervention to reduce risk, or a supply by the public sector is called for.

2. Transport Development in Albania

2.1. Analyzing Transport Development in Albania and the Region

Table.1 and Figure.1 shows that road network in Albania with all the types of roads, where the vehicles can move, is about 18.000 km long where 3136 km are national roads. Although its density is comparable with that of other neighboring countries in the region (0.62 km/km^2), the actual situation of road network is still not in good condition, with only 32% of national roads in accessable conditions.the situation get worst because of insufficient maintenance.

Table 1. Road infrastructure (National road network)

Country	Total roads per 1000km	National roads per 1000km	% of paved roads	Density in km/km^2
Albania	18	3.136	12.4	0.62
Macedonia	8.634	-	63.8	0.34
Serbia/Montenegro	48.603	18.99	62.3	0.49
Greece	117	40.4	91.8	0.89

Source: MPPTT, 2011

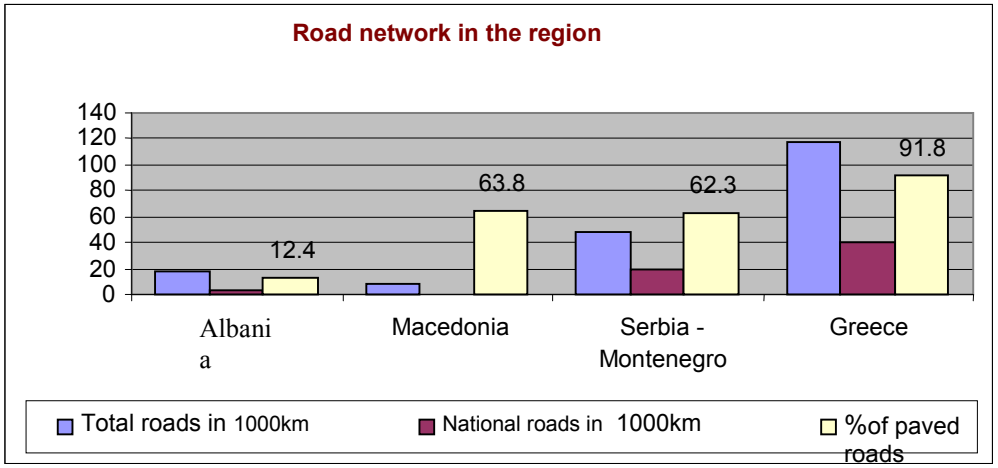
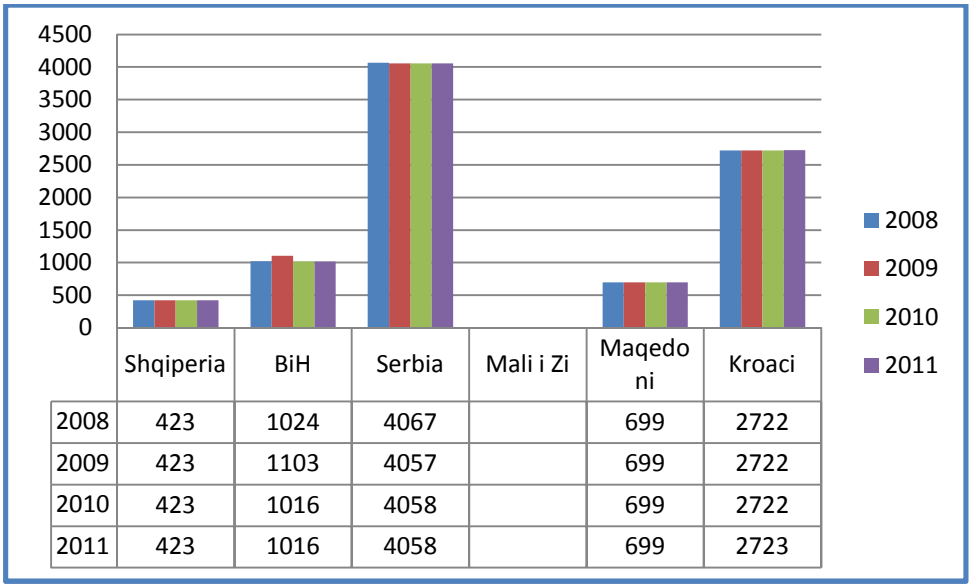


Figure 1. National road network to the region

Source: MPPTT, 2011

Another land transportation mode that is also important for movement of people and goods is rail transport, which in Albania has not gained the necessary attention by policy makers and actually is in very bad conditions. This can be noticed by the comparative analysis made with other countries of the region (Figure 2), according to the total length of rail lines, and also by making an analysis of investments realized in Albania related to rail transport over last 10 years. Only in case of rail transport is noticed a total missing of foreign financial resources in increasing and improving of rail transport network. The main reason for this is that this network is almost damaged and in fact is not of considerable importance for movement of people and goods in Albanian territory.



	Shqiperia	BiH	Serbia	Mali i Zi	Maqedoni	Kroaci
2008	423	1024	4067		699	2722
2009	423	1103	4057		699	2722
2010	423	1016	4058		699	2722
2011	423	1016	4058		699	2723

Figure .2 Rail transport infrastructure in Western Balkans

Source: http://data.worldbank.org/indicator/IS.RRS.TOTL.KM/countries (2011)

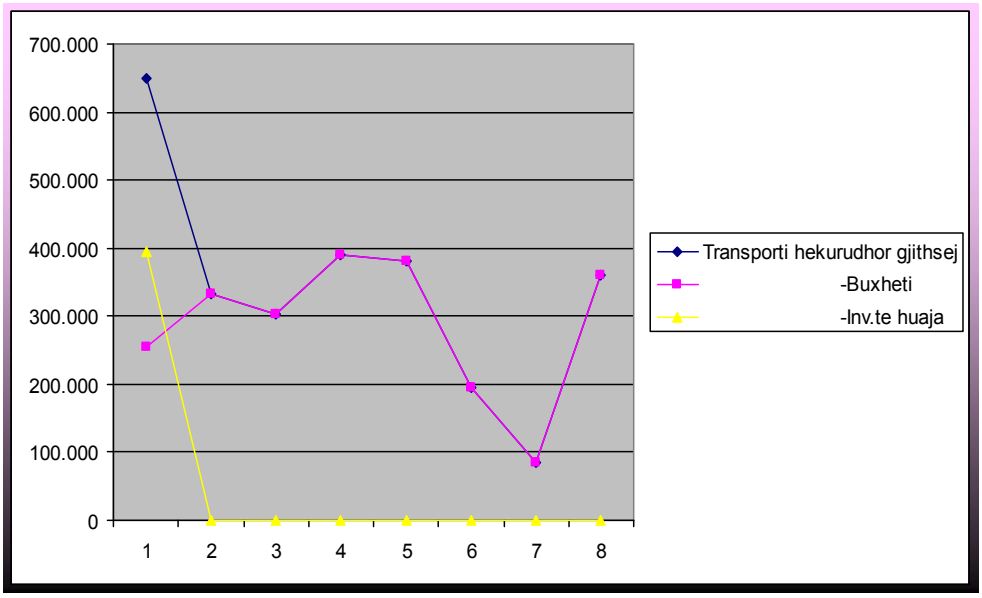


Figure 3. Investments realized in rail transport infrastructure

Source: MPPTT, 2011

A completely different situation is noticed in the case of road transportation infrastructure, where the level of investments is in increasing trend, especially from 2005 and so on. Also, looking at the figure below it is evident that a very high level of foreign investments is focused on road transportation infrastructure during last years in comparison to the level of investments in this kind of infrastructure financed by state budget.

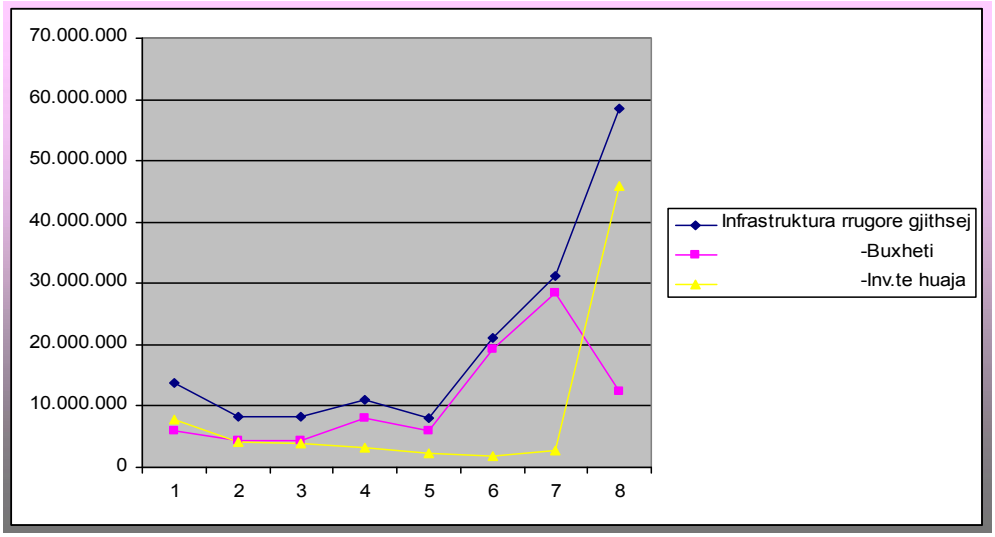


Figure 4. Investments realized in road transport infrastructure

Source: MPPTT, 2011

2.2. Transportation Planning Problems in Albania

The previous section shows that Albania faces infrastructure deficiencies. This paper identifies the problem of infrastructure development from three perspectives:

- Financial resources in regard to investment in infrastructure
- Regulations and institutional framework in regards to policy making
- Rules of investment and the decentralization issue in regard to changing responsibility of infrastructure development.

The importance of planning in transportation is obvious. Ineffective planning, with regard to its concepts and instruments does not reduce the problems at all.

The most striking fact of the last 10 years of the transportation field is that the majority of highways built in recent years were built by spending more than being planned. On the other hand, at the stage where decisions were being made for these motorways, " National Transportation Plan" was in operation and it was paid a lot

of attention in building secondary roads, despite the fact that in Albania primary roads are not yet in good conditions, as seen in the section above. So, the sustainable development in the transportation sector in Albania has faced problems related to the planning process. Some of the examples are unplanned developments resulting from the lack of or a misunderstanding of the planning concept. The others are developments against plans under operation. The lack of a planning tradition causes diffidence against the planning concept and reduces the effects of the efforts made in favor of planned development.

Policy Objectives

The challenge of developing transport policies for sustainable development is to orient the sector towards a compromise that maximizes the economic and social benefits of transport and minimizes associated environmental, social and economic costs. Many of the measures required to achieve this balance are not new, the main difficulty is effective implementation.

Efficiency

The most efficient approach to achieving sustainable development of the transport sector requires a combination of regulatory instruments (particularly for vehicle emissions) and restructuring of charges and taxes on the basis of marginal costs to provide incentives to reduce external costs to optimal levels. It often also requires improvement of the quality of transport, especially rail services (ensuring reliability and complete logistic services) and promotion of inter – modal services. Failure to structure charges efficiently will make the use of other tools much less cost effective.

Initially the structure of charges is more important than the precise level. It should be noted that efficient prices do not generally coincide with coverage of total infrastructure costs. In this context it has to be acknowledged that efficiency is not the only political consideration in setting the level of charges, and budgetary pressures at times result in increasing charges above marginal social cost levels.

Decision Making

Despite the major environmental costs of transport, the benefits are large and the real issue is in making decisions that achieve the greatest benefits while minimizing the costs. How this balance is reached in making decisions on transport projects, and also policies, is critical to making the transport system sustainable in practice.

Evaluating Transport Policies and Projects

Recent work underlines the importance of good cost benefit analysis (CBA) to making sustainable investment and policy decisions. It also provides a framework for arriving at reliable results in the face of market failures that are widespread in transport, overcoming weaknesses in traditional CBA that has undermined its use in many countries in which additional analysis is appropriate according to the degree to which there is a distortion in a) transport prices and b) the prices of products on the market:

- Where distortion is minor, good traditional CBA is adequate to capture all economic benefits flowing from the decision to invest. There are no significant additional economic benefits (e.g. from regional development) beyond those captured by the analysis.
- Where prices are distorted there will be additional benefits and costs to consider.
- But where transport prices are distorted, it will be appropriate to correct transport prices rather than shape investment decisions on the basis of inefficient pricing.

3. Problems of Transport Development in Albania

The previous section shows that Albania faces infrastructure deficiencies. This paper identifies the problem of infrastructure development from three perspectives:

- Financial resources in regard to investment in infrastructure

The level of infrastructure is influenced by how much the government invests in infrastructure. The deficiencies in Albanian infrastructure can be partly traced to the lack of financial resources, and partly to the problems of planning process.

- Regulations and institutional framework in regards to policy making

Despite the problem of the budget being negatively affected by the economic crisis, this paper argues that the problem does not arise merely from inadequate financial resources. While the government has recognized the need for infrastructure investment, at the same time it has fiscal constraints; therefore, one choice might be to seek private participation in infrastructure.

To attract private participation in investment in infrastructure, certain conditions have to be met, for which reforms are needed – reforms that would make infrastructure services more competitive and provide strong and independent economic regulation of natural monopolies.

It is believed that bringing more private sector participation into the economy could improve the situation by creating competition. However, in the case of infrastructure industries, simply moving a monopoly from the public to the private sphere will not result in competitive behavior. A key requirement for the success of privatization then becomes the effectiveness of the regulatory regime in promoting competition or in controlling the anti – competitive behavior of dominant firms (Kirkpatrick, 2009).

- Rules of investment and the decentralization issue in regard to changing responsibility of infrastructure development.

Following the decentralization policy, there has also been a decentralization of responsibilities in infrastructure development. The central government has to share its authority and responsibilities for infrastructure development with local governments. This has become a new challenge that the government faces in infrastructure policy making. In a new era of decentralization, local governments play a greater role than before in regional infrastructure development and policy. However, the new system also creates new problems.

In land transport infrastructure, for example, problems associated with decentralization are related to investment, rehabilitation and assets maintenance of the infrastructure. There has been a trend for regional governments not to provide enough budget for infrastructure maintenance and rehabilitation.

4. Conclusions and Recommendations

Sustainable development in the transportation sector in Albania has faced problems related to the planning process. Some of the examples are unplanned developments resulting from the lack of or a misunderstanding of the planning concept. The others are developments against plans under operation. The lack of a planning tradition causes diffidence against the planning concept and reduces the effects of the efforts made in favor of planned development.

The policies and efforts have been made by the government to tackle the problems in transport infrastructure development. Despite some achievements, there are a few lacunae. Even though the need of building more transport infrastructure has been realized, the decision and finally construction of transport infrastructure growth is not balanced among different regions in Albania. To this extent, the government has to pay more attention to developing transport infrastructure from the view of regional basis and also paying more attention to the building of secondary roads, promoting tourism and agricultural development.

There is an important issue in relation to regional development policy and infrastructure policy. Special attention should be directed towards an interplay of spatial and infrastructure development policy.

The challenge of developing transport policies for sustainable development is to orient the sector towards a compromise that maximizes the economic and social benefits of transport and minimizes associated environmental, social and economic costs. Many of the measures required to achieve this balance are not new, the main difficulty is effective implementation.

Despite the major environmental costs of transport, the benefits are large and the real issue is in making decisions that achieve the greatest benefits while minimizing the costs. How this balance is reached in making decisions on transport projects, and also policies, is critical to making the transport system sustainable in practice.

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The Impact of the Bioeconomy on the Economic Development under the Global Crisis

Romeo-Victor Ionescu[1]

Abstract: The paper is focused on the idea that bioeconomy represents a real solution to the future sustainable development. The main objectives of the paper consist of an evaluation of the bioeconomy's impact on the global economy, followed by finding solutions for the Romanian economy. The bioeconomy is a new concept in Romania. As a result, there are just a few theoretical contributions to this topic area. This is why**,** we realised a pertinent analysis, in order to quantify the impact of the bioeconomy on the EU economy and to find pertinent solutions for the development of this approach in Romania. The main conclusion of the paper is that bioeconomy is a good solution for a sustainable development in Romania.

Keywords: bioeconomics; sustainable development; resources sustainably; knowledge transfer networks.

JEL Classification: Q1; Q2; Q3; Q4; Q5

1. General Approach

The present global economic development model is not able to ensure and to promote a sustainable development. It is based on high consumptions of rare materials and often low economic returns. Moreover, the limits of this kind of growth are much closed. The direct and indirect effects of the classical model of economic growth are almost all negative and cover the natural, social and cultural environment. The humanity has to discover and implement another model of economic development, a more sustainable one. The actual economic growth model is based on an unsustainable production, which uses extensively the natural and labour resources. This model is the main reason for the food and energy insecurity and the climate change across the world. Moreover, it affected the public health (see Figure 1).

As a result, a new economic challenge for the global economy becomes the need of another economic growth model, which to be able to preserve and to use the natural and labour resources under a sustainable way. This is why bioeconomy is considered to be a real alternative for the global economy. There are a lot of

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initiatives connected to this bioeconomy across the developed and emergent countries, in the last period.

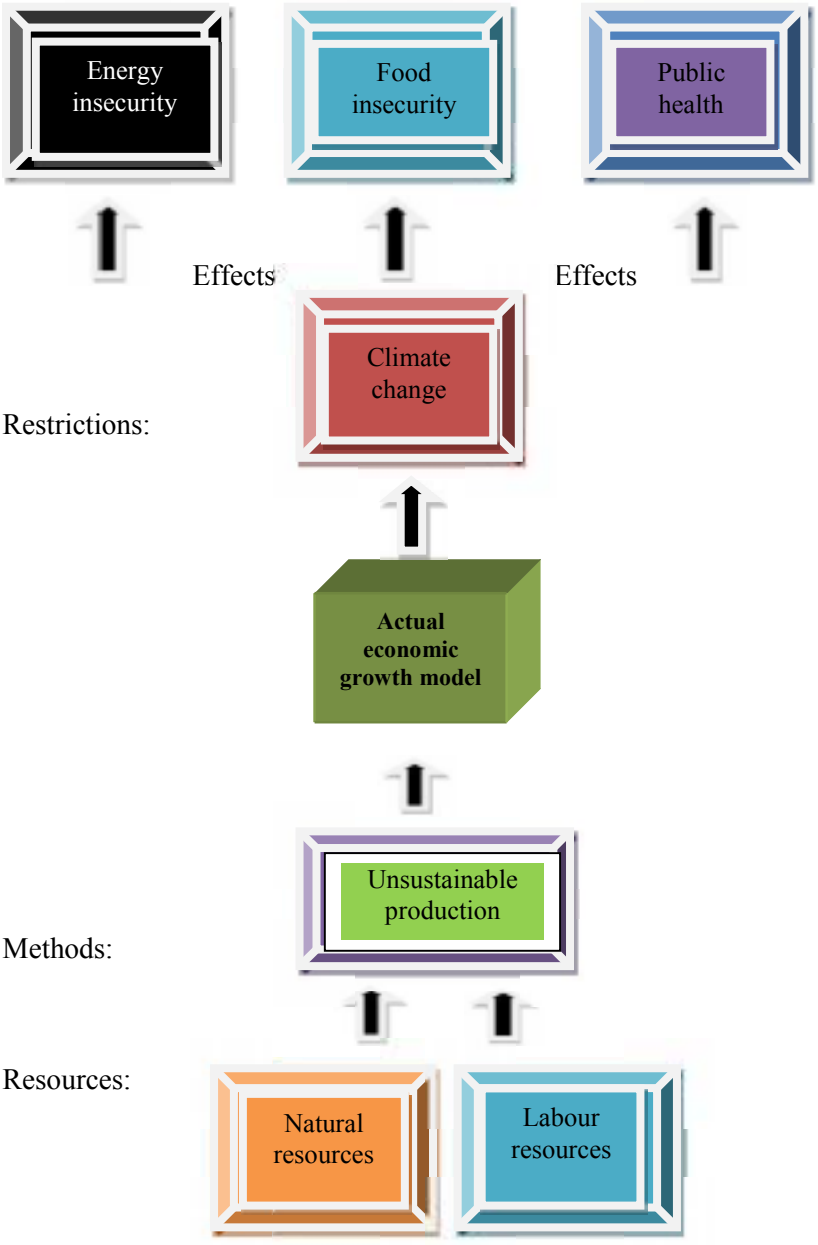

Figure 1. Actual economic growth model

Source: Personal contribution

2. Other Research in this Topic Area

The research in bioeconomy developed quickly in the last decade and they were focused on finding solutions to the global crisis challenges. The international approach connected to bioeconomy is more developed than the Romanian one. An interesting book of bioeconomy is a classical research which received the PROSE Award for Best Engineering and Technology Book from the Association of American Publishers. (Carlson, 2011). The book covers 14 chapters and starts with the concept of biology and its implications in the real economic life. A distinct part of the book deals with the foundations for a bioeconomy and the need of a revolution in the present economic approach.

OECD recognises the importance of the bioeconomy in a special policy agenda (OECD, 2012). This is an International Futures Programme (IFP) of the OECD which will be supported by other interested OECD directorates, OECD Government Ministries, and outside partners. The main idea of this paper is that "the application of biotechnology to primary production, health and industry could result in an emerging "bioeconomy" where biotechnology contributes to a significant share of economic output". The research tries to find those external elements which will drive the bioeconomy to 2030, starting to the state of this bioeconomy today. The analysis is divided into two time periods: 2012-2015 and 2016-2030. An interesting idea is that of the policy options for the bioeconomy. Another interesting approach is that which realises a connection between the bioeconomy and the need of a revolution in the global economy (Mayes R.E., 2012). The basic idea of this book is that the 21st century is a century of biology, connected to the potential of genomics. The evolution of the bioeconomy will be based on anticipated revolutions. The Romanian research in bioeconomy is minimally, excepting a research collective from the Romanian Academy. An interesting research is that connected to the food security and the need of a bioeconomic approach (Bogdan, 2012). The proposed solution for this problem is the biodiversity of the farm animals. Another approach is that connected with Romania as an agrifood green power (Bogdan & Ipate, 2012). The authors consider that Romania is able to become an important economic power using its green development resources. Last, but not the least, the global food crisis can be eliminated under a strategic and integrated management focused on bioeconomy and ecoeconomy (Bogdan, 2012).

3. The Bioeconomy as a Platform to a Sustainable Development

We noticed above that the actual global economic model implies an unsustainable use of the biological and non-biological resources. This model is not able to support the use of the food, water and energy on long term. Moreover, the pollution made by the actual economic system is higher and the developed countries do not

support an important decrease of the pollution level. The bioeconomy is based on the idea that any biological material can be used to support food, health, fibre and industrial products and energy. This implies a sustainable production and the conversion of biomass. The main result of the bioeconomy is the possibility to move from fossil biomass to current biomass. On the other hand, the importance of agriculture, natural resources and sustainable energy production will increase.

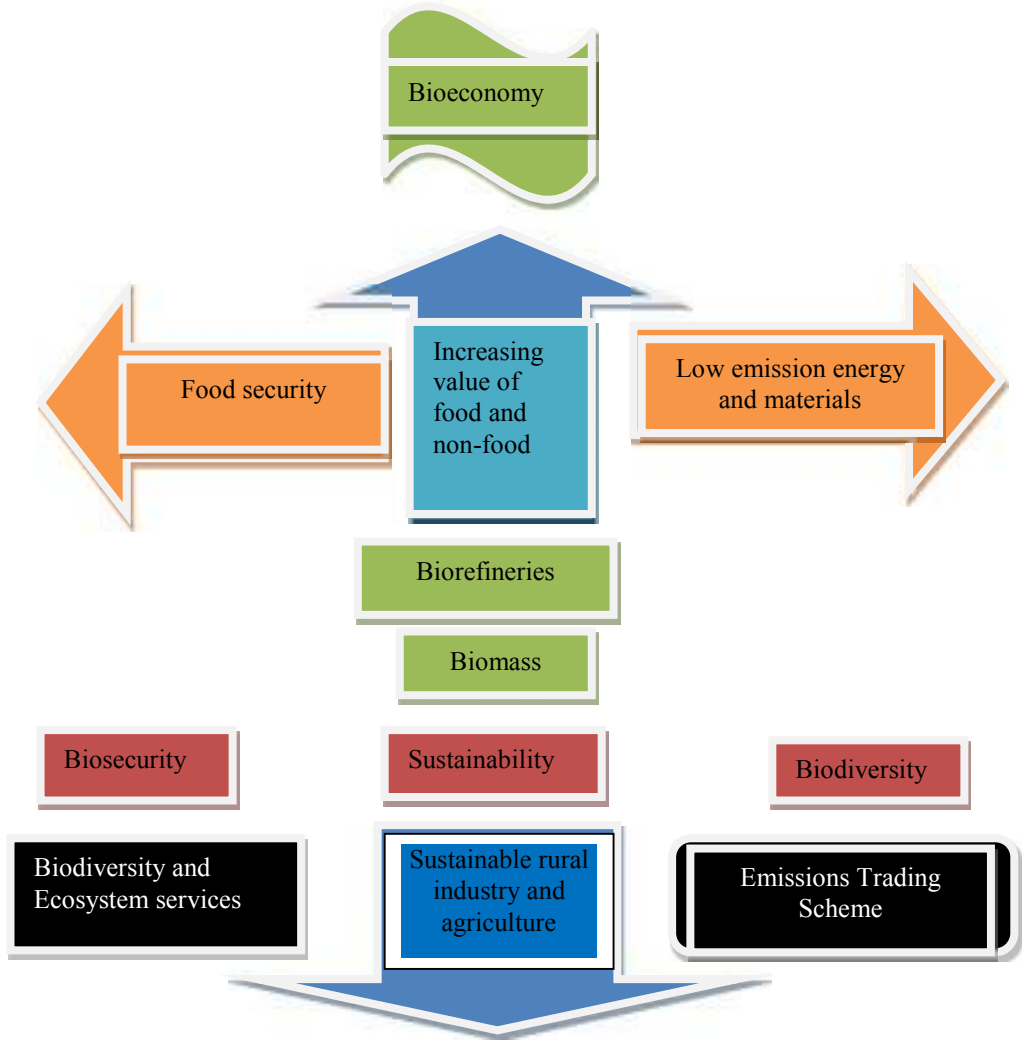

Figure 2. Bioeconomic model

Source: (Begley & Hirsch, 2008)

Like the classical economic system, the bioeconomy is based on efficiency. This is supported by higher biomass productivity, adequate prices and an incentive law framework. On the other hand, bioeconomy needs a new proactive management focused on sustainable development.

According to Figure 2, the bioeconomy is able to increase the value of food and non-food outputs using a sustainable rural industry and agriculture. As a result, there are at least two opportunities. The food opportunities consist of the change of the demand to the high value goods and processed foods, developing sustainable biomass production systems and improving biosecurity systems.

On the other hand, the non-food opportunities are connected to the possibility to transform resources and offals into biobased products, to protect the environment and to decrease the dependence on imported oil, as well.

4. The Bioeconomy across the EU

The European economy understood the importance of the bioeconomy. It tried to implement this new approach in order to maximise the socio-economic positive effects.

Nowadays, the bioeconomy covers 17% from the EU27's GDP and 9% from the European total employment (see Figure 3).

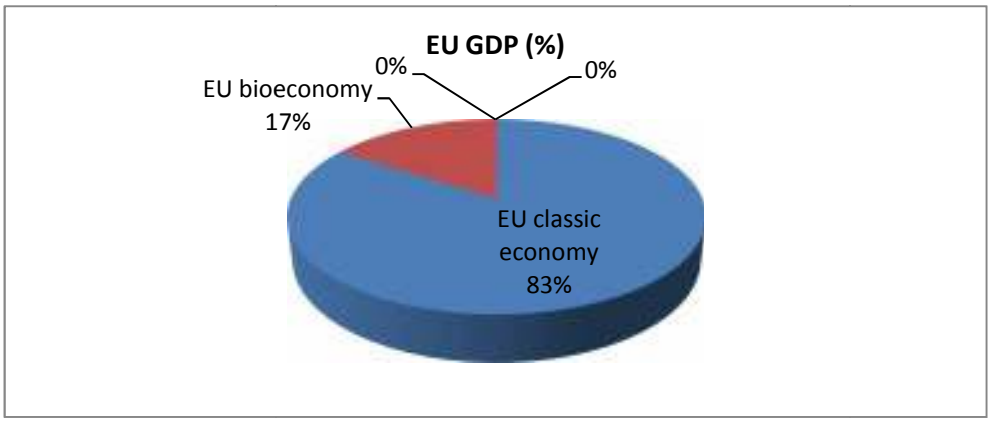

Figure 3. The contribution of the bioeconomy

Source: Personal contribution using European Commission, 2012

The largest share of annual turnover of the European bioeconomy is covered by food. It is followed by agriculture and paper/pulp (see Figure 4).

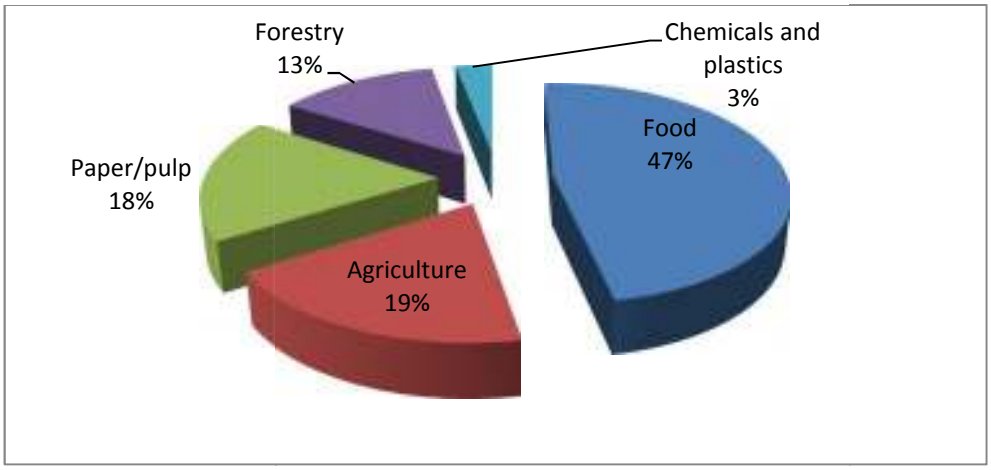

Figure 4. The distribution of the EU bioeconomy turnover

Source: Personal contribution using European Commission, 2012

9% from the European employment operates in bioeconomy, most of them in agriculture and food. There are other industries connected to the bioeconomy: paper/pulp, forestry, wood products, biofuels, chemicals and plastics (see Figure 5).

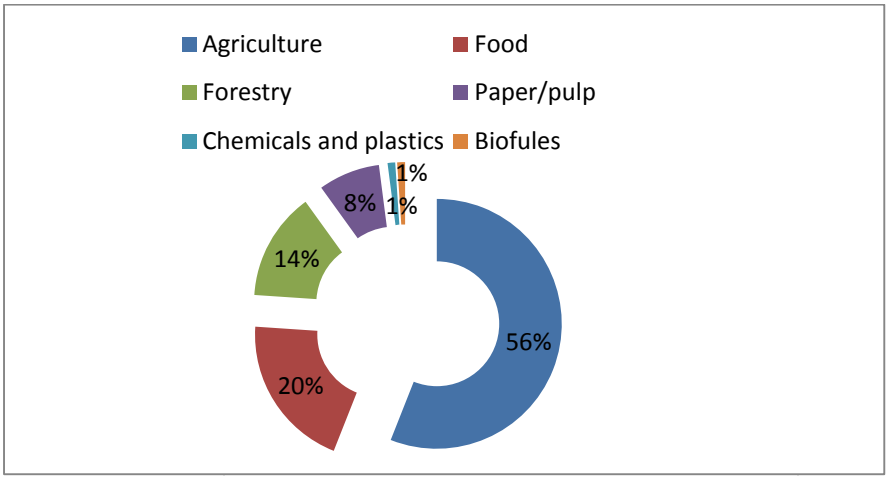

Figure 5. Employment within the EU bioeconomy

Source: Personal contribution using European Commission, 2012

European Commission realised a White Paper connected to the future of the bioeconomy. This document describes six major challenges: sustainable management of natural resources, sustainable production, improving public health, mitigating climate change, integrating and balancing social developments and

global sustainable development. All these challenges are described and are followed by solutions under a sustainable management.

This is why the document makes a set of recommendations which are focused on: research, innovation, education and training and governance and public dialogue.

Moreover, the European Commission realised a communication, to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, connected to the sustainable growth in Europe under the bioeconomy (European Commission, 13.02.2012).

Bioeconomy represents a way of fighting against the main challenges of the present global economy: ensuring food security, managing natural resources sustainably, reducing dependence on non-renewable resources, mitigating and adapting to climate change, creating jobs and maintaining European competitiveness. The target of the European Bioeconomy Strategy is to generate 130000 jobs and 45 billion Euros in value added by 2025.

5. Conclusions

The above presentation leads to the idea that the bioeconomy is very important as a solution to the sustainable development. This approach is difficult to apply in Romania, where is not a theoretical support for it, yet. As a result, we propose some solutions for the Romanian economy. These solutions have to be used both at national and regional level. An interesting solution covers the need of a coherent policy connected to the environment policy. This means more informed dialogues, encourage private investment and implementing of a dedicated information system. The bioeconomy strategy in Romania has to align of EU research and innovation funding about the priorities of bioeconomy-related policies.

Another solution is the investment in knowledge, innovation and skills. This asks for a good public-private partnership in order to support bioeconomy research programmes.

A distinct solution is that connected to participative governance and informed dialogue with society. As a result, the science and technology have to be seen as a opportunity for the future generations. Last but not the least, Romania needs new infrastructures and instruments connected to bioeconomy. The infrastructure has to cover more research, rural, marine and industrial components. This infrastructure will be support by better knowledge transfer networks. As a final conclusion, bioeconomy is a good solution for a sustainable development in Romania.

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Treasury Bond Market Segment at Bucharest Stock Exchange August 2008 – June 2012

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Abstract: The present paper aims to present the level of development reached by Romanian Treasury bond market segment at Bucharest Stock Exchange. A trial will be made to identify the determinants that contributed to the current level of development of domestic secondary government bond market and the factors that can generate a further (and improved) development. The analysis will be descriptive (the data series available for Romania are short), based on the secondary data offered by Bucharest Stock Exchange.

Key words: Treasury-bond; secondary market; liquidity; Romania

JEL Classification: H74; G18; G12; G10

1. Introduction

The development of debt market in Central and Eastern European Union countries has as main objective to encourage their respective central, regional and local governments to consider bond finance as an important way for regional and local project investments (De Haan et al., 2009). Also, a closer relationship between the local/ regional/ central authorities and the capital markets could enhance the quality and the efficiency of projects financed and encourages long term financial planning.

The literature regarding the Romanian bond market, in general, is relatively scarce and appeared only starting with 2004. One of the first studies presenting the details of Romanian municipal bond market was that of Pop and Dumbrava (2004). The study of Skully and Brown (2006) had a special section dedicated to the Romanian bond market and a subsection for the municipal bonds. Corduneanu and Milos (2008), Grecu (2008), Mosteanu and Lacatus (2008), Matei et al. (2009) are Romanian academic studies dealing with some aspects of the Romanian bond

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market. Only one study (Bunescu 2009) deals with a specific bond issue in its trial for a detailed analysis. An in-depth analysis of the Romanian municipal bond market was made by Pop and Georgescu (2011 and 2012).

2. Treasury-bond Sector at BVB[1]

Since August 4th 2008, domestic T-bonds denominated in RON start listing at Bucharest Stock Exchange (BVB hereinafter). The bond market segment at BVB was launched in November 2001, with the listing of municipal bonds. The diversity of listed bonds grew with the introduction of domestic corporate bonds in May 2003, and of international (corporate) bonds in September 2006.

Table 1 presents the evolution of the BVB bond market segment, which, in average represents about 10% of the BVB main market total turnover. Graph 1 shows the dominance of the various sub-segments of BVB bond market. As it can be seen, the Treasury-bond segment became dominant starting with 2009.

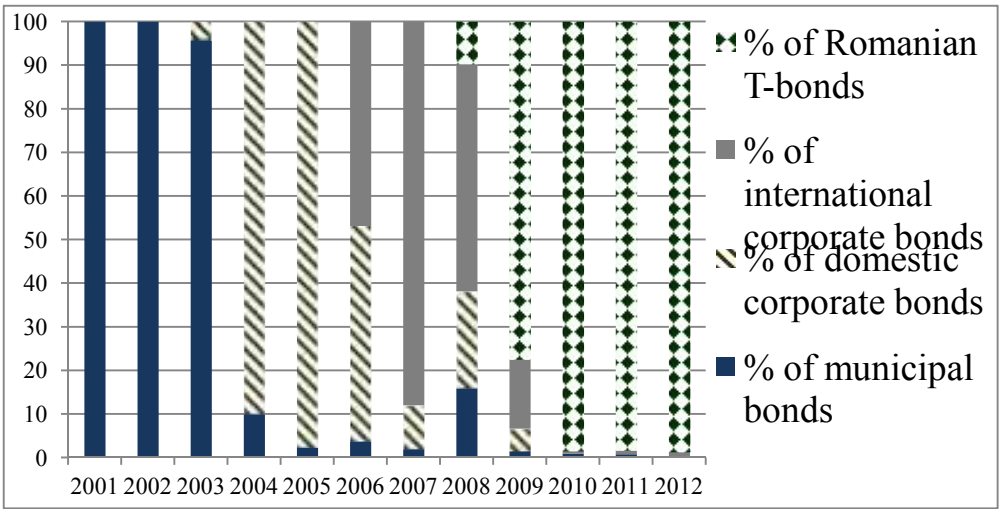
Table 1. BVB bond market (public offerings excluded)

Year	Number of trades	Volume	Value (EUR)[2]	Number of listed issues (end of the year/ period)	New entries
2001	5	45	185.13	2	2
2002	10	59,050	250,295.75	4	2
2003	37	29,870	355,584.29	10	9
2004	274	118,136	13,148,120.07	25	17
2005	334	197,107	29,666,788.77	19	6
2006	319	603,208	53,877,527.98	18	5
2007	233	3,652,467	147,985,261.23	22	11
2008	547	862,927	53,465,296.51	50	34
2009	958	1,822,908	277,746,575.81	60	16
2010	540	591,511	552,865,212.24	55	7
2011	245	857,248	105,205,882.66	59	6
2012 (June 30th)	206	183,528	185,769,995.15	61	5

Source: Authors' calculations based on BVB daily reports

[1] For the present paper the abbreviation BVB (from Romanian name Bursa de Valori/Stock Exchange Bucharest) was chosen in order to avoid any confusion with the possible abbreviation for Budapest Stock Exchange, Bulgarian Stock Exchange and Bratislava Stock Exchange.

[2] The exchange rates used: annual average based on the daily data provided by RNB (Romanian National Bank) available at http://www.bnro.ro/Baza-de-date-interactiva-604.aspx.



Graphic 1. The importance of each bond market sub segment in total turnover (total value)

Source: Authors' calculations based on BVB daily reports

In table 2 the number of listed T-bond issues is presented. As it can be seen, after the introduction of 25 Treasury-bond issues for listing in August 2008 (of which one reached the maturity in September 2008), only a relatively small number of new Treasury-bond issues were allowed to be listed on the BVB bond market segment.

Table 2. BVB Treasury-bond issues available for trading

Year	Number of listed **outstanding bond issues** (end of the year/ period)		
	New entries	Reached maturity	End of period
2008	25	1	24
2009	2	0	26
2010	2	10	18
2011	4	1	21
2012 (June 30th)	5	3	23

Source: Authors' calculations based on BVB daily reports

The characteristics of domestic Treasury-bonds listed at BVB are:

- they are denominated only in RON;
- their nominal value is 10,000 RON (**2,405** EUR[1]);
- they have fixed interest rate for their entire life;
- the coupon is paid annually;

[1] Using an average exchange rate of 4.1576 RON/ EUR – the average for the period 2008 to 2012 (June)

- the principal is reimbursed only at maturity.

Table 3. Presents the evolution of the Treasury-bond market segment at BVB

Year	Number of trades	Volume	Value (EUR)[1]	Value/ Turnover (mil. EUR)	Liquidity (end of period)[2] %
2008	17	2,069	5,182,444.41	5.18	0.16
2009	346	85,689	214,978,790.75	214.98	4.45
2010	435	203,724	544,126,776.96	544.13	11.18
2011	181	35,889	85,780,936.40	85.78	1.88
2012 (June 30th)	199	79,027	183,273,745.31	183.27	3.78

Source: Authors' calculations based by BVB daily reports

Table 3 BVB Treasury bond market data (no public offerings were launched through the BVB system).

The trading volume and the turnover were not expected to reach high levels in 2008, when the Treasury-bonds were first listed. Both trading volume and turnover grew significantly during 2009, and doubled in 2010 compared with 2009. This evolution indicated that while the BVB equity market segment performed poorly (under the influence of financial crisis), the investors turned toward Treasury-bonds as alternative investments (flight to safety). During 2011 the investors' attention turned again towards the equity sector, and the Treasury-bond trading registered only a modest level, showing a sharp decrease compared with 2010. Another reason that can explain the relatively low levels of Treasury-bond trading during 2011 might be the situation at the European level regarding the public debt problems of Greece and Ireland, and the fears regarding the level of public debt and the payment capacity of Italy, Portugal and Spain. Thus Romania has a relative low level of public debt, compared with other European Union member countries, and thus the Romanian government's capacity of fulfilling its payment obligations was not a concern, the relative poor economic conditions which affect Romania also, had an impact on those looking at Romanian domestic Treasury-bonds as an investment alternative. Year 2012 is marked by an improvement which might have as cause the relative disappointing performance of the equity sector driving investors to consider Treasury-bonds as alternative for their portfolios.

Table 4 shows the trading frequency by days for Treasury-bonds. The 2008 should be taken into consideration remembering that Treasury-bond listing started only on August 4th 2008, during the holiday period, and in September 2008 the climax of

[1] The exchange rates used: annual average based on the daily data provided by RNB available at http://www.bnro.ro/Baza-de-date-interactiva-604.aspx.

[2] The liquidity was calculated as a ratio between the T-bond market segment turnover at the end of the year and the outstanding listed T-bonds total (nominal) value at the end of the year.

the global financial crisis had an important impact on the capital markets all over the world.

For 2009 and 2010, Treasury-bonds registered transactions in over 50% of the trading days, while in 2011, the interest toward Treasury-bonds transactions decreased, the trading occurring only in about 31% of the trading days, in concordance with the data presented in table 3. For 2012, the situation registered an improvement, in concordance with the data presented in table 3.

Table 4. Trading frequency for listed Treasury-bonds

Year	Number of days when trading occurred	Number of trading days at BVB
2008	11	101*
2009	137	250
2010	134	255
2011	80	255
2012 (June 30th)	73	125

*Number of trading days for the period between August 4th 2008 and December 23rd 2008 (the last trading day at BVB for 2008)

Source: Authors' calculations based on BVB daily reports

The data presented above show an oscillating evolution of the Treasury-bond segment at BVB and its relative poor position in total BVB turnover: it represented 0.04% at the end of 2008, 1.81% at the end of 2009, grew at 5.40% at the end of 2010, decreased at 5.07% at the end of 2011 and reached a higher level of 5.76% by the end of June 2012, mainly due to a decrease in equity segment turnover.

The factors that have an influence on the relative low profile of T-bond market segment compared with BVB share market can be:

- the relative low volume per Treasury-bond issues; as graph 2 and table 5 both show, about 61% of the Treasury-bonds issues listed at BVB have a volume of less than 50,000 securities, which is not expected to generate enough liquidity for the respective issues; for 2008 and 2009 the Ministry of Finance authorities seemed to understand the need for an increased volume/ issue; but for 2010, 2011, and the first half of 2012, the volume per issue decreased again, having an impact over the marketability of the respective Treasury-bonds;
- the nominal value for the listed T-bonds is 10,000 RON (or about **2,405** EUR[1]); this nominal value is almost prohibitive for any individual investor;

[1] Using an average exchange rate of 4.1576 RON/ EUR – the average for the period 2008 to 2012 (June)

at this nominal value almost only the institutional investors are those who can acquire a high enough volume/ issue to generate transactions;

- the number of Romanian institutional investors is relative low; a number of 9 private pension funds in the second pillar and 11 pension funds within the 3rd pillar are currently active[1]; to these should be added the 6 domestic bond mutual funds[2] that are functioning and between 20 and 23 domestic diversified mutual funds[3] which are likely to include Treasury-bonds in their portfolios; while a number of 19 closed-end funds are registered in Romania[4], they have mostly international portfolios and their interest toward the domestic Treasury-bonds might be considered low or very low. Romanian banks are also important investors in Treasury-bonds (as the data of Romanian Ministry of Finance indicate, in average for the period 2000 – June 2012, about 65% of the domestic Treasury securities are held by 'private banks and others'), but they have the secondary (inter-bank) market on which they can trade the Treasury-bonds they bought much more easily.

With such a small number of investors able to access the Treasury-bond market segment at BVB, it is easy to understand the relative low level of trading registered.

The problem of lack of liquidity through low volume/ issue might be simply solved, if the Ministry of Finance authorities will lower the nominal value at 1,000 RON; a level still high, but more affordable for small investors and which will multiply by 10 the volume/ issue, while keeping the level of public debt under control. However, until now, this alternative was not even taken into consideration by the relatively inflexible Ministry of Finance authorities.

[1] http://www.csspp.ro/date-statistice-pilonul-2 and http://www.csspp.ro/date-statistice-pilonul-3
[2] Based on data offered by the Romanian Association of Asset Managers at http://www.aaf.ro/
[3] Based on data offered by the Romanian Association of Asset Managers at http://www.aaf.ro/
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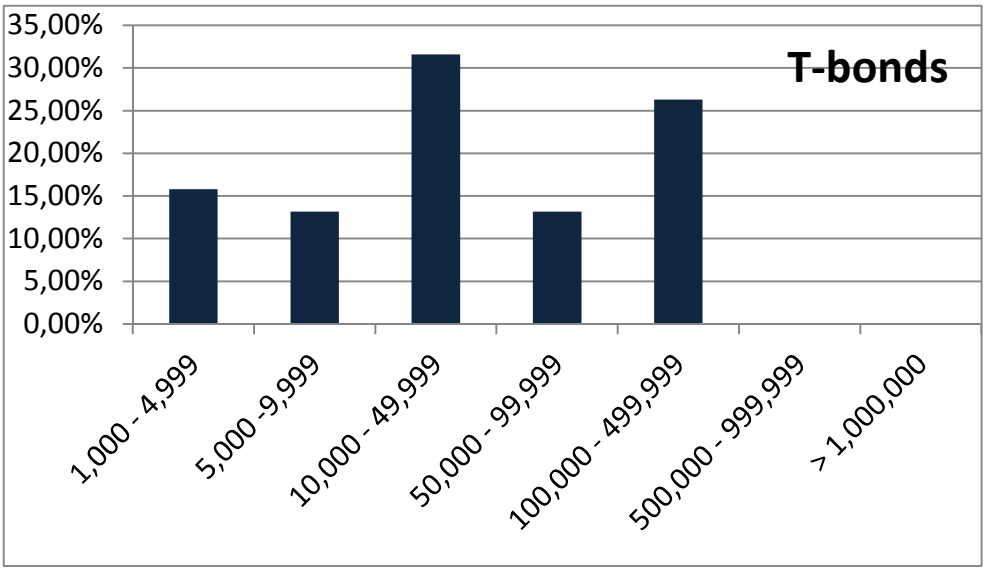

Graphic 2. Treasury-bonds listed at BVB structured by volume of the issue

Source: Authors' calculations based on BVB daily reports

Table 5. The average volume for the Treasury-bond issues listed at BVB

The year when the issue was launched	T-bond issues average volume
2005	8,028
2006	No issue was launched
2007	167,445
2008	274,869
2009	423,342
2010	113,381
2011	52,229
2012 (June 30th)	84,677

Source: Authors' calculations based on BVB data available at www.bvb.ro
Note: In August 2008, the T-bonds listed at BVB were issued during 2005, 2007 and 2008

Table 6 presents the average maturity for the listed issues, at the moment of their launching, along with the average interest rate. It can be seen that the borrowing costs increased in 2008 and 2009 as a consequence of the global financial crisis. However, for 2010, 2011, and the first half of 2012, the Romanian Ministry of Finance reduced the borrowing costs. This creates a wave of protests among the primary dealers and the other institutional investors (since the yield of Treasury-bonds decreased almost at the level of the current inflation rate for 2010 and 2011). However, the Treasury-bond issues were subscribed because they are relatively

scarce and are needed for portfolio diversification reasons mainly by the domestic pension funds, and also by the domestic bond mutual funds.

Table 6. Average maturity and interest rates for BVB listed Treasury-bonds by year of issuance

Year	Average maturity	Average interest rate (%)	Minimum (%)	Maximum (%)
2005	93.6 months (7.80 years)	7.33	6.47	8.00
2006	-	-	-	-
2007	74.7 months (6.22 years)	6.42	6.00	6.75
2008	52.0 months (4.36 years)	8.13	8.00	8.25
2009	52.5 months (4.38 years)	11.13	11.00	11.25
2010	51.0 months (4.25 years)	6.13	6.00	6.25
2011	61.5 months (5.13 years)	6.05	5.95	6.25
2012 (June 30th)	82.0 months (6.83 years)	5.85	5.75	5.95

Source: Authors' calculation based on the information offered by BVB for T-bonds bonds
Note: In 2006 no T-bond issues was launched by the Romanian Government

Up until the end of June 2012, 38 T-bond issues were listed at BVB. Of these:

- ✓ 15 reached their maturity (1 in 2008, 10 in 2010, 1 in 2011, and 3 up until June 2012); of the expired issues, 12 were common Treasury-bond issues and 3 were benchmark issues;
  - of these expired issues, 7 were never traded; all seven were common issues.
- ✓ 23 are active issues; of the active Treasury-bond issues, 8 are common issues and 15 are benchmark issues;
  - of the active issues, 6 were never traded.

The brief data presented above are consistent with the low liquidity level of the Treasury-bond segment, as presented in table 3 and shows the preference of BVB investors toward the benchmark issues, thus these Romanian benchmark issues have none of the features of what is important at international level through such a benchmark.

The low liquidity level, in general, is consistent with the low trading frequency pattern and, mainly in the case of common issues, with the very low number of trades (between 1 and 3).

Until the trading frequency and the liquidity level will not increase, the T-bond sector at BVB will continue to have a low profile, not attracting investors.

3. Conclusions

BVB launched in November 2001 its bond market segment listing municipal bonds. As expected, not having a benchmark provided by T-bonds, the BVB bond market segment had a very slow development and up until the end of 2008 it represented less than 4% of the total BVB turnover.
In August 2008 the listing of some Treasury-bonds at BVB became in a way compulsory, since the 2nd pillar domestic pension funds was launched on the market during July 2008 and an important part of their portfolios, according to the regulations, was supposed to be formed by Treasury securities.
For the listed Treasury-bond issues the level of transparency increased, all the necessary details being provided by BVB.
The efforts of RNB (Romanian National Bank) and BVB to build a liquid and credible market for domestic government bonds should be matched by the Ministry of Finance willingness to provide an improved level of information and to increase its transparency and flexibility. Until then, for any investors in Romanian domestic government bonds, to get reliable information will be a struggle that will probably generate the abandon of such an investment. Even when the idea is not abandoned, the low level of liquidity of BVB Treasury-bond market segment and the lack of details regarding the secondary market of Treasury securities organized by RNB will prove another difficult barrier for any investor.

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Redefining Project Management Information Systems with New IT Services

Luminita Hurbean[1]

Abstract: Achieving successful adoption of an innovative project management information system should involve influencing the project management environment by providing useful tools, training, reusable templates, techniques, and methods that improve the project manager's ability to successfully execute. This paper suggests that project management practice, enabled by emerging IT, could more explicitly recognize, represent, and manage the interdependencies that are pervasive throughout projects, thereby fully exploiting the potential of the IT to improve overall project performance. The last few years IT&C evolution led to new approaches to application and infrastructure architecture. Breaking from the traditional procedures used by organizations, they propose a cloud operating platform that reduces complexity and improves agility and scalability by altering the approach to the way data centres are built, applications are developed, infrastructure is managed, and organizations align and collaborate. Further, the paper explores the growing impact of mobile computing, cloud delivery and social business collaboration project management information systems and proposes a shift of a Five C's for information systems in a cloud based operating platform, driven by cooperation, teamwork and continuous improvement.The proposed shift in the cloud indicates actual tools that may be adopted for better collaboration and higher business value of the project information management.

Keywords: project management; information systems; cloud computing

JEL Classification: O32; O33

1. Introduction

In organizations or at home, computers have revolutionised the way documents are generated and managed when data turned to the digital form. Likewise, information technology and communication (ITC) is bound to transform the way people exchange information and documents (Airinei, et al., 2006). Basically, ITC is defined as "the use of electronic machines and programs for the processing, storage, transfer and presentation of information" (O'Brien, 2004). ITC encompasses many technologies such as computers or electronic devices of all types, many sorts of software, and networks. The purpose of ITC is to facilitate the

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exchange and management of information and has a lot of potentials for the information process component of the project management domain. Information technology is driving fundamental changes in our society, from how tasks are done to our expectations for the timeliness and accuracy of their completion (Baldauf and Stair, 2008). It also offers an element of self-perpetuation – one technology creates a need for another to fill. The pace and scope of technological change has prompted a profound change in the way organizations manage their projects. The leading companies become those that can harness the power of the Internet and other technologies to manage their business more efficiently, to effectively address governance compliance and manage risk and how the stakeholders interact (Nagy, 2010).

The shift in focus from work being performed by operations to work being performed through projects requires that an organization establish standard project management practices, including best practices, consistent processes, standards, guidelines, tools, and templates. To ensure consistency of execution and reporting, the organization must also provide appropriate project management training and a data repository for the timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information. This can be achieved through the implementation of a well-organized and constantly developed information system, based on a reliable information management.

Most of the key project management solutions' vendors are mature and well positioned as a result of the many years of experience. Main players like Primavera, NIKU, PlanView, and others have a market stronghold in managing projects of all sizes and scope. That being said, comparatively newer, up-and-coming organizations should be recognized not only as visionary for their real time capabilities, but for developing and offering solutions based on technology trends and new IT services. Solutions built in this scope have the capability of managing project portfolios, programs, projects and resources with necessary diligence; managing IT and corporate governance; providing enhanced processes, tools, and best practices methodology support; improving project team collaboration; and supporting and measuring progress toward project initiative objectives (Crosby, 2012).

2. The Information and Communication Technology in a Digital World

Digital, communication, and *technology* are three very simple words when defined separately. Digital is data, information, images, or media represented by a series of bits in 1s or 0s that can be sent via digital networks (Malecki and Moriset, 2007). Communication is an exchange of verbal or nonverbal interaction between two or more individuals (or machines), whereby the input may or may not have an effective output. Human communication (face to face or electronically) involves

interpersonal messages delivered either verbally or nonverbally through speech, body language, written English, or symbolic messages. Machine communication can be the same exchange or can simply be programming communication via a digital mode. Finally, in simple terms, technology can be defined as all the hardware and software that make up a computer system, a network, and others likewise.

When the three terms are combined, the phrase now becomes an intricate, all-inclusive, and sometimes complicated blend of characteristics that takes on new meaning and includes not only the entire realm of technology (hardware and software), but also the people or organization responsible for the design and use of the technology. To understand the phenomenon of organizational adoption of new IT technologies, organizations must understand that they do more than adopting new automated processes, they are adopting an information system. Figure 1 represents this system, along with the human element controlling it.

In project management, digital communication technologies, such as the model presented in Figure 1, may represent the ability to automate or process data faster, but they also produce challenges for organizations. These challenges include things such as producing an overwhelming amount of data and information, changing business conditions, acceptance of new technologies, meeting training needs, managing data production, finding qualified IT professionals, and ultimately meshing together process control strategies with business plan objectives. This is where the information system may help.

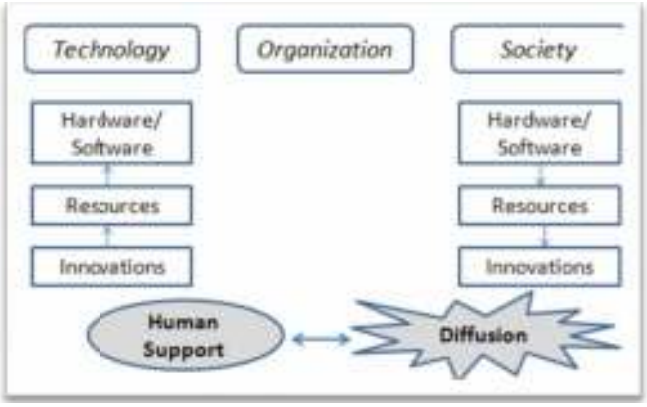

Figure 1. Digital communication technology framework

IT complies with the long-standing saying "nothing is more constant than change". We assist to an avalanche of new technologies. The role of IT teams has changed from defining the business and building transactional systems, to driving innovation to the point of engagement with customers, partners, and suppliers (Kehal & Singh, 2005; Williams & Sawyer, 2004). IT departments are now

charged with developing innovative solutions that improve engagement and information sharing, ultimately creating new value and efficiency in these relationships. Projects are focused beyond the four walls of the enterprise, ensuring that companies bring information to bear at the moment it's needed. IT is seeking ways to manage an extended information architecture, which allows all employees access to crucial information in real time, and where it can have the biggest impact (Schwalbe, 2010). An IDC survey (2011) indicated that 48% of IT professionals believe that faster access to information (i.e., faster query response times) would have the most positive impact on their organization and project.

3. Project Management Information Systems Challenges

Project Management Information Systems (PMIS) are software applications that help managers track projects from their conception to their execution (Braglia, Frosolini, 2013). They provide them with pertinent information and collaborative tools. Currently, most businesses use disconnected instruments which are not designed for managing complex projects. Increases in complexity, both due to the extent of scope and the fact that the users who contribute to the decision making process are physically separated, have led to initiatives that deal with cooperation, teamwork and continuous improvement (Marchewka, 2012).

Practically, a project management information system consists of a collection of solutions for engineering document management, document control, and project collaboration. It is based on a collaboration platform, providing an integrated suite of server capabilities for developing all the web-based applications required by a firm, like Intranet, Internet, and Extranet, and a central repository for shared workspaces and documents.

The project management interface of the application allows tasks lists to be generated for any user, with automated email notifications to inform team members of tasks. Anyone linked to the project can view and post information and see the lists of open and closed items, enabling transparency and better accountability. In addition to tasks assigned collectively, individual users can create their own to-do lists in the system which can be viewed only by them. The project administrator can set up deadlines and milestones with a Gantt chart to help keep the team up-to-date and on schedule.

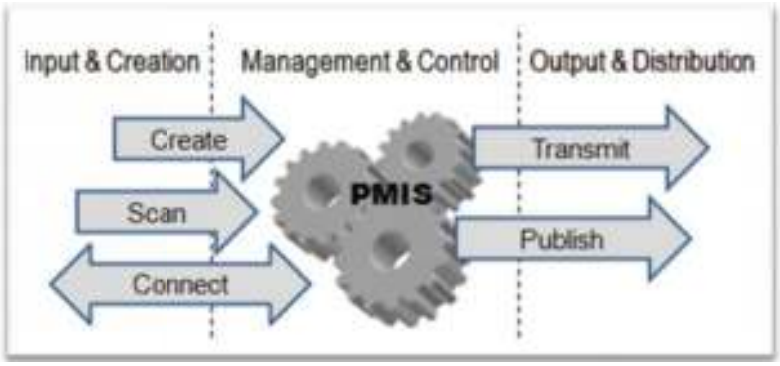

Figure 2. The Project Management Information System functions

A PMIS comprises several different applications that work together to support the basic operations, as shown in Figure 2. The central application provides all the fundamental document management functionality to create, store, search, retrieve, view, check in, check out, edit and revise documents.

No matter what software it uses, the project management information system is aimed towards better information sharing, better accountability, more transparency, less redundancy, and less duplication of content (Yang, 2013).

4. Project Management Information Systems Redefinition. The 5 C's Model

Current trends in information and communication technology (ICT) are yielding a wide range of new computer-based tools to support the project management area. The report "Predictions: Welcome to the New Mainstream" (IDC, 2010) states that in the near-term, we expect to see transformative technologies make the critical transition from early adopter status to early mainstream adoption. We'll see the IT industry revolving around the build-out and adoption of this next dominant platform, characterized by mobility, cloud-based application and service delivery, and value-generating overlays of social business and pervasive analytics. This prediction is based on unarguable demographic data: 269.6 million mobile devices shipped in 2010 – a 55% increase over 2009 (IDC Report, 2010). A Gartner report estimates mobile phones will overtake PCs as the most common web access device worldwide by 2014. While users are going mobile, business IT is taking to the cloud, opting for subscription-based IT services. In fact, by 2014, 20% of businesses will own no IT assets at all (Gartner Report, 2010). Social software, with its familiar interfaces and intuitive functions, has already supplanted e-mail as the communication and collaboration method of choice for the rising generation of corporate workers. According to a Gartner survey, almost half of respondents

indicated they use social software more than e-mail. We conclude that the following four key technologies are enabling a new breed of information systems:

- cloud computing;
- mobile computing;
- social computing;
- big data.

These technologies have allowed market leaders to extend the reach and accelerate the cycle time of their information systems. Cloud services are providing massively scalable computing, ubiquitous access to data and closer proximity to customers. Mobile solutions have created exciting new services for field workers and customer service alike. Social business capabilities enable collaboration and deliver a connected enterprise, customer communities, and market feedback. Big data and the use of analytics are delivering a greater value for today's business leaders. Analytics are essential to improving every aspect of business performance, from strategy to operational excellence, and creating agility.

Cloud computing is considered the next great wave in IT and is currently the major buzzword, so we will further refer to this topic. Practically, cloud computing means using the Web server facilities of a third party provider on the Internet (the "cloud") to store, deploy and run applications. Cloud computing takes two forms. It may refer to "utility" computing in which only the hardware and software infrastructure (operating system, databases, etc.) are offered, or it may refer to "software as a service" (SaaS), which includes the software applications as well. Regardless whether the cloud is infrastructure only or includes applications, major features are self service, scalability and speed. Self service stands for users doing everything online, on their own: they sign on to the service and run their applications as desired. Scalability and speed indicate that the cloud provides virtually unlimited computing capacity and supports extra workloads on demand.

The biggest reason for using cloud services is to reduce costs, followed by speed to adoption and process transformation. Consequently, providers feel their top challenge is to demonstrate clear evidence of cost savings, along with the development of usage-driven pricing and the creation of a realistic business case for the switch to cloud. On the other hand, loss of control is the organizations' biggest concern, with additional worries over data security and the integration of cloud with existing architecture. Organizations are most likely to consider using cloud when they face major technology upgrades, or alternatively, when they're undergoing some form of business transformation.

Cloud computing can provide a fast path to IS redefinition, and there are three major opportunities for cloud computing to accelerate IS renewal:

1. Finding and validating new business opportunities.
2. Improving existing business capabilities.
3. Transforming how IT capabilities are managed and deployed.

The third listed opportunity is significant in relation to the project management information system due to following reasons:

- Traditionally, organizations are typically quite lacking in their own use of IT – managing project tasks via Excel spreadsheets, email and a lot of meetings.
- As specialists estimate, moving to the cloud is inevitable – at this moment organizations have the opportunity to lead the shift and get ahead, at least in terms of learning and experience.
- The nature of IT work in project management, with its complexity and knowledge intensiveness, justifies a more collaborative and networked approach, which might be accomplish on a cloud-based platform.

Based on the new characteristics of PMIS, organizations can leverage cloud computing in their efforts of IS redefinition. The characteristics of complex systems (Cilliers, 1998) offer some important insights into this subject. Accordingly, organization is a natural, spontaneous act and that emergent structure dislikes imposed hierarchy and control. It reveals that creativity arises from variety and randomness. It highlights the importance of relationships, porous boundaries, and free flows of information and self-reference.

These complex system characteristics lend themselves to the use of collaborative approaches to managing information systems (Chiocchio et al., 2012). In the notorious convention of the "Five C's", the following components – types of management activities – may constitute a model for deploying the PMIS:

1. **C**ollaborating;
2. **C**oordinating;
3. **C**onnecting;
4. **C**o-creating;
5. **C**oalescing.

Because each of these activities is increasingly being conducted across time and space and across organizational boundaries, enabling them through flexible, scalable cloud solutions becomes an attractive proposition. Practical solutions for enabling the "Five C's" in the cloud are detailed subsequently in Table 1.

Table 1. A cloud computing based Five C's project management IS model

COLLABORATING	Much project work is performed through teams – increasingly distributed across geographies, organizations and time zones. This change forces a shift in work management from a document-centric (write-attach-email-review-attach-email, repeated) to a more collaborative Wiki-based approach, with noteworthy advantages: • Wiki's are naturally non-linear and encourage a 'constructive informality' that improves quality over time, drives organizational clarity and reduces redundancy and contradictions. • Wiki's encourage multi-author collaboration. Whereas the typical document-centric approach has one or two main authors with everyone else in a review role, Wiki's encourage a collaborative approach to authoring – with higher engagement and understanding in the content. • A Wiki approach simplifies search and discovery. The ability to hyperlink, tag, and use a well-factored semantic Wiki leads to content that is far more accessible, intelligible and searchable for all stakeholders. There are many good Wiki products available as SaaS, including SharePoint, Confluence, and MediaWiki.
COORDINATING	As project work becomes more distributed, the need to coordinate activities in time and space becomes both increasingly important and challenging. SaaS offerings are ideally suited to helping distributed teams coordinate their activities, including: • Real-time communication and collaboration (Instant Messaging, Google Wave) • Collaborative Project Management (Bamboo, BaseCamp) • Desktop videoconferencing (Go To Meeting, WebEx)
CONNECTING	In project management, the need to identify and connect people and ideas is important to innovation and learning. As work becomes more distributed, cloud-based SaaS solutions become effective ways of connecting people and ideas, through tools such as: • Social Networking (FaceBook, LinkedIn, Plaxo) • Mind Mapping (MindMeister, WebBrain, Bubbl.us) • Virtual Electronic Whiteboards (FlockDraw, Colabopad) • Social Network Analysis (9Netminer, InFlow)
COCREA	As business and IT converge, opportunities emerge to co-create experiences within a project team. New types of SaaS solutions for co-creation include: • Modeling and Simulation (Creately, FlexSim, Second Life)

T I NG	• Prototyping (iRise, Dreamweaver) • Virtual Worlds (Second Life)
C O A L E S C I N G	With the increasing distribution of project work comes the need to poll stakeholders, tap into sentiment, come together around ideas and reach consensus around decisions. New approaches and supporting tools emerge into this space, including: • Polling (Survey Monkey, Kluster, IdeaScale) • Group Decision Making (Resolve) • Prediction Markets (NewsFutures)

(The recommended applications were included in an IT management case study on the blog of Vaughan Merlyn, a management consultant - http://vaughanmerlyn.com)

5. Conclusions

The Information Technology landscape is at the dawn of a radical change in response to a new set of business realities. The nature of work (how and where it gets done), the expectations of a new generation of workers (accustomed to an "always-on/always connected" electronic lifestyle), and emerging business models that challenge traditional concepts of IT cost and time-to-value are driving the change. In response, mobile computing, cloud and Software-as-a-Service (SaaS) delivery and social business collaboration technologies are rapidly gaining momentum in organizations' information systems.

We identified mobile computing, cloud and SaaS delivery and social technologies to be on the rise in project management information systems. A new way of managing activities emerged – across organizational boundaries, across geographies and across cultures and cloud computing is leading technology. The 5 C's model of PMIS was defined based on the major activities that are involved and then it was rearranged in the cloud computing frame. IDC predicts global spending on public cloud services alone will approach US$100 billion in 2016 (IDC, 2012), therefore marrying these activities to the cloud computing based technologies extends their value for growth and innovation. The challenge for IS managers is to combine the power of mobile, cloud and social in a reliable, cost-effective, secure, and user-friendly information system.

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EU Regional and Cohesion Policy. Analysis 2007-2013 vs. 2014-2020

Elena-Daniela Onica[1]

Abstract: The EU cohesion policy aims at reducing disparities between EU regions, knowing that there are major development levels among all member states. Through the financial instruments of the regional policy, certain incentives are sustained in order to generate economic growth, competitiveness, job creation, all of them having the same goal, namely to increase the life standards of EU citizens. The actual stage of research underlines that regional solutions should be implemented for regional problems and therefore nowadays it is considered necessary to build a model of regional development. The regional development policy is financed from the EU budget, in that regard the article tries to make an analysis on the financial allocations between the current financial perspective 2007-2013 and the new financial framework 2014-2020. Due to budgetary constraints the total amount allocated for the next 7 years is situated beneath the financial allocations for 2007-2013 for the first time.

Keywords: EU regional development policy; New Financial Framework; competitiveness

JEL Classification: R11; R58; O10

1. Actual Stage of Research in the Field of Regional Policy Instruments

The researchers Fujitu, Krugman and Vanable revealed that: "*the economies of different states are characterized by heterogeneity, and consequently the economic relation between them must be treated taking into account the diversity*". Therefore, it is recommended that the assembly of regional policy instruments should serve the national economic policy of each EU member state, in order to reduce the disparities between life standards of EU citizens (Constantin, Ionescu & Marchis, 2006).

The European integration process contributes to the attenuation of borders between member states, by eliminating the commercial obstacles, assuring the free circulation of factors of production and by removing the state aids. This idea was underlined also by Krugman which showed that: "*the more unified the European market is, the mobility of capital and the labor market becomes increasingly higher*

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and there is no use to approach the economic relations between member states in terms of international commerce, but rather in terms of interregional commerce".

The researchers Batchler, Wishlade and Yuill considered that: "*the development of regional policy in an expansive European Union cannot be realized only from the national perspective, without taking into account the existing connections between national regional policies, the European regional policy and the EU competition policy*". Enhancing the European integration process had as result the deepening of the inequalities regarding the economic development of the member states, relevant discrepancies being found at regional level. At EU level, researchers had identified three types of regions (Plumb & Zamfir, 2002), as follows: prosperous regions which are at the ground of the economic development within their countries - Banden-Wuntenberg (Germany), south-east of England, Catalonia (Spain), Rhone-Alpes (France);regions with industrial traditions, which undertake sustained efforts for the growth of the competitiveness – the Basque Country (Spain), Liguria (Italy), Lorena (France);regions with structural deficiencies, which are under the community average, such as Mezzogiorno regions in Italy (Calabria, Campania, Sicilia, Pulia, Sardinia, Basilicata and Molise), east German lands, Castilla-La Mancha (Spain), Auvergne (France), Scotland (United Kingdom).

The results of the studies on the regional policy instruments of member states led to the identification of six typologies of regional policy instruments (Wishlade & Yuill, 2001), as follows: regional incentives, particularly in the form of investments directed at assisting the companies; promoting measures to ensure the general development framework of the business; infrastructure development; the development of regional strategies; controlling the disposing of the economic activities and the discouragement of the firms' localization in crowded areas; the adequate spatial distribution of the economic activities belonging to the state.

Practice showed that the importance of the last two categories of regional policy instruments had considerably decreased. Controlling the disposing of the economic activities, as instrument of regional policy, was especially used between 1970-1980, mainly in France (Ile de France and Paris regions) and in United Kingdom (London and South-East). Nowadays, only France and Greece still encourage the decongestion of the capitals and the location of the economic activities out of them. Regarding the distribution of the economic activities belonging to the state, it can be stated that Italy used that instrument extensively. The privatization of the industrial activities led to reducing the state influence on localization of industrial activities and to coming out of unemployment, even in the prosperous regions. For example, in France was taken into consideration the movement of public services outside Paris, as a measure to revitalize some declined urban centers. In Denmark, the territorial relocation of central public authorities was considered a way to solve the regional problems.

Regarding the other instruments of the regional policy, the researchers appreciate that they are operational at the level of all member states and they are differently used from one state to another. Studies revealed that lately the focus is on regional planning which: "*is materialized on regional social and economic development programmes at two levels: national one, including the regional characteristics and at the level at each region*" (Constantin, 2004), detrimental to regional incentives.

The concept of regional economic planning is encountered from 1950-1960, when various forms of territorial planning were promoted – regional *physical plan* in UK, *raumnordnung* in Germany, *amenajament du territoire* in France – we can speak about "*the new era in drawing up plans and regional development strategies*" (Bachtler & Yuill, 2001) since 1988, which is the moment when structural funds were reformed.

By adopting the French model of concluding contracts/plans between the state and the region – *contracts du plans* – the European Commission requested member states to carry out regional development national plans designed to reflect the development strategy of the regions, in order to access the EU financial resources for regional development (Marchis, 2008). Those programs became more and more complex, being at present programming instruments of the regional policy.

As regards the regional incentives, they are seen as financial assistance given by the state in order to encourage the companies to locate themselves or to invest within "problem regions". The incentives take the form of investment subsidies, loans awarded in favorable conditions, fiscal concessions, subsidies awarded to labor factor or transport, etc. Although, in the last 40 years, the regional incentives occupied a top position within instruments of regional policy, they have suffered various transformations in time, becoming more selected and concentrated.

Moreover, the amount of expenditures allocated to regional incentives have been reduced very much in most member states, due to on one hand the growth of budget constraints and the negative perception on awarding direct support to the companies, and on the other hand the pressures from the European Commission regarding the removal of state aids.

Regarding the development of business environment, it implies assuring the necessary infrastructure (Onica, 2009) such as: physical infrastructure, ensuring information, technical assistance and consultancy, access to education and training, spreading of the innovation among traditional industries, sustaining the dialogue between university centers, research centers and business environment, etc.

The difficulty in using this instrument comes from the fact that it implies a high level of cooperation between all operators involved in regional development. In such circumstances, it appears more clearly the need of adequate regional development strategies to solve the problems identified at regional level. It should also be added the influence exerted by EU structural funds on transformations of

national policies of member states and on promoting "*friendly competition among regions*" (Şerban, 2004) in the context of "*conflict between efficiency and equity*" (Constantin, 2004), now known as "*debate between competitiveness and cohesion*" (Batchler, 2003).

The EU regional policy "*is indissolubly linked to the horizontal dimension of cohesion policy",* being *"more, than anything else, a solidarity policy built around the social an economic cohesion objective*" (Constantin et al., 2007). The achievement of economic and social cohesion in an enlarged European Union is the main challenge in the present, in relation with the EU aim at becoming "*the most dynamic and competitive economy in the world*", according to Lisbon Strategy. By creating a regional policy that assists every region of a state and not only the "problem regions" will generate economic growth and competitiveness al national level, thus having direct effects on deepening the disparities among the regions belonging to the same state. This approach of regional development policy is increasingly present in EU member state. The Swedish regional policy aims to stimulate regional competitiveness, economic growth and employment in all its regions. In Finland, it is mainly focused on promoting regional competitiveness than to maintain a balanced territorial development. In the Netherlands, the regional policy is shifted from assisting the north part of the country to promoting areas characterized by a high level of competitiveness. In Austria, there were established regional instruments targeted to thematic objectives without territorial bordering. The same tendency is also seen in the United Kingdom where the focus is on economic development of all regions and the areas with economic growth are strengthened by stimulating regional innovation capacity, entrepreneurship and human factor skills.

It worth underlining that those redefinitions of regional development policies of member states lead to an endogenous approach of regional economic development, after the principle "*regional solutions to regional problems*" (Batchler, 2003).

The actual stage of research in the field of regional policy instruments shows that it is necessary to design a model of regional development. Previous studies that approached this issue have shown that the main objective of EU regional policy was to achieve inter-regional equity al national level by "*reducing disparities (...) related to incomes, welfare and economic growth of the regions*" (Constantin, 1998).

The term equity is used in the sense that the European citizen should not be disadvantaged, regardless the place he/she lives in the EU. (Adaptation after Bachtler & Yuill, 2001, p. 12)

Table 1. The instruments of regional development policy

Criteria	Classic regional policy	Contemporary regional policy
Basic concepts	Theories on location The key factors are the *characteristics* of the regions (e.g.: production costs, availability of labor, etc.)	Knowledge-based theories The key factors are the *potential* of the regions (e.g. innovation capacity, the ability to form clusters, dissemination networks, new technologies, etc.)
The characteristics of regional policy		
Goal	Equity *or* efficiency	Equity *and* efficiency
Objective	New jobs creation Investments growth	Competitiveness growth (e.g. to encourage the entrepreneurs to develop new business, innovation promotion, to stimulate human factor skills).
Influence area	Restraint (economic/industrial sector)	Extended (multi-sectorial)
Put in practice	Slowly, based on projects	Active, planned, strategic
The structure of regional policy		
Territorial Concentration	Problem-regions	All regions
Analytic basis	Statistic Indicators Regional exports	SWOT Analysis
Key instrument	Financial facilities	Programmes for development
Assistance for:	Companies „hard" infrastructure	Business environment „soft" infrastructure
The organization of regional policy		
Application	From top to bottom - centralized	Collective – based on negotiations
Management	Central administration	Regional authorities
Partners	-	Local authorities, sectors involved, civil society
Operate	Simple – in reasonable terms	Complex, bureaucracy
Project selection	Internal	Participative
Execution term	Carrying out/Finalized	Multi-annual planning
Phases	Ex-post	Ex-ante/intermediary/ex-post
Outputs	Measurable	Difficult to measure

The regional development policy is financed from the EU budget, therefore I shall make an analysis between two financial perspectives, namely the current and the next one.

2. Comparison of EU Budget: The New Financial Framework 2014-2020 vs. the Financial Framework 2007-2013

The New Financial Framework is applicable for a period of 7 years, between 2014 and 2020, and it is the correspondent of the Financial Framework for 2007-2013. It was elaborated for the an enlarged European Union containing 28 member states, taking into consideration Croatia which is supposed to adhere in July 2013.

The deal reached at the European Council limits the maximum possible expenditure of EUR 959.99 billion (in 2011 prices) in commitments, corresponding to 1.0% of the EU's Gross National Income (GNI). This means that the overall expenditure ceiling has been reduced by 3.4% in real terms, compared to the current financial framework (2007-2013). This is the first time that the overall expenditure limit of a financial framework has been reduced compared to the previous one. The ceiling for overall payments has been set at EUR 908.40 billion, compared to EUR 942.78 billion in the 2007-2013.

For the next period, the Commission proposed to bring under a common strategic framework, the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund, together with the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund.

A new element was adopted in the financial framework 2014 – 2020 compared to the current one, namely the extinction of the following instruments outside the agreed financial allocations: the European Development Fund which will finance the development assistance of African, Caribbean and Pacific Group of States (EUR 26,98 billion), for the period 2014-2020; other flexibility instruments which will be mobilized, only in case of emergency, and will enter into the annual EU budget, as follows: Emergency Aid Reserve (it is used to finance the operations of protection and manage the civil and humanitarian crisis, under unforeseen circumstances), European Globalization Adjustment Fund (meant to sustain the redundant workers as consequence of major structural changes of world wide commerce), Solidarity Fund (assures the financial assistance in case of a major disaster in state/candidate country) and Flexibility Instrument (it is mobilized for clearly identified needs that cannot be financed under the multi-annual financial framework).

The New Financial Framework 2014-2020 is structured into five chapters, as follows:

- **Smart and inclusive growth (EUR 450,763 billion)**: composed of Competitiveness for growth and job creation (EUR 125,61 billion) and Economic, Social an Territorial Cohesion (EUR 325,15 billion). The EU leaders agreed on a sustainable growth of the means oriented towards future, as regards research, innovation, education, promotion of economic growth and job creation. For 2014-

2020, the amount was increased by 37% compared to the current allocations. In order to reduce the development disparities between EU regions, it was settled that the poor member states will receive a bigger share from the cohesion policy allocation package compared to the current 2007-2014.

- **Sustainable growth: Natural resources (EUR 373,18 billion).** The Council agreed on some orientation elements for the reform of the Common Agriculture Policy, towards a more ecological agriculture. The subsidies will be distributed more equitable between member states.

- **Global Europe:** The Council decided to extend the role of EU as important actor.

- **Administration:** The EU personnel will be diminished with 5% and their working time will be increased with 2,5 hours/week. The salaries and pensions of EU personnel will be frozen for a two year period and the solidarity tax will be increased from 5,5% to 6%. (ec.europa.eu/budget).

- **Security and citizenship:** the measures include actions regarding asylum, migration, initiatives in the fields of external borders and internal security.

A new budgetary limit was introduced, namely **Compensation** with a view to avoid Croatia to became a net contributor to the EU budget for the first years after its EU integration.

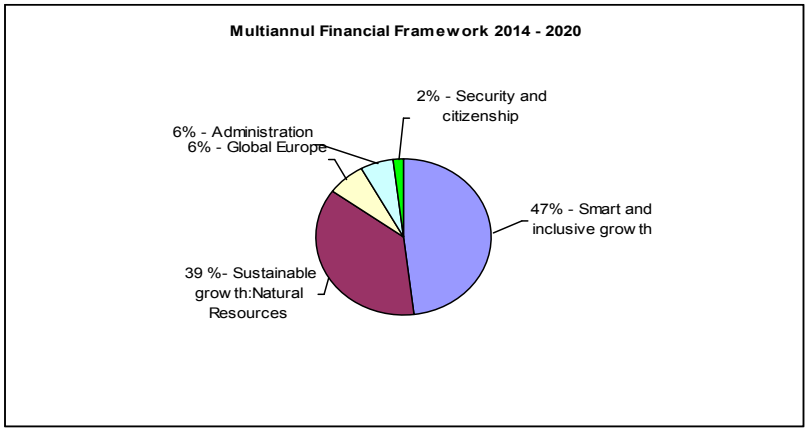

Figure 1. The New Financial Framework

A comparison (in 2011 prices) between The New Financial Framework 2014-2020 vs. the Financial Framework 2007-2013, is presented below: (http://www.consilium.europa.eu/special-reports/mff/summary-of-the-european-ouncil-agreement?lang=ro)

Table 2. A comparison (in 2011 prices) between The New Financial Framework 2014-2020 vs. the Financial Framework 2007-2013

	New Financial Framework **2014-2020**	Financial framework **2007-2013**	Comparison	
Commitment appropriations	billion Euro	billion Euro	Billion Euro	%
1. Smart and inclusive growth	450,763	446,310	+4,45	+1%
1.a Competitiveness for growth and job creation	125,614	91,495	+34,12	+37,3%
1.b Economic, Social an Territorial Cohesion	325,149	354,815	-29,67	-8,4%
2. Sustainable growth: Natural resources	373,179	420,682	-47,5	-11,3%
3. Security and citizenship	15,686	12,366	+3,32	+26,8%
4. Global Europe	58,704	56,815	+1,89	+3,3%
5. Administration	61,629	57,082	+4,55	+8%
6. Compensations	27	na	na	na
Total Commitment appropriations	**959,988**	**994,176**	**-35,19**	**-3,5%**
% of GNI	1%	1,12%		
Total payment appropriations	908,400	942,778	-34,38	-3,5%
% of GNI	0,95%	1,06%		
Emergency Aid Reserve	1,96	1,7	+0,3	15,5%
European Globalization Adjustment Fund	1,05	3,5	-2,5	-70,6%
Solidarity Fund	3,5	7,14	-3,6	-51%
Flexibility Instrument	3,3	1,42	+1,9	+130,9%
European Development Fund	26,984	26,82	+0,2	+0,6%
Total, outside financial framework	**36,794**	**40,67**	**-3,9**	**-9,5%**
Total EU Budget	**996,782**	**1034,85**	**-38**	**-3,7**
% of GNI	1.04%			

As regards Cohesion policy, Romania has allocated, for the New Financial Framework 2014-2020, EUR 21,825 billion, amount which will be indexed by inflation over the 7 year period.

Due to the fact that Romania concluded a financing agreement with the European Union, International Monetary Fund, it will benefit of a pre-financing of 4% from

this amount. Also, the 85% co-financing rate for projects financed by structural funds may reach 95%.

The provisions of the New Financial Framework 2014-2020, related to the financial allocations for Romania, may enter into force after its approval by the European Parliament.

3. Conclusion

To summarize, the study presents the actual stage of research in the field of regional policy instruments, altogether with a brief analysis on the financial allocations from the EU budget in the current period and the next one.

Due to financial crisis and the budgetary constraints, the Commission tries to extent the current financing instruments, such as the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Agricultural Fund for Rural Development, by adding other flexibility instruments, which are outside the agreed financial allocations. Those new instruments can be mobilized by member states, in case of emergency.

The topic of this study is, as follows: to understand the side effects of the European integration; to identify the types of regions at the EU level and the typology of the regional instruments, as result of deepening of the inequalities in relation to economic development of the member states; to analyze the afore-mentioned typologies in different member states; to examine the instruments of regional development policy (classic and contemporary); to pinpoint the differences between the financial framework 2007-2013 and the new financial framework 2014-2020.

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