

# REVIEW OF ECONOMIC AND BUSINESS STUDIES

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RESEARCH ARTICLE

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# GOVERNMENT POLICIES AND MICRO LENDING IN EMERGING MARKETS

Nicolas A. LASH\*, Bala BATAVIA\*\*

**Abstract:** *Although microfinance institutions have expanded rapidly since their inception in 1983, their growth has varied substantially among countries. This study examines the impact of government expenditures, taxes and regulations on the volume of microcredit for 92 emerging market countries for the period 2000-2011. The Index of Economic Freedom data is used as a proxy for government intervention while microcredit is represented alternatively by either the Gross Loan Portfolio Per-Capita or Penetration Index variables. While excessive government intervention could potentially encourage more lending in the informal microfinance markets, our findings suggest that, for both credit variables, the net impact is to reduce microcredit. The variables appearing to be most responsible are business regulations, taxes, and corruption. Tests using subperiods and also with a dynamic version suggest that our model is quite robust.*

**Keywords:** *Microfinance Institutions, Government Regulation, Emerging Markets*

**JEL Classification:** *G21, G28, 016*

## 1. INTRODUCTION

This study analyzes the impact of government macroeconomic policies and regulation on microfinance institution (MFI) lending. More precisely, this study investigates which specific components of government activity and regulations impact MFI lending and whether these effects facilitate or impede lending. As will be discussed, numerous studies have studied the impact of government policies and regulation on MFI sustainability, profitability, operating costs, and outreach.

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This study, which builds upon previous research, instead looks at the impact of government policies and regulations on both the volume of micro lending as measured by the Gross Loan Portfolio Per-Capita (GLP), and also MFI market penetration, i.e., the number of microfinance borrowers per-capita, as estimated by the Penetration Index (PI). Given the importance of MFIs in funding small and medium size enterprises, it is essential for policymakers to know which areas of government activity and regulation nurture, and which deter, micro lending. The analysis is complicated by the possibility that while restrictive regulations might reduce MFI activity, they might also encourage a shift to informal markets – the domain of MFIs.

Our paper is organized as follows: Section 2 discusses the importance of small and medium-sized enterprises, Section 3 introduces our model, Section 4 presents and analyzes our empirical results.

## **2. MICROFINANCE'S CONTRIBUTION TO SMALL AND MEDIUM-SIZED ENTERPRISES**

### **2.1. The importance of small and medium-sized enterprises (SMEs)**

Throughout the globe, small business plays an important role by providing employment and stimulating innovation. In their study of developing countries, Ayyagari et al. (2014) find that small firms create most new jobs and have the highest employment growth. Moreover, while SMEs are sparse among transition countries, in the remaining developing countries, they account for most of the private sector and almost half of total employment. (Ayyagari et al (2007).

Small business entrepreneurship may also foster innovation that Schumpeter (1934) believed was the major engine of economic growth and development. Innovation is increasingly viewed as a major contributor to economic performance, be it at the local or national level (Cumming et al., 2009). Beaugrand (2004, p. 12) asserts that “poor countries should stop concentrating on their traditional activities and... embrace a dynamic approach to economic growth. Development is foremost a process of transformation, or evolution.” He posits that in third world countries innovation is most likely to stem from individual, homegrown small businesses. In such countries, Armendariz and Morduch (2005), de Soto (2000), and Paulson and

Townsend (2004) have found considerable interest in small business. Much of small business entrepreneurship takes place in the informal, non-banking, sector.

## **2.2. Microfinance Institutions (MFIs) and Small Business Entrepreneurships**

Development and expansion of the financial sector, which reduce transactions costs by providing reliable and accessible information, have been found to contribute significantly in raising a country's income level while reducing income inequality (Beck et al., 2007). However, de Soto (2000), Armendariz and Morduch (2005), and Paulson and Townsend (2004) found that funding constraints severely limited small firm creation and expansion. Small firms typically require micro-loans (usually ranging from \$ 50 to \$ 1,000 in emerging markets) to start and expand firms. Unable to secure funding elsewhere, they rely heavily on family and friends. In the U.S., it is estimated that two-thirds of their funding comes from these sources (Paulson and Townsend, 2004). Because of the high risk of unsecured loans and high operating costs of underwriting small loans particularly to those in rural areas, mainstream lending institutions, such as commercial banks, have typically avoided small loans to small firms.

To meet this demand, beginning with 1983, microfinance institutions (MFIs) were established when Muhammad Yunus and Grameen Bank in Bangladesh lent the equivalent of \$ 27 of their own money to a group of 42 women from villages. A startling result was the 100% repayment rate which triggered the global adoption of Grameen's practice of group lending or joint liability. Group lending has been credited for severely reducing both adverse selection and moral hazard risk thereby leading to lower risk premiums and loan rates. This success has led to an explosion of micro-lending. "If the growth of microfinance has demonstrated nothing else, large numbers of low-income borrowers can be served while achieving a remarkably high level of repayment. Billions of dollars in loans to more than two hundred million borrowers are outstanding, and data from top lenders show that that only 2-3 % of those are delinquent in recent years." (Cull et al 2014 p.2). Yet, despite this rapid growth of microfinance, Crabb (2008) cites estimates that there are at least 1 billion potential customers that have yet to be served.

The rapid growth of the MFI sector reflects the existence of the large role played by bottom-up, informal finance in the third world. For example, de Soto

(1989) found that in Peru 48 % of the economically active population, 60 % of all work hours, and 38.9 % of GDP emanated from the informal sector. Research in Latin America, Asia, and Africa also point to a very large informal sector (Woller and Woodworth 2001). Moreover, Vanroose (2008) has observed that MFI expansion has been much more extensive in some countries than others. Honohan (2004) finds that microfinance development in the last couple of decades has been concentrated in a few large institutions in a few countries.

### **3. THE IMPACT OF GOVERNMENT POLICY AND REGULATIONS ON MFI LENDING**

#### **3.1. Government policy in microfinance**

MFIs' rapid expansion has turned increasing attention to appropriate government policy and regulations. In particular, there has been rising interest in increasing MFI regulations and supervision. Governments have attempted for some time to support financial enterprises and reduce poverty through development banks, directing lending requirements for commercial banks and grants to NGOs, but generally without much success. "These efforts failed due, in large part, to low repayment rates, politically-motivated loan write-offs, and capture of subsidized credit by wealthy farmers." (Hubka and Zaidi (2005: 7). For example, in his study of Asian MFIs, McGuire (1999:721) observed that "India, Indonesia, Pakistan, Sri Lanka and Thailand all have unsustainable and / or unsuccessful mass programs, operated either through banks or by government agencies." In fact, Bird et al (2011) have found that government programs and regulations in Thailand have basically eliminated all private MFIs.

In addition, not only were development banks unsuccessful in attaining their objectives, but their activities also increased income inequality and hindered the development of rural financial markets. (Gonzales-Vega 1977; Adams et al 1984) In the same vein, government-sponsored MFIs likely would enjoy subsidized funding that would result in a competitive advantage that could crowd out other MFIs. Governments can also provide direct support to private MFIs but there would be the potential danger that such support could have political strings attached. Consequently, Hubka and Zaidi (2005:1) suggest that "ideally

governments should exit the microfinance sector.” Otherwise, they suggest that government-sponsored MFIs disclose their budgets and also lend only at market rates. They further recommend significant reductions or even elimination of prudential regulations for credit-only MFIs. The authors instead call upon governments to focus on providing constructive environments characterized by macroeconomic stability and developed infrastructure that reduce information and transactions costs, particularly in rural areas. Schreiner and Colombet (2001 and Yaron and McDonald (1997) also find infrastructure to be important for MFIs. Hubka and Zaidi further advocate the improvement of property rights including registration of assets especially for the poor.

### 3.2. Regulations

Traditionally, MFIs have been subject to less regulation than institutions in the formal banking sector. Yet, given the rapid growth of microfinance and also the expansion of some MFIs into deposit taking, there has been an increased call for more regulations (Cull et al 2011). Currently, many MFIs face both prudential and non-prudential regulation. Prudential regulations and supervision are imposed to promote safety for depositors but are irrelevant for the large majority of credit-only MFIs. These regulations are also designed to protect the financial system as a whole, but while they may be critical for large financial institutions, they are far less applicable for the majority of MFIs, who, because of their modest size, pose little systemic risk. Consequently, Hubka and Zaidi (2005), Hartarska and Nadolnyak (2007) among others, advocate the elimination of prudential regulations for MFIs.

**Non-prudential regulations already exist for many MFIs that, in addition to entry regulation also govern their operations and include issues such as consumer protection, fraud prevention, credit information services, interest rate limits, accounting requirements and foreign ownership limitations** (Christen et al. 2000). Whatever their benefits, regulations, particularly prudential regulations, can result in very high costs especially for MFIs. In the US, regulatory costs are estimated around 12%-13% of the banks’ non-interest expenses (Thornton 1993; Elliehausen 1998).

As Cull et al (2011) suggest, the costs could be significantly higher for MFIs who lack the size to exploit economies of scale. For inexperienced MFIs, the

startup costs can be even higher. Christen and Rosenberg (2003) estimate the cost for MFIs at 5 % of the assets in the first year and 1 % or more afterwards. In addition, regulations require compliance which, in turn, require skilled, and therefore, expensive labour. Given that Morduch (2000) estimates that only 1 % of MFIs are financially self-sufficient, the impact of any such cost increase could have major adverse effects.

MFIs react by raising loan rates to pass onto borrowers some of the high costs of regulations (Ahlin et al 2010). Given the capital scarcity in many third world countries, higher rates might still be affordable for borrowers and are highly likely to be lower than those of alternative credit sources, such as money lenders. Cull et al (2006) found that up to a point MFIs charging higher loan rates had higher profits. Yet, government-imposed interest rate ceilings combined with high regulatory costs could adversely affect MFIs. Moreover, MFIs have been found to react to interest rate ceilings by increasing loan size thereby lending more to better-off customers at the expense of low-income borrowers including women (Cull et al, 2011; Cull et al 2009). Thus, interest rate ceilings that are imposed to benefit the poorest of borrowers actually have the opposite effect. Interest rate ceilings can also shrink the total amount of micro loans.

Sometimes, regulations also include directed lending, or policy loans, but this could result in lower MFI profits and, as discussed previously in the example of development banks, it causes resource misallocation. There are yet other problems posed by regulations. It has been found that corruption is associated with the degree of regulation (Holcombe and Boudreaux 2015, Lash and Batavia 2013; Elliot 1997). Bribes are sometimes a useful means of avoiding onerous regulations. Numerous studies, such as Manzetti and Blake (1996), found that extensive government control and regulation provide an environment ripe for corruption. Hartarska and Nadolnyak (2007) point to the danger of regulatory capture whereby regulated MFIs may support government measures to keep out potential competitors. For example, in the U.S., community banks were alleged to have lobbied successfully previously to limit branching for precisely this reason.

However, another way that regulations can impede microfinance is by making it more difficult for MFIs and small businesses alike to open a business. The World Bank, in its annual series of *Doing Business* analyses the impact of government laws and regulations on the establishment, management and termination of businesses.

Such constraints have been found to impede entrepreneurship (Fonseca et al 2001) and so could reduce the demand for MFI loans.

#### **4. GOVERNMENT INFLUENCES ON MICROCREDIT IN EMERGING MARKETS**

##### **4.1. The Gross Loan Portfolio Per-capita (GLP) and Penetration Index (PI) variables**

Despite the trend by MFIs to increasingly provide more deposit and insurance services, lending still dominates MFI lending and so is the focus of this study. One direct measure is Gross Loan Portfolio Per-capita (GLP), where GLP is defined as “outstanding principal for all loans, including current, delinquent and restructured loans, but not loans that have been written off” (Mix Market 2013). Another measure is the Penetration Index (PI) which is the ratio of borrowers to the size of the population. Krauss et al (2012) point out that the PI is frequently considered as one of core performance indicators for the state of the microfinance industry though a standard definition has yet to be adopted.

The GLP variable directly measures the amount of funding made available whereas the PI may be a better measure of outreach. Krauss et al (2012) point out that the PI may sometimes overstate MFI lending because some borrowers who borrow from more than one institution may be double counted. Unlike the PI, GLP incorporates average loan size. In our tests, we will use both GLP and PI as dependent variables to measure MFI lending. The correlation between these somewhat similar measures is 0.694.

##### **4.2. GLP AND PI: Regional Distribution of MFI Lending**

As cited earlier, MFI lending varies substantially throughout the world (Table 1). We divided the 92 economies into the following five groups: Latin America, Asia and the Pacific, Eastern Europe and Central Asia, North Africa and the Middle East, and Sub-Saharan Africa. While microcredit has an important role to play in all economies, we narrow our focus to emerging economies where the attack on poverty is most critical. Hence, in our sample we do not include wealthy, advanced countries (i.e. Western Europe is excluded altogether).

Table 1 shows that both the Eastern Europe and Central Asia region and the Latin America region have over six times the average GLP of both the North Africa and the Middle East region and the Sub-Saharan Africa region. In the Middle East and North Africa, the Arab Spring of 2010 has caused severe disruptions to MFIs in terms of staffing, lending and loan collection (Djre et al, 2011). Sub-Saharan Africa's relatively small amount of loans may be attributable to it having the lowest per capita income of all the regions. Table 1 also shows that North Africa and the Middle East, along with Sub-Saharan Africa, have standard deviations that are only about one-sixth of the other three regions. This suggests that, in terms of loan size per capita, the countries of these two regions are decidedly more homogenous in MFI lending, as measured by GLP, than the other three regions.

**Table 1** *Distribution of Gross Loan Portfolios Per-capita (GLP) by Region, 2000-2011*

<b>Regions</b>	<b>Average Gross Loan Portfolios per capita GLP</b>	<b>Standard deviation</b>
Latin America	30.06	30.6
Asia and the Pacific	16.17	34.97
Eastern Europe and Central Asia	34.97	37.39
North Africa and Middle East	4.64	5.39
Sub-Saharan Africa	4.26	5.73

*Source:* Mix Market

Table 2 presents the PI which uses the per capita numbers of borrowers' to measure MFI activity. The ranking changes somewhat but the Asian and Latin American regions continue to rank high while Sub-Saharan Africa remains at the bottom. Asia clearly dominates the other four regions in outreach with over 85 % of its loans to women and over 75 % to rural borrowers (Microfinance Information Exchange 2013). In sharp contrast, the Eastern Europe and Central Asia region is the only region with less than 50 % women borrowers. Furthermore, the loans of both North Africa and the Middle East (34 %) and Latin America (27 %), have far fewer loans to rural borrowers than the other three regions (Djre et al, 2011). As measured by the standard deviation, Sub-Saharan Africa and North Africa and the Middle East again have the greatest homogeneity.

**Table 2** *Distribution of Penetration Index (PI) by region in the period 2000-2011*

<b>Regions</b>	<b>Average Penetration Index*100 PI</b>	<b>Standard deviation</b>
Latin America	2.200	2.204

<b>Regions</b>	<b>Average Penetration Index*100 PI</b>	<b>Standard deviation</b>
Asia and the Pacific	4.190	4.358
Eastern Europe and Central Asia	1.763	2.396
North Africa and Middle East	1.79	1.216
Sub-Saharan Africa	0.841	0.749

Source: Mix Market

### 4.3. GLP AND PI: Per capita income distribution of MFI Lending

We also divided the 92 economies into three income groups: upper-middle, lower-middle and low-income. We excluded the high-income group for the same reason we omitted Western Europe, namely that our focus is on emerging economies. The economies are divided according to 2012 per capita gross national income. As defined by the World Bank, the groups are: low-income (\$ 1,035 or less). lower-middle income (\$ 1,036-\$ 4,085); uppermiddle income (\$ 4,086-\$12,615) and highincome (\$ 12,616 or more). Among the income groups, Table 3 shows that the lower-middle Income group has approximately three times the GLP of both the upper-middle income and low-income groups. Conceivably, this may reflect that the upper-middle income group, because of its relatively high income, has relatively better developed financial systems so that the need for informal finance is less critical. As for the low-income group, there may be some threshold level of infrastructure necessary before micro lending can truly hit its stride. Yet, it may be difficult to generalize too much about individual economies in the upper-middle income group as it clearly has the largest standard deviation.

**Table 3** *Distribution of per capita gross loan portfolios (GLP) by income in the period 2000-2011*

<b>Income Group</b>	<b>Average Gross Loan Portfolios Per capita GLP</b>	<b>Standard deviation</b>
Upper-Middle Income	11.048	14.57
Lower-Middle Income	29.79	33.54
Low-Income	9.53	23.66

Source: World Bank, Mix Market

Table 4 suggests that for PI, the difference in income groups is less pronounced than for GLP and also that the lower the per-capita income of a region, the higher the number of borrowers. Comparing the GLP and PI measures for the different income groups shows that the low-income group has the smallest average loan size perhaps

signifying that there is less money to lend. Interestingly, whereas the low middle-income group has the largest standard deviation in terms of GLP, it has the lowest in terms of PI, thereby, reflecting a large standard deviation in loan size.

**Table 4** *Distribution by Income of Penetration Index (PI) in the period 2000-2011.*

<b>Income Group</b>	<b>Average Penetration Index*100 PI</b>	<b>Standard deviation</b>
Upper-Middle Income	1.70	2.60
Lower-Middle Income	1.83	1.90
Low-Income	2.26	3.27

*Source:* World Bank, Mix Market

#### **4.4. Independent Variables: Per capita Income and Economic Freedom Variables**

As we have seen in the above section, there appears to be a relationship between per capita income and MFI lending. Per capita income has figured prominently in a number of studies on MFIs. Vanroose (2002) found that microfinance has greater outreach in regions with high per capita income. In contrast, Honohan (2004) found that higher per capita income was associated with lower microcredit penetration. Given the above evidence, we wish to investigate the impact of per capita income on MFI lending as measured by the GLP and PI measures.

In our tests for government economic intervention we also utilize nine variables from the Heritage Foundation's Index of Economic Freedom (IEF). The IEF measures the degree to which markets are free from government intervention. One of the most controversial issues in finance and economics regards the optimum level of, or freedom from, government intervention and regulation. For example, in their literature review of 198 studies employing the Economic Freedom Index of the World as an independent variable, Hall and Lawson (2014) find that over two-thirds of these studies found positive outcomes such as faster growth and higher income levels and less than 4 % found negative outcomes such as increased income inequality.

This study leaves aside this important policy issue and focuses solely on whether, and how, government intervention influences MFIs. The IEF ranges from 100 (free) to 0 (repressed). We dropped the labour variable due to a lack of data prior to 2005. We use the following nine remaining IEF variables: business

freedom, trade freedom, fiscal freedom, government spending, monetary freedom, investment freedom, financial freedom, property rights and freedom from corruption.

Hermes and Meester (2011) have pointed out that the effect of macro variables upon MFI growth and development is not unambiguous. Accordingly, in introducing IEF variables it is important to note that their potential impact on MFI lending is not obvious. On the one hand, greater freedoms should establish an environment that would stimulate entrepreneurship and microfinance lending. On the other, less freedom while oppressing business development might divert more to a less regulated, informal sector such as the microfinance market. That is, there may be a countervailing effect.

1. **Business freedom** is based on the World Bank's annual reports of Doing Business and measures the ability to establish, manage and terminate a business unfettered by excessive government requirements, such as licensing and environmental, consumer safety and other regulations. In many countries, particularly those in the developing world, engaging in business requires numerous licenses and permits. A lack of such freedom could curb entrepreneurship and thus reduce the demand for funding from MFIs. However, it is also possible that too many restrictions could drive businesses underground where MFI funding would be available (e.g., Ahlin et al (2008)).
2. **Trade freedom** refers primarily to the absence of tariff and nontariff barriers. There are a number of restrictions that governments impose on international trade. Crabb (2008) found that less trade freedom is associated with greater MFI sustainability.
3. **Fiscal freedom** reflects freedom from fiscal burdens both in tax rate progressivity and also tax revenue as a percent of GDP. Less fiscal freedom might curb business growth and development as pointed out in the World Bank's Doing Business 2013 and thus have a negative impact on MFI lending (Fisman and Svensson, 2007). Despite this, microfinance customers could be small enough that they could avoid some taxes. If so, a heavy tax burden in the larger, more visible organized sector could divert more activity to the microfinance market.
4. **Government spending** measures government consumption and transfers as a percentage of the economy and also government ownership of business and industries. For most governments, expenditure data includes local as well as federal government. Government spending could crowd out private markets

including those in the informal sector. Crabb's results (2008) are consistent with this view. On the other hand, some government spending could be spent on infrastructure which could improve access to rural microenterprises. Hubka and Zaidi (2005) who generally are quite critical of government intervention point out that are examples of positive effects from government microfinance such as Thailand's Bank for Agriculture and Agriculture Cooperatives. Furthermore, some government spending (e.g.: Bangladesh) has been utilized to fund MFIs (McGurie 1999).

5. **Monetary freedom** combines measures of price stability with the absence of price controls. Numerous studies, including Goldfajn and Rigobon (2000), Rhyne (2001), Vander Weele and Markovich (2001), Cull et al (2011), point out the harmful effects of inflation on financial and MFI development. In contrast, Hartarska and Nadolnyak (2007:1217) found that "MFIs seem to have developed sufficient safeguards and perform successfully in highly inflationary environments." Ahlin et al (2010) drew a similar conclusion though Vanroose (2008) did not find any statistically significant impact.
6. **Investment freedom** refers to the absence of restrictions on capital flows, particularly foreign. There are numerous impediments for foreign business such as investment codes, unequal treatment under the law, and restrictions on investment, land ownership, and earnings repatriation. MFIs could be adversely affected by curbs on foreign equity holdings.
7. **Financial freedom** measures the degree of independence from government ownership and financial regulation including selective credit controls. Such freedom could provide an environment that would encourage entrepreneurship and financial development, in both the formal and informal markets. Crabb's results (2008) are consistent with this view. This also could be a case where financial constraints in the most visible sector would divert funding to the MFI sector.
8. **Property rights** measures freedom from government influence over judicial decisions. The IEF measure includes legally and protected private property, commercial codes defining contracts, and unbiased enforcement. It also assesses the likelihood of government expropriation of private property. The importance of private property rights has been emphasized by Hayek (1944) and de Soto (2000). Buckley (1997) has pointed out that the absence or weakness of property rights has been a major impediment to enterprise activities in Africa. However, while the above would imply that a lack of property rights would adversely affect MFIs, it has been pointed out by de Soto (2000) that

unreasonably time-consuming property registration procedures can drive business underground (, possibly to the MFI market). In addition, Hermes and Meesters (2011) failed to find any significant statistical relationship between rule of law and the cost-efficiency of MFIs, while Crabb (2006) did not find a relationship between property rights and MFI sustainability.

9. **Freedom from corruption** is derived primarily from Transparency International’s Corruption Perceptions Index which measures the level of corruption for various countries. The highest possible score is 100, indicating a very clean government with little corruption to 0 reflecting a highly corrupt government. Corruption can impede economic development (Lash 2000) and can also impede small and medium-sized enterprise growth (Fisman and Svensson, 2007) and thus reduce demand for MFI services. Ahlin et al (2011: 115) found evidence suggesting that corruption may impede MFIs “at least to start-up if not to subsequent growth.” On the other hand, corruption may result in the countervailing effect, that is, businesses moving into the informal market thereby increasing demand for MFI services. However, neither Crabb (2008), nor Hermes and Meesters (2011) found corruption to have a statistically significant impact on MFI performance.

## 5. EMPIRICAL RESULTS

### 5.1. The Impact of Government Policies and Regulation on MFI Lending

Our study used cross-section, annual data for 92 countries for the period 2000-2011. Although this sample had a potential maximum of 1104 data points, missing data for some countries resulted in a sample size of 846 observations. Table 5 presents the descriptive statistics for all of the variables. We note that the dependent variables, GLP and PI have large coefficients of variation relative to the explanatory variables excepting GDP per-capita. The regression model will investigate to what degree this variation in microcredit can be explained by GDP per-capita and IEF’s economic freedom variables.

**Table 5** *Descriptive statistics: Annual data 2000 to 2011 for 92 countries, for GDP per-capita and Economic Freedom Variables*

Variable	N	Average	Standard Deviation	Coefficient Of Variation
Corruption	846	29.119	11.711	0.402

Variable	N	Average	Standard Deviation	Coefficient Of Variation
Business freedom	846	58.264	11.690	0.201
Trade freedom	846	66.626	13.303	0.200
Fiscal freedom	846	76.440	9.7485	0.128
Government spending	846	76.443	16.251	0.213
Monetary freedom	846	73.238	10.890	0.149
Investment freedom	846	48.203	16.162	0.335
Finance	846	47.638	15.601	0.327
Property rights	846	36.578	14.309	0.391
Per capita GDP	846	1749.70	2002.600	1.145
Per capita Gross Loan Portfolio	846	18.038	39.794	2.206
Penetration Index	846	1.5028	2.350	1.564

Sources: Annual Reports: World Bank, Heritage Foundation's Index of Economic Freedom, Mix Market

In our first test, we regressed the gross loan portfolio per capita variable (GLP) upon GDP per capita and nine components of the IEF excluding, as explained previously, the labour freedom measure. Only the monetary freedom variable, which is closely related to inflation, was found to be insignificant. This result is consistent with Vanroose's findings (2008), but at odds with those who found inflation to be harmful (Rhyne (2001), Vander Weele and Markovich (2001)) and those who found it to be beneficial (Crabb (2008) and (Hartarska and Nadolynyak (2007))).

We then ran a second set of regressions omitting the monetary freedom (inflation) variable and the results are presented in Table 6.  $R^2$  was 0.24 and seven variables were statistically significant at the 1 % level, while corruption and investment freedom were significant at the 5 % and 10 % level respectfully. Six explanatory variables (business freedom, fiscal freedom (from taxes), financial freedom, freedom from corruption, investment freedom and trade freedom) had positive signs (higher IEF values) suggesting that less government intervention, lighter regulation, less corruption, and lower taxes provide a business-friendly environment that encourages MFI lending. Our finding for the business freedom variable supports the World Bank's (2013) thesis that regulations can discourage business development and is also consistent with Crabb's (2008) results. Our results that taxes discourage MFI lending are consistent with Fisman and Svensson (2007). Our findings that corruption impairs MFI lending conflicts with those of

Crabb (2008) and Hermes and Meesters (2011) but is consistent with those of Fisman and Svensson (2007) and also Ahlin et al (2011). In addition, our result that trade freedom has a beneficial effect on MFI lending contrasts with Crabb (2008) who found it reduced MFI sustainability.

**Table 6** *Regression of per capita Gross Loan Portfolio (GLP) on per capita Income and Index of Economic Freedom Variables for 92 Countries in the period 2000-2011*

<b>Economic freedom and GDP Variables</b>	<b>Coefficient</b>	<b>t-ratio</b>
Business freedom	0.59	4.61
Fiscal freedom	0.68	5.16
Government	- 0.38	4.85
Financial freedom	0.43	4.35
Property rights	- 0.87	7.27
Freedom from corruption	0.35	2.28
Investment freedom	0.17	1.78
Trade freedom	0.55	5.35
Per capita GDP	0.3	4.24
Constant	-77.67	6.12

$$R^2 = 0.24$$

*Source:* Annual Reports from the World Bank, Heritage Foundation's Index of Economic Freedom, Mix Market

In our analysis, property rights, government spending and per capita GDP had negative signs, suggesting that MFI lending benefited from weak property rights, more government spending, and a lower income population. We find the negative sign of the property rights variable counter-intuitive as it contrasts with Hayek (1944) and Buckley (1997). A possible explanation might be the countervailing effect that an environment with weak property rights diverts businesses to the more informal, microfinance sector as De Soto (2000) has suggested. Our finding that more government spending encourages MFI lending may reflect governments providing MFI subsidies and building infrastructure. Spending on the road and transportation systems could allow financial institutions to reach rural communities. On the other hand, government spending may crowd out some private business activity and move such SMEs into informal markets where the MFIs operate. The negative relationship with per capita GDP is similar to Honohan's findings (Honohan, 2004:6): "The results are consistent with the idea that the presence of a market for microfinance (e.g. many poor people) and good country institutions help the microfinance industry grow."

With PI as the dependent variable we first ran a regression, removed the insignificant variables, and then ran a second regression (similar to the GLP tests. Table 7 shows that the PI results had less explanatory power than the GLP model as the  $R^2$  dropped from 0.24 to 0.14. Moreover, only seven, rather than nine, independent variables were statistically significant. The corruption and financial freedom variables were statistically significant at the 5 % level while the five (five what? the noun is missing!), including the monetary freedom variable, insignificant in the GLP tests, were significant at the 1 % level. Thus, price stability appears to have little impact on MFI loan volume, but results in a larger number of borrowers. The low nominal interest rates that normally accompany low inflation may be more important for borrowers (i.e. small entrepreneurs and farmers) than for lending institutions. In other words, borrowers may be more susceptible to money illusion than lenders. While the signs of the coefficients for four variables were the same as those in the GLP regressions, three variables (government spending, investment freedom and trade freedom) were statistically insignificant. Otherwise, the results are consistent with those for the GLP and suggest that MFI lending is enhanced by weak poverty rights, but repressed by regulatory constraints on business and financial activity, high taxes, and corruption. These results build upon the findings of other studies which were reported in section 4.4.

**Table 7** *Regression of Penetration Index (PI) on per capita income and Index of Economic Freedom Variables for 92 Countries for the period 2000-2011*

<b>Economic freedom and GDP Variables</b>	<b>Coefficient</b>	<b>t-ratio</b>
Business freedom	0.03	3.40
Fiscal freedom	0.05	6.08
Monetary freedom	0.02	2.94
Financial freedom	0.02	2.51
Property rights	- 0.04	5.91
Freedom from corruption	0.02	2.28
Per capita GDP	- 0002	4.56
Constant	- 4.83	6.96

$R^2 = 0.14$

*Source:* Data from annual reports from the World Bank, the Heritage Foundation's IEF and Mix Market

## 5.2. Robustness Check

Since our model covers 11 years, including the financial crisis period of 2007-2008, we wished to investigate the stability of our model for the entire period. To do so, we employed a dynamic model to control for the influence of previous values of our dependent variables, GLP and PI. The empirical results are provided in Tables 8 and 9. For both the GLP and PI models, the results are very similar to the original tests which did not include the lagged values presented in Tables 6 and 7. All the independent variables have the same signs and same levels of statistical significance. The lagged values for both GLP and PI are significant at the 1 % level. These findings suggest that the model is robust for the period considered.

**Table 8** *Regression of per capita Gross Loan Portfolio (GLP) on per capita Income, Index of Economic Freedom Variables and lagged GLP for 92 Countries for the period 2000-2011*

<b>Economic Freedom and GDP Variables</b>	<b>Coefficient</b>	<b>t-ratio</b>
Business freedom	0.58	4.65
Fiscal freedom	0.65	5.04
Government	- 0.31	3.97
Financial freedom	0.46	4.62
Property rights	- 0.82	6.87
Freedom from corruption	0.31	2.06
Investment freedom	0.16	1.65
Trade freedom	0.52	5.13
Per capita GDP	00.3	4.26
Lagged GLP	0.14	4.43
Constant	- 82.64	6.55

$R^2 = 0.25$

Sources: Data from annual reports from the World Bank, the Heritage Foundation's IEF and Mix Market

**Table 9** *Regression of Penetration Index (PI) on per capita income, Index of Economic Freedom Variables and lagged PI for 92 Countries for the period 2000-2011*

<b>Economic freedom and GDP Variables</b>	<b>Coefficient</b>	<b>t-ratio</b>
Business freedom	0.03	3.38
Fiscal freedom	0.05	6.46
Monetary freedom	0.02	2.94
Financial freedom	0.01	2.44
Property rights	- 0.04	5.66
Freedom from corruption	0.02	2.23

<b>Economic freedom and GDP Variables</b>	<b>Coefficient</b>	<b>t-ratio</b>
Per capita GDP	- 0002	4.77
Lagged PI	0.11	3.27
Constant	- 5.07	6.26

$$R^2 = 0.15$$

*Sources:* Data from annual reports from the World Bank, the Heritage Foundation's IEF and Mix Market

### **5.3. Impact of the Financial Crisis**

Although it had been believed that MFIs were largely sheltered from international and domestic economic shocks, the financial crisis beginning in late 2007, triggering the great recession of 2008, was severe enough to sharply reduce the growth of the microcredit throughout the world (Di Bella 2001). Hence, we further explored the impact of the financial crisis and its aftermath (2008-2011) upon our two lending models. Given the shortness of the time period, especially 2008 to 2011, our results should be interpreted with caution. Nonetheless, the results suggest only minor differences from the results of our previous tests (Tables 10-13).

Of the independent variables, GLP has 7 of 9 and PI has 6 of 7 that retain the same signs and are statistically significant at levels varying from 1 % to 10 % for both periods. There is some variability, however, in the significance levels between the two periods. For GLP (Tables 10 and 12), the exceptions to the findings of the original model are for investment which is statistically insignificant in both periods, corruption which is insignificant in the first period, and trade which becomes insignificant in the second period. Given the sharp reduction in global trade and investment during the crisis, it may not be surprising that there was a weakening of some relationships for loan volume (GLP). Tables 11 and 13 show that for PI, business freedom is insignificant in the first period. It is puzzling that corruption is significant for PI in the first period but insignificant in the second period, while for GLP the results for corruption are precisely the opposite. Perhaps some of these discrepancies may be partially explained by the shortness of the time framework. Nonetheless, our findings point overall to the robustness of our model and, given the severity of the crisis, we might have anticipated an even greater impact on our model.

**Table 10** *Regression of per capita Gross Loan Portfolio (GLP) on per-capita income and Index of Economic Freedom Variables for 92 Countries for the period 2000-2007*

<b>Economic freedom and GDP variables</b>	<b>Coefficient</b>	<b>t-ratio</b>
Business freedom	0.19	1.76
Fiscal freedom	0.37	3.97
Government	- 0.23	3.94
Financial freedom	0.37	5.36
Property rights	- 0.49	5.84
Freedom from corruption	0.15	1.48
Investment freedom	0.05	0.70
Trade freedom	0.27	3.78
Per capita GDP	0.001	2.37
Constant	-32.31	3.42

$R^2 = 0.21$

Source: Annual Reports: World Bank, Heritage Foundation's Index of Economic Freedom, Mix Market

**Table 11** *Regression of Penetration Index (PI) on per capita Income and Index of Economic Freedom Variables for 92 Countries: 2000-2007*

<b>Economic freedom and GDP variables</b>	<b>Coefficient</b>	<b>t-ratio</b>
Business freedom	0.01	0.10
Fiscal freedom	0.04	4.34
Monetary freedom	0.02	3.10
Financial freedom	0.01	1.99
Property rights	-0.03	3.50
Freedom from corruption	0.02	2.05
Per capita GDP	-0.000	3.52
Constant	- 3.14	3.66

$R^2 = 0.11$

Source: Annual Reports: World Bank, Heritage Foundation's Index of Economic Freedom, Mix Market

**Table 12** *Regression of per capita Gross Loan Portfolio (GLP) on per capita income and the Index of Economic Freedom Variables for 92 Countries for the period 2008-2011*

<b>Economic freedom variables</b>	<b>Coefficient</b>	<b>t-ratio</b>
Business freedom	0.72	2.77
Fiscal freedom	0.98	2.68
Government	-0.59	3.13
Financial freedom	1.17	3.98
Property rights	-1.57	3.88
Freedom from corruption	1.23	2.10
Investment freedom	0.30	1.26
Trade freedom	0.02	0.06

<b>Economic freedom variables</b>	<b>Coefficient</b>	<b>t-ratio</b>
Per capita GDP	0.005	2.90
Constant	- 86.47	2.49

$R^2 = 0.28$

*Source:* Annual Reports: World Bank, Heritage Foundation's Index of Economic Freedom, Mix Market

**Table 13** *Regression of Penetration Index (PI) on per capita income and Index of Economic Freedom Variables for 92 Countries for the period 2008-2011*

<b>Economic freedom variables</b>	<b>Coefficient</b>	<b>t-ratio</b>
Business freedom	0.04	3.14
Fiscal freedom	0.06	3.09
Monetary freedom	0.04	2.00
Financial freedom	0.03	2.08
Property rights	- 0.05	2.59
Freedom from corruption	0.02	0.53
Per capita GDP	- 0002	2.73
Constant	- 7.52	3.80

$R^2 = 0.18$

*Source:* Annual Reports: World Bank, Heritage Foundation's Index of Economic Freedom, Mix Market

## 6. SUMMARY AND CONCLUSIONS

Despite the rapid growth of MFIs and their extensive outreach, one billion people are still underserved (Crabb 2008). Moreover, the growth and development of MFIs globally has been very uneven. Thus, there is a very important need for governments to undertake appropriate policies and regulatory measures that support, rather than discourage, MFI development. In sharp contrast to past statist policies, microfinance emphasizes a bottom-up, market orientation. Numerous past studies cited previously found that regulation can be costly for MFIs given that the vast majority are not financially self-sufficient. Thus, much of the literature cited previously suggests that excessive regulations can impede both entrepreneurial development and micro lending. Moreover, for the majority of small, credit-only MFIs, a case may be made for the complete elimination of costly prudential regulations. Nonetheless, plausibly corruption, inflation, taxes, and some regulations could actually trigger a countervailing incentive for businesses to shift to informal markets which are the domain of MFIs.

The goal of our study has been to identify which regulations along with factors such as government spending, taxes, corruption, property rights, inflation and regulation have a significant impact on microcredit as measured both by the per capita Gross Loan Portfolio (GLP) and the Penetration Index (PI). We were further interested in determining whether these factors would reduce or expand microcredit.

Our empirical results, based on the observations for 92 countries for the 2000-2011 period, find that taxes, corruption, inflation, and regulations on business, finance, investment and trade reduce MFI micro loans. These findings suggest that the direct impact of regulatory and other government policies in impeding MFI lending swamps any countervailing indirect effect of driving businesses into the informal credit market. In our results, an exception may be that weak property rights encourage MFI lending. It is worth remarking also that when we test our model using a dynamic version, splitting the time framework in two subperiods (to account for the financial crisis), the results are very robust.

To conclude, our findings suggest that government policies can play a positive role through well-designed government expenditures, such as on improving infrastructure, maintaining price stability and implementing strong anti-corruption programs. In addition, business and financial regulations should be subject to rigorous cost-benefit analysis to remove unnecessary burdensome regulations, thus following the advice provided by the World Bank (2004: xv), namely that “good regulation does not mean zero regulation.... The optimum amount of regulation is not none, but may be less than what is currently found in many countries, and especially poor ones...” This would appear to be especially true for micro financial institutions.

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# MEASURING FINANCIAL DISTRESS AND PREDICTING CORPORATE BANKRUPTCY: AN INDEX APPROACH

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**Abstract:** *In this paper, we follow Anderson et al. (2009) and suggest a simple approach to employ a set of financial ratios as inputs to estimate an aggregate bankruptcy index (ABI). This index is a within sample measure, ranges between 0 and 1, and ranks the firms on the basis of their relative financial distress. ABI can be used to predict the propensity of financial failure and corporate bankruptcy. For the purpose of comparison and assessment of the robustness of this index, we estimate Z-score by multivariate discriminant analysis, using the same set of financial ratios to compare the predictive accuracy of two approaches.*

*We find that, to some extent, ABI can predict the bankruptcy of the firms more accurately than Z-score. The empirical results of the paper suggest that ABI has relatively robust predictive power and, therefore, can be applied together with other, based on parametric and non-parametric models to predict corporate bankruptcy.*

**Keywords:** *corporate bankruptcy prediction, financial distress, aggregate bankruptcy index*

**JEL Classification:** *G33, M41*

## 1. INTRODUCTION

During the last six decades and following the seminal papers by Beaver (1968) and Altman (1968), a voluminous body of literature has been developed in finance and accounting to measure financial distress and to predict the bankruptcy of the firm (i.e., Altman, 1968; Beaver, 1968; Altman, 1973; Altman et al., 1977; Jones, 1987; Altman et al., 1994; Mensah, 1984; Scott, 1981; Zmijewski, 1984;

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Hillegeist et al., 2004; Jones and Hensher, 2004; Beaver and McNichols, 2005; Altman and Branch, 2015; see also Bellovary et al., 2007 for a review of studies on the topic). In a notable portion of these studies, the authors utilize, in general, parametric-based and/or non-parametric-based methodologies.

In his seminal work, Altman (1968), developed a multivariate discriminant analysis (MDA) to analytically enhance the quality of financial ratios analysis to predict corporate bankruptcy. We label this approach and any statistical variations derived from it as *parametric* (e.g., MDA: Altman, 1968, 1973; conditional logit analysis: Ohlson, 1980; logit model and mixed logit model: Johnson and Melicher, 1994; probit Model: Lennox, 1999; hazard model: Shumway, 2001; mixed logit model: Jones and Hensher, 2004; market-based and accounting-based: Agarwal and Taffler, 2008; logistic regression: Premachandra et al., 2009; hybrid bankruptcy prediction model: Li and Miu, 2010; multi-period logistic model: Topaloğlu, 2012; dynamic logit models: Hwang et al., 2013; option-pricing theory: Charitou et al, 2013). Later, Altman and other researchers revised the original MDA model to incorporate more financial ratios, to introduce other statistical techniques to capture random fluctuation in the data set, and to consider the cost of misclassification of firms as bankrupt and non-bankrupt (Kida, 1998; Wu et al., 2010).

While parametric-based bankruptcy prediction models have been extensively employed to quantify the financial position of the firm, these models are subject to several drawbacks. First, the estimated discriminant coefficients are mostly treated as constant without considering the time varying characteristics of the industry under study. Second, as noted by Edmister (1972), the estimation of discriminant function is usually exposed to potential multicollinearity problems, since financial ratios derived from financial statements are likely to be collinear. Although a selection procedure can be utilized to reduce multicollinearity, this procedure may disregard some relevant ratios, which may cause the misspecification of the model. Third, multiple discriminant analysis is a parametric approach by nature, where the variables utilized are assumed to be normally distributed as they must satisfy several statistical requirements (Ohlson, 1980); this is rather a restrictive assumption. Some studies, in fact, find that financial ratios exhibit non-normality in distribution (Bedingfield et al., 1985). Finally, multivariate discriminant analysis

does not offer the possibility for sensitivity analysis, which can be regarded as an appropriate managerial and selection tool.

Recently, several researchers have attempted to use data envelopment analysis (DEA), artificial neural networks (ANN), and market-based contingent claims models as alternative methodologies to measure and quantify a firm's financial distress to predict bankruptcy (Back et al., 1996; Zhang, 1999; Cielen et al., 2004; Hillegeist et al., 2004; Premachandra et al., 2009; Sueyoshi and Goto, 2009; Jackson and Wood, 2013). We label these methodologies as *non-parametric*, employing contingent claim model to gauge the probability of financial failure; there are no functional forms and implied normality assumptions imposed on the structure and the distribution of the financial variables utilized. However, the non-parametric approaches are also exposed to shortcomings of their own. For instance, DEA (non-parametric) is not a stochastic approach; therefore, tests of the statistical significance of coefficients are not possible. Additionally, DEA does not provide possibility to isolate shocks, measurement errors, or random fluctuations in data in the estimation procedure. Accordingly, performance measures may be affected by the presence of outliers.

The purpose of the present paper is to introduce and offer a simple and straightforward methodology through which an aggregate bankruptcy index (ABI) is estimated to evaluate the financial position and measure the financial distress of firms using financial ratios. Additionally, this methodology may offer an alternative method for predicting bankruptcy. There are multiple advantages to this approach. First, it avoids the restrictive normality assumption. Second, the multicollinearity among the financial ratios can be avoided because this approach is non-parametric and no coefficient is estimated. Third, sensitivity analysis is feasible in the framework of this technique, which is a potential shortcoming associated with the parametric approach. Finally, no functional form is imposed on data set. Furthermore, this approach is not exposed to limitations related to non-parametric technique, and results are not contaminated by random fluctuations and the presence of outliers in data.

Following Anderson et al. (2009) we use financial ratios as inputs to estimate ABI, which provides a possibility to rank firms based on their relative financial position in the sample. The index is then used to predict the probability of bankruptcy in the firms included in the sample. The empirical results of the study,

in general, suggest that ABI is an appropriate measure to rank the firms according to their level of financial performance and, to some extent, predict bankruptcy more accurately when compared to Z-score. Specifically, our results of ABI4 show that the prediction accuracy one-year prior to bankruptcy is 93 % and 76 % for bankrupt firms and non-bankrupt firms, respectively. Similar to the results of ABI4, the prediction accuracy of ABI5 is 90 % and 76 % for bankrupt sample and non-bankrupt sample one-year before the bankruptcy date. The prediction accuracy of both ABI4 and ABI5 is higher than that of Z-score, which accurately predict bankruptcy and non-bankruptcy at 88 % and 45 %, respectively, one-year prior to bankruptcy. Therefore, ABI greatly improves the prediction accuracy over Z-score, especially for non-bankrupt firms. We also investigate the correlation between ABI and Z-score. The results show that the correlation coefficient between ABI and Z-score is 0.75, which is positive and significant at 1 %, suggesting that ABI measures the same underlying financial positions for companies as Z-score.

The remainder of the paper is organized as follows. Section 2 describes the data set and methodology of the study. Section 3 presents the empirical results and discusses the findings. Section 4 provides the summary and conclusions.

## **2. DATA AND METHODOLOGY**

### **2.1 Data**

We collect the data of bankrupt and non-bankrupt firms from Compustat database. Bankrupt firms are identified as bankrupt if they filed for Chapter 11 in a certain year. The year of bankruptcy varies across the firms. The bankrupt sample contains firms from 1987 through 2013, with non-missing values for all of the variables used to estimate ABIs. A five-year period prior to the date that firm files for bankruptcy is saved as a test period.

In order to form a control sample containing non-bankrupt firms, we match non-bankrupt firms one-to-one with bankrupt firms in the same year and the same 3-digit SIC industry with the closest total assets. In the matching procedure, we limit the “difference in the size” to be less than or equal to 20 %, where the difference in size is calculated as the absolute value of the difference of total assets between bankrupt and non-bankrupt as a percentage of total assets of the bankrupt

firms. Following this process, we form our sample, which consists of 42 bankrupt firms and 42 matching non-bankrupt firms with complete data.

In order to calculate our measure of bankruptcy, we utilize five variables as follows:

$$\begin{aligned} \text{WCTA} &= \frac{\text{working capital}}{\text{total assets}}, \\ \text{RETA} &= \frac{\text{Retained earnings}}{\text{total assets}}, \\ \text{EBTA} &= \frac{\text{Earnings before interest and taxes}}{\text{total assets}}, \\ \text{MVCE} &= \frac{\text{Market value of equity}}{\text{book value of total debt}}, \text{ and} \\ \text{SATA} &= \frac{\text{Sales}}{\text{total assets}}. \end{aligned}$$

We employ the same financial ratios used in the Z-score developed by Altman (1968) in order to facilitate the process of comparison.

## 2.2 Methodology

As mentioned above, the methodology of the study involves estimation of an aggregate bankruptcy index. We follow an approach developed and proposed by Anderson et al. (2009), which ranks firms based on their relative financial position, using financial ratios as inputs. This index is established on the financial ratios that are derived from financial statements of the firms. In order to develop the index, we rank individual financial ratios (WCTA, RETA, EBTA, MVCE, and SATA) into deciles with the least distressed firms taking a value of 10, and the most distressed firms taking a value of 1. The five rankings are then summed up and scaled by a factor of 50 to obtain an aggregate bankruptcy index (ABI5). We drop SATA to estimate another aggregate bankruptcy index (ABI4) by employing four ratios to check for the robustness and sensitivity of estimated ABI with respect to number of ratios employed.<sup>1</sup>

This index is within a sample measure that ranks firms based on their financial position, and is calculated over time to discriminate between bankrupt firms and non-bankrupt firms. The estimated ABI ranges between 0 and 1, i.e., ABI

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<sup>1</sup> We chose to drop SATA because there is no statistically significant difference of SATA between bankrupt and non-bankrupt firms.

$\in (0, 1]$ . The higher the ABI for a given firm, the lower the financial distress and the probability of bankruptcy of that firm.

### 3. EMPIRICAL RESULTS

The descriptive statistics for financial ratios used in the estimation of the ABI are presented in Table 1, panel A. As it can be seen, the means of all ratios are higher for non-bankrupt firms compared to bankrupt firms, except for SATA. Additionally, as the table shows, the volatility of financial ratios of bankrupt firms is higher compared to non-bankrupt firms, except for MVCE. Considering the ratios are not generally normally distributed, we perform non-parametric Kruskal-Wallis mean and the Mann-Whitney median tests to statistically test the differences of mean and median of financial ratios between the two groups. As the statistics in Table 1 panel B suggest, the mean and median of financial ratios of non-bankrupt firms are statistically significantly higher than those of bankrupt firms, except in the case SATA.

Panel A of Table 2 shows the descriptive statistics of estimated ABI4, ABI5, and Altman Z-scores for bankrupt and non-bankrupt firms. We use five ratios as initially used by Altman (1968) to estimate Altman's Z-scores and ABI5 for the purpose of comparing the two measures with each other. From Table 2 panel A, we find that the estimated Z-scores and ABIs for non-bankrupt firms, on average, are higher than those for non-bankrupt firms. The Z-scores are, on average, below the 1.8 threshold for bankrupt firms and above the 3.0 limit for non-bankrupt firms. While the results in panel A of Table 2 indicate all ABIs and Z-scores are higher for non-bankrupt firms compared to bankrupt firms, we further perform two non-parametric tests (Kruskal-Wallis and Mann-Whitney) to check whether the differences are statistically significant. The results of these tests are reported in Table 2 panel B. According to these tests, the means of the Z-score and ABIs are statistically significantly higher for non-bankrupt firms relative to bankrupt firms.

Table 3 reports the mean, median, and standard deviation of the three bankruptcy measures (ABI4, ABI5, and Z-score) during a period of five years prior to date of bankruptcy for bankrupt and non-bankrupt firms. The means of ABI4 and ABI5 suggest a trend of steady deterioration of the indices over the five years prior to the bankruptcy for the bankrupt firms. The situation is reversed in the case of non-bankrupt firms where both ABI4 and ABI5 exhibit an upward trend during

the same period. Furthermore, we observe the same declining trend for the mean of Z-score in the case of bankrupt firms as the time approaches the date of bankruptcy. Note that the means of Z-scores for non-bankrupt firms do not reveal any trend in the course of the same five-year period.

Table 4 presents the classification matrix based on ABI4 during the period of one to five years prior to the date of bankruptcy for bankrupt and non-bankrupt firms. There are 5 panels (A to E) in Table 4, and each panel (such as panel A) contains two sub-tables. The first sub-table (on the left) of panel A reports the “predicted group” i.e., the number of bankrupt and non-bankrupt firms as predicted and classified by ABI4. For instance, five years prior to the date of bankruptcy, ABI4 classifies 17 firms correctly as bankrupt but misclassifies 14 firms, which go bankrupt as non-bankrupt (Type I error). The second row of this sub-table shows the classification of non-bankrupt firms as bankrupt or non-bankrupt. We find that 9 non-bankrupt firms are misclassified as bankrupt and 13 non-bankrupt firms are correctly classified as non-bankrupt five years prior to the date of bankruptcy.

The second sub-table of panel A (on the right) presents the results of the first sub-table (on the left) in percentages. According to this sub-table, fifty-five percent of bankrupt firms are correctly classified as bankrupt and forty-five percent of them are misclassified as non-bankrupt. In the bankruptcy prediction literature, this misclassification is termed as Type I error. On the other hand, 41 % of the non-bankrupt firms are misclassified as bankrupt. This type of misclassification is defined as Type II error. Panels B, C, D, and E have the same structures as panel A, with a one-year incremental towards the date of bankruptcy. As we observe, in general, the percentage of misclassification of the bankrupt and non-bankrupt firms declines and the level of classification accuracy rises as the date of bankruptcy nears. However, the relative costs of prediction errors and credit risks have not been measured, therefore, these findings should be interpreted cautiously. Table 5 reports the classification matrix of the bankrupt and non-bankrupt firms over the five-year period prior to the date of bankruptcy based on ABI5. We employ five financial ratios (the same ratios used by Altman, 1968) to estimate ABI5. Similar to Table 4, Table 5 includes 5 panels (A to E) and each panel has two sub-tables. The first sub-table (on the left) of panel A reports the number of bankrupt and non-bankrupt firms as classified by ABI5. According to the results, ABI5 predicts 16 firms accurately as bankrupt but it misclassifies 15 bankrupt firms as non-bankrupt

(Type I error). The second row of this sub-table indicates that 11 non-bankrupt firms are wrongly classified as bankrupt and the same number of non-bankrupt firms is correctly classified as non-bankrupt five years prior to the date of bankruptcy. The sub-table (on the right) of panel A of Table 5 shows that 52 % percent of bankrupt firms and 50 % of non-bankrupt firms are accurately classified. However, 48 % percent of bankrupt firms are incorrectly grouped as non-bankrupt firms (Type I error), and 50 % percent of the non-bankrupt firms are misclassified as bankrupt (Type II error).

Panels B, C, D, and E are organized as panel A with a one-year increment towards the date of bankruptcy. As in the case of ABI4, the percentage of misclassification of the bankrupt and non-bankrupt firms decreases and the classification accuracy improves as the date of bankruptcy comes near. We can interpret this result as Type I and Type II errors steadily decrease over time.

In order to compare ABI5 with Z-score, we estimate Altman (1968) Z-scores for bankrupt and non-bankrupt firms for our sample. The classification results over the five-year period prior to the date of bankruptcy are reported in Table 6. This table is organized in the same way as Tables 4 and 5. We choose ABI5 because it is based on the same five financial ratios used in Altman's (1968) model.

Table 6 contains 5 panels (A to E). Each panel has two sub-tables similar to the format of Tables 4 and 5. The first sub-table (on the left) of panel A reports the number of bankrupt and non-bankrupt firms as classified by Z-score five years before the bankruptcy occurs. The results reveal that Z-score appropriately classifies 15 firms as bankrupt but it misclassifies 16 bankrupt firms as non-bankrupt (Type I error). According to the second row of this sub-table, 14 non-bankrupt firms are incorrectly classified as bankrupt and 8 non-bankrupt firms are accurately classified as non-bankrupt.

The second sub-table (on the right) of panel A suggests that 48 % of bankrupt and 36 % of non-bankrupt firms are correctly classified. However, we find that 52 % of bankrupt firms are falsely classified as non-bankrupt firms (Type I error). In addition, according to Z-score, 64 % of the non-bankrupt firms are inaccurately classified as bankrupt (Type II error). Panels B, C, D, and E of Table 6 are organized the same way as panel A with a one-year increment towards the date of bankruptcy. Considering the prediction based on Z-score as a whole, we see that

the percentage of correct classification increases over time during the five-year period prior to the date of bankruptcy.

As is the case of ABI5, the numbers of Type I and Type II errors decline steadily overtime as the date of bankruptcy approaches. Moreover, the Type II error of ABI5 is lower than that of Z-score, indicating that ABI5 is less likely to classify non-bankrupt firms as bankrupt. Even though the Type I error predicted by ABI5 is higher than error predicted by Z-score three to four years before bankruptcy date, it becomes smaller one to two years prior to the date of bankruptcy. This implies that ABI5 has a lower propensity to misclassify bankrupt firms as the date of bankruptcy approaches.

There are several possible practical financial applications of our empirical findings. First, the portfolio managers and institutional investors can utilize ABI in process of security selections and investment decisions because the measure provides valuable information concerning the financial health of the firms under consideration. Second, the loan officers at financial institutions and analysts at bond rating agencies can apply ABI when they determine credit scores, default risk, bond ratings, and credit worthiness of the companies and the borrowers. Third, the ABI can also be used along with Altman's z-score to evaluate financial positions of both publicly and privately held companies in manufacturing and nonmanufacturing sectors.

#### **4. SUMMARY AND CONCLUSIONS**

This paper employs an approach proposed by Anderson et al. (2009) to estimate an aggregate bankruptcy index (ABI) as an alternative to parametric and non-parametric models to measure financial distress and to predict corporate bankruptcy. The index is a within sample estimate that ranges between 0 and 1. We can use this index to rank firms according to their relative financial distress and to predict the propensity of bankruptcy. The findings of this study provide evidence to indicate that ABI has reasonably robust predictive power and can be a compliment to the other parametric and non-parametric models to predict corporate bankruptcy.

We estimate multivariate discriminant analysis to obtain Z-core using the same set of financial ratios in order to compare the predictive accuracy between ABI and Z-score. The results indicate that ABI could predict the likelihood of bankruptcy reasonably more correctly compared to Z-score.

While more research is necessary to assess the applicability of ABI, we believe that this index can potentially be employed together with other financial stress indicators by credit officers for credit scoring, by investors for investment decisions, by auditors for risk assessment, and by financial managers for financial planning.

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## APPENDIX

**Table 1.** *Descriptive Statistics for Variables Used in Analysis*

Variable	N	Mean	Std. Dev.	Min.	Q1	Median	Q3	Max.
<b>Bankrupt firms</b>								
$\frac{\text{working capital}}{\text{total assets}}$ (WCTA)	42	-0.573	1.518	-8.570	-0.568	-0.086	0.077	0.485
$\frac{\text{Retained earnings}}{\text{total assets}}$ (RETA)	42	-4.397	9.591	-39.218	-1.912	-0.803	-0.313	0.420
$\frac{\text{Earnings before interest and taxes}}{\text{total assets}}$ (EBTA)	42	-0.426	0.885	-4.668	-0.510	-0.114	0.009	0.257
$\frac{\text{Market value of equity}}{\text{book value of total debt}}$ (MVCE)	42	0.790	2.342	0.001	0.028	0.071	0.373	13.259
$\frac{\text{Sales}}{\text{book value of total debt}}$ (SATA)	42	1.386	1.163	0.011	0.575	1.313	1.744	5.507
<b>Non-bankrupt firms</b>								
$\frac{\text{working capital}}{\text{total assets}}$ (WCTA)	42	0.205	0.276	-0.194	0.056	0.140	0.311	0.919
$\frac{\text{Retained earnings}}{\text{total assets}}$ (RETA)	42	-0.843	2.205	-8.323	-0.330	-0.006	0.223	0.430
$\frac{\text{Earnings before interest and taxes}}{\text{total assets}}$ (EBTA)	42	-0.027	0.274	-0.952	-0.063	0.030	0.094	0.383
$\frac{\text{Market value of equity}}{\text{book value of total debt}}$ (MVCE)	42	7.029	11.363	0.313	1.043	2.040	7.601	45.612
$\frac{\text{Sales}}{\text{book value of total debt}}$ (SATA)	42	1.067	1.099	0.000	0.261	0.985	1.449	5.678

Table 1-continued

**Panel B: Tests between Bankrupt and Non-bankrupt Firms**

Variable	Kruskal-Wallis Mean Test		Mann-Whitney Median Test	
	Chi-Square	p-value	Z-value	p-value
$\frac{\text{working capital}}{\text{total assets}}$ (WCTA)	21.309	<.0001	3.905	<.0001
$\frac{\text{Retained earnings}}{\text{total assets}}$ (RETA)	17.454	<.0001	4.338	<.0001
$\frac{\text{Earnings before interest and taxes}}{\text{total assets}}$ (EBTA)	15.144	<.0001	3.471	0.0005
$\frac{\text{Market value of equity}}{\text{book value of total debt}}$ (MVCE)	42.183	<.0001	6.074	<.0001
$\frac{\text{Sales}}{\text{book value of total debt}}$ (SATA)	2.423	0.1196	-1.302	0.1931

Panel A presents descriptive statistics for variables used in calculating ABIs and Z-scores. The bankrupt sample contains firms in Compustat from 1987-2013 with non-missing values for all variables used to calculate bankruptcy measures. The non-bankrupt firms are matched with bankrupt firms in the same year and the same 3-digit SIC industry with closest total asset (within 20 %). Panel B shows the Kruskal-Wallis mean test and the Mann-Whitney median test.

**Table 2.** Descriptive Statistics for Aggregate Bankruptcy Indices (ABIs) and Z-score

**Panel A: Descriptive Statistics of ABIs and Z-score**

Variable	N	Mean	Std. Dev.	Min.	Q1	Median	Q3	Max.
<b>Bankrupt firms</b>								
Aggregate bankruptcy index4 (ABI4)	42	0.275	0.131	0.100	0.175	0.250	0.350	0.650
Aggregate bankruptcy index5 (ABI5)	42	0.352	0.113	0.120	0.280	0.340	0.420	0.700
Altman Z-score	42	-6.390	15.869	-64.566	-3.907	-0.652	0.895	4.837
<b>Non-bankrupt firms</b>								
Aggregate bankruptcy index4 (ABI4)	42	0.589	0.172	0.200	0.500	0.625	0.675	0.925
Aggregate bankruptcy index5 (ABI5)	42	0.579	0.147	0.280	0.500	0.570	0.680	0.880
Altman Z-score	42	4.262	7.004	-11.687	1.276	2.600	7.461	27.132

**Panel B: Tests between Bankrupt and Non-bankrupt Firms**

Variable	Kruskal-Wallis Mean Test		Mann-Whitney Median test	
	Chi-Square	p-value	Z-value	p-value
Aggregate bankruptcy index4 (ABI4)	43.046	<.0001	6.172	<.0001
Aggregate bankruptcy index5 (ABI5)	38.289	<.0001	5.206	<.0001
Altman Z-score	28.812	<.0001	5.640	<.0001

Panel A presents descriptive statistics for ABIs and Z-score. Panel B shows the Kruskal-Wallis mean test and the Mann-Whitney median test.

**Table 3.** *Descriptive Statistics of Aggregate Bankruptcy Indices (ABIs) and Z-scores Over Time*

Variable	Group	Measure	Year Prior to Bankruptcy				
			5	4	3	2	1
Aggregate Bankruptcy Index4 (ABI4)	Bankruptcy	Mean	0.485	0.431	0.367	0.341	0.275
		Median	0.475	0.425	0.350	0.350	0.250
		Std. Dev.	0.167	0.148	0.138	0.145	0.131
	Non-bankruptcy	Mean	0.540	0.559	0.561	0.606	0.589
		Median	0.563	0.550	0.575	0.600	0.625
		Std. Dev.	0.202	0.174	0.204	0.183	0.172
Aggregate Bankruptcy index5 (ABI5)	Bankruptcy	Mean	0.497	0.459	0.408	0.388	0.352
		Median	0.480	0.460	0.420	0.380	0.340
		Std. Dev.	0.141	0.133	0.127	0.109	0.113
	Non-bankruptcy	Mean	0.534	0.541	0.555	0.597	0.579
		Median	0.520	0.520	0.600	0.580	0.570
		Std. Dev.	0.178	0.166	0.176	0.164	0.147
Altman Z-score	Bankruptcy	Mean	3.638	1.647	-0.353	-2.159	-6.390
		Median	1.878	1.434	1.125	0.151	-0.652
		Std. Dev.	6.403	4.190	7.274	11.885	15.869
	Non-bankruptcy	Mean	1.823	5.631	1.687	2.812	4.262
		Median	1.890	2.403	2.444	3.261	2.600
		Std. Dev.	5.819	17.556	11.169	7.763	7.004

This table presents the mean, median, and standard deviation for ABIs and Z-scores during the period of 1-5 years prior to bankruptcy.

**Table 4.** *Classification Results Using Aggregate Bankruptcy Index4 (ABI4)***Panel A: 5 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankrupt	Non-bankrupt				
Bankrupt	17	14	Type I	55	45	31
Non-bankrupt	9	13	Type II	59	41	22

**Panel B: 4 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankrupt	Non-bankrupt				
Bankrupt	24	11	Type I	69	31	35
Non-bankrupt	10	15	Type II	60	40	25

**Panel C: 3 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankrupt	Non-bankrupt				
Bankrupt	32	7	Type I	82	18	39
Non-bankrupt	12	17	Type II	59	41	29

**Panel D: 2 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankrupt	Non-bankrupt				
Bankrupt	32	9	Type I	78	22	41
Non-bankrupt	8	27	Type II	77	23	35

**Panel E: 1 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankrupt	Non-bankrupt				
Bankrupt	39	3	Type I	93	7	42
Non-bankrupt	10	32	Type II	76	24	42

This table presents the classification matrix based on ABI4 in the period of 1-5 years prior to bankruptcy.

**Table 5.** *Classification Results Using Aggregate Bankruptcy Index5 (ABI5)***Panel A: 5 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankruptcy	Non-bankrupt				
Bankrupt	16	15	Type I	52	48	31
Non-bankrupt	11	11	Type II	50	50	22

**Panel B: 4 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankruptcy	Non-bankrupt				
Bankrupt	18	17	Type I	51	49	35
Non-bankrupt	8	17	Type II	68	32	25

**Panel C: 3 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankruptcy	Non-bankrupt				
Bankrupt	29	11	Type I	73	27	40
Non-bankrupt	11	18	Type II	62	38	29

**Panel D: 2 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankruptcy	Non-bankrupt				
Bankrupt	36	5	Type I	88	12	41
Non-bankrupt	9	26	Type II	74	26	35

**Panel E: 1 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankruptcy	Non-bankrupt				
Bankrupt	38	4	Type I	90	10	42
Non-bankrupt	10	32	Type II	76	24	42

This table presents the classification matrix based on ABI5 in the period of 1-5 years prior to bankruptcy.

**Table 6.** Classification Results Using Altman Z-score

**Panel A: 5 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankrupt	Non-bankrupt				
Bankrupt	15	16	Type I	48	52	31
Non-bankrupt	14	8	Type II	36	64	22

**Panel B: 4 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankrupt	Non-bankrupt				
Bankrupt	23	12	Type I	66	34	35
Non-bankrupt	15	10	Type II	40	60	25

**Panel C: 3 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankrupt	Non-bankrupt				
Bankrupt	29	10	Type I	74	26	39
Non-bankrupt	16	13	Type II	45	55	29

**Panel D: 2 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankrupt	Non-bankrupt				
Bankrupt	34	7	Type I	83	17	41
Non-bankrupt	16	19	Type II	54	46	35

**Panel E: 1 Year Prior to Bankruptcy**

Actual Group membership	Predicted group			% correct	% error	N
	Bankrupt	Non-bankrupt				
Bankrupt	37	5	Type I	88	12	42
Non-bankrupt	23	19	Type II	45	55	42

This table presents the classification matrix based on Altman Z-score in the period of 1-5 years prior to bankruptcy.





## DETERMINANTS OF FIRM PERFORMANCE: EVIDENCE FROM ROMANIAN LISTED COMPANIES

Sebastian LAZĂR\*

**Abstract:** *The paper investigates firm-specific determinants of firm profitability for Romanian listed companies over the 2000-2011 period within the framework of resource based view of the firm. The results show that tangibles, leverage, size and labour intensity have negative effect on firm performance, while sales growth and value added have a positive effect. The results prove robust when introducing two-way fixed effects model and industry year effects model (in order to simultaneously account for specific industry characteristics and time effects).*

**Keywords:** *firm performance, firm-specific determinants*

**JEL Classification:** *L25*

### 1. INTRODUCTION

The issue of firm performance is of large interest on corporate finance research agenda. The performance of companies is an important source of sustainable economic growth. Profitable companies create value, hire people, promote innovation, and pay taxes from which we all benefit. Investigating the determinants of firm performance may provide insights in what drives performance up and down and teach valuable lessons both for business executives and policy makers. This is especially valid for a former communist country such Romania, who experienced the troubles of transition and the lessons that come with it. Consequently, such an investigation is of particular interest since it may disclose peculiarities valid only for transition countries. For instance, if size is generally considered to positively affect firm performance for developed economies (Lee, 2009), mainly because of economies of scale or entry barriers, for a transition economy, the things may be opposite, since size may stand for former large state

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owned enterprises who had hard times in dealing with market economies requirements. Similarly, according to agency cost theory, leverage decreases agency costs and make managers more selective and responsible thus leading to increasing performance, but this is not likely to be true in a transition country where conflicts between stakeholders are something new and interest rates are high. In this setting, I believe that the sign and significance of well-established determinants of firm performance in previous related literature for developed countries are questionable when it comes to transition countries where economic and social climate triggers specific constraints.

Apart from the peculiarities that stem for the investigation of firm performance for a former communist country, the paper investigates the labour and capital firm-specific inputs as determinants of firm performance. This also presents peculiarities for a transition country. For instance, labour intensity may negatively affect firm performance mainly because of the management's inability to conduct proper human resources policies, which often implies firing people. The same applies to tangibles intensity, which, in many cases, stand for huge industrial platforms that do not generate profits anymore.

Therefore, my investigation deals with firm-specific determinants of firm performance in a former communist country where specific characteristics affect the determinants' nature and sign. The paper contributes to the literature in two ways: it investigates the determinants of firm performance for a former communist country and it expands the determinants by looking at the labour and capital firm-specific inputs. The sample consists in all non-financial Bucharest Stock Exchange listed companies over the 2000-2011 period.

The rest of the paper is organized as follows: section 2 presents a brief literature review, section 3 develops the hypotheses, section 4 describes the data, section 5 presents the results, while section 6 concludes.

## **2. LITERATURE REVIEW**

Literature related to firm performance is extremely vast and developed around two broad theoretical perspectives: marked based view (MBV) and resource based view (RBV). While the former puts the emphasis on firm's external environment and market characteristics (Porter, 1979, Geroski and Masson, 1987, Cano et al 2004, Grinstein, 2008), the latter focuses on firm-specific resources

which companies use in order to increase performance (Barney, 1991; Peteraf, 1993; Day, 2011). There is strong evidence that, in former communist countries, the experiment transition to market economy, the resources based view has greater importance than market based view, because in such economy, the instability of markets make the firms' current market positions less relevant to their performance (Grant 1991, Makhija, 2003). Moreover, Hawawini et al (2003) found that for dominant firms, firm-specific factors matter more than market characteristics. Since the sample comprises all non-financial companies listed at Bucharest Stock Exchange, generally leaders in their field, the investigation strategy will emphasize firm-specific determinants. Therefore, for the purpose of this research the focus will be on RBV approach of firm performance.

According to RBV, firm resources include all assets, capabilities, organizational processes, firm attributes, information, knowledge controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness (Daft, 1983). Barney (1991) classified firm resources into three categories: physical capital resources, human capital resources and organizational capital resources. These inputs are then used by the firms in order to enhance performance measured by various profitability ratios.

In related literature there is a huge heterogeneity with respect both to firm performance measurement (dependent variable) and its determinants (independent variables). In most cases, firm performance is measured as a financial ratio, namely return on assets (ROA) such as in Hansen and Wernerfeld (1989), Glancey (1998), Goddard et al (2005), Zeli and Mariani (2009), Asimakopoulos et al (2009), Maçãs Nunes et al (2009), Crespo and Clark (2012), Yazdanfar (2013). Alternative measures are share value (Makhija, 2003), profit-cost margin (McDonald, 1999) or net income plus advertising expenses to assets ratio (Lee, 2009).

With regard to dependent variables, the heterogeneity is even greater and varies across the countries. The majority of studies deals with a single country setting, but multi-country analysis is also present. For instance, Hansen and Wernerfeld (1989) used firm-specific human resources determinants for a sample of US firms, while Glancey (1998) used companies' characteristics such size, age, location, inter-industry differences and growth for Scottish firms. For Greece, Asimakopoulos et al (2009) investigated company size, leverage, sales growth, investments and current assets as determinants of firm profitability, while for

Portugal Maçãs Nunes et al (2009) investigated size, growth, leverage, liquidity and tangibility. Lee (2009) covers 7,000 US public companies over 20 years and investigated size, market share, capital intensity, advertising and research and development intensities, bad debt ratio and inventory, while Yazdanfar (2013) looked upon size, age, growth, productivity and lagged profitability and industry affiliation as determinants of current profitability for Swedish small firms. With regard to multi-country setting, Goddard et al (2005) investigated lagged profitability, size, market share, financial gear and liquidity for Belgium, France, Italy, Spain and UK, while Crespo and Clark (2012) used as dependent variables sales, net working capital, assets mix and firm location for 12 European countries.

The results are mixed. For instance, company size is found to have a positive effect on firm performance (Yazdanfar, 2013; Asimakopoulos et al, 2009), Maçãs Nunes et al (2009), Lee (2009), a negative effect (Goddard et al, 2005) or no effect at all (Glancey, 1998; Crespo and Clark, 2012). Company growth is generally seen as having a positive impact (Asimakopoulos et al, 2009; Maçãs Nunes et al, 2009; Lee, 2009; Yazdanfar, 2013), while leverage is considered to have a negative impact (Asimakopoulos et al, 2009; Maçãs Nunes et al, 2009). Liquidity was found to have a positive effect (Goddard et al, 2005; Crespo and Clark, 2012) or no effect at all (Maçãs Nunes et al, 2009). Lagged profitability has a positive effect (Yazdanfar, 2013; Goddard et al, 2005), Lee (2009).

With regard to Romania, the literature on firm performance is rather small. Pantea et al (2014) found that firm size, capital intensity and number of employees positively affect firm performance. Gavrea and Stegorean (2012) focusing on a corporate governance approach found that board size has a negative impact on firm performance. Mihai & Mihai (2012) found that leverage has a negative impact on performance of Romanian mining and quarrying companies.

The main contribution of this paper consist in expanding both the companies' coverage and the determinants investigated within the resource-based view of the firm, while at the same time developing an investigation strategy that allows to capture the time-specific effects for companies or industries, which adds up to the robustness of the results.

### 3. RESEARCH DESIGN AND HYPOTHESES

#### **The dependent variable**

The firm performance is measured using return on assets (ROA) computed as net income to total assets ratio.

#### **The independent variables**

Most of the independent variables were intensively used in similar previous research: firm size, leverage, tangibles, growth, while others were not (labour intensity). The decision to include labour intensity is justified by the generally accepted opinion in Romania that labour costs negatively affects firm performance mainly because of high social security contributions borne by employers<sup>1</sup>. Another reason consists in the hypothesised soft labour policies of Romanian listed companies.

With respect to firm size, there are two opposite views concerning the effects on firm performance. According to the first one, larger firms are able to make use of economies of scale, have better access to capital markets (Titman and Wessels, 1988) and possess a greater ability to put barriers to new comers (Maçãs Nunes et al, 2009). All these are factors that promote performance. The second view (Pi and Timme, 1993) claims that larger companies might also display more conflicts between managers and shareholders, which can lead to diminished profitability due to less control of management's behaviour. Also, larger companies might display huge diversification, which makes them less efficient. Moreover, for the case of former communist countries, large companies stand in many cases for former or actual state owned enterprises that do not perform very well since they failed to properly adapt to market economy requirements. Therefore, I have no expectations regarding the sign of the relation between size and firm performance.

Leverage is another determinant that was extensively used in the previous studies. Goddard et al (2005), Asimakopoulos et al (2009), Maçãs Nunes et al

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<sup>1</sup> Based on Doing Business portal, Romania ranks 16th (out of 27) in European Union in terms of statutory aggregate social contributions rates for which the legal incidence falls on the employer (data for 2011). In addition, there are others surveys (KPMG, 2011) ranking Romania on the 15th position (out of 24) in terms of effective employer and employee social security rates corresponding to an annual gross income of 300,000 USD. In 2011, out of the EU-27 member states, only Estonia, Lithuania and Slovenia were not covered by the survey. The employer statutory aggregate social security rates were 34.4 % for Estonia, 31.18 % (for Lithuania, and 16.1 % (for Slovenia (data compiled from Doing Business portal and OECD tax database).

(2009) found a negative effect of leverage on firm profitability. The argument is that the need of continue servicing the debt reduce the ability of companies to invest in profitable projects with negative effects on profitability. On the other side, authors like Jensen (1986), Wells, Cox and Garver (1995) and Adams (1996) claim that debt forced the managers to use resources more efficiently, thus not wasting them on unprofitable projects. However, for the specific case of Romania, I expect a negative sign of leverage, given higher interest rates for company loans.

With respect to tangible assets it is hard to emit a hypothesis. Nevertheless, given the fact that most of the Romanian listed companies are former socialist enterprises with high levels of fixed assets and poor performance, I expect a negative effect of tangibles on firm profitability. Moreover, the negative effect is further supported by the fact that buildings and land which in principle are not directly involved in producing goods for sale (as oppose to machines and equipments), represent a significant share of tangible assets and subject to frequent revaluations.

Labour intensity (personnel expenses to turnover ratio) is expected to have a negative impact, mainly due to the fact that Romanian companies generally avoid making radical adjustments to their personnel policy. This often means overstaffing, which, together with relative high social contributions rates borne by employers, negatively affects firm performance.

Company growth (percentage sales growth) was also investigated as a determinant of firm performance. Generally/Usually, growth is seen as having a positive impact, mainly due to the additional income that company generates. Therefore, I expect a positive sign, similar to Asimakopoulos et al (2009), Maçãs Nunes et al (2009) and Yazdanfar (2013).

Value added (value added to turnover ratio) is expected to have a positive sign. After all, the value that a company adds to its inputs is what drives the performance up and down.

A synthesis of independent variables and their expected sign is provided in Table 1.

**Table 1.** *Independent variables and their expected sign*

Firm size (SIZE)	Logarithm of total assets	+/-
Leverage (LEV)	Total debt to total assets ratio	-
Tangibles (TANG)	Tangible assets to total assets ratio	-

Labour intensity (LAB)	Personnel expenses to turnover ratio	-
Company growth (GROWTH)	Sales growth in percentage	+
Value added (VA)	Value added to turnover ratio	+

All variables are computed using relevant data collected from companies financial reports. The items from balance sheet were scaled by total assets, while the items from income statement were scaled with respect to sales. A detailed description of data structure is provided in Appendix. Usual checking did not reveal any concerns with regard to multicollinearity between explanatory variables.

#### 4. DATA AND METHODOLOGY

The dataset used in this paper contains detailed information from balance sheet and income statement. It follows closely the BACH data scheme (see Appendix) and covers all non-financial Bucharest Stock Exchange listed companies for twelve years period (2000–2011), thus having 668 complete company-years observations. I did not cover years following 2011 because the implementation of International Financial Reporting Standards (IFRS) from 2012 makes company reports data less comparable. Nevertheless, the time spanning and company coverage is large enough for valuable insights.

I used unconsolidated data in order to better capture the specific company relevant data and to provide a longer period of comparable data. The sources of data were financial reports of listed companies available on the Internet sites, both of the companies and of the Bucharest Stock Exchange and National Security Commission. The list of companies is available at <http://www.cnvmr.ro/InfoUtile/ro/RapoarteEmitenti/RapoarteEmitenti.html><sup>2</sup>. Also, a subscription access to Bucharest Stock Exchange data directory was needed in order to get the data for earlier years. The data are reliable and have already a history, being previously used in papers dealing with effective corporate taxation in Romania (Lazăr, 2013; 2014). Since I use percentage sales growth from previous years, 60 firm-years are removed, thus the final sample having 608 firm-years observations.

Descriptive statistics for dependent and independent variables are reported in Table 2.

<sup>2</sup> Our dataset comprises all the companies, thus we have the entire population (non-financial companies traded at Bucharest Stock Exchange).

**Table 2.** *Descriptive statistics for dependent and independent variables*

stats	N	mean	sd	min	p25	p50	p75	max
ROA	608	2.44	11.06	-116.65	0.21	2.66	7.54	82.1
TANG	608	50.80	20.19	0.00	37.93	50.02	64.31	96.75
LEV	608	39.39	25.61	0.51	19.76	36.23	53.17	158.08
SIZE	608	18.65	1.51	15.90	17.55	18.39	19.30	24.24
GROWTH	608	0.16	0.41	-0.91	-0.05	0.12	0.29	3.51
LAB	608	21.04	12.65	0.11	11.61	19.93	28.22	76.91
VA	608	31.02	26.19	-262.17	20.67	31.88	44.09	177.64

The mean for ROA is 2.44, while the median is rather close at 2.66. The majority of firms display positive ROA which suggest that listed companies are in general profitable. The tangibles represent in average half of total assets, and again the mean and the median are very close (50.8 and 50.02 respectively). The zero value for tangibles is for one IT seller company at the beginning of the period. Average leverage is around 40 %, slightly lower than the average corporate indebtedness for the Euro area non-financial companies of 43 % in the first quarter of 2011 (ECB, 2012). Annual average percentage sales growth is 0.16 which is quite a low figure. The mean for labour intensity is approximately 21 %, while the median is around 20 %. Corporate value added also displays similar values for the mean and median (around 31 %). In general, a raw inspection of data does not suggest significant skewness.

Since the data covers listed companies over a period of 12 years, the investigation strategy consists in fixed-effects panel data estimation. The fixed-effects general specification is:

$$Y_{it} = \alpha + X_{it}\beta + u_i + \varepsilon_{it} \quad (1)$$

where  $Y_{it}$  is the dependent variable observed for individual  $i$  at time  $t$ ,  $X_{it}$  is the time-variant  $1 \times k$  regressor matrix,  $\alpha$  is the intercept,  $u_i$  are the unobserved time-invariant individual effect and  $\varepsilon_{it}$  is the error term. Unlike  $X_{it}$ ,  $u_i$  stand for permanent differences between firms which cannot be observed, but are likely to be correlated with explanatory variables (ownership structure, managers team, earnings management, corporate culture, etc.). Since as a result of the fixed effects estimator,  $u_i$  are cancelled out, I can control for the unobservable or unmeasurable firm characteristics correlated with firm-specific regressors.

Since I suspect that there are also time-specific effects which affect all companies in the same way (tax changes, general economic climate, etc.) I also implement a two way fixed effects model:

$$Y_{it} = \alpha + X_{it}\beta + u_i + v_t + \varepsilon_{it} \quad (2)$$

where  $v_t$  controls for time-specific effects, i.e. impacts common to all firms but varying by year.

Finally, in order to control for industry-specific time effects (the industry business or financial risks), I also implement an industry-year-dummies model:

$$Y_{it} = \alpha + X_{it}\beta + u_i + v_t i_j + \varepsilon_{it} \quad (3)$$

where  $i_j$  stand for a rough classification of industries (manufacturing, energy and extractive industry, commerce, construction, transport and hotels and restaurants).

The major advantage of the fixed-effect estimator is that it controls for firm-characteristics which are not observable or measurable, but are likely to be correlated with the regressors, thus allowing a limited form of endogeneity. A shortcoming of the fixed effect model is that the results, being conditional on the sample, cannot be extrapolated. But, since data covers all non-financial companies traded at Bucharest Stock Exchange, this remains only a marginal problem (when inferring the results beyond public companies<sup>3</sup>).

## 5. RESULTS

Table 3 summarizes the results of fixed effects regression:

- (1) depicts the results of the base model;
- (2) presents the results of a two-way fixed model with year dummies variables included (not reported), while
- (3) adds industry year effects (not reported).

**Table 3.** *Determinants of firm performance (ROA)*

	(1)	(2)	(3)
TANG	-0.125** (0.0475)	-0.141*** (0.0467)	-0.143*** (0.0479)

<sup>3</sup> Privately held companies have different financing and investment choices, therefore extrapolating the results from public companies remains questionable irrespective of the estimation technique.

	(1)	(2)	(3)
LEV	-0.178*** (0.0283)	-0.182*** (0.0285)	-0.182*** (0.0296)
SIZE	-2.307*** (0.746)	-0.326 (1.279)	-0.0434 (1.327)
GROWTH	1.717** (0.693)	1.197* (0.665)	1.248* (0.710)
LAB	-0.473*** (0.0712)	-0.435*** (0.0675)	-0.429*** (0.0713)
VA	0.263*** (0.0343)	0.262*** (0.0333)	0.260*** (0.0348)
Constant	60.35*** (13.44)	25.50 (22.09)	20.71 (23.05)
Observations	608	608	608
R <sup>2</sup>	0.617	0.636	0.657

Clustered robust standard errors at firm level in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

- (1) Base model
- (2) Year effects
- (3) Industry year effects

ROA = return on assets (net income to total assets ratio)

TANG = capital intensity (tangible assets to total assets ratio)

LEV = leverage (total debt to total assets ratio)

SIZE = company size (natural logarithm of total assets)

GROWTH = sales growth (annual sales growth in percentage)

LAB = labour intensity (personnel expenses to turnover ratio)

VA = value added (corporate value added to turnover ratio)

Tangibles negatively affect firm performance. One percentage point increase in tangibles triggers 0.121 pp reduction in ROA. This suggests that Romanian companies do not make use of their tangibles in a profitable manner. Apart from the systemic cause hypothesised (former socialist enterprises with high levels of obsolete fixed assets), frequent revaluations of buildings and land cause an increase in tangible assets without any subsequent increase in profits. Moreover, in order to get real-estate tax reductions, companies were enticed to constantly reevaluate their

buildings, which lead to an increase in tangibles without any corresponding real economic performance.

Leverage displays a significant negative effect on firm performance. One p.p. increase in debt ratio determines 0.08 decrease in profitability. The theory stating that debt makes managers more responsible in allocating corporate funds is not valid for Romania, but on a contrary, there is evidence in favour of the fact that servicing the debt reduces the ability of companies to invest in profitable projects, especially when taking into account the relatively high company interest loan. During the period surveyed (2000–2011), the annual average interest rate for new corporate bank loans in Romanian New Currency (RON) was more than 15 % in eight of the twelve years, while the minimum annual average interest rate of 9.40 % was recorded in 2010 (National Bank of Romania reports available at <http://www.bnro.ro/Publicatii-periodice-204.aspx>). Prior to 2005 when corporate income tax rate was 25 %, the annual average interest rate for corporate bank loans was more than 24 %. Therefore, tax deductions triggered by higher corporate income tax rate were offset by higher nominal interest rates, which made debt financing less appealing.

Size has a negative effect on firm performance, but the effect is statistical significant only for the base case model. The negative sign suggests that Romanian listed companies are not able to make use of economies of scale, but rather points out that their size stands as evidence of the performance issues associated with former or present state owned enterprises (failure to properly adapt to market economy requirements) as hypothesised. This is in line with the finding on tangibility.

Labour intensity also plays a negative role with regard to firm profitability. The coefficient is negative and statistically significant in all model specifications. The results prove robust when using the number of employees as alternative regressor. This suggests that Romanian companies were not able to efficiently use their labour force, mainly because of weak firing policies and strong labour unions.

Growth measured as annual percentage change in sales has also a positive effect on firm performance. Additional proceeds from sales represent an important factor for increasing profits.

Value added positively affects firm performance in all model specifications. Due to public scrutiny and the prestige derived from the listing, public companies

are able to enhance the value of the products offered to customers, which drives performance upwards.

When introducing a two-way fixed effects model (2), by allowing year dummies, the coefficients retained both their level and significance, while time specific effects are precisely identified. The model is similar with the base model, with much of the variation being explained by the companies' heterogeneity.

The third specification (3) introduced industry year dummies in order to simultaneously account for specific industry characteristics and time effects. While coefficients record only slight changes, they also retain their level of statistical significance in most cases. One must take into account that, due to the reduced number of companies ( $n = 60$ ), only a rough classification of industries was possible (see the previous section), and, therefore, extreme caution has to be displayed when interpreting the results. Nevertheless, the deviations from base (manufacturing 2001) were significant in the vast majority of cases. Commerce recorded the largest deviations (negative) from base, while manufacturing the smallest.

Overall, the results show that the hypotheses stated taking into account the peculiarities of a transition country were confirmed empirically.

## 6. CONCLUSIONS

The paper investigates firm-specific determinants of corporate performance for Romanian non-financial companies listed at Bucharest Stock Exchange over twelve years period (2000–2011) using corporate financial reports publicly available. The investigation was carried out within the framework of resource based view on firm performance according to which a firm is able to use its physical capital, human capital and organizational capital resources in order to increase profits. The research hypotheses were developed taking into account the peculiarities of a transition economy such as Romania.

The results showed that tangible intensity, leverage, size and labour intensity negatively affects firm performance, while sales growth and corporate value added have a positive impact. The roots of these causalities lie in the transition character of Romanian economy. Tangibles who count for half of the total assets for Romanian listed companies include industrial platforms that do not generate profits anymore. Moreover, the real-estate assets were subject to

frequent revaluations that increase their share without a corresponding increase of the profits. Leverage negatively affects firm performance mainly due to high interest rates common for a transition country. The lack of hard budget constraints adds up to this effect. The findings on size, although significant only for the base model, are in line with those on tangibles. Labour intensity also displays a negative effect, mainly because of the strong labour unions and of the political connections of managers and members of the board, which triggered a soft personnel policy. As expected, sales growth had a positive impact on firm performance, as well as value added that companies created. Romanian listed companies are able to create value in spite of their ineffective personnel policy and asset mix. The results have several policy implications.

First, the asset mix of Romanian listed companies is not value driving. Too much emphasis put on tangibles, especially on real-estate assets is bad for business. The share of intangibles is only 1 %, which suggests a poor orientation to knowledge intensive activities. In the actual global knowledge based economy this is a handicap hard to overcome, but tax incentives related to intangibles may provide a boost in that respect. For instance, expanding the availability of accelerated depreciation beyond patents, by including software as well may contribute to a knowledge-based value driving conduct of Romanian companies.

Second, with regard to leverage, things are more readily to change. The recent drop in interest rates all over the world, together with increasing budget constraints, makes debt more appealing and managers more responsible in dealing with it. Nevertheless, caution has to be taken if the interest rates trend will reverse. Expanding the use of financial derivative instruments (i.e. interest rates swaps) will boost the propensity for debt of Romanian listed companies. Also, adopting and applying codes of corporate governance with strict rules on how managers respond before shareholders with regard to debt performance may force managers being more responsible in taking debt.

Third, the negative effect of labour intensity suggests that reforms meant to reduce the overall labour costs should be undertaken. This can be done either by reducing the number of employees, either by reducing the labour payments charged to companies. If the former requires more determination from the management and less intrusion from the politics, the latter is hard to implement in a country where average salary is among the lowest in the European Union.

Nevertheless, the reduction of social security contributions borne by employers may act in this respect<sup>4</sup>.

The results are robust to several robustness checks. However, they are valid only for Bucharest Stock Exchange listed companies and cannot be extrapolated to private held companies, since they have different investment and financing choices and certainly, different reporting requirements.

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<sup>4</sup> The social security contributions borne by employers were diminished by 5 p.p. in October 2014.

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## APPENDIX

### The structure of data

<b>The balance sheet</b>	
<p>A        <b>Fixed assets</b></p> <p>A.1.     Intangible fixed assets</p> <p>A.2.     Tangible assets, from which</p> <p>A.2.1.   <i>land and buildings</i></p> <p>A.3.     Financial fixed assets</p> <p>B        <b>Current assets</b></p> <p>B.1.     Stocks</p> <p>B.2.     Receivables</p> <p>B.3.     Current investments</p> <p>B.4.     Cash at bank and in hand</p> <p>C        <b>Prepaid expenses</b></p> <p>AC      <b>Total assets</b></p>	<p>D        <b>Short term creditors</b></p> <p>G        <b>Long term creditors</b></p> <p>H        <b>Provisions</b></p> <p>I        <b>Deferred income, from which</b></p> <p>I.1.     <i>investment subsidies</i></p> <p>J        <b>Capital and reserves, from which</b></p> <p>J.1.     <i>Share capital</i></p> <p>J.2.     <i>Share premium</i></p> <p>J.3.     <i>Revaluation reserve</i></p> <p>J.4.     <i>Reserve</i></p> <p>J.5.     <i>Profit or loss brought forward</i></p> <p>J.6.     <i>Profit or loss for the financial year</i></p> <p>DJ      <b>Total liabilities</b></p>
<b>The profit and loss account</b>	
<p>1    Net turnover, from which</p> <p>1.4. Revenues from current subsidies related to net turnover</p> <p>S    Total operating income</p> <p>5    Cost of materials and consumables, from which</p> <p>5.a. <i>Raw materials and consumables</i></p> <p>5.b. <i>Other external charges</i></p> <p>8    Other operating charges and taxes, from which</p> <p>8.1. <i>third parties services charges</i></p> <p>8.2. <i>other taxes, duties and similar expenses</i></p> <p>8.3. <i>compensation, donation and assets related charges</i></p> <p><b>T    Added value (S-5-8)</b></p> <p>6    Staff costs, from which</p> <p>6.a. <i>wages and salaries</i></p> <p>6.b. <i>social security costs</i></p> <p><b>U    Gross operating profit (T-6) - EBITDA</b></p> <p>7    Value adjustments for non financial assets</p> <p>7.a. Depreciation on fixed assets</p> <p>7.b. Value adjustments for current assets</p> <p><b>V    Net operating profit (U-7) - EBIT</b></p> <p>9_11 Financial income, from which</p>	

- 11 *interest income*
- 12\_13 Financial expenses, from which
- 13 *interest expenses*
- W Net financial income**
- 14 Profit or loss on ordinary activities
- 15 Extraordinary income
- 16 Extraordinary expenses
- 17 Net extraordinary income
- X Profit or loss before taxes (14+17)**
- 18 Corporate income tax
- 20 Profit or loss for the financial year (X-18)
- 

**Informative notes**

Number of employees

Meal vouchers granted to employees

Innovation expenses

Affiliation

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**Formulas for computing corporate effective tax rates****Dependent variables**

$$ROA = 20/AC*100$$

**Independent variables**

$$TANG = (A2)/AC*100$$

$$LEV = (D+G)/AC*100$$

$$SIZE = \ln(AC)$$

$$LAB = 6/1*100$$

$$GROWTH = 1_t - 1_{t-1}/1_{t-1}*100$$

$$VA = T$$


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# INVESTIGATION ON THE CAUSAL RELATIONSHIP BETWEEN INFLATION, OUTPUT GROWTH AND THEIR UNCERTAINTIES IN ROMANIA

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**Abstract** *Based on monthly-recorded data for the 1990-2014 period related to output growth and inflation, we use heteroskedastic models in order to estimate the nominal and real uncertainty in Romania. Real uncertainty is derived from output growth volatility and nominal uncertainty is derived from inflation volatility. Of the 12 possible hypotheses regarding causal relationships between output growth, inflation, nominal uncertainty and real uncertainty, we consider 7 hypotheses for which we find strong theoretical arguments and empirical evidence in literature. In order to ensure the robustness of the results, the Granger-causality tests are performed for 4, 8 and 12 lags, which are then used to test 7 economic hypotheses.*

**Keywords:** *output growth, inflation, uncertainty, heteroskedastic models*

**JEL Classification:** *E31, E50*

## 1. INTRODUCTION

The insurance of a sustainable economic growth and macroeconomic stability represents a major objective for the economic policy of every state. The recent economic crisis determined larger volatilities of the output growth and inflation and accentuated the uncertainty regarding the evolution of the most

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important macroeconomic indicators. In this context, the study of the relationship among inflation, output growth and their uncertainties represents an important topic for the national policy makers as well as for the specialists.

Starting from the 1990s, besides the implementation of economic reforms and the transition to market economy, the Central and East European countries have experienced great inflationist phenomena. Among these countries, Romania experienced one of the highest inflation rates (256.1 % in 1993). The inconsistency of the economic reform measures determined a significant variability of inflation, 2005 being the first year in which a single digit inflation (9 %) was recorded. Thus, in Romania's case, inflation is considered to be one of the main phenomena of instability of the economic environment and the uncertainty about future inflation can lead to uncertainty about other economic variables. For Romania, as a member of the European Union, an important objective of economic policy is to ensure real convergence with developed economies and this can be achieved by registering a high level of growth in conjunction with macroeconomic stability.

The economic crisis which started in 2008 resulted in a significant reduction of the GDP growth, which emphasized the variability and uncertainty of ensuring sustainable economic growth. In this economic context, the analysis of the relationship among inflation, economic growth and their uncertainties for Romania may represent a foundation for the formulation of proposals that would aim at the insurance of a sustainable economic growth.

In the present paper, we analyse the causalities between inflation, output growth and their uncertainties in Romania. We use monthly-recorded data for the 1990-2014 period related to output growth and inflation to estimate their uncertainties by different heteroskedastic models. Inflation is measured by means of the Consumer Price Index (CPI) and Output Growth is measured by the Industrial Production Index (IPI).

The inflationist phenomenon represented for Romania one of the main factors of instability of the economic environment. In compliance with the strategy of inflation targeting, that aimed, in the pre-adherence program to the European Union, to reach an inflation level below 10 %, we split the data series in two sub-samples because in the first part of the period we have very high values for inflation. We chose the breaking-point by determining the first month for which the inflation average for the last 12 months is lower than 10 %. This condition was

fulfilled for the November 2004.. Therefore, the first sub-sample comprises the values registered until October 2004, while the second sub-sample comprises the values registered for the period November 2004 – November 2014.

Of the 12 possible hypotheses regarding causal relationships between uncertainties, output growth and inflation, we consider the ones for which we find strong theoretical arguments and empirical evidence in the literature. In order to ensure the robustness of the results, the Granger-causality tests are performed for 4, 8 and 12 lags, which are then used to test the selected hypotheses.

The paper is structured as follows: Section 2 presents the hypotheses regarding the causality between output growth, inflation and their uncertainties, as well as the empirical literature to date; Section 3 describes the methodology, namely the heteroskedastic models used for the estimation of the conditional residual variances as measures of uncertainty; Section 4 presents the results, while Section 5 concludes.

## 2. LITERATURE REVIEW

The relationship between inflation, output growth and their uncertainties has been extensively researched since the 1970s, following the publication of Milton Friedman's (1977) Nobel lecture.

The most discussed issue concerns the relationship between inflation and its uncertainty, which was first analysed by Okun (1971), who found a positive relationship between the inflation rate and its variability for 17 OECD countries. Yet the real contribution would later belong to Friedman's (1977) work on the real effects of inflation. The latter author states that an increase in inflation leads to more uncertainty, which ultimately leads to a decrease in output.

The literature on the subject is thus fairly vast and regards both the theoretical foundation for the existence and direction of those relationships and the empirical evidence found for the developed and transition economies (Grier and Perry, 2000; Neanidis and Savva, 2012; Hartmann and Roestel, 2013, Goktas and Disbudak, 2014; Clements and Galvao, 2014).

In the present paper, we analyse 7 out of the 12 possible hypotheses regarding the causal relationship among inflation, output growth and their uncertainties (Grier and Perry, 2000) and we find strong theoretical as well as

empirical proof in various studies (Griet et al. (2004), Fountas et al (2006), Fountas et al. (2007)).

#### H1: Inflation Granger-causes inflation uncertainty

The first hypothesis according to which inflation Granger-causes inflation uncertainty is the most investigated in the literature. Various studies prove that inflation causes important costs for the economy, one of which is related to uncertainty about future inflation rates due to the effects it has on future investment and saving decisions of economic units. Friedman (1977) and Ball (1992) found empirical evidence for a positive relationship between inflation and inflation uncertainty, while other authors, such as Pourgerami and Maskus (1987), Hungarian and Zilberfarb (1993), Davis and Kanago (2000) found an opposite causal relationship. Seen as a cause or an effect of inflation, the literature highlights the negative effects of inflation uncertainty on economic variables like investment and growth. More recent studies confirm the causal relationship between inflation and inflation uncertainty (Grier and Perry, 1998; Fountas, 2001; Hwang, 2001; Thornton, 2007, 2008).

#### H2: Inflation uncertainty Granger-causes output growth

In his Nobel lecture, Friedman (1977) argued that an increase in inflation will lead to more uncertainty about inflation, leading to a decrease in output. Inflation uncertainty affects resource allocation through its effects on interest rates, the real cost of inputs and final goods prices.

Contrary to Friedman, Dotsey and Sarte (2000), using "cash-in-advance" type of model, showed that high levels of inflation uncertainty have a positive impact on economic growth. Increased inflation uncertainty causes increased savings and thus increased investment and output. The relationship between inflation and growth is confirmed by recent studies by Hasanov and Omay (2011) and Khan et al. (2013) that investigated the phenomenon in the countries of Central and Eastern Europe.

### H3: Inflation uncertainty Granger-causes inflation

The hypothesis that uncertainty about inflation has an influence on inflation has been tested in numerous studies. Cukierman and Meltzer (1986) found a positive relationship between inflation and inflation uncertainty, arguing that when inflation uncertainty increases, monetary authorities adopt an opportunistic behaviour in order to stimulate output growth by increasing the money supply, thereby generating higher inflation. In the opposite direction, Holland (1995) shows a negative relationship between inflation and inflation uncertainty. Holland found that, in conditions of high uncertainty, monetary authorities have a stabilizing behaviour manifested by reducing the money supply in order to reduce the negative effects of inflation uncertainty on the economy (also known as the Fed hypothesis). The opportunistic or stabilization behaviour of the monetary authorities depends on the level of independence of the central bank (Grier and Perry, 1998), and on the economic situation of a country. Therefore, the extent to which monetary policy affects inflation is difficult to predict. Recent studies have confirmed this hypothesis (Grier and Perry, 1998; Apergis, 2004; Narayan et al., 2009; Jiranyakul and Opiela, 2010).

### H4: Output growth uncertainty Granger-causes inflation

In addition to inflation uncertainty, it is generally acknowledged that the real uncertainty can affect the inflation rate. Devereux (1989) and more recently Cukierman and Gerlach (2003) identified a positive relationship between real uncertainty and inflation, while Cukierman and Meltzer (1986) claimed the existence of a negative relationship between the two variables. Using the Barro-Gordon model, Devereux (1989) showed that the optimal amount of wage indexation is reduced when the real uncertainty increases causing the monetary authority to generate unexpected inflation for agents. Cukierman and Meltzer (1986) stated that a greater uncertainty about economic growth reduces inflation uncertainty, therefore it reduces inflation. More recent studies conducted mostly in developed countries have shown a relationship between the growth and inflation uncertainties (Fountas and Karanasos, 2007).

#### H5: Output growth uncertainty Granger-causes output growth

Numerous studies have identified a relationship between real uncertainty and output growth, but the sign of this effect is ambiguous. Mirman (1971) argues that high levels of economic growth uncertainty causes an increase in the savings rate and thus it leads to higher economic growth rate. After studying the impact on investments in riskier technologies, Black (1987) shows that there is a positive relationship between the real uncertainty and the output growth if the expected return is large enough to offset the risks associated with the investments. On the other hand, Pindyck (1991) showed that between output growth and output growth uncertainty there is a negative relationship determined by the fact that higher uncertainty about future profits generated by these investments leads to a delay or cancellation of investments, leading further to a lower level of economic growth. Recent studies have confirmed the influence of output growth on real uncertainty, but with the same ambiguity concerning the sign of this relationship (Henry and Olekalns, 2002; Blackburn and Pelloni, 2004; Grier et al., 2004; Fountas et al., 2004; Fountas and Karanasos, 2007; Narayan, 2009).

#### H6: Output growth Granger-causes inflation uncertainty

Regarding the impact of output growth on inflation uncertainty, Bruner (1993) demonstrated the existence of a negative relationship between the two. On the other hand, Hungarian and Zilberfarb (1993) found that high levels of economic growth can lead to low levels of inflation, resulting in a reduced inflation uncertainty. More recently, Grier and Perry (2000), Elder (2004) and Fountas et al (2006) provide evidence that nominal uncertainty is a negative determinant of growth in almost all the developed countries considered in their studies.

#### H7: Output growth Granger-causes output growth uncertainty

The least tested hypothesis in the literature is the assumption on the influence of output growth on real uncertainty. A negative relationship between the two can be explained by the fact that, in the short term, sustained economic growth leads to an increase in inflation. Based on Friedman's theory (1977), this will increase inflation uncertainty. This, paired with Taylor's theory (1979) that there is a trade-off between inflation uncertainty and output growth uncertainty, will result

in a lower output growth uncertainty. A positive relationship between output growth and real uncertainty can be explained by the fact that, when the economic growth rate decreases, the monetary policy's response makes the inflation rate become more uncertain, thus – meaning that it will be characterized by a higher uncertainty (Brunner, 1993). A positive relationship between the output growth and the real uncertainty can be explained by the fact that, when the economic growth rate decreases, the monetary policy's response makes the inflation rate highly uncertain (Brunner, 1993). Furthermore, under the Taylor effect, we can conclude that in this case the uncertainty of output growth will increase, thus highlighting the positive direction of the relationship.

The debates over the relationships between inflation, output growth and their uncertainties, and respectively over the empirical estimations of these casual relationships are very numerous in the literature. However, there is not an empirical unanimity in the results of the studies, which can be explained by the high degree of cross-country heterogeneity (Greenspan, 2004) or by the actual specific challenges that cause fundamental changes in the monetary policies (Hartmann and Roestel, 2014).

For Romania, we found few studies concentrating on the analysis of the causal relationship between inflation, output growth and their uncertainties. Jemna et al (2014) and Viorica et al (2014) analyse only 2 hypotheses regarding the causality between inflation and inflation uncertainty. In a larger study regarding the European emerging economies, Pintilescu et al (2014) take into consideration, 5 of the 7 hypothesis tested in the present paper, which uses two subsamples (October 1990-October 2004 and November 2004-November 2014), for a better data homogeneity.

### 3. DATA AND METHODOLOGY

Following previous studies by Gillman and Harris (2008), Kewebbar and Nenovsky (2013) and Jemna et al (2014), we use the Consumer Price Index (CPI) to measure the inflation, and the Industrial Production Index (IPI) to measure the output growth, as was previously done by Fountas, Karanasos and Kim (2006), Hasanov and Omay (2011), Pintilescu et al (2004).

The data considered (January 1990-November 2014) was retrieved from the IMF indicators, using the International Financial Statistics (IFS). Inflation ( $\pi$ ) is

measured by the annualized monthly difference of the log CPI [ $\pi_t = \ln(\text{CPI}_t/\text{CPI}_{t-1}) \times 1200$ ]. The output growth ( $y_t$ ) is considered through the annualized monthly difference in the log of the IPI [ $y_t = \ln(\text{IPI}_t/\text{IPI}_{t-1}) \times 1200$ ].

When discussing the uncertainty of the inflation and the output growth, other means can be used for their estimation. One of the simplest method was proposed by Hafer (1986) and Davis and Kanago (2000), who use standard deviation to estimate uncertainty. Another manner is introduced by Johnson (2002), who estimates the uncertainty by the error generated by a simple forecast model.

A very large part of the literature proposes the estimation of the uncertainty, with good results, by means of the conditional variance estimated through a heteroskedastic model.

From this family of models, authors like Evans (1991), Vörk (2000) or Neanidis and Savva (2012) use models that are simpler, easy to control and to manipulate, such as the GARCH model. A more complex mode, EGARCH, is used in studies like Asghar et al (2011), Baharumshah et al (2011).

Grier et al (2004), Ajevskis (2007), Khan (2010) or Pintilescu et al (2014) use GARCH-in-mean models for the estimation of the uncertainty. A different approach from the previously presented one is used by Berument et al (2011), where they estimate uncertainty through a model of the type stochastic volatility in mean (SVM).

In the present analysis, for estimating uncertainty we take into consideration more heteroskedastic models (ARCH, GARCH, EGARCH, GARCH-M, PARCH), that were in accordance with the literature and recent research papers. From the estimated models, we will choose the best fitted model based on the values of the information criteria Akaike (AIC) Schwarz (SIC) and Hannan-Quinn(HQ).

The first part of the analysis consists in testing the stationarity of the series taken into consideration. If we do not confirm the stationarity hypothesis for one of the series, then we have to stationarize the series through one of the traditional procedures, such as the creation of the series of first-order differences. We will use the Augmented Dickey-Fuller (ADF), Phillips-Perron and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests in order to test the stationarity.

Then, according to the methodology proposed by Fountas and Karanasos (2007), based on the stationary series, we will estimate a bi-variate VAR model which computes the conditional means of the inflation rate and the output growth.

The scope of this method is to identify the optimum lag length of their correlation. The number of lags is chosen using the Akaike (AIC) and Schwarz (SIC) information criteria.

After obtaining the optimum lag length, we estimate the uncertainties for the two considered variables, namely inflation and output growth. By means of Granger causality tests, we search for the existence of a causality relationship between these two variables. As stated before, we measure the uncertainties through the conditional variance of these variances estimated based on the heteroskedastic models.

We consider five heteroskedastic models for estimating uncertainty, namely: ARCH, GARCH, EGARCH, GARCH-M and PARCH. The model used for estimating the conditional variance, which measures the inflation uncertainty, will be chosen based on the Akaike and Schwarz information criteria applied to the lowest absolute values.

The starting point for many subsequent developments is the ARCH model (Engle, 1982), which was highly debated and analysed (Bollerslev, Chou and Kroner (1992), Bera and Higgins (1993), Bollerslev, Engle and Nelson (1994) or Diebold and Lopez (1995)). Unlike the previous models, the ARCH model does not rely on the past standard deviation, but on the conditional variances, noted with  $h_t$  ( $\sigma_t^2 = h_t$ ).

In the ARCH process of order  $q$ , the conditional variance takes the following form:

$$h_t = \omega + \sum_{j=1}^q \alpha_j \varepsilon_{t-j}^2 \quad (1)$$

where  $\omega > 0$  and  $\alpha_j \geq 0$  to ensure the conditions that  $h_t$  should always be positive.

The GARCH model (Bollerslev, 1986) offers the possibility to measure uncertainty for inflation and output growth, including the lagged conditional variances as autoregressive terms.

For GARCH (1,1) the model has the specification:

$$Y_t = \mu + \beta' X_t + \varepsilon_t \quad (2)$$

where  $X_t$  is a  $k \times 1$  vector of independent variables,  $\beta$  is a  $k \times 1$  vector of regression coefficients, and  $\varepsilon_t$  is the residual, respecting the condition  $\varepsilon_t \sim N(0, h_t)$ .

$h_t$  is the conditional variance, which is estimated by the equation:

$$h_t = \alpha_0 + \alpha_1 \cdot h_{t-1} + \alpha_2 \cdot \varepsilon_{t-1}^2 \quad (3)$$

EGARCH (1,1) proposed by Nelson (1991) has the same specification and the conditional variance is obtained by the equation:

$$\ln h_t = \alpha_0 + \alpha_1 \cdot \ln h_{t-1} + \gamma_1 \xi_{t-1} + \gamma_2 |\xi_{t-1}| \quad (4)$$

where  $\xi_t = \frac{\varepsilon_t}{\sqrt{h_t}}$ .

GARCH-M (1,1) (Engle, Lilien and Robins, 1987) model has the same conditional variance as GARCH (1,1), but the conditional mean depends on its own conditional variance. This model has the specification:

$$Y_t = \mu + \beta' X_t + \theta h_t + \varepsilon_t \quad (5)$$

Another development of the GARCH models was achieved by Taylor (1986) and Schwert (1989), who introduced the standard deviation GARCH model, where the standard deviation rather than the variance is modelled. This model, along with several others, was generalized by Ding et al. (1993) with the Power ARCH specification. In the Power ARCH model, the power parameter  $\delta$  of the standard deviation can be estimated rather than imposed, and the optional  $\gamma$  parameters are added to capture asymmetry of up to order  $r$ :

$$h_t^\delta = \omega + \sum_{j=1}^q \beta_j h_{t-j}^\delta + \sum_{i=1}^p \alpha_i \cdot \left( |\varepsilon_{t-1}| - \gamma_i \cdot \varepsilon_{t-i} \right)^\delta \quad (6)$$

The Bollerslev (1986) model sets  $\delta = 2$ ,  $\gamma = 0$ , and the Taylor (1986) model sets  $\delta = 1$  and  $\gamma = 0$ . Empirical estimates indicate the power term is sample dependent and values of near 1 are common in the case of stock data (Ding et al. 1993), while for foreign exchange data the power term varies between 1 and 2 (McKenzie and Mitchell, 2002).

After choosing the best fitted model, we generate the conditional variance series and we will use these series as the uncertainties of the two macroeconomic variables. The next step is to test the Granger causality for 4, 8 and 12 lags. The

causality tests will be applied for the 7 relationships between inflation, output growth and their uncertainties, with the corresponding number of lags. The results of the tests will point out the type of correlation between the variables. For the statistical significant correlations we will estimate a VAR model, in order to determine the sign of the causality.

#### 4. EMPIRICAL RESULTS

The empirical analysis performed in our paper concerns the causality between inflation, output growth, inflation uncertainty and output growth in Romania.

Because the analysed period (1990-2014) is characterized at its beginning by the struggle of the policy makers to create the institutional framework for a free economy, in the 1990's we encounter very high inflation rates. In order to capture the specificity of that decade, we worked with 2 sub-samples. The breaking point was chosen in compliance with an earlier analysis (Jemna et al, 2014). Therefore, the two sub-samples used are October 1990 – October 2004 and November 2004 – November 2014.

After 2001, the monetary policy strategy of the National Bank of Romania was direct inflation targeting. We chose the breaking point considering that November 2004 was the first month to have an inflation average for the last 12 months lower than 10. The breaking point highlighted a level of steady-state inflation uncertainty which reflects the uncertainty when inflation is at its steady-state level and there are no shocks to the system (Caporale et al, 2010). This breaking point was tested by means of the Chow test. The results indicated that November 2004 represents a breaking point in the inflation series.

As stated previously, the inflation is measured by the annualized monthly difference of the log CPI and the output growth by the annualized monthly difference of the log of the IPI. The summary statistics of these two variables are provided in Table 1.

**Table 1:** Summary statistics for inflation and output growth

Macroeconomic indicator	Sub-sample 1 October 1990 - October 2004			Sub-sample 2 November 2004 – November 2014		
	Mean	Std.dev.	Jarque-Bera	Mean	Std.dev.	Jarque-Bera
<i>Inflation (CPI)</i>	24.25	25.55	340.35	2.12	2.40	77.43
<i>Output growth (IPI)</i>	-0.56	34.37	11.38	2.00	45.12	0.91

Table 1 highlights very high values of inflation and very low values for the output growth in the first sub-sample. The first decade is represented by the period when Romania began the transition towards the market economy system and the price liberalization was one of the first economic measures to be adopted. Following the measures of economic policy adopted in the 1990s, the yearly inflation in Romania exceeded 200 %. The reformation and restructuring process of the economic system determined important output drops in the early stages of transition.

The second sub-sample is characterized by a more stable and significantly lower inflation determined by an increased stability of the macroeconomic environment. The output growth has a low mean value and is characterized by a high variability, enhanced by the recent economic crisis.

#### a. Testing for stationarity

We start by testing the stationarity of data series using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, for which the null hypothesis is the non-stationarity hypothesis and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, for which the null hypothesis is the stationarity one. The results of the statistical testing are presented in Table 2.

**Table 2:** *Unit root tests*

Macroeconomic indicator	Sub-sample 1 October 1990 - October 2004			Sub-sample 2 November 2004 – November 2014		
	ADF	PP	KPSS	ADF	PP	KPSS
<i>Inflation (CPI)</i>	-4.652	-6.775	1.172	-8.23	-8.41	0.67
<i>Output growth (IPI)</i>	-2.622	-16.41	0.407	-2.93	-27.11	0.076

Note: A constant and 12 lagged difference terms are used for the Augmented Dickey-Fuller test. The MacKinnon critical value for the rejection of the unit root null hypothesis at the 1 % significance level is -3.45. The KPSS critical values for the rejection of the unit root null hypothesis at the 1 %, 5 % and 10 % significance levels are 0.739, 0.463 and 0.347, respectively.

The applied tests highlight that the analysed variables are stationary for the 2 sub-samples. Because the stationarity condition is satisfied for the 2 variables, for both periods, we continue our analysis by applying VAR and Granger-causality test methods in order to identify the adequate number of lags for each variable, as well as the lead-lag interactions between variables.

### b. Modelling of the inflation, output growth and their uncertainties

Using the Likelihood Ratio (LR), Akaike (AIC), Schwarz (SIC) and Hannan-Quinn (HQ) information criteria, we identify a maximum of 3 lags in the first period and 12 lags in the second period for each relation between inflation and output growth. Using VAR Granger Causality, we identified the dependent variable which will be used to estimate the five specified models (ARCH, GARCH, EGARCH, GARCH-M and PARCH). The best fitted model is chosen using information criteria. The estimated equations for inflation, output growth and their uncertainties are presented in the Table 3.

**Table 3:** *Inflation, output growth, inflation uncertainty and output growth uncertainty equations*

<i>Sub-sample 1: October 1990 - October 2004</i>	
<i>Inflation equation</i>	$\pi_t = \frac{6.346}{2.99} + \frac{0.502}{7.37} \cdot \pi_{t-1} + \frac{0.200}{3.05} \cdot \pi_{t-3} - \frac{0.119}{2.87} \cdot y_{t-3}$
<i>Output growth equation</i>	$y_t = \frac{6.10}{1.97} - \frac{0.246}{3.24} \cdot y_{t-1} - \frac{0.279}{3.79} \cdot y_{t-2} - \frac{0.153}{2.05} \cdot y_{t-3} - \frac{0.266}{2.69} \cdot \pi_{t-3}$
<i>Inflation uncertainty equation</i>	$\sqrt{(h_\pi)^{0.514}} = \frac{0.208}{2.52} + \frac{0.180}{5.20} \left  \varepsilon_{\pi,t-1} \right  - \frac{0.987}{11.46} \cdot \left  \varepsilon_{\pi,t-1}^{0.514} \right  + \frac{0.812}{22.72} \cdot \sqrt{h_{\pi,t-1}^{0.514}}$
<i>Output growth uncertainty equation</i>	$h_{y_t} = \frac{1586}{6.41} + \frac{0.162}{2.60} \varepsilon_{y,t-1}^2 - \frac{0.820}{6.36} h_{y,t-1}$
<i>Sub-sample 2: November 2004 – November 2014</i>	
<i>Inflation equation</i>	$\pi_t = \frac{1.550}{5.38} + \frac{0.263}{2.95} \cdot \pi_{t-1}$
<i>Output growth equation</i>	$y_t = \frac{-0.246}{4.70} \cdot y_{t-1} - \frac{0.185}{3.49} \cdot y_{t-3} - \frac{0.211}{3.85} \cdot y_{t-10} + \frac{0.774}{14.11} \cdot y_{t-12}$
<i>Inflation uncertainty equation</i>	$h_\pi = \frac{352}{3.48} + \frac{0.374}{3.77} \varepsilon_{\pi,t-1}^2 - \frac{0.520}{2.41} h_{\pi,t-1}$
<i>Output growth uncertainty equation</i>	$h_{y_t} = \frac{-0.004}{3.89} + \frac{-0.045}{5.91} \varepsilon_{y,t-1}^2 + \frac{1.045}{86.42} h_{y,t-1}$

Notes: Absolute *t*-statistics are given below the estimations.

For measuring uncertainties, we generate the conditional variance series given by the chosen heteroskedastic model. Then we test the 7 economic

hypotheses using the Granger-causality methodology. The results of Granger-causality tests between inflation, output growth and their uncertainties are presented in Table 4. In order to ensure the robustness of the results, the Granger-causality tests are performed for 4, 8 and 12lags.

**Table 3:** *Granger-causality tests between inflation, output growth and their uncertainties*

Tested hypothesis	Sub-sample 1			Sub-sample 2		
	October 1990 - October 2004			November 2004 – November 2014		
	4 lags	8 lags	12 lags	4 lags	8 lags	12 lags
H <sub>1</sub> : Inflation Granger-Causes inflation uncertainty	216.65* (+)	108.50* (+)	76.86* (+)	19.19* (+)	12.83* (+)	8.14* (+)
H <sub>2</sub> : Inflation uncertainty Granger-Causes output growth	2.92* (-)	2.26* (-)	1.97* (-)	0.15 (-)	2.07* (-)	1.23 (+)
H <sub>3</sub> : Inflation uncertainty Granger-Causes inflation	4.31* (-)	2.44* (-)	2.76* (-)	2.28* (-)	1.90* (+)	1.37 (+)
H <sub>4</sub> : Output growth uncertainty Granger-Causes inflation	1.41	1.30	1.74	1.09	1.12	0.55
H <sub>5</sub> : Output growth uncertainty Granger-Causes output growth	1.84	1.01	1.31	5.58* (-)	1.62	1.55
H <sub>6</sub> : Output growth Granger-Causes inflation uncertainty	0.38	0.89	0.91	0.78	3.03* (+)	1.88* (+)
H <sub>7</sub> : Output growth Granger-Causes output growth uncertainty	3.31* (-)	1.64	2.31* (-)	0.87	1.67	0.93

Note: Figures are F-statistics.

+(-) indicates whether the sum of the lagged coefficients of the causing variable is positive/negative

\* denotes the significance at the 0.05 level.

For the statistically significant causality relations, we determined the sign of the relationship by means of VAR. The Friedman-Ball hypothesis is the only hypothesis that is fully confirmed for both sub-samples. The second Friedman hypothesis is fully validated for the first period and partially validated for the second one. A negative causality between inflation uncertainty and inflation is obtained for the period before 2004, while for the second period the results are inconsistent.

Strong empirical evidence was also found for the positive causality between output growth and inflation uncertainty after 2004, while for the negative relation between output growth and output growth uncertainty we found evidences for the first period.

## 5. CONCLUSIONS

It is widely accepted that an economy characterized by low inflation is beneficial for the growth and stability of the macroeconomic environment.

Important variation of inflation and economic growth generates an increase in uncertainty about the future evolution of these indicators, which may affect the decision-making process of business and consumers.

In this paper, using monthly-recorded data for Romania (for the period 1990-2004) 7 hypotheses were tested regarding the causal relationships between inflation, output growth and their uncertainties, for which strong theoretical and empirical evidence was found in literature.

Using real economic criteria and a breaking point test, we built two sub-samples of data (October 1990-October 2004 and November 2004-November 2014). Empirical study results confirmed the Friedman-Ball hypothesis for both periods. In the first sub-sample, the price liberalization measures adopted in Romania in the early 1990s caused very high values for inflation, which led to an increase of uncertainty about future inflation rates. Increased uncertainty about the inflation generated high risks on long-term investments, on interest rates and on other economic variables, generally affecting the economic activity. Thus the negative effect of inflation uncertainty on economic growth emerged very clearly in Romania, in a time characterized by a high macroeconomic volatility.

In 2001, the National Bank of Romania has set inflation targeting as a priority of monetary policy strategy, specifically implemented in 2005. Thus, the second sub-sample corresponds to a period in which Romania was characterized by a lower variation of inflation, which led to a reduction in uncertainty about inflation. These results, consistent with those of Fountas et al (2004) and Hartmann and Roestel (2013), emphasize the fact that in Romania's case, the effects of inflation on output growth have been stronger than in other countries, due to the fact that policy makers had to strengthen their efforts in order to keep inflation low. Keeping a low inflation rate and assuring a stable macroeconomic environment supports the Romanian National Bank's strategy aimed at ensuring a real convergence with the European Union.

Presently, measures adopted by the authorities for maintaining a reduced level of inflation have accentuated the apparition of a phenomena never encountered before in the Romanian economy, namely deflation. Even though, in the short term, the deflationist shocks may have positive effects, in the long term, this can generate negative effects (decreased production, increased unemployment rate, stagnation of the economic growth).

Moreover, the implementation in Romania, as of 1<sup>st</sup> June 2015, of the measure regarding the decreased Value Added Tax on food and non-alcoholic drinks and the new Fiscal Code (as of 1<sup>st</sup> January 2016), will lead to a continuous decrease in the inflation rate. In order to control deflation, the policy makers should adopt a mixture of monetary and fiscal policies which would maintain price stability and assure a sustainable economic growth.

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# ASSESSING THE DETERMINANTS OF FIRMS' COMPETITIVENESS IN GREECE: A STRUCTURAL EQUATION MODELING ANALYSIS

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**Abstract:** *The paper investigates the importance of territorial features/assets (i.e. agglomeration economies, urban infrastructure, factors of labour and cost, development policies, qualitative factors, inter alia) on small and medium-sized firms' competitiveness. The analysis uses primary data from 204 small and medium-sized firms located in Thessaloniki (Greece). These firms operate in the industry, commerce and services sectors. Through the use of Structural Equation Modeling (SEM) analysis, the importance of particular factors for the competitiveness of firms has been analysed, reaching valuable conclusions not only for the firms and the city of Thessaloniki, but also for the firms and areas with similar characteristics in Greece and the wider area of the Balkans.*

**Keywords:** *firms' competitiveness, territorial features/assets, Structural Equation Modeling (SEM) analysis, Greece*

**JEL Classification:** *O18, R5, R11*

## 1. INTRODUCTION

There are two basic theories of strategic management, the Resource-Based View and the Industrial Organization Theory, which focus on the investigation of firms' competitiveness. The first one refers to the internal environment of firms and their abilities and resources to be competitive (Barney, 1991, 2001; Wernerfelt, 1984; Snow and Hrebiniak, 1980)). Following Hart (1995), resource-based theory

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takes the perspective that valuable and costly to copy firm resources and capabilities provide the key sources of sustainable competitive advantage. The second one focuses on the external dynamics of the firms' environment which affect (alternative: environment affecting) their competitiveness (Porter, 2000) and their ability to strategically design and to be effective (McLarney, 2001; Mukherji and Hurtado, 2001). Among the external environment's forces, (the combination of) territorial features/assets (such as agglomeration economies, urban infrastructure, factors of labour and cost, development policies, qualitative factors etc.) is of extreme importance (i.e. Deas and Giordano, 2001; Maskell and Malmberg, 1999; Kresl and Singh, 1999; Keune, 2001; Christiaans, 2002; Fujita and Thisse, 2003). Several studies, using mostly statistical, econometric and correlation analysis, measure the firms' competitiveness at the international level. For instance, Bargegil and Modrego (2011) using a sample of 2,357 firms in Spain, measure the impact of R & D organizations on the medium-sized firms, Bayyurt and Duzu (2008) present a comparison of the relative efficiencies of the manufacturing firms in China and Turkey, Kumar and Chadee (2002) evaluate the competitiveness of Asian manufacturing firms, while Parida (2008), using a sample of 1,471 information and communication technology firms (ICT), conceptualize the dynamic capabilities, studied the influence of ICT in related small Swedish firms. Finally, Henderson and Cockburn (1994), through econometric and structural interviews, measure firms' productivity and the nature of competencies in pharmaceutical firms.

By taking into consideration that the supply of a favorable business environment is crucial for both the attraction of new investments and the development of the existing ones, the paper, using Structural Equation Modeling (SEM) Analysis, focuses on the evaluation of the impact of territorial characteristics/assets on 204 small- and medium-sized firms (SMEs), located in Thessaloniki (Greece), operating in the sectors of industry, commerce and services. The impact of the factors identified using the SEM application on the overall firms' competitiveness is econometrically assessed. The present paper's contribution is of twofold importance: a) the findings come from a primary research: the way the dataset is constructed allows us to capture the local firms' perceptions and opinions regarding the factors affecting the competitiveness dynamics of the area under investigation and, b) the relationship between local business environment and

competitiveness in Greece, particularly in Thessaloniki, has drawn a limited amount of research so far, thus the present analysis contributes to the literature regarding the competitiveness determinants in the area of interest.

Furthermore, as Liargovas and Skandalis (2007) underline, current increasing globalization conditions exert an increasing pressure upon local enterprises in terms of more intense international competition. In particular, Greece's case constitutes an interesting one since most of the firms are small and medium-sized enterprises which need to address the limitations of the small local markets and expand their operation in order to ensure survival and international competitiveness. In addition, the economic and monetary integration of the European Union member states and the opening of markets in the Eastern European countries intensifies the competition faced by the local native firms since the barriers related to the free movement of production factors have been lifted (Floros et al., 2014). An understanding of the factors affecting firms' competitiveness at the local level in Greece will shed light on the issues and problems that need to be addressed by local firms if they aim to improve their competitiveness and extend their operation in this increasingly globalizing environment. Furthermore, the firms' competitiveness is a significant determinant of the whole economy's competitiveness level and it also affects the local (native) citizens' employment level and standard of living (Floros *et al.*, 2014). While some studies addressed similar issues in Greece, to our knowledge, none uses local primary data in order to examine the factors affecting the local firms' competitiveness with a wide range of indicators proposed by previous research.

The following section presents the literature review and, in particular, the variables (factors) under consideration, as well as the corresponding sources. The third section describes the research profile and the methodology. The fourth section presents the results of the SEM for the firms considered. The fifth section presents the results of the econometric analysis with regard to the determinants of the firms' competitiveness. The last section of the paper offers the conclusions.

## **2. LITERATURE REVIEW**

### **2.1 Development of the research and selection of variables**

The main purpose of this study is to shed some light on the factors (criteria) that may affect the competitiveness of SMEs in the area of Thessaloniki in Greece. In doing so, the study utilizes primary level data and it empirically approximates the determinants of SMEs competitiveness at the firm level. In addition, the empirical investigation incorporates a wide variety of factors that have been identified to affect competitiveness by previous research. Therefore, it is of importance to understand the research conclusions drawn by previous similar studies.

In addition, the selection of the variables (factors), which constitute criteria for the firms' location in specific areas, was mainly based on the report of CEC (1993), and, on the empirical studies of Herrin and Pernia (1987) and Trofimenko (2010). According to the CEC report (CEC, 1993), industrial firms pay more attention, comparing to the commercial/services ones, to the existence of agglomeration economies, the geographic location, the existence of supporting services, and to the area's low taxes. In addition, factors associated to labour and to the existence of effective urban infrastructure (i.e. airports, ports, telecommunications) are considered important to their competitiveness. However, large commercial enterprises pay more attention to qualitative factors, workforce, and economic factors concerning the markets' size and their accessibility to customers and suppliers.

Herrin and Pernia (1987), using 34 criteria, which form 6 groups, and primary data, on a 1 to 5 Likert scale, from 100 local and foreign firms in the Philippines, found that closeness to major customers, easy road access, reliable electrical power, adequate telephone/telex services, availability of a suitable plot of land, availability of a suitable building, and adequate space for expansion are, more or less, equally important location factors for local and foreign firms.

Trofimenko (2010), using data from the World Bank's Study of Competitiveness, Technology and Firm Linkages, for 1,409 exporters and foreign-owned firms in China, examined 4 groups of location criteria. The empirical results indicated that exporters and foreign-owned firms are attracted by the size of the

local market, the quality of telecommunications, and the supply of skilled labour, while the quality of the transportation was not significant.

Besides traditional economic factors, such as the size of local market, the production structure, and the labor cost, the aforementioned studies attribute great importance to other non-conventional factors, such as the quality of cultural and social infrastructure, the existence of investment support agencies, as well as partnerships among local public authorities and private sector (Metaxas, 2011). This list of non-conventional factors can be enriched with input from other studies, such as D'Archy and Keogh (1999), Rogerson (1999), and Craglia et al., (1999), who use the variables of land use and values, quality of life, and international connections, respectively. These studies examine how firms belonging to different sectors, and located in particular areas, evaluate and exploit local/regional assets and policies in order to support their development and competitiveness.

On the basis of the discussion previously held, the literature identifies several groups of local/regional factors that affect the firms' competitiveness. Agglomeration economies, including proximity to customers/suppliers – market size – supporting services – availability of natural resources - similar business existence (Crozet *et al.*, 2004; Nachum and Keeble, 2003; Rocha and Stenberg, 2005; Graham, 2007; Doeringer *et al.*, 2004; Combes *et al.*, 2008). In this case, clusters enhance the firm access to specialized labour, materials, and equipment and enable lower operating costs. Easy access to markets is defined as the primary factor since the new markets, at regional and national level, are places where the new products have to be promoted to the new potential consumers, directly and effectively increasing the demand levels of these products (Doeringer, et.al, 2004; Trofimenko, 2010). In addition, highly concentrated markets attract skilled local workforce by offering job mobility and specialized suppliers and service providers by providing substantial business opportunities in close proximity (Austrian, 2000; Keune, 2001; Alonso-Villar, 2002; Trofimenko, 2010), while the creation and application of innovative and entrepreneurial local knowledge is deemed especially critical for securing regional economic advantage (i.e. Keeble and Wilkinson, 2000; Simmie, 2002; Karlsson et al 2008).

Furthermore, the management of labour relationships is directly linked to the existence of the employees' satisfaction deriving from this work. There are a number of studies stressing the fact that the provision or absence of motives

influences the behaviour of employees and, consequently, the firms' efficiency (Herzberg et al., 1959; Locke, 1976; Parsons and Broadbridge, 2006).

In addition, urban infrastructure, including road/highway, train, seaport and air connections, plays a crucial role on the firms' competitiveness as well as on cities' development since it is strongly related with the direct distribution of goods, the easy access to markets, the decrease of transportation (alternative: shipping) cost and, finally, the price of goods (Vickerman, 1996; Wheeler and Mody, 1992; Glaeser, 1999; EC 2003).

A number of studies support the importance of the shipping cost and land use cost on the firms' decision making process for establishment (Harrington and Warf, 1995; Zhu 2000). In the new economic geography models, in particular, firms seek to create new establishments in areas with lower costs and market shares in the emergent states economically and geographically well-positioned (Disdier and Mayer, 2004; Vazquez-Rozas, 2009).

Finally, quality factors, including, urban aesthetic, attractiveness of physical environment and quality of education, research and training, contribute to business creativity, especially for SMEs, to the increase of their productivity and the development of innovative actions (Keune, 2001; Twomey, 2002). International practice mentions cases of cities that improved their images through the adaptation of regeneration and (possible alternative: reinvention) policies in order to attract investments and specialized human resources and to award their competitive advantages, based on their particularities as competitive destinations (Hall, 1998; Hope and Klemm, 2001). Table 1 presents an overview of the variables used in the particular studies.

**Table 1:** *An overview of the variables used in particular studies*

<b>Sources (Studies and Reports)</b>	<b>Variables (factors)</b>	<b>Method and Analysis</b>
Vernon Henderson (1986) Brazil	Labour quality and specialisation	Secondary data and econometric analysis
Herrin and Pernia (1987) Philippines (100 firms)	Proximity to customers/suppliers Availability of support services Labour availability Sufficient connections by air Sufficient road/highway connection	Empirical research– Likert scale
CEC (1993) Europe (Industrial, Commercial, Services and R&D sectors)	Local market size Proximity to customers/suppliers Accessibility to other national markets Presence of foreign business	Empirical research– Likert scale

Sources (Studies and Reports)	Variables (factors)	Method and Analysis
	Availability of strong investment incentives Low local taxes Labour morality/ethics- Labour availability Existence of similar business	
Luce (1994) (Philadelphia Metropolitan Area)	Local Taxes	Econometric Analysis - equation partial adjustment model
D'Arcy and Keogh (1999) UK cities	Low cost of land	Econometric analysis
Edward Glaeser, Jed Kolko and Albert Saiz (2001), USA cities	Urban aesthetic and culture / recreation	Econometric analysis and case-study (Manhattan)
Stephen Redding and Antony Venables (2004), USA counties	Access to other national markets Proximity to customers/suppliers	Econometric analysis
Keith Head and Thierry Mayer (2004), Western Europe (Japanese firms)	Proximity to customers/suppliers Market potential	Empirical research, econometric analysis
Mihir Desai, Fritz Foley and James Hines, (2004) USA (multinational firms)	Local taxes	Secondary data and econometric analysis
Fernando Galindo-Rueda and Jinathan Haskel (2005), England (Annual Business Inquiry and Employer Skills Survey)	Labour quality and specialization	Descriptive statistics and econometric analysis
Gerard Marlet and Clernes van Woekerns (2005), Dutch cities	Urban aesthetic and culture / recreation	Statistics and factor analysis
Murillo-Luna and Ramón-Solans-Prat (2008) (98 Spanish industrial firms)	Natural resources	Empirical study (structured questionnaire and PCA Analysis)
Shangqin et al. (2009) New Zealand (75 local firms)	Local market size	Empirical research, descriptive and econometric analyses
Trofimenko (2010) China (1,409 export firms)	Local market Availability of strong investment incentives Sufficient railroad connections Quality of local higher education Quality of local training/continuing education Quality of research institutes	Econometric analysis
Rademaekers, et al., (2011)	Natural resources	Analytical report for EU, Comparative sector analysis
Hsiao-Chi and Chia-Han (2014) (Domestic firms from	Natural resources- Labour quality	Analytical Hierarchy Process (AHP) approach and TOPSIS

<b>Sources (Studies and Reports)</b>	<b>Variables (factors)</b>	<b>Method and Analysis</b>
China and Taiwan)		analysis (internal firm's data)

In the present analysis, a set of indicators grouped in three categories were chosen, namely: Agglomeration economies, Quality of life /labour, Urban infrastructure. The indicators were chosen based on their performance and significance in the estimated model, and a total of nine independent variables were finally included in the analysis.

## **2.2 The analysis' importance for Thessaloniki and other similar cities**

It is very important to underline that the above mentioned factors of competitiveness, which have been thoroughly studied using up-to-date empirical research, indicate that certain factors exert a strong and significant effect in the development and competitiveness of firms in specific regions. In the present paper, the competitiveness factors used are drawn from firms located in Thessaloniki and their investigation is considered to be very useful not only for Thessaloniki but also for other regions that share similar economic environment characteristics in the Balkans, namely Varna, Burgas or Constanta and the like.

Similar to the above-mentioned regions, Thessaloniki hosts a harbour with special development dynamics and characteristics. The competitiveness factors examined here are considered to be territorial assets of the region and are closely related to the development and the competitiveness of the firms located in Thessaloniki.

The same applies for the rest of the regions discussed above. A recent study of Varna (Metaxas, 2008) showed that several factors such as the agglomeration economies, urban infrastructure and the environment's quality are positively related with the local firms development. Other factors such as the local taxes, land and labour costs, as well as the availability of strong investment incentives, were found to be negatively related with a firm's competitiveness. All these factors are expected to be very important, despite the obstacles which rose in the last years and the slowdown in the industrial development of the region and the limitations of the harbor operation (van Winden, 2014).

In addition, following the Municipality Development Plan of Constanta (2006:43-44) we will sustain the idea that, according to the development objectives of the city, similar factors of interest are presented similar to the Varna's case. The role of port and urban infrastructure is crucial, while the city lacks the existence of investment incentives and the capacity to manage European development projects.

In the case of Thessaloniki, agglomeration economies are considered to be extremely important since the city is located in a strategically significant location, with numerous SMEs operating in the broader area. The market size and the transportation system at the national, Balkan and European level might strongly affect the firms' competitiveness levels and the city's development, as well as at the regional level. The local taxation system and the low costs of land use can encourage new firms in the area, as well as facilitate the development of the existing firms. At the same time, the city's infrastructure, which is located in a focal point for the road, air and sea transport systems, can further affect the investment levels attracted in the area. The conclusions drawn by the present study can serve as an initial guide for the SMEs in Thessaloniki, as well as for other Balkan cities sharing similar characteristics. Therefore, the study's findings are important not only for the city of Thessaloniki and Greece in general, but also for other similar regions and cities in the wider area of Balkans and South European regions.

### **2.3 Thessaloniki in brief**

Thessaloniki is the second-largest city in Greece and the capital of the periphery of Central Macedonia, as well as the *de facto* administrative capital of the Greek regions of Macedonia and Thrace. According to the 2011 census, the municipality of Thessaloniki has a population of 322,240, while the Thessaloniki Urban Area (the contiguous built up area forming the "City of Thessaloniki") has a population of 790,824; making it the fifth largest and most populated city in the Balkans and the second most populated city that is not a capital. Furthermore, the Thessaloniki metropolitan area extends over an area of 1,455.62 km<sup>2</sup> (562.02 sq mi) and its population reached a total of 1,006,730 inhabitants (National Statistical Service of Greece, 2011). With a history of over 2,300 years, it is one of Europe's oldest cities. Thessaloniki is Greece's second major economic, industrial, commercial and political centre, and a major transportation hub for the rest of

South-East Europe; its commercial port is also of great importance for Greece and the South-East European hinterland. The city itself has faced a rather severe “de-industrialization” over the period of the last two decades mainly due to the changes in the international industrial environment, the restructuring of the Greek economy, the new priorities of the European Union and the unstable environment in the Balkan States (RIMED Report No.9, 2005; Konsolas *et al.* 2002; Coccosis and Psycharis, 2008). The Port of Thessaloniki is one of the largest ports in the Aegean and as a free port, it functions as a major gateway to the Balkan hinterland. In the first six months of 2010, more than 7.2 million tons of products went through the city's port, making it one of the largest and most used ports in the Balkans. Thessaloniki has also been slowly turning into a major port for cruising in the Eastern Mediterranean (Thessaloniki Port Authority, 2010). The city is a major transportation hub for the whole of South-East Europe, carrying, among other things, trade to and from the neighbouring countries. Its economy is being transformed into a service economy with a rapidly grown logistic sector, whereas its economic hinterland shows industrial concentration. Its exports (20% of total national exports) are oriented towards the EU Member States such as Germany and the United Kingdom, while in the last 15 years exports towards Eastern Europe and Balkans have been growing rapidly. In 2009, the regional unit of Thessaloniki had a gross domestic product of € 21.321 billion (ranked 2<sup>nd</sup> amongst the country's regional units), comparable to Bahrain or Cyprus, and a per capita of € 18,400 (ranked 15<sup>th</sup>). In purchasing power parity, the same indicators are € 22.998 billion (2<sup>nd</sup> place,) and € 19,800 (15<sup>th</sup> place) respectively. In terms of comparison with the European Union average, Thessaloniki's GDP per capita indicator stands at 78 % of the EU's average and 84 % in PPP. Overall, Thessaloniki accounts for 9.2 % of Greece's total economy of Greece. In 2009 the economy contracted by -1.6% (Eurostat, 2010).

### 3. METHODOLOGY

#### 3.1 Dataset

The dataset used in the study is drawn from a questionnaire survey applied to managers and business owners ] (123 business owners and 81 managers filled the questionnaire), as they are considered to be the most appropriate to answer

questions regarding specific firm characteristics related to their territorial environment, development policies, future prospects and competitiveness issues. The survey was conducted during the period April 2007-June 2008, and the survey's target included firms located in the Thessaloniki region (Greece). In order to sustain the chance of clarifying ambiguous questions, and to avoid "quick" and "non-skeptical" answers the programming method was preferred instead of a random interview; A Likert scale from 1 to 10 (Stathakopoulos, 2005) was used. The dataset contains detailed information regarding the characteristics that are addressed by the literature as the most important in assessing firms' competitiveness. The response rate ranged to approximately 90 % (out of 227 questionnaires, 204 with complete information). The vast majority of the firms who answered was local (87,1 %), an element revealing the firm's appreciation, as well as the fact that they are aware of the territorial environment (weaknesses and strengths) as well as of the development policies applied by the local authorities, for the benefit of the cities and the firms. The firms included in the sample were required to employ at least 20 employees. Interviews were made with high level managers and business-owners, and each interview lasted around 25-30 minutes. Interviews were certified with the signature of the responder who filled in the questionnaire and the business stamp. Finally, the selection of the firms was based on data provided by the Commercial and Industrial Chamber of Thessaloniki. Regarding the profile of the studied firms, 32,3 % of them belong to the industrial/manufacturing sector, 25,9 % to the commercial sector, 22 % to services and 19,6 % to the tourism sector. Furthermore, the average number of employees is 62 employees. Consequently, we reported only on small-medium firms.

### 3.2 Variables

A lot of information regarding the most important determinants of the firms' competitiveness are included in the questionnaire. Based on the existing research, various questions are asked regarding the indicators found to have consistently affected the firms' competitiveness, namely *agglomeration economies*, *quality of life*, *labour* features and *urban infrastructure*. In Table 2, the detailed definitions and the name of the variables, along with their descriptive statistics utilised in the study are presented.

Based on the mean values shown in Table 2, we observe that, in most of the cases, the mean values of the respondents' answers are relatively low, barely above the cut-off value of six. The lowest mean value is observed for the question regarding the existence of "*Natural resources availability*", indicating that in Greece the natural resources are not available in an efficient way.. The highest respective mean value is observed for the "*Size of local market*".

In addition, there maybe a systematic bias in responses between business owners and managers, arising from the different status they hold within the firm. Such discrepancies in responses can significantly affect the findings of the present study. Therefore, the last two columns in Table 2 separately present the mean values in the responses of business owners and managers. As it can be seen, their responses are very close and the differences in the mean ratings are negligible. Perhaps this fact is also due to the nature of the questions asked, since they are related to the features of the local market and infrastructure, and not so much to the specific firm characteristics. This way, systematic differences in responses are not observed.

**Table 2:** *Definitions of the variables and descriptive statistics*

Variables	Variable Measurement	Mean	Standard Deviation	Business Owners Mean Values	Managers Mean Values
<b>Agglomeration economies</b>					
Size of local market	1-10,	7.225	1.713	<b>7.195</b>	<b>7.272</b>
Natural resources availability	1-10,	5.794	2.011	<b>5.878</b>	<b>5.667</b>
Presence of similar business	1-10, 10: Highest degree	5.995	2.013	<b>6.001</b>	<b>5.975</b>
<b>Quality of life - labour</b>					
Labour availability	1-10,	6.230	2.136	<b>6.341</b>	<b>6.062</b>
Culture / Recreation	1-10,	6.686	1.705	<b>6.756</b>	<b>6.889</b>
Quality of local training / Continuing education	1-10,	6.515	1.757	<b>6.390</b>	<b>6.580</b>
<b>Urban infrastructure</b>					
Sufficient road / Highway connections	1-10,	6.809	1.713	<b>6.041</b>	<b>7.086</b>
Sufficient railroad connections	1-10,	6.466	1.732	<b>6.756</b>	<b>6.580</b>
Sufficient seaway connections	1-10,	6.456	2.504	<b>6.659</b>	<b>6.296</b>
Number of observations	204				

Source: Authors' calculations

Note: 10 represents the highest value.

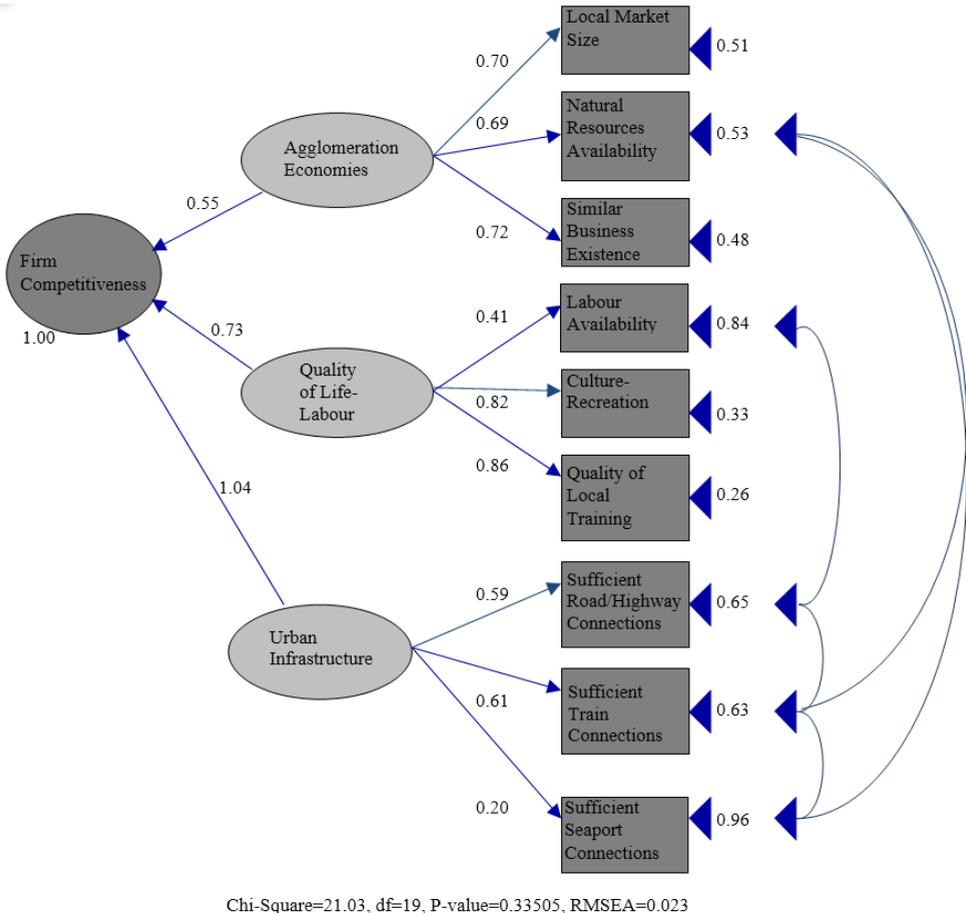
### 3.3 The Model

Structural Equation Modeling (SEM) can be viewed as a combination of factor analysis and regression or path analysis (Hox and Bechger, 1998). The basic idea is that, following the defining of the indirect and direct pathways operating within the relationships of interest, the latent variables, though they cannot be observed by the researcher, can be estimated using their relation with the observed variables (multiple indicators) (Maruyama, 1997; Joreskog and Sorbom, 1998).

Regarding the firms' competitiveness and performance studies, SEM has been used in a variety of scientific works. For instance, Ling et al. (2012) investigate in Porter's 'diamond' environment the components of competitiveness, develops and validates mathematical models in order to predict the competitiveness levels of architectural, engineering and construction firms headquartered in mainland China. Momeni et al. (2011) investigate the relationship between knowledge management process capabilities and core competencies in Iranian companies using a questionnaire survey and the factor and SEM analysis. Furthermore, Tong et al. (2010) used the SEM analysis to evaluate the core competence of insurance companies. Based on empirical research of 108 Hong Kong-based China family owned manufacturing firms, Wu (2008) made use of regression and SEM analysis to examine the mediating role of information sharing in the relationships between dimensions of social capital and firm competitiveness. In addition, Graig et al. (2007) applied SEM in order to investigate how the promotion of family-based brand identity influences competitive orientation (customer versus product) and firm performance in family businesses. Finally, Chi et al. (2009) conducted SEM analysis by using collected industrial survey data, in order to provide a systemic understanding of the relationships between the individual business environment characteristics, the individual competitive priorities and supply chain structures, and the impact of alignment between these elements on firm business performance.

Generally, the SEM models are applied in order to simultaneously examine more complex relationships between observed and latent variables and to incorporate the latent variable of firm competitiveness in the analysis. Using the empirical literature quoted above, the present study goes one step ahead and, based on the SEM model, tries to examine the relationship between the firms' competitiveness and the crucial indicators related to it.

We assume that the three latent (unobserved) variables, namely agglomeration economies, quality of life / labour and urban infrastructure are determined by three sets of ordinal, observed variables (namely, local market size, natural resources availability, and the like). These three latent factors are assumed to exert an impact on the firm competitiveness levels (another latent, unobserved variable). The scale of the latent factor firm competitiveness is fixed by assuming that it has a unit variance (Jöreskog and Sörbom, 2001). The hypothesized SEM model is estimated as described above and it is presented in the path diagram (Figure 1), being similar to the model provided by Strandskov (2006).



**Figure 1.** Path model on the determinants of firms' competitiveness

The estimation method is the Weighted Least Squares (WLS), analysing the matrix of polychoric correlations. When the observed variables are ordinal with highly non-normal distribution, the WLS method is preferred in order to produce correct estimates, standard errors and goodness of fit statistics (Jöreskog and Sörbom, 2001). The estimated parameters presented in the study are standardized since they are considered more appropriate for a clearer interpretation and comparison of the estimated effects (Diamantopoulos and Siguaaw, 2000; Moustaki and Knott, 2000). Furthermore, correlated error terms are introduced in the models (Figure 1). While correlated error terms are generally viewed with suspicion by researchers, however they can be justified in cases such as ours, where the observed indicators come from similar wording questions, reflecting very close meanings (Diamantopoulos and Siguaaw, 2000) and have been introduced in the past in a similar manner (van de Ven and van der Gaag, 1982).

## 5. RESULTS

Table 3 presents the results of the SEM model. All estimated factor loadings are positive and statistically significant. Regarding the latent factor agglomeration economies we see that it is positively related to all outcomes. Specifically, agglomeration is higher among firms operating in a larger sized market, who have a better availability of natural resources and where there are similar firms. The estimated correlation for the outcome variable similar business existence seems to be the highest among the observed estimated correlations. In this regard, we would like to emphasize the fact that the variable similar business existence concerns the concentration of similar firms in a given geographic area, which could develop into partnerships, knowledge and knowhow exchange, shared infrastructure and networks, thus, through their connection, be able to increase their competitiveness. In other words, operating in the frame of a cluster.

Quality of life is also strongly related to its outcomes. In particular, firms enjoy quality of life with increasing levels of labour availability, quality of local training and cultural factors that can affect the firms' performance and productivity. The strongest correlation is found for the outcome variable of quality of local training / Continuing education".

Finally, *urban infrastructure* is, as expected, also strongly and positively related to its outcome indicators. Firms enjoy higher levels of urban infrastructure

with increasing sufficiency of road/highway, train and seaway connections. For this factor of infrastructure, the greater loading is observed for the outcome variable of train connections.

When the relationship of the latent factors is examined, it is evident that the firms' competitiveness is strongly and positively related to all three elements (*agglomeration economies*, *quality of life / labour* and urban infrastructure, indicating that these factors are important indicators for competitiveness of firms. A very high loading is observed for the factor urban infrastructure in comparison to the remainder, revealing the very strong correlation this factor has with competitiveness of firms. As Joreskog (1999) argues, such a high standardized coefficient does not necessarily emphasize a modelling. Based on the fit indices (Table 2, last rows), it seems that the model adequately fits the data.

**Table 3:** SEM Results on the Effects of Firms' competitiveness on Firms Characteristics (Completely Standardised Estimates), WLS

<i>Dep. Variables</i> / <i>Ind. Variables</i>	<i>Agglomeration Economies</i>	<i>Quality of Life – Labour</i>	<i>Urban Infrastructure</i>
Size of Local Market	0.701		
Natural Resources	0.688 ***		
Accessibility			
Similar Business Existence	0.719 ***		
Labour Availability		0.405	
Culture / Recreation		0.821 ***	
Quality of Local Training / Continuing Education		0.859 ***	
Sufficient Road / Highway Connections			0.593
Sufficient Train Connections			0.608 ***
Sufficient Seaway Connections			0.198 ***
<b>Firm Competitiveness</b>	<b>0.550 ***</b>	<b>0.725 ***</b>	<b>1.043 ***</b>
<i>Chi square (prob.)</i>		21.032 (0.335)	
<i>DoF</i>		19	
<i>RMSEA</i>		0.023	
<i>CFI</i>		0.997	
<i>NNFI</i>		0.994	
<i>GFI</i>		0.992	
<i>Observations</i>		204	

<sup>a</sup> The asterisks next to the coefficients indicate \*\*\* significance at 1%, \*\* significance at 5%, \* significance at 10%.

<sup>b</sup> Error terms are allowed to correlate as shown in Figure 1. All error term correlations are statistically significant.

## 6. CONCLUSIONS

The present study examines the external environment factors that affect firms' competitiveness, in the Thessaloniki area (Greece). A series of factors, considered to mainly affect competitiveness, are used (namely agglomeration economies, quality of life/labour, urban infrastructure (Deas and Giordano, 2001).

All estimated relationships are found to be statistically significant and in accordance to the findings of previous research. Agglomeration economies are significantly associated with local market size, availability of natural resources and similar business existence in line with previous empirical findings (Crozet *et al.*, 2004; Duranton and Puga, 2004; Nachum and Keeble, 2003; Rocha and Stenberg, 2005; Graham, 2007; Doeringer *et al.*, 2004; Combes *et al.*, 2008). Similarly, high values of *quality of life/labour* are associated with higher values of labour availability, greater cultural and recreational environment and higher quality of local training. As the literature argues, these findings are expected since they are accompanied with higher productivity and innovation in the production process (Keune, 2001; Twomey, 2002). Finally, urban infrastructure is increased with higher availability of road/highway, train and seaport connections. Based on existing research, these factors are identified as major determinants of firms' competitiveness since they facilitate firms' ability to reach new markets for its products and, at the same time, decreases transportation costs and consequently prices, leading to higher competitiveness advantages (Vickerman, 1996; Wheeler and Mody, 1992).

As expected, the factors mentioned above are significant indicators of the firms' competitiveness, with urban infrastructure exerting the higher effect among all. Once again, *agglomeration economies*", *quality of life/labour*", *urban infrastructure*", are shown to be highly associated with firm competitiveness since regional market characteristics, greater availability and quality of labour force and availability of adequate connections will facilitate production process, productivity and opening to other markets.

All in all, this study presents evidence on the factors that are major determinants of firms' competitiveness at the regional level. These findings may serve as guideline to policymakers and researchers on the challenges needed to tackle if the aim is to improve the competitiveness of our firms. Increasing their competitiveness is vital not only for the firms *per se*, but for the economy as a

whole, since increased competitiveness is an indicator of a healthy economy and of improved living conditions for its citizens. Still, further/additional research is needed with the use of large scale surveys that will facilitate to examine in more detail the main determinants of firm competitiveness.

Finally, we argue that the survey results contribute, to a degree, to the other studies and approaches so far, because they reveal the dynamics of the spatial environment connected to the development and competitiveness of the city of Thessaloniki and the study firms. In a geographical area where there is a lack of empirical researches production, the results of this study form at the same time the framework in the policies and activities planning towards the support of the medium firms' development. Also, this contribution is enhanced even more by the fact that the estimations presented refer to existing firms, which play a really important role in the development of the city of the research as they experience the development conditions every day. At this point, however, we have to highlight a weakness of the present research. This weakness is connected to the generalization of the conclusions for other firms as well, situated in other cities of the South-East Europe. We mention the examples of Bari and Constanta, but of course, we cannot argue that the results express the attitude of all cities and firms in the wider area of South-East Europe. Clearly, if we have had studied more cities or we had presented a more representative sample of firms, the conclusions of the research would have had a greater generalization coefficient and the final estimations would have been more representative. Despite this weakness, the results of the study refer to a great number of firms, situated in very interesting and dynamic city, in key geographical location. Consequently, the estimations of the firms are very important and can contribute to the existence of similar estimations also by a wider number of firms situated in other cities of the Southeast Europe.

Regarding *policy implications* for Thessaloniki development, the findings of this study related to the following significant points. *Firstly*, the central geographical position of the city is the main advantage. Local decision makers and politicians should focus on the exploitation of these providing motives for supporting the existence firms and attracting new ones. *Secondly*, the strategic development of the city should be connected to the investigation and situation audit analysis of the current business environment. Many cities in Greece try to create, in a general way, an appropriate competitive and attractive entrepreneurial climate,

without any focus on the particularities and the needs of their business. This study presents and supports this necessity if we want to build an efficient spatial development strategy. *Thirdly*, this study aims to award the need of local authorities with organising and entrepreneurial capacity and knowledge to evaluate primary evidence and to plan development policies and actions by listening the market, the business but also the responses of the wider community.

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# DETERMINANTS OF LOAN QUALITY: LESSONS FROM GREEK COOPERATIVE BANKS

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**Abstract:** *The article focuses on the credit risk of cooperative banks in Greece. The main objective is to define which factors are responsible for variations in loan quality during the period 2003-2014. Loan quality is measured by Loan Loss Reserves Ratio (LLR) and dynamic regression techniques are implemented for the econometric estimations. The outlined results suggest that the macroeconomic environment (i.e. public debt, local unemployment, economic activity and inflation) and the accounting ratios (i.e. past loan quality and profitability) seem to be the explanatory variables of problem loans.*

**Keywords:** *credit risk, loan quality, loan loss reserves, accounting factors, macroeconomic environment and generalized methods of moments.*

**JEL Classification:** *C23, G21*

## 1. INTRODUCTION

Since 2009, Greece has sunk into great economic depression, and thus the structural weaknesses of Greek economy were revealed. The severe sovereign debt crisis caused tremendous economic, financial and political instability, making it the first developed country in modern economic history which failed to repay an IMF loan. Therefore, there seems to be no compelling reason to argue that the Greek banking system was dramatically influenced. Towards this direction, problem loans expanded significantly (i.e. non performing loans ratio exceeded 34 % in 2014<sup>6</sup>), affecting the creditability of financial system. Moreover, the last three years, six

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<sup>6</sup>Source: World Bank Indicators.

cooperative banks collapsed and considerably traumatized their local economies. According to the announcements made by the National Bank of Greece, the main reasons for these credit institutions to be under special liquidation procedure, were the high proportion of problem loans in their portfolios and the incapability of taking initiatives in order to reassure their sustainability.

Generally, cooperative banks are private institutions, whose members are simultaneously their customers. The motive behind the establishment of these banks is regional development and the need to eliminate the obstacles in granting resources and providing loan guaranties for small borrowers and depositors (Karafolas, 2005). Despite local advantages, cooperative banks influence national economy as well since they improve the stability and profitability of financial system (Papadimitriou and Toay, 2014). Fonteyne (2007) highlights that cooperative banks, due to their commitment on traditional financial intermediation activities and undoubtedly on significant credit exposures, are more sensitive in changes of credit quality and interest rates. In Europe, cooperative banks account for 50 % of the market of EU bank deposits and loans and play a crucial role in European economic environment, serving more than 250 million customers (around half of the EU's population) mainly retailers, small and medium size enterprises (SMEs) and local communities (EACB, 2014).

Although the examination of the explanatory variables of loan quality is very popular internationally, in Greece is at a very premature level. To the authors' best knowledge so far in Greece very few studies have examined credit risk determinants of commercial banks (i.e. Louzis, Vouldis and Metaxas, 2010; Makri and Papadatos, 2014) and none of cooperative banks. In this context, the present study covers the gap in the existing literature, providing for the first time a comprehensive account of macroeconomic and accounting factors, affecting loan quality in Greek cooperative banks, for the period 2003-2014. Our analysis is focused on the aforementioned period in order to capture not only both economic growth and recession of the domestic economy, but also to include the wave of cooperative bank failures, in Greece. Furthermore, Loan Loss Reserves (LLR) is used as a proxy indicator of loan portfolio quality. LLR is a contra asset account, which reduces total loans value to the amount of estimated loan losses by bank managers, considering future prevailing economic conditions (Ahmed Takeda and Thomas, 1999; Balla and Mckenna, 2009).

The aim of our analysis is to create a tool for identifying any existing vulnerabilities of Greek cooperative bank industry. More precisely, the determinant factors can serve as an instrument for reducing loan losses, monitoring loan quality and designing strategies and decision making processes for Greek cooperative banks. Despite their small share to the Greek financial system numbers, its contribution on local economy is crucial, since they offer banking products based on local needs and existing economic conditions. The findings of our study demonstrate that variations in loan quality are driven from macroeconomic environment and accounting indices.

The remainder of the paper is organized into eight sections. Section 2 introduces an analysis on the evolution of Greek cooperative banks. Section 3 presents the literature review. Section 4 demonstrates the methodological framework, as well as the econometric estimations. Section 5 analyzes the sample and data. Sections 6 and 7 provide the empirical findings and an analytical discussion of the results, respectively. Finally, section 8 highlights the main concluding remarks of the paper.

## **2. THE EVOLUTION OF THE GREEK COOPERATIVES BANKS**

Greek cooperative banks were established during the 1990s by the law no. 2076/1992 and the act number 2258/1993 issued by National Bank's Governor. Cooperative banks can offer all types of banking activities and operate on prefectural, regional or national basis. Their minimum capital requirements are depended on their network and the location of each bank's headquarters. Cooperative banks, similar to any other commercial bank, must follow supervisory and regulatory legislation imposed by the Bank of Greece. Until recently, cooperative financial institutions were limited to serving only their members, the government and other financial institutions. Later on law number 3483/2006 gave the opportunity to the cooperative banks to expand their services to non-members in a proportion up to 50 % of the bank's loans or deposits (Karafolas and Katarachia, 2009). Another important thing to remember is that they constitute a less developed industry, since their operation has started 20 years ago. Table 1 briefly presents the basic indicators of the Greek cooperative industry.

**Table 1** Key figures regarding the Greek cooperative banks

	2004	2006	2008	2010	2012	2014
Banks	16	16	16	16	13	10
Banking outlets	114	145	177	191	162	127
Staff	762	974	1.238	1.307	1.133	922
Total assets (millions €)	1.574	2.570	3.752	4.500	3.610	3.261
Deposits (millions €)	1.273	2.135	2.927	3.400	2.933	2.630
Loans (millions €)	1.270	1.935	3.064	3.500	3.259	2.923
Market share deposits (%)	0,8%	0,8%	0,8%	1,0%	1,8%	1,1%
Market share credits (%)	1,0%	1,0%	1,1%	1,0%	1,3%	0,8%
Members	144.176	175.541	196.179	212.488	189.232	163.135
Clients	144.176	175.541	N/A	430.686	396.173	407.633

Source: Annual Reports of the European Association of Co-operative Banks (2005, 2007, 2009, 2011, 2013 and 2015).

In 2014, only 10 cooperative banks were operating in Greece, since a wave of bank failures started on 2012. The off-balance sheet deposits, the granting resources without underwriting requirements and generally the existence of severe corruption in the industry, led to the collapse of six cooperative banks (Papadimitriou and Toay, 2014) and made the investigation of credit risk determinants on this industry a matter of vital importance. At the end of 2014, the sector had 922 employees and more than 400.000 customers. Additionally, from the remaining cooperative banks, two were active in their geographical region, five exerted activity on prefectural and three on national level. Their ROA and ROE approached 0,01 % and 0,11 %, respectively and capital ratio exceeded 9,5 %. Moreover, despite their 20-year operation, their market share for deposits and credits is still underdeveloped since their contribution on Greek banking system was 1,1% and 0,8%, respectively. Nevertheless, due to the fact that their banking products are based on local needs of SMEs, their market penetration on SMEs reached 15 % (EACB, 2015).

### 3. LITERATURE REVIEW

In order to assess credit risk determinants, several loan quality indicators have been widely used in the literature. The most popular are Loan Loss Provisions (LLP), Loan Loss Reserves (LLR), loan losses, Non Performing Loans ratio (NPL) and Probability of Default (PD). Among first studies was that of Keeton and Morris (1987), in which loan losses were used as main indicator of problem loans. The

authors explored why the banks' loan losses vary significantly in 2500 commercial banks in seven US states during the 1979-1985 period. Their research underlined that loan losses variations' are related to local economic climate and low efficiency of various economic sectors. Furthermore, they noted that the banks which were prone to taking more risks presented more loan losses. Similarly, Sinkey and Greenawlat (1991) analyzed the loan losses of the US commercial banks for the period 1984-1987. They found that both internal and external factors have a decisive impact on loan quality.

The empirical analysis of Cavallo and Manjoni (2001) aimed to define the interdependencies between LLP and various bank, macroeconomic and legal-institutional factors. They collected data from 1.176 banks in 36 countries, between 1988 and 1999, concluding that LLP is positively interacted with loans to total assets ratio and profitability, results that were interpreted as a sign of profits manipulation. Conversely, negative correlations were reported with loans growth rate and public debt. Finally, it was demonstrated that banks from common law countries formulate fewer provisions. Laeven and Manjoni (2003) explored which micro and macro variables exert significant impact on LLP in commercial banks of 45 countries for the period 1988-1999. Despite the significant differences among the examined countries, their results highlighted the negative impact of GDP, confirming the existence of procyclicality. At the same time, it was claimed that LLP is positively associated with profitability and negatively with the rate of change of loans. Bikker and Metzmarkes (2005), based on the two aforementioned studies, examined LLP and LLR in 29 OECD countries from 1991 to 2001. Their findings for both loan quality indicators corroborated the existence of procyclicality and the hypothesis that when capital ratios are being kept low, loan quality is deteriorating.

Moreover, Floro (2010) identified macroeconomic and banking factors influencing LLR in Philippines, by examining 32 commercial banks for the period 2001-2009. His findings supported that LLR shows a positive correlation with NPL, loans to total assets ratio, previous period LLR, earnings before taxes and provisions and short-term interest rates. Negative associations were documented with bank size, capital adequacy ratio, excess capital to risk-weighted capital ratio and GDP growth. Additionally, it was revealed that when banks record losses, they reduce their LLPs. Similarly, Liu and Yang (2010) concentrated on the economic

and financial factors responsible for the deterioration of loan quality in Taiwan from 1986 to 2005. According to their concluding remarks, LLR is negatively related with ROA and land prices, while credit expansion worsens significantly loan quality.

Makri, Tsagkanos and Bellas (2014) detected which bank specific and macroeconomic variables exert significant power on NPL in Eurozone's banking systems for the pre-crisis period 2000-2008. Their results recorded important relationships between NPL and various macroeconomic factors (public debt, unemployment, economic activity) and micro indicators (capital adequacy ratio, past loan quality and performance).

Makri and Papadatos (2014) studied the influence of accounting information and macroeconomic environment on aggregate LLP of the Greek banking sector, during 2001-2012. They provided evidence that LLP is positively related to unemployment, public debt, previous quarter's LLP and negatively to capital adequacy ratio. Following the same direction, Makri (2015) explored, both at individual bank and banking system level, whether LLP and LLR are driven from bank specific and macro determinants. Her analysis claims that Greek loan quality is influenced by unemployment, public debt, GDP, inflation, past loan quality, capital adequacy, liquidity and profitability.

Apart from commercial banks, international literature also focused on cooperatives banks. Porath (2006) dealt with micro (capital, profitability, loan quality portfolio and market risk etc.) and macro (GDP, interest rates, equity prices, etc.) factors that predict PD of German cooperative and savings banks during the period 1993-2002. His results demonstrated that both macro and micro variables constituted determinant factors of PD, concluding that models including exclusively accounting indicators may not reflect thoroughly bank risk.

Altunbas, Carbo, Gardener and Molyneux (2007) discussed the connection of bank risk, capital and inefficiency in various financial institutions (commercial, savings, cooperative banks etc.) in Europe. The authors analyzed data from 15 European countries, from 1992 to 2000, expressing credit risk via LLR ratio. Their results suggested that LLR is negatively influenced by loans to total assets and solvency ratio of non-financial businesses and positively by the overall banking system's risk (total provisions). However, their findings regarding capital and profitability indices, liquid assets to deposits ratio and interest rates of government

bonds differentiated among bank categories (commercial, savings, cooperative banks etc.). Furthermore, Deelchand and Padgett (2009) determined the relationship of credit risk, capital and profitability in 263 Japanese cooperative banks for the period 2003-2006. They reported that LLR is influenced positively with inefficiency and bank size, while negatively with capital adequacy ratio and loans to total assets ratio.

Mare (2012) identified factors that are responsible for the bankruptcy of small banks. His research focused on PD of 434 Italian cooperative banks in 20 Italian regions for the period 1993-2011. The investigation presented that macroeconomic factors (such as interbank deposit rate and concentration of local business) are negatively associated with PD, while inverse relationship was noted for local unemployment. Regarding bank specific indicators, positive interdependencies emerged between LLP and liquidity ratio (loans to deposits) and negative with leverage ratio, wage costs (in relation to operating income), ROA and bank size. Similarly, Fiordelisi and Mare (2013) examined which indicators are connected with PD and efficiency in 476 Italian cooperative banks for 1997-2009. Their analysis showed that high efficiency levels improve significantly PD. Moreover, they revealed a positive correlation between PD and loan portfolio quality, loans to deposits ratio and liquidity ratio, while negative with capital adequacy ratio, bank size and economic growth.

Skala (2014) studied which factors influencing the credit policy of 356 polish cooperative banks and their income smoothing behavior, during the period 2006-2012. According to their conclusions, LLP is positively associated with pre provisioning income, confirming income behaviour. Bank size and non-performing loans were found to be positively and strongly significant, while reverse relationship recorded with loan growth. Macroeconomic indicators unemployment and bankruptcy ratio proved to have positive impact on LLP.

Finally, Alessi, Di Colli, and Lopez (2014) analysed the main determinants of LLP for Italian commercial and cooperative banks during the period 2006-2012. They found that the cooperative banks' LLP is negatively related to guaranteed loans and positively with bad loans ratio and loan to assets ratio. On the contrary, the hypotheses of income smoothing behaviour and procyclicality were not confirmed.

Based on the merits of the aforementioned studies, it is obvious that there is a large gap in the literature concerning the explanatory factors of loan quality in cooperative banks, in Greece. The necessity of such research is even greater, given the impact of cooperative banks on SMEs and local economies development and the recent failures of six cooperative banks in Greece. In this context, to the authors' best knowledge, this is the first empirical analysis that focused on accounting and macroeconomic determinants of credit risk at cooperative banking industry both in booming and financial crisis periods of the Greek economy.

## **4. METHODOLOGY**

### **4.1. Methodological framework**

There is ample support that loan quality is characterized by the existence of dynamic relationships (Castro, 2013; Louzis, et al., 2010) identified from the inclusion of lagged dependent variables as independent variable (Baltagi, 2001). Taking this claim into consideration, sophisticated estimators are considered suitable for the exploration of these linkages (Baltagi, 2001 and Quagliariello, 2007). For this reason, GMM First Difference (or GMM Difference) is chosen for our analysis, since GMM estimators account for problems that might arise from the existence of autocorrelation and heteroscedasticity, providing results with correct standard errors (Cragg, 1983) and being suitable for panel data, which is the case of the present study. GMM estimator was developed by Hansen (1982), while GMM Difference was developed by Holtz-Eakin, Newey and Rosen (1988), and Arellano and Bond (1991) and extended by Arellano and Bover (1995) and Blundell and Bond (1998). The implementation of GMM specification necessitates the use of instrumental variables. Arellano and Bond (1991) argued that GMM presents better results when lagged values of dependent and independent variables are used as instruments. Moving towards this direction, Roodman (2009) suggested that instruments could be originated from the dataset itself and corresponded to lagged variables. For our investigation, the validity of instruments is examined by J statistics for over-identifying restrictions and AR statistical tests in order to control for serial correlation in the residuals.

Credit risk and loan portfolio quality are two concepts that are extremely interrelated. As noted by Saunders and Cornet (2008), credit risk is identified as

the risk that promised cash flows from loans and securities might not be paid in full. Generally, credit risk is inextricably associated with extensive bank failures and instability in banking system (Berger and Humprey, 1997; Mullings, 2003). The main goal of this study is to define which factors influence loan portfolio quality of cooperative banks. Based on the consideration that loan quality is characterized from the existence of dynamic relationships, our basic equation is formulated as following:

$$LQ_{i,t} = LQ_{i,t-j} + ACC_{i,t-j} + MACRO_{t-j} \quad (1)$$

where LQ denotes loan quality indicator, ACC accounting (bank specific) factors, MACRO macroeconomic indicators, i the examined cooperative bank and t-j the examined period. In the current analysis, the depended variable, hence loan quality is measured via LLR ratio. Loan loss reserves are banks' estimations arising from varying economic circumstances, credit risk and loan quality (Walter, 1991; Ahmed et al., 1999, Balla and Mckenna, 2009). The level of LLR reflects the exposure risk and loan portfolio quality (Walter, 1991), due to its dependency on provisions and loan losses (Gebhardt and Novotny-Farkas, 2013). Along similar lines, Bikker and Metzermarckes (2005) argued that LLR are the year-on-year accumulated net provisioning that have to be associated with real expected loan losses. Additionally, Fillat and Montoriol-Garriga (2010) underlined that loan loss reserves should cover expected losses since an inadequate reserves level can have a direct impact on the capital of financial institutions. To this end, if a bank has insufficient reserves it is considered that the regulatory capital ratios have been overestimated and the bank is in great danger (Balla and Mckenna, 2009). Bearing in mind this, the detection of determinant factors of loan loss reserves is crucial not only for the stability of the financial system itself but also for a healthy and well-functioning society<sup>7</sup>.

Table 2 summarizes the examined independent variables and their expected sign according to economic theory and literature. It must be underlined that these variables are investigated at current time (t) and previous periods (t-j). More

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<sup>7</sup> It must be mentioned that data availability for non-performing loans (NPL) and loan loss provisions (LLP) of Greek cooperative banks, did not allow us to control the results for alternative loan quality measures. Difficulties in collecting data for Greek cooperative banks have also been observed by Pasiouras et al. (2007) and others.

precisely, it is assumed that the current level of loan quality is influenced not only by current accounting and macroeconomic variables, but also by accounting and macroeconomic variables of previous time periods, as their impact can be either direct or with time lag. In this case, the basic econometric equation (1) is calculated thrice. Once, by exploring micro and macro variables of current period (t) and afterwards those of previous years (t-1) and (t-2). Ultimately, by calculating equation (1) separately at time (t), (t-1) and (t-2), econometric problems from the inclusion of same explanatory variables several times in the same equation are considerably reduced. Furthermore, it is recorded a clearer picture of the accounting and macroeconomic determinants. Moreover, our basic model was presented in three different versions. In the first one, both accounting and macroeconomic variables incorporated in the same equation. Additionally, bank specific and macroeconomic indices independently investigated so as to provide more extensive information, concerning the relation among explanatory variables and loan quality.

**Table 2.** *Presentation of Variables*

	Symbol	Explanation	Expected Sign
Past Loan Quality	LLR <sub>t-j</sub>	Loans Loss Reserves as % of Total Loans	(+)
Accounting variables	CAP	Bank Capital and Reserves to Total Assets	(+)/(-)
	LtA	Bank Liquidity: Total Loans to Total Assets	(+)
	ROA	Performance indicator: Return on Assets	(-)
Macroeconomic variables	LUNMP	Local unemployment rate	(+)
	GDP	GDP growth rate	(-)
	INFL	Average inflation rate	(+)/(-)
	DEBT	Public debt as % of GDP	(+)

The first examined explanatory variable is the dynamic performance of credit risk in time. The inclusion of past loan quality on the right hand of the equation is required in order to evaluate whether past loan decisions (LLR<sub>t-j</sub>) define changes on the current level of LLR (Laeven and Manjoni, 2003; Fonseca and Gonzalez, 2008; Frait and Komárková, 2013).

Apart from the dynamic persistence of credit risk, accounting variables are also investigated as possible determinants. To begin with, capital ratio (CAP) reflects the bank's risk attitude and is widely used as a proxy indicator of capital adequacy. Its impact on loan quality can be either positive or negative (e.g. Shrieves and Dahl, 1992, Fiordelisi and Mare, 2013). Based on moral hazard hypothesis, regarding its negative impact, it is supported that banks with low capital ratios might correspond more easily to moral hazard incentives and their loan quality is considerably deteriorated (Berger and De Young, 1997). Similarly, Orgler and Taggart (1983) suggested that banks, due to collapse risk, might decrease (increase) their capital ratios, when problem loans reduced (increased). However, as underlined by Berger and De Young (1997), a positive influence between capital and loan quality is also feasible due to the fact that banks might react cautiously, when loan quality is deteriorated, by increasing their capital base in advance.

The effect of bank liquidity, expressed through loans to totals assets ratio (LtA), is comprised in the analysis too. Bank liquidity, to some extent, is associated to bank's attitude towards risk and severe bank failures (Sinkey and Greenwalt, 1991; Festić and Repina, 2009; Cotugno, Stefanelli and Torluccio, 2010; Guy and Lowe, 2011). Towards this direction, low bank liquidity equals high value of LtA indicators and high amount of problems loans. Consequently, a positive relationship is expected between LtA and loan quality. Further empirical evidence supporting its positive impact may lie in the findings of Cavallo and Manjoni (2001), Floro (2010), etc.

Bank performance, measured by ROA, is also linked to loan quality in the present econometric specification. Financial institutions with significant amount of bad loans must formulate higher provisions, hence expenses, which are responsible for decreasing profits (Sinkey, 1998). This suggests that the sign of the relationship is expected to be negative and is usually ascribed to the risk behaviour of the bank managers. Indeed, banks with low profitability indices are forced to generate more income, so they are getting involved into riskier lending activities. In contrast, profitable banks are not strained to augment their income and have fewer stimulus to provide credit to less trustworthy loan applicants. Moreover, Boudriga, Taktak and Jellouli (2009b) underlined that banks with low profitability ratios might not be able to control their operating expenses and their borrowers' quality.

Macroeconomic indicators were also explored as possible explanatory factors of credit risk. First of all, the unemployment rate was examined. However, taking into account that cooperative banks finance local economy, local unemployment rate was included in (LUNMP) instead of the national unemployment rate, in order to control for the existing local economic conditions. In fact, when economic conditions ameliorated, the number of unemployed is decreased, their disposal income is increased and consequently they are consistent with their loan obligations. Hence, it is anticipated a positive relationship between unemployment and loan quality (Brookes, Dicks and Pradhan, 1994; Bikker and Metzmarkes, 2005; Glogowski, 2008 etc.).

Additionally, the impact of business cycle and economic activity investigated through national GDP growth index<sup>8</sup>. During economic development, households and businesses repay normally their loan instalments and generally bad loans are kept low. At the same time, due to extreme competition, banks relax their lending criteria, providing credit even to less trustworthy borrowers and, as a result, loan demand is considerably expanded. Conversely, when unfavourable economic conditions take place, the borrowers' financial condition is deteriorating, the levels of problem loans are being risen, banks' profitability is decreased and the financing of new investments is extremely limited. Based on the above argument, GDP growth and loan quality considered to be negatively associated, confirming the existence of procyclicality (Salas and Saurina, 2002; Pederzoli, Torricelli and Castellani, 2010; Jakubik and Reininger, 2013).

Contrary to local unemployment and GDP, inflation's impact is equivocal (e.g. Babihuga, 2007; Kavkler and Festić, 2010; Guy and Lowe, 2011). On one hand, loan repayment can be difficult, when high inflation exists, as borrowers' real income is decreasing (when wages and salaries remain stable). On the contrary, high inflation may ease the payment of loan instalments, since the real value of loan is reducing (Jakubík and Schmieder, 2008; Nkusu, 2011; Castro, 2013). Taking into consideration all of the above, the effect of the inflation rate can be either negative or positive.

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<sup>8</sup> Similar to unemployment rate, since cooperative banks finance local economies, our main objective was to examine all macroeconomic variables with their local values. Nevertheless, due to data unavailability, we ended up using GDP and the remaining macro factors with their national values.

Recent developments in the field of loan quality determinants have led to a renewed interest in the connection of public debt with credit risk (e.g. Makri et al., 2014; Makri, 2015). Until now, the evidence demonstrate that debt and banking crises are interdependent (Furceri and Zdzienicka, 2012; Tagkalakis, 2014). Therefore, the investigation of public debt as a possible determinant factor of loan quality is indispensable. The basic motive behind its examination was to explore whether a country's financial position could define the level of problem loans. It is valuable to note that a country's banking system is significantly induced, when its financial condition is reduced, since its creditability is on stake. In other words, significant liquidity problems might arise on the banking system due to the deterioration of the country's credit liability (Reinhart and Rogoff, 2010). Furthermore, during periods of public debt expansion, governments are forced to take strict fiscal measures in order to limit considerably their expenses (abolition or reduction social benefits). This implies that the repayment of loan obligations is getting more and more difficult, as the disposable income is being reduced (Perotti, 1996). Given the above discussion, a positive relationship between public debt and loan quality is expected.

#### 4.2. Econometric specifications

Based on the methodological framework, our first empirical model, in which the LLR explanatory factors of the Greek cooperative banking industry are determined, is the following:

$$LLR_{it} = a_0 + a_1LLR_{i,t-1} + a_2CAP_{i,t} + a_3LtA_{i,t} + a_4ROA_{i,t} + a_6GDP_{i,t} + a_7LUNMP_{i,t} + a_8INFL_{i,t} + a_9DEBT_{i,t} + \varepsilon_{i,t} \quad (2)$$

where LLR is the loans loss reserves to total loans ratio and stands for credit risk,  $i$  and  $t$  the examined bank and year respectively. The independent variables along with their expected signs are briefly presented in Table 1. Moreover, in order to explore the significance power of micro and macro variables separately, econometric equations are shaped as follows:

$$LLR_{i,t} = a_0 + a_1LLR_{i,t-1} + a_2CAP_{i,t} + a_3LtA_{i,t} + a_4ROA_{i,t} + \varepsilon_{i,t} \quad (2a)$$

$$LLR_{i,t} = a_0 + a_1GDP_{i,t} + a_2LUNMP_{i,t} + a_3INFL_{i,t} + a_4DEBT_{i,t} + \varepsilon_{i,t} \quad (2b)$$

As mentioned before, so as to investigate whether the previous years' (t-1 and t-2) micro and macro variables exert significant impact on current level of LLR, the following models are also tested:

$$LLR_{i,t} = a_0 + a_1LLR_{i,t-1} + a_2CAP_{i,t-1} + a_3LtA_{i,t-1} + a_4ROA_{i,t-1} + a_6GDP_{i,t-1} + a_7LUNMP_{i,t-1} + a_8INFL_{i,t-1} + a_9DEBT_{i,t-1} + \varepsilon_{i,t-1} \quad (3)$$

$$LLR_{i,t} = a_0 + a_1LLR_{i,t-1} + a_2CAP_{i,t-1} + a_3LtA_{i,t-1} + a_4ROA_{i,t-1} + \varepsilon_{i,t-1} \quad (3a)$$

$$LLR_{i,t} = a_0 + a_1GDP_{i,t-1} + a_2LUNMP_{i,t-1} + a_3INFL_{i,t-1} + a_4DEBT_{i,t-1} + \varepsilon_{i,t-1} \quad (3b)$$

$$LLR_{it} = a_0 + a_1LLR_{i,t-2} + a_2CAP_{i,t-2} + a_3LtA_{i,t-2} + a_4ROA_{i,t-2} + a_6GDP_{i,t-2} + a_7LUNMP_{i,t-2} + a_8INFL_{i,t-2} + a_9DEBT_{i,t-2} + \varepsilon_{i,t} \quad (4)$$

$$LLR_{i,t} = a_0 + a_1LLR_{i,t-2} + a_2CAP_{i,t-2} + a_3LtA_{i,t-2} + a_4ROA_{i,t-2} + \varepsilon_{i,t-2} \quad (4a)$$

$$LLR_{i,t} = a_0 + a_1GDP_{i,t-2} + a_2LUNMP_{i,t-2} + a_3INFL_{i,t-2} + a_4DEBT_{i,t-2} + \varepsilon_{i,t-2} \quad (4b)$$

Econometric analysis is implemented through GMM difference estimator, where previous years' variables (time lags) are used as instruments. The instruments' validity was controlled through J statistics, while statistical tests AR1 and AR2 are implemented for exploring serial correlation among the residuals of first differences. With regard to control whether the series are autoregressive, Kao panel cointegration test is implemented.

## 5. SAMPLE AND DATA

In the present study, individual bank level data are used. Specifically, the final sample consisted of an unbalanced panel data of 11 cooperative banks with 149 annual observations. The examined period extended from 2003 to 2014, including both economic growth and recession of the Greek economy. The accounting information is collected through the financial statements of cooperative banks and macroeconomic indices from the Hellenic Statistical Authority (EL.STAT.).

## 6. EMPIRICAL RESULTS

The estimation results are presented in Table 3, which also presents the coefficients of the independent variables with their corresponding p-values and

statistical tests AR1, AR2 and J for all the examined time periods. We underline that in most of the equations, the aforementioned tests demonstrate acceptable values and the null hypothesis ( $H_0$ : no cointegration) of Kao panel cointegration test is not rejected ( $p$ -value = 0.275).

The analysis for period  $t$  showed that profitability, public debt and local unemployment define changes in loan quality. In particular, it was ascertained a negative relationship between loan loss reserves and ROA (Model 2, 2a), while an inverse one with public debt (Model 2 and 2b) and local unemployment (Model 2b). The results for period  $t-1$  confirmed that current loan loss reserves are linked to previous year's loan quality and various macroeconomic indicators. More precisely, previous year's LLR (Model 3 and 3a), public debt (Model 3 and 3b), inflation (Model 3b) and local unemployment (Model 3b) demonstrate positive association with current level of loan quality. Finally, the econometric estimations for period  $t-2$  detected the dynamic persistence of credit risk and the significant effect of economic activity and public debt. Specifically, two years ago LLR (Model 4a) and public debt (Model 4 and 4b) exert positive significant impact on current level of credit risk, while GDP (Model 4 and 4b) negative.

Table 3. Empirical results

Variables	t			t-1			t-2		
	Model (2)	Model (2a)	Model (2b)	Model (3)	Model (3a)	Model (3b)	Model (4)	Model (4a)	Model (4b)
LLR <sub>it-1</sub>	0,259 (0,474)	0,633 (0,265)		<b>5,041**</b> <b>(0,047)</b>	<b>4,873**</b> <b>(0,032)</b>				
LLR <sub>it-2</sub>							0,139 (0,876)	<b>1,737***</b> <b>(0,009)</b>	
CAP <sub>it</sub>	0,109 (0,646)	0,199 (0,662)							
CAP <sub>it-1</sub>				0,858 (0,194)	0,035 (0,958)				
CAP <sub>it-1</sub>							0,216 (0,297)	0,425 (0,207)	
LtA <sub>it</sub>	0,046 (0,379)	0,070 (0,367)							
LtA <sub>it-1</sub>				0,049 (0,848)	0,531 (0,127)				
LtA <sub>it-2</sub>							-0,111 (0,125)	-0,180 (0,177)	
ROA <sub>it</sub>	<b>-0,490***</b> <b>(0,008)</b>	<b>-0,899**</b> <b>(0,019)</b>							
ROA <sub>it-1</sub>				4,162 (0,121)	5,498 (0,173)				
ROA <sub>it-2</sub>							-0,175 (0,804)	-2,072 (0,241)	
GDP <sub>it</sub>	0,195 (0,137)		0,162 (0,339)						
GDP <sub>it-1</sub>				-0,293 (0,398)		-0,055 (0,586)			

GDP <sub>it-2</sub>							<b>-0,273***</b> <b>(0,007)</b>	<b>-0,267**</b> <b>(0,024)</b>	
LUNMP <sub>it</sub>	0,046 (0,678)	<b>0,337 ***</b> <b>(0,001)</b>							
LUNMP <sub>it-1</sub>			-0,805 (0,214)		<b>0,289***</b> <b>(0,000)</b>				
LUNMP <sub>it-2</sub>						0,290 (0,243)		0,092 (0,337)	
INFL <sub>it</sub>	-0,101 (0,554)	0,100 (0,669)							
INFL <sub>it-1</sub>			0,676 (0,363)		<b>0,390**</b> <b>(0,022)</b>				
INFL <sub>it-2</sub>						-0,164 (0,506)		-0,275 (0,139)	
DEBT <sub>it</sub>	<b>0,042**</b> <b>(0,023)</b>	<b>0,064**</b> <b>(0,030)</b>							
DEBT <sub>it-1</sub>			<b>0,242*</b> <b>(0,092)</b>		<b>0,075**</b> <b>(0,011)</b>				
DEBT <sub>it-2</sub>						<b>0,068**</b> <b>(0,047)</b>		<b>0,075***</b> <b>(0,003)</b>	
AR1 (p-value)	0,032	0,076	0,043	0,000	0,062	0,039	0,057	0,070	0,000
AR2 (p-value)	0,197	0,211	0,168	0,883	0,676	0,114	0,797	0,159	0,895
J statistic (p-value)	0,431	0,935	0,290	0,962	0,413	0,320	0,784	0,613	0,624

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Note: Table shows the coefficients estimates (coefficients in bold are significant), and p-values of the difference GMM regression model,

\* Significance at the 10 % level,

\*\* Significance at the 5 % level,

\*\*\* Significance at the 1 % level,

LLR is the loan loss reserves to total loans, CAP is the capital ratio (defined as capital and reserves to total assets), LtA is the loans to Assets ratio, ROA is the profitability ratio: return on assets, GDP is the annual percentage growth rate of GDP, LUNMP is the local annual unemployment rate, INFL is the annual rate of inflation and DEBT is the public debt as percentage of GDP, where  $i$  corresponds to the examined bank and  $t$  to the year,

## 7. DISCUSSION

The evaluation of estimation results implies that macroeconomic and accounting factors contribute decisively on defining loan quality, hence credit risk for the Greek cooperative banking industry. Regarding macroeconomic conditions, several interesting results were obtained. Firstly, the public debt is undoubtedly a significant determinant factor, since its positive impact is presented in all the examined models. Indeed, it was revealed that not only the current values of public debt but also those of two previous periods are correlated with the current level of LLR. This relationship argues that fiscal problems in Greece are linked to loan quality and can be attributed to the imposed strict measures by the governments (Perotti, 1996) and the banks' liquidity problems due to the country's bad credit ratings (Reinhart and Rogoff, 2010). Despite the fact that debt and banking crises are interdependent, until recently the relationship between public debt and credit risk had been underestimated in empirical studies. However, similar to Makri and Papadatos (2014) and Makri (2015), the impact of the public debt is strongly confirmed for the Greek cooperative banks. It must be noted that this result might lead to further investigation in other countries too, particularly those with high public debt and generally important fiscal problems.

Similarly, local unemployment, which examines the local economic activity in the operating area of cooperative banks, is another explanatory factor. More precisely, it was recorded that local unemployment determines the current and next year values of LLR. Therefore, it seems that when banks operate in areas with high unemployment level, are forced to formulate higher loan loss reserves. In particular, when the number of unemployed is increased, their disposable income is drastically reduced and the payment of loan instalments is becoming more difficult. This finding is consistent with many studies in different countries, such as Brookes et al. (1994), Mare (2012), Skala (2014), Makri and Papadatos (2014).

GDP growth rate also defines credit risk. Nevertheless, contrary to public debt and local unemployment, GDP does not have current impact on LLR, since its negative significant effect take place after two years. This negative relationship supports the view that in periods of economic expansion, households and firms have sufficient income to repay their loans and the levels of loan quality indicators are being kept low. In contrast, during economic distress, the borrowers' economic

situation is deteriorated and, consequently, loan quality is considerably worsened. Thus, similar to previous research (Porath, 2006; Louzis et al., 2010; Fiordelisi and Mare, 2013; Curcio and Hasan, 2015; Makri, 2016 etc.), the existence of procyclicality is confirmed.

Inflation is another macro index that explains changes on loan portfolio quality, since it was recorded that an increase (decrease) in inflation rate worsens (improves) LLR of the following year. Although, economic theory suggests that the impact of inflation on credit risk is ambiguous, it seems that in Greece when high inflation exists, the borrowers' real income is decreasing (when wages and salaries remain stable) and loan repayment is difficult.

Along with macroeconomic environment, the dynamic persistence of credit risk is an additional determinant, since past performance of loan quality exerts significant positive effect on the current level of loan loss reserves. This result is consistent with the findings of Jimenez and Saurina (2006), Fonseca and Gonzalez (2008), Frait and Komárková (2013), Castro (2013), Makri (2016) etc.

Finally, profitability, expressed through ROA, influences negatively loan quality. However, its significant impact is exclusively direct without presenting time lag. This negative correlation is linked to the bank behaviour towards risk. Financial institutions with high (low) profitability indices have less (more) pressure to increase their revenues and apparently less (more) incentive to provide higher-risk loans. Furthermore, banks with low profitability might encounter more difficulties in monitoring loan quality and their operating expenses (Boudriga et al., 2009b). Similar conclusions concerning profitability and credit risk, were obtained by Louzis et al. (2010), Zoubi and Al-Khazali (2007), Boudriga et al. (2009a), Liu and Yang (2010), Stefanelli and Cotugno (2012), Mare (2012), etc.

The determination of loan quality factors in cooperative banking industry revealed significant economic insights for taxpayers, regulatory and supervisory authorities, bank's management and local communities not only for Greece, but also for countries with similar characteristics i.e. comparable cooperative banking industries (short time of operation, market share, small size etc.) and fiscal problems (severe public debt burden). The revealed accounting and macro indices of cooperative banks can serve as a signalling and predictive tool for the maintaining of financial health in the region, the deterioration of loan losses, the formulation policy and decision-making strategies. The existence of a healthy

financial environment can play a crucial role on the development of local market by supporting and encouraging local entrepreneurship.

## 8. CONCLUSION

The present study contributes to our understanding of determinants in loan quality in Greece, by exploring for the first time the cooperative banking sector, for the period 2003-2014. This prolonged period gave us the opportunity to include in our research both the economic growth and the recession period of the domestic economy. The empirical investigation clearly showed that macroeconomic and accounting indicators define loan loss reserves, hence credit risk. Particularly, public debt, local unemployment, GDP, inflation, dynamic persistence of credit risk in time and profitability seem to interpret significantly changes on loan quality levels.

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## APPENDIX

**Table A.** *Statistical measures of examined variables*

<b>Variables</b>	<b>Mean</b>	<b>Median</b>	<b>Max</b>	<b>Min</b>	<b>SD</b>
LLR <sub>it</sub>	0,072	0,056	0,297	0,003	0,058
LLR <sub>it-1</sub>	0,064	0,047	0,290	0,003	0,056
LLR <sub>it-2</sub>	0,058	0,040	0,290	0,003	0,055
CAP <sub>it</sub>	0,986	0,138	8,544	0,054	2,437
CAP <sub>it-1</sub>	0,147	0,135	0,421	0,054	0,070
CAP <sub>it-2</sub>	0,162	0,148	0,451	0,054	0,082
LtA <sub>it</sub>	0,780	0,786	1,064	0,487	0,101
LtA <sub>it-1</sub>	0,776	0,782	1,378	0,487	0,112
LtA <sub>it-2</sub>	0,772	0,779	1,729	0,487	0,141
ROA <sub>it</sub>	0,005	0,009	0,046	-0,260	0,031
ROA <sub>it-1</sub>	0,010	0,011	0,046	-0,136	0,017

Variables	Mean	Median	Max	Min	SD
ROA <sub>it-2</sub>	0,013	0,012	0,057	-0,032	0,013
GDP <sub>it</sub>	-0,009	-0,002	0,059	-0,071	0,045
GDP <sub>it-1</sub>	-0,002	-0,002	0,059	-0,071	0,045
GDP <sub>it-2</sub>	0,009	0,022	0,059	-0,071	0,043
LUNMP <sub>it</sub>	0,009	0,022	0,059	-0,071	0,043
LUNMP <sub>it-1</sub>	0,139	0,117	0,371	0,029	0,070
LUNMP <sub>it-2</sub>	0,126	0,112	0,291	0,029	0,059
INFL <sub>it</sub>	0,026	0,031	0,047	-0,014	0,017
INFL <sub>it-1</sub>	0,029	0,033	0,047	-0,009	0,014
INFL <sub>it-2</sub>	0,032	0,033	0,047	0,010	0,010
DEBT <sub>it</sub>	1,317	1,297	1,771	0,974	0,286
DEBT <sub>it-1</sub>	1,242	1,129	1,751	0,974	0,263
DEBT <sub>it-2</sub>	1,173	1,074	1,703	0,974	0,226

Note: LLR is the loan loss reserves to total loans, CAP is the capital ratio (defined as capital and reserves to total assets), LtA is the loans to assets ratio, ROA is the profitability ratio: return on assets, GDP is the annual percentage growth rate of GDP, LUNMP is the local annual unemployment rate, INFL is the annual rate of inflation and DEBT is the public debt as percentage of GDP, where *i* corresponds to the examined bank and *t* to the year,

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# THE EFFECTIVENESS OF BRANDED MOBILE APPS ON USER'S BRAND ATTITUDES AND PURCHASE INTENTIONS

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**Abstract:** *The mobile device market, particularly for smart phones, has experienced incredible growth over the past five years. What sets this market apart is the use of applications or apps for just about anything from information to purchases. The purpose of the study was to examine the effectiveness of branded apps on consumers' attitudes toward brands as well as purchase intentions. The sample was drawn from students enrolled at a southwestern university in the United States, resulting in 50 usable questionnaires. Results of Pearson's correlation analysis indicated that using branded apps strongly influenced users' attitudes toward brands; however, using branded apps had a smaller impact on purchase intentions. As well, attitudes towards the branded apps, although significant, had a limited impact on purchase intentions. Implications of the findings were then discussed.*

**Keywords:** *Branded mobile apps, attitudes toward brands, purchase intention*

**JEL Classification:** *M31 Marketing*

## 1. INTRODUCTION

The mobile device market, particularly for smart phones, has experienced incredible growth over the past five years. More specifically, the increase use of smart phones has spurred the development of hundreds, perhaps thousands, of mobile apps used daily by consumers to provide information or to make purchases

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of products and services. According to the Internet Marketing Association (2014), about 60 percent of all Internet activities in the United States originate from mobile devices. In fact, almost (50%) of this traffic flows through mobile apps (Lipsman, 2014).

With this rapid growth of mobile apps usage, marketers responded by investing in mobile marketing and developing new channels to reach, communicate, and engage with current and prospective customers. These channels are known as branded mobile apps. Bellman et al. (2011) defined branded apps as “software downloadable to a mobile device which prominently displays a brand identity, often via the name of the app and the appearance of a brand logo or icon, throughout the user experience” (p191).

Through mobile applications on smart phones, users can perform any number of tasks from searching for information, to communicating, to shopping and buying. Mobile apps are becoming the dominant form of digital interactions given their prevalence and mobility where consumers spend more time with apps than on the Web (Newark-French, 2011). This provides opportunities for marketers to capture consumers' attention and sales via branded apps.

The popularity of branded applications as a marketing tool is due to their high level of user engagement, enhancing the influence of advertising on consumers' attitudes toward the sponsoring brand (Hutton and Rodnick, 2009). However, to date, there is a dearth of studies regarding the effect of branded apps on consumers' attitudes toward the brand and purchase intentions.

Hence, the purpose of the study was to examine the effectiveness of branded apps on consumers' attitudes toward brands as well as purchase intentions. Specifically, the objectives of this study were: 1) to determine consumer's mobile app usage; 2) to determine attitudes towards brands by users of branded mobile apps; and, 3) to determine the influence of branded mobile apps on purchase intentions. Findings from the study will assist marketers in developing strategies and applications that increase favorable attitudes toward brands, as well as, drive purchase intentions.

## **2. LITERATURE REVIEW**

### **2.1 Attitudes toward Brands**

Brand attitudes have been studied by many researchers (Wilkie, 1994; Solomon, 2009; Park et al. 2010). Wilkie (1994) defined brand attitudes as “consumers’ overall evaluations of a brand that often form the basis for brand choice” (p.4). The researcher noted that brand attitudes depended on specific attributes and benefits of the brand as viewed by consumers. Solomon (2009) explained that attitudes are made up of three components: 1) affective as emotions and feelings toward the brand; 2) behavior as intentions to act regarding attitudes toward the brand; and, 3) cognition regarding beliefs and thoughts about the brand. Attitudes toward brands are influenced by different factors such as communication, quality, and experience with a particular brand and can be positive or negative (Park et. al., 2010)

Mobile advertising is a type of marketing communication that targets mobile device users, including smart phones and tablets. Tsang et al. (2004) studied consumers’ attitudes towards advertising on mobile devices and found that attitudes were negative, unless permission was obtained as opt-in, there were positive attitudes. Tsang et. al. (2004) concluded that due to the personal nature of mobile phones, advertisers should seek authorization to advertise to mobile device users. However, since consumers initiate downloads of apps that they are interested in, it presents an opportunity to create a favorable attitude toward the sponsoring brand.

### **2.2 Purchase Intention**

Spears and Singh (2004) defined purchase intentions as “an individual’s conscious plan to make an effort to purchase a brand” (p. 56). Belch and Belch (2003) stated that purchase intentions are formed when there is a match between purchase motives and brand attributes (p.120). Kokkinaki and Lunt (1999) noted that “purchase decisions typically involve a selection among different brands of a given product category”; therefore, advertising serves to form favorable attitudes toward the brand to increase purchase intentions (p. 42).

Kumar and Mukherjee (2013) studied mobile users’ attitudes toward shopping and their purchase behavior through devices and found that mobile

shopping does not always drive users to purchase through the device. Additionally, results showed that attitudes toward technology influenced users' perceptions toward mobile shopping, impacting users' attitudes toward it and subsequently purchase behavior. The authors found that personality traits did affect users' perceptions, but had an indirect effect on attitudes toward mobile shopping and purchase intention.

Several researchers have investigated the relationship between attitudes toward the brand and purchase intention and found that they play an important role in shifting consumer' purchase intentions (Shimp & Gresham, 1985; Batra & Ray, 1986; Phelps & Hoy, 1996). Phelps & Hoy (1996) found that attitudes toward the brand significantly affected purchase intention for both familiar and unfamiliar brands.

### **2.3 Mobile App Usage**

The large proliferation of mobile devices is attributed to the heavy usage of mobile applications. McRae et al. (2013) tested the response times for consumers on all personal communication platforms, including desktop computers and laptops, netbooks, tablets, and mobile phones. The researchers monitored consumers' behavior during their visits and use of the different personal communication devices. Results showed that consumers have positive emotional responses to site visits when the visit is conducted on a mobile platform such as an app than other platforms. Consumers' responded positively to the branded messages because they believed that the messages were trustworthy when received on mobile devices than on other personal communication devices.

Marketers are trying to approach consumers through mobile media with the majority of heavy users among Millennials. Given this, Bhave et al. (2013) studied how Millennials interact with brands through branded apps and found that the major factors that influence consumers' attitudes toward advertising in branded apps included involvement with the app, obstruction caused by the ad, screen size, contextualization, personalization, relevance, credibility, permission, control, and incentives. Using a qualitative approach, the researchers found that even though Millennials do not mind in- app advertisements, they prefer ads that are based on involvement with the apps. Bhave et al. (2013) concluded that in- app advertising

could lead to higher brand awareness than through other platforms, which could generate purchase intention.

Nielsen and Budiu (2012) found that mobile device users performed better with native apps rather than with mobile-optimized sites. The authors suggested that native apps are preferred by consumers because native apps can cope with the limitations and abilities of each device better than mobile-optimized sites and are likely to be simpler with easily accessible functionalities than mobile-optimized sites.

## **2.4 The Effect of Branded Mobile Apps**

Branded apps, as a communication channel, enhance and promote brands to create positive evaluations and attitudes toward brands among consumers. Bellman et al. (2011) investigated the effect of branded apps, including informational and experiential apps regarding brand attitudes and purchase intention. Findings indicated that branded apps had a positive effect on brand attitude, but a smaller impact on purchase intentions. According to Bellman et al. (2011), branded apps are a new form of interactive advertising media, such as Web sites, yet they differ from online and mobile advertising because apps are distinguished by their high level of engagement with consumers. Branded apps include a variety of interactive features that allow marketers to communicate, interact, and deliver messages in unique ways unlike mobile websites (Moceri et al. 2011). Bellman et al. (2011) found that this high level of interactivity reinforces the effectiveness of advertising messages within apps.

Yu (2013) examined the effects of mobile ad messages in creating positive attitudes toward the brand and purchase intentions among Millennials. Results showed that mobile ads with interactive features led to positive attitudes toward the brand and purchase intentions; however, mobile ads that did not provide interactivity increased negative attitudes toward the brand and intentions. Similarly, Hoogendoorn (2013) examined the influence of branded mobile apps on cognitive and affective brand equity and found that interacting with branded apps resulted in more positive affective brand equity regarding the brand relationship but not regarding brand attitude. Moreover, findings showed that interacting with branded apps did not improve cognitive brand equity. These findings contradict with those of Bellman et al. (2011) that found that interacting with branded apps

resulted in positive brand attitudes. In addition to interactive features, Xie et al. (2013) found that the interface design of mobile devices, such as screen size, advertisement size, and ease of use impacts consumers' emotional responses to mobile advertising that can generate positive emotions and increase purchase intentions. Given the above discussion, the following hypothesis was developed:

H1: Using branded mobile apps affects users' attitudes toward the brand resulting in increased purchases intentions.

### **3. METHODOLOGY**

#### **3.1 Sample**

The population for this study was consumers 18 to 45 as the literature has shown that they are heavy app users. A convenience sample was drawn at random at a southwestern university in the United States resulting in 54 respondents participating in the survey. As smart phone owners, respondents were asked to use one of their apps already downloaded, navigate it and complete the survey. If they did not have any apps downloaded, participants were asked to download the app from Target or Walmart from the application stores, navigate it, and complete the survey.

#### **3.2 Instrument**

A questionnaire was developed to measure: 1) consumer's mobile app usage, 2) attitudes towards brands after using branded apps, 3) the influence of branded mobile apps on purchase intentions, and 4) demographic characteristics. To measure consumers' mobile app usage five questions were developed that were categorical in nature. Respondents were asked to indicate their mobile app usage by answering the following questions: 1) do you have a smart phone; 2) how much time do you spend on the Internet on your smart phone per day; 3) have you downloaded any branded apps; 4) how many branded apps have you downloaded to your smart phone or tablet; and 5) how often do you use branded apps.

To measure users' attitudes toward brands after using branded apps respondents were asked to rate their feelings toward the app by answering the statement "After using the branded app, I think the app is..." The statement was

measured via a seven-point semantic differential scale of five adjectives modified from Mittal's (1995) study that included Unlikable/ Likable, Unpleasant/ Pleasant, Not informative/ Informative, Bad/Good, and Not Useful/ Useful. Similarly, attitudes toward the brand were measured by the statement used by Zang (2014), "After using the branded app, my attitude towards the brand is..." This statement was measured using a seven-point semantic differential scale and included six adjectives: Not relevant /Relevant, Low quality/ High Quality, Less than other Brands/Better than other Brands, Unreliable /Reliable, Invaluable /Valuable, and Not attractive/Attractive.

Purchase intention was measure by three statements used previously by Zang (2014) and modified for the present study. To determine the likelihood of buying the product from the sponsoring brand, respondents were asked 1) I like the app and I want to use it to purchase the brand's products; 2) I want to purchase the brand's products, but not by using the app; and 3) I like the app, but I do not want to purchase the brand. Statements were measured using a Likert scale from 1 – Strongly Disagree 5 – Strongly Agree. Demographic characteristics measured were based on the literature reviewed.

## 4. RESULTS

### 4.1 Sample Description

Fifty-four participants completed the questionnaire; however, four were not usable resulting in a total of 50. The majority of respondents were female (57%) between the ages of 21 -23 (72%) and single (74%) (Table 1). Almost half of the respondents (46%) indicated that they had some college or technical school, and (30%) were college graduates. Finally, about half (48%) of respondents had annual household incomes ranged from \$21,000-\$49,999.

**Table 1** Demographic Characteristics of Respondents *N* = 50

		Frequency	Percent
Gender	Male	22	56.0
	Female	28	44.0
Age	Under 20	11	22.0
	21-30	35	70.0
	31-40	3	6.0
	41-50	1	2.0

		Frequency	Percent
Marital Status	Single	36	72.0
	Married	14	28.0
Level of Education	Some college or technical school	22	44.0
	Completed college(4 year degree)	15	30.0
	Graduate studies or degree	10	20.0
	Post graduate studies or advanced degree	3	6.0
Household Income	Under \$20,000	6	12.0
	\$21,000 to \$34,999	14	28.0
	\$35,000 to \$49,999	10	20.0
	\$50,000 to \$74,999	7	14.0
	\$75,000 to \$99,999	9	18.0
	\$100,000 to \$149,999	3	6.0

## 4.2 Mobile App Usage

Findings showed that all respondents owned a smart phone with the majority (70%) spending one to five hours on the internet per day with them (Table 2). Almost all (92%) reported having up to 12 branded apps on their phones while over a quarter (28%) of respondents used branded apps a few times a week and 26 percent used them more than once a day.

**Table 2** Mobile App Usage N=50

		Frequency	Percent
Smartphone Owner	Yes	50	100.0
	No	0	0
Time spent on the Internet on smartphone per day	Less than 1 hour	3	6.0
	1-5 hours	35	70.0
	More than 5 hours	12	24.0
Have you downloaded branded apps	Yes	46	92.0
	No	4	8.0
Number of Branded apps	1-5	27	54.0
	6-12	18	36.0
	13-20	4	8.0
	21-25	1	2.0
How often use branded apps	Once a day	9	18.0
	More than once a day	13	26.0
	Once a week	5	10.0
	A few times a week	14	28.0
	A few times a month	6	12.0
	Never use branded apps	3	6.0

### 4.3 Use of Branded Apps

After navigating the branded app results indicated that respondents were generally positive about the experience (Table 3). The informative nature of the app was rated less positively than the other values.

**Table 3** Feelings about Branded Apps after Use N=50

Unlikeable	—:—:—:—:—:—:—	Likeable	M = 5.40
Unpleasant	—:—:—:—:—:—:—	Pleasant	M = 5.24
Not Informative	—:—:—:—:—:—:—	Informative	M = 5.18
Bad	—:—:—:—:—:—:—	Good	M = 5.36
Not Useful	—:—:—:—:—:—:—	Useful	M = 5.41

### 4.4 Attitudes toward the Brand

After navigating the branded app respondents were asked about their attitudes towards the brand. Findings were generally positive with Quality, Reliability and Attractiveness more positive than Relevance, Value and comparison with other branded app experiences (Table 4).

**Table 4** Attitudes toward the Brand N=50

Not Relevant	—:—:—:—:—:—:—	Relevant	M = 5.08
Low Quality	—:—:—:—:—:—:—	High Quality	M = 5.32
Less than other Brands	—:—:—:—:—:—:—	Better than other Brands	M = 5.02
Unreliable	—:—:—:—:—:—:—	Reliable	M = 5.46
Invaluable	—:—:—:—:—:—:—	Valuable	M = 5.18
Not Attractive	—:—:—:—:—:—:—	Attractive	M = 5.24

### 4.5 Purchase Intention

After using the app, participants were asked their agreement regarding purchasing from it. Forty-two percent of respondents liked the app but did not want to purchase from it and 44% liked the brand's products but did not want to purchase them through the app. However, when participants interacted with branded apps, 54% indicated that they would purchase products through the app (Table 5).

**Table 5** *Purchase Intentions N=50*

Statement	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I like the app, but I do not want to purchase the brand.	18%	6%	34%	26%	16%
I want to purchase the brand's products, but not by using the app	12%	22%	22%	18%	26%
I like the app and I want to use it to purchase the brand's products	14%	8%	24%	22%	32%

#### 4.6 Hypothesis Testing

H1: Using branded mobile apps affects users' attitudes toward the brand resulting in increased purchases intentions.

To test the hypothesis, Spearman's correlation analysis was conducted. Findings indicated a significant association ( $p < .01$ ) between using branded apps, attitudes toward the brand, and purchase intentions. Results indicated that using branded apps and attitudes toward the brand were positively correlated ( $r = .78$ ,  $p < .000$ ). Furthermore, a positive correlation existed ( $r = .40$ ,  $p < .004$ ) between using branded apps and purchase intentions. As well, between attitudes toward branded apps and purchase intentions a positive correlation existed ( $r = .45$ ,  $p < .001$ ). Therefore, using branded apps strongly influenced users' attitudes toward sponsoring brands, however, attitudes toward the apps had a smaller impact on purchase intentions.

### 5. CONCLUSIONS AND IMPLICATIONS

With the growing use of smart phone apps, marketers are realizing the potential of branded apps as an effective marketing tool. To obtain more insights

about branded apps, this study investigated the effectiveness of branded mobile apps regarding attitudes toward brand and purchase intentions among Millennials given they are highly experienced app users. Results confirmed that a positive use of branded apps increases positive attitudes toward sponsoring brands, but only have a slight impact on purchase intentions.

The findings support those found by Bellman et al. (2011), that interacting with branded apps has a large effect on brand attitudes. However, the study results disagreed with the findings of Hoogendoorn (2013), which revealed that using branded apps had no effect on brand attitudes. Findings indicated that respondents were comfortable purchasing from apps when they liked the app; however, others indicated that although they liked the app they did not want to purchase the brand and wanted to purchase products through other means suggesting reservations in using apps for purchases.

Findings reveal that branded apps need to be likeable, useful, pleasant and good to encourage their use. More importantly the information in the app needs to be reliable, high quality, and attractive to users to build positive attitudes toward the brand. Most respondents were positive about buying through branded app; however, some reservations were apparent.

Implications of the findings are several and suggest that marketers develop apps that elicit positive feelings during navigation and include content that is reliable, high quality, and attractive. As well, marketers should develop apps for different platforms, such as tablets and smart phones, so the experience is pleasant and that information is appropriate for the varying screen sizes. Moreover, marketers need to be sensitive to download speeds and the effects of buffering that often produces frustration among users and prompt departure from the site. Marketers should utilize ways to encourage brand purchases in real time through downloadable coupons and promotions specifically for smart phone users given that these are portable devices. Moreover, marketers are encouraged to use social media along with apps and streamline the process so that users can share their experience online or in-store and drive sales. Apps that have meaningful content and that are easy to access build positive attitudes toward the brand because it resonates with the target market and invites them to engage with the brand. Marketers need to understand fully their target market's behavior and information needs so as to convey branded messages that are meaningful while keeping users

entertained. As technology becomes more compact and consumers become comfortable purchasing from smaller devices, security and privacy of information will be paramount to encourage consumers to maximize the use of branded apps for purchases.

Additionally, marketers and app developers should employ engaging attributes on branded apps such as games and trivia to increase knowledge and build positive attitudes toward the brand. Findings indicated that reservations existed when using app for purchases and so marketers should consider a long-term strategy in building sales via apps. As with computers of former years, new technology requires a confidence and trust in the technology, as well as, trust in the brand. Due to the personal nature of smart phones, marketers should include customized engagement features in branded apps that users can adjust the interfaces according to their preferences, such as displaying information based on users' locations or interests. For instance, adding customization engagement features in apps for retailers will help personalize and tailor content based on consumers' interests for particular products; hence, increase the efficiency of brand messages that can increase attitudes toward brand and the likelihood of purchase.

The behavior of users of smart phones differs from other platforms such as tablets and laptops, where simplicity and quickness in branded apps is essential; thus, marketers need to optimize their effectiveness. For retailers, where product offerings are many, marketers should design apps to streamline navigation from general to specific categories so users are able to find what they are looking for easily. When users cannot easily find what they are looking for in the app, they may leave the app and/or delete it.

### **5.1 Limitations and Future Research**

The study was limited to a convenience sample that was drawn from a southwestern university and limited to a navigation of one branded app. Moreover, the study was limited to participants employing their own apps, where attitudes toward the brand were already established.

Future research should consider employing a sample across all age groups and outside the parameters of a university setting. Research has shown that Millennials are comfortable using apps; however, other age groups may develop brand attitudes and evaluate apps differently. Moreover, future studies might focus

on using selected apps as oppose to having participants self-select from what they are already used to. Navigating a new app may elicit different responses that may affect attitudes toward the brand. Perhaps, researchers may employ a utilitarian app and an entertainment app to determine differences in the navigation experience as well as its influence in affecting attitudes toward the brand. Furthermore, future studies may determine how positive attitudes toward the brand are generated and how they influence purchase intentions. Finally, further study is needed regarding how repeatable usage of branded apps influences users' attitudes toward brands and purchase intentions.

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SURVEY ARTICLE

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## BUSINESS INTELLIGENCE SECURITY

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**Abstract:** *Excess information characteristic to the current environment leads to the need for a change of the organizations' perspective and strategy not only through the raw data processing, but also in terms of existing applications generating new information. The overwhelming evolution of digital technologies and web changes led to the adoption of new and adapted internal policies and the emergence of regulations at level of governments or different social organisms. Information security risks arising from the current dynamics demand fast solutions linked to hardware, software and also to education of human resources. Business Intelligence (BI) solutions have their specific evolution in order to bring their contribution to ensure the protection of data through specific components (Big Data, cloud, analytics). The current trend of development of BI applications on mobile devices brings with it a number of shortcomings related to information security and require additional protective measure regarding flows, specific processing and data storage.*

**Keywords:** *Business Intelligence, information control, cloud computing*

### 1. INTRODUCTION

Business Intelligence tools play a decisive role in the implementation and compliance of management strategies. As a basic definition, Business Intelligence is a set of economic applications designed to analyze data in order to be converted into information that provides consistency to the decision [2].

The multitude of data or information faced by an organization under today's business environment complicate the analysis and control systems. The development of the Internet economy, digitization of most of the processes, considerable cheapening of data sources and access to information, diversity of

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knowledge presentation formats led to “bombing” the entities with data/information excess.

The information is considered a good or asset, but only recently organizations have understood its true potential. As its value increases, more attention is given to information management, storage practices, transfer methodologies, disaster recovery and security [3]. This is why focus is on accuracy, consistency and reliability of data to support sound decisions, thus bringing into question the need for integrity of accessible and used information. If, traditionally, information security relies on IT departments within the entities, increasingly more researchers discovered that all employees must be fully involved in this. The Business Intelligence systems must have the ability to help organizations create a culture of information security through monitoring activities, setting goals for users, providing responsibilities [5].

This paper focuses on the information security for BI users because these facilities tend to become essential tools for management in its struggle in a dynamic and competitive market. The main objective is to analyse the best way to reach a desired level of information security, when using BI instruments. In order to bring arguments, the author suggests a number of secondary endpoints:

- Reveal context – a short introduction in the world of big data and cloud computing
- The notion of information security – definition and trends in the BI environment
- Approaches on improving information security – threats, costs and benefits.

A case study is shortly analysed in order to underline the role of Business Intelligence in improving efficiency in terms of financial results and also in terms of acquiring a higher security level in the information flow.

## **2. CONTEXT – BIG DATA, CLOUD, ANALYTICS**

Storage facilities automatically refer to the concept of data warehouse that are providing architectures and useful tools for the executive management, through systematic organization, understanding and use of data in making strategic decisions [1]. Building and maintaining a successful trustworthy data warehouse

became the result of a joint composed of an automated control of information, partnerships and execution [3].

Data storage has always been a vital item for BI capabilities as technology is dynamic and a constantly changing one. Due to the opportunity of storing information at low costs, BI manager goal is somehow to filter and manipulate this asset of the company for the construction of accurate predictive models [4].

Invariably there must be taken into consideration the term of Big Data which can be defined as a set of techniques and technologies that require new forms of integration to discover the value in a data set characterized by diversity, complexity, and at a massive scale. Thus, the information acquires a new dimension and it increases in value based on robust and adjustable analytics platform. In the 2001 research report, META Group (now Gartner) defines Big Data through the prism of 3 elements (the 3 V):

- **Velocity** - data are processed at a high speed. Although real-time processing brings benefits, it puts pressure on the ability to validate data and the entity infrastructure.
- **Volume** - information captured through various channels by consumers is of huge volume, making data traditional sampling almost impossible. In terms of internal policies and authorization levels, the question of data storage exists within the entity.
- **Variability** - data aggregation becomes a challenge as big data involves unstructured and different formats: text, image, audio, video, etc. and missing parts are replaced by merging data.

In 2012, Gartner updated the definition by introducing the fourth V:

- **Veracity** - this new coordinated highlighted in the representation of Big Data is oftenly forgotten, although it is essential for a successful business.

Under the current conditions, the growing complexity of information flow facing any organization suggest the idea of pressure from speed, volume, and variability factors on veracity of big data. But these dimensions must work together and provide value through specific technologies and analytical methods. Thus, the emphasis is not only on the processing capacity but also the accuracy of the data processed.

The huge volume of data which needs to be processed through existing facilities and the need for quick access to the terminals in common use has led to the solution of Cloud Computing. The benefits derived from cloud storage

availability on multiple devices with increased mobility give the companies the opportunity to escape from investments in software, hardware and storage infrastructure required for operations and data analysis. The applications and data are running and stored somewhere other than on the user's servers and terminals and the access is done from distance. Thus, it becomes more attractive to buy Business Intelligence resources that folds domestic demand from option of building and maintaining its own data warehouse.

Ironically, this variant of storage created serious enough security risks for a business through the proposed centralized BI architecture. It can be said that many potentially sensitive data are gathered in one place and accessed by many users. Gaining access by an attacker may lead to theft or damage of data in large quantities. Moreover, cloud storage does not maintain or drive itself. This kind of storage is, after all, a business requiring administrators and managers who understand the internal software and the security issues in the cloud.

### **3. INFORMATION SECURITY**

As a simplistic definition, information security can be seen as a protection of integrity, availability and confidentiality of data and systems, which is vital in maintaining the operations of an organization [5]. Oftenly, this concept can be seen as software and hardware systems designed to improve information security. There are examples of well-known technologies like anti-virus programs, firewalls, anti-spyware, based on technology that alerts and tend to frustrate users who ignore and even close these protective systems in many cases.

Hence, it becomes essential to have an analysis of the causes of security issues in the sense that these cannot be left solely to the discretion of the IT departments, but requires an approach through the prism of business and through the human factor. From the business point of view, management is interested in how the information security protects the organization. The budget allocated influences the level of security that an entity can maintain. Thus, a risk analysis and an estimation of cost in case a security breach, unfortunately, drive often to the conclusion that undesirable expenses should be budgeted, and this should be better to be ignored. The human factor is often seen as an enemy of information security, statistics showing that in many cases employees act maliciously or through

negligence on data integrity without paying attention to internal security procedures. The education of staff regarding information protection requires time, effort and budget and the results are not encouraging meaning that often the staff is not interested in this direction.

Research and studies undertaken so far, the solutions offered by providers of BI tools come with different approaches on improving information security by:

- Establishing clear criteria in selecting suppliers of cloud storage facilities
- Protecting data before storing in the cloud
- Information access control
- Information Control
- Creating a culture of information security within organization

### **Establishment of clear criteria in selecting suppliers of cloud storage facilities**

Depending on user requirements, there are three broad categories of storage services on the market:

**IaaS** (Infrastructure as a Service) - provider handling a rented and complex technology infrastructure which can span multiple geographic areas. The level of security offered doesn't go beyond protecting the infrastructure itself and the operating systems, applications and content will be managed and secured by the user.

**SaaS** (Software as a Service) - supplier offering various applications to end users via web: spreadsheets, word processing records, register of shared mail, etc. The security offered is relatively high, the supplier having an important responsibility task on the line of security.

**PaaS** (Platform as a Service) - provider offering advanced solutions and applications hosting. Thus there is little need for user to have specific additional hardware or software internally. Through this offered flexibility, there is the possibility of integrating an additional layer of security.

Cloud storage feature presents obvious benefits, but carries security risks also. Two of the biggest fears in adopting cloud methods are unauthorized access to information held and security flaws. Security and privacy issues are generated because of the fact that data is located in different jurisdictions with different levels of protection. Guidelines developed by the National Association for Information Systems Security – “Security in the cloud” advance the idea of ensuring

information in the cloud computing environment through three levels of security [7]: network security, server security, and application security

In each case there are solutions which can be adopted in advance in order to prevent such shortcomings.

Cloud storage providers must ensure that they have a safe infrastructure, client's data and applications are protected and supply disruptions in the system are minimized. In turn, client companies must avoid vendors who refuse to give details about their security programs. A study by Gartner highlights some issues to be considered in selecting a cloud provider:

- Privileged access to data: Who handles customer data?
- Respect for the rules: Are external audits conducted or safety certifications valid?
- Location of data: Where to store data?
- Data segregation: It provides encryption? What exactly is in the process of segregation of data?
- Recovery: What happens in case of disaster?
- Investigative Support: are there any illegal activities?
- Validity term: it is possible to recover data in case of necessity?

With the gathered information regarding the selected cloud operator, the client organization shall ensure that, at least, the conditions offered by traditional data storage are fulfilled.

### **Protecting data before storing in the cloud**

Given previous recommendations, companies using cloud services have a range of measures that can minimize security risks. Once storage provider is selected, relatively simple steps can be taken in order to identify the information user:

- Knowledge: something only the user knows (password or PIN);
- Possession: something only the user has (magnetic card or token); and
- Inherence: something only the user is (fingerprint or voice).

The variant of encoding or encrypting messages or information can be taken into consideration and this is how data can be read and processed only by authorized user. Of course, companies providing cloud services can offer encryption but there is also the possibility of undesirable decryption. By encrypting

data before transfer to the cloud ensures that access is unlikely without the decryption key [10].

### **Information access control**

It is well known that everybody wants to access the needed information in a fast manner and from various devices and from various places. Of course, BI tools claim to be a clever solution for this task but also, these instruments carry a lot of vulnerabilities. Accelerated development of the mobile terminals (phones, laptops, tablets) brings a number of security vulnerabilities of BI tools. Users tend to have mobile access to everything in the office for reasons of efficiency including the use of BI capabilities in this way. Mobility puts sensitive data for an organization to be combined with personal data, so a mixture of information occurs on the same terminal [9].

Securing Business Intelligence facilities primarily involves a rudimentary technique: the application of controlling the access to information. So:

- Users can get permission to access only the data required or that are dedicated to them. Obviously analysis or processing of data or information not concerning a user by error may have totally irrelevant results and could also be serious security vulnerability.

- Access can be granted directly to the data warehouse or only to reports or presentations. This dilemma occurs quite frequently within entities and is a subject of intense debate among analysts involved in the field. It is clear that in terms of information security and, sometimes, quite complicated bureaucratic procedures it is safe to limit access only to reports and presentations. It appears, however, the disadvantage that many users of BI tools access the same information or data - in fact counter-productive - and management waste precious time on security details and procedures.

Another major data security risk is the loss or theft of the mobile terminal. In such situations, legal notices on occurred security breaches are recommended. The variant in which the mobile device has offline capabilities implies data theft risk and, therefore, Business Intelligence applications should avoid local copies of data retention. In this case, encryption is a welcomed security measure.

The implementation of a security policy in the area of BI can be based on several factors:

- Data classification - establishing data "sensitive" in terms of BI capabilities and, therefore, measures should be taken to protect them. There may be several levels of sensitivity that may require specific measures.
- Classification BI users facilities - is performed depending on the position and role within the organization.
- Standardization of rights - determines how BI tools are allowed to access data and perform specific functions.
- Transmission – it refers to encryption and the authorization levels are established for access and file transfer.
- Data storage - permitted storage locations and manner of back-up are taken into account.

### **Information control**

The goal of all processes related to information control (exercised by human or system) is getting its veracity by achieving predetermined quality standards [3]. These approach methodologies are grouped into three categories:

- intra-system control - exercised within a system or application. It is characterized by an existing logic and follows the organization's needs.
- inter-system control - check data integrity between systems validating actually an exchange of information.
- transactional balance control - include both of the above. It captures data errors that occur in the systems but also during data transfers. Such control is quite difficult to achieve due to the initial set up that requires extra time and effort.

In all variants presented it is essential that these procedures are non-intrusive (to act independently of monitored systems) and have a flexible logic (to have the ability to verify, balance, reconcile and track data).

Implementing an appropriate control of information must be supported by a series of internal factors of which the most relevant are: support from executive level, internal partnership and existence of a plan of action.

As the main beneficiary of BI tools, the executive level makes budgets, supports, implements and maintains control policies. Decision makers have a top-down approach on work processes and can impose control information.

Internal partnership aims at a common approach by the departments involved in control policies (IT, audit, ownership, etc.) even if there are different

views on the desired outcomes, costs or methodologies. It is essential to have a collection and proper symbiosis of all existing views in this respect in an organization in order to avoid internal policies and regulations reversals or delays in ongoing projects.

The existence of a proper plan is based on a correct drafting of current processes within an entity, with all their characteristics (information flows, current controls, incomplete analyzes, lack of conclusive data or excess/ballast of information).

### **Information security culture**

The culture within an organization can be defined as the way activity goes at various levels within an entity. This term encompasses beliefs and values essential to the conduct of the members and may confer a competitive advantage through business excellence, product quality, customer satisfaction, partners' engagement and employee mobilization. This last aspect plays a decisive role and translates into behaviour within the organization which helps protect data, information and knowledge, and which includes perceptions, attitudes, assumptions and beliefs about information security.

Creating and implementing a proper information security within an organization primarily involves creating a culture in which all users, at all levels and departments, understand threats and security procedures, acquire active practice in this regard, take decisions based on the protection of information and understand the information security as an integral part of their service prerogatives [5].

National Association for Information Systems Security (ANSSI) of Romania defines in the *Code of Proper Practices for Information and Communication Systems Security* [6] a set of recommendations for an entity management and other employees. Thus, information system security is seen as a responsibility belonging to the management structures, who are expected to provide a clear direction in this regard by undertaking the following actions:

- a) Review and approve the security policy and establish related responsibilities;
- b) Monitore significant changes in exposure of information system to major threats;
- c) Review and monitor information system security incidents;
- d) Approve measures to improve information security.

Policy makers are given a list of directions to follow in order to emphasize the human resource, beginning with the recruitment stage, up to training programs for IT specialists and beyond. Furthermore, regarding the management levels in charge of the information protection, two strands are becoming increasingly important: *implementing an information security culture* and *BI facilities*. The latter ones primarily intended for collection, storage, knowledge management through analytical methods providing solid information for decision. Role of BI tools to improve data transparency and visibility eventually translates into information security monitoring and sustain development of an information security culture within an organization.

Implementation of such an organizational culture entails two specific dimensions of the human factor: *knowledge* and *behaviour*. The in-company training programs must aim not only at training, but also human resource modeling in order to comply with internal policies, with emphasis on data protection procedures. The aim is to induce an employee appropriate behaviour in order to respect and ensure the information security through the pursuit of knowledge and the application of proper practices.

IT departments play the key role in providing management speedy information in the required form. The quality of the specialist's work is influenced by the volume of processed data and by available resources in the company. This is why a higher level of information security is also a result of the infrastructure meaning platforms, applications, servers, procedures, etc.

### **Case study**

In 2009, the Rompetrol company decided to change strategy through consolidation of the management process and of the IT system optimization. Internal analysis revealed that there was a low level of CPU usage, there was no virtualized environment for optimizing servers loading and there was no solution available for disaster recovery for the whole system. By choosing the SAP application, the organization decided to replace the IT Business Units, which had too many slow-working and asynchronous servers, platforms and applications, with a Vblock solution, provided by an alliance between Cisco, EMC and VMware.

The result was a unique platform combining the best solutions regarding information handling, namely information processing, storing, administration and

security. The integration of servers, operating systems and business applications (Business Intelligence, ERP, CRM) led to financial (Return on Investments of 22 %, Internal Rate of Return of 64 %) and operational advantages (reduced operational costs, higher level of hardware availability and CPU usage). In the new conditions, human resource gained efficiency due to improved speed of response from IT department and also to 50 % reduction of workload of IT team.

These results, related to a complex virtualization process made in a private cloud that hosted a successful IT & C solution, proved to be essential for management in terms of efficiency and security [8].

The management is responsible to recruit proper human resources and also to create conditions for modelling employees in the spirit of organizational needs in the field of security. Obviously, knowledge is fundamental but it should be used and directed to the common interest that should be a safe information flow. This is why behaviour is essential and must be determined by the awareness of the fact that individual benefits are determined by the company's results. Business Intelligence tools measure performances at various levels: on different products or services, on individuals or teams and may provide a strong starting point for establishing strategies or future policies. In fact, these are internal analysis based on information issued by different departments or organizational levels and from different terminals. The whole process is marked by the human touch, which is essential because the system (hardware, software, applications, etc.) must be "fed" and maintained with safe and quality data.

#### 4. CONCLUSION

Business Intelligence tools have evolved and tend to keep up with current challenges existing in public and private sectors. The market offers designed by providers regarding such instruments is more varied and adapted, supporting decision makers through integrated solutions and processing capabilities, reporting, presentation and storage, all being attractive in terms of costs and flexibility.

Thus, the BI user should have a positive general picture: quick access to the needed information from anywhere, friendly and suggestive charts or dynamic reports, analysis of trends, KPI's evolution, sales and margin analysis, budget status ,

etc., all at a click distance. However, these facilities may hide threats that are often forgotten or not seriously taken into consideration by literature or BI providers.

It remains a real challenge to ensure protection of information at all stages of BI-specific flow. Now regarded as a basic resource for an enterprise, information held should be clean, consistent and able to provide confidence to managerial act. In this regard, the solutions promoted by software providers and literature converge on the idea of implementing strict and clear policies and procedures. When a company decides to step into the path of BI tools and cloud solutions, the issue of information security becomes a priority and, at the end of the day, it turns into Business Intelligence security. So far, research focused mainly on technical solutions, all requiring more costs and, in many cases, leading to few results. This is why Business Intelligence instruments may fail in their initial task by becoming untrustworthy applications.

Thus, the big question is: What does it take for a company to implement a secure BI solution? Does it require additional costs to ensure a safe information flow, or more attention should be paid to the human factor?

Beyond written rules, this paper suggests a greater focus on human resources during the BI tool implementing steps: from the evaluation of the initial information flow to the final desired reports and analyses. Involving all human resources is a smart thing to do due because the employees are supposed to gather data, introduce it in the system, follow procedures, maintain a certain discipline and permanently evaluate the results. It should be more sustainable and profitable on long term to induct a proper organizational culture in order to keep the fundamental values of the company always alive.

A culture of information security that is actively supported by management can help users understand the concept of data protection and BI tools in use.

The range of BI applications must adopt functions in order to ensure information integrity. The developers of such systems are already in the position to create flexible architectures adapted to this end and to establish confidence in the final product.

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