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## Modeling the relationship between bank efficiency, capital and risk in Albanian banking system

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### Abstract

Bank efficiency is considered to be very important in the relationship between risk and capital. It affects both capital and risk and it is seen as one of the factors that determine them. On the other side, capital regulation and risk-taking behaviour influenced by it have an impact on efficiency. This paper gives an overview of theoretical and empirical studies that are going to be used on modelling the relationship between efficiency, capital and risk-taking behaviour of commercial banks operating in Albania during the period 2002-2014. Based on previous works worldwide, a three stage model is found to be a proper one for such analysis about Albanian banking system. According to this model: *first*, the regression of efficiency and variables indicating risk and capital has to be analysed, *second* capital will be regressed against variables indicating efficiency and risk and *in the third stage* risk-taking will be regressed against variables indicating efficiency and capital. Based on previous studies related to this issue there are findings of a positive trade off between inefficiency and bank risk-taking (such as US evidences) and also negative one (such as European banks that seem to hold more capital and take on less risk in case of inefficiency). Defined independent factors of efficiency, capital and risk-taking are going to be used on an empirical study, subject of prospective research. To my knowledge there is no previous study on this issue for Albanian banking system. This model enables testing of different hypotheses about risk, capital, efficiency and relationship between them. It is going to respond to the effects that reduction in cost efficiencies might have on future risks of Albanian commercial banks. Furthermore, this model gives the possibility to test the bad management hypothesis and efficiency version of moral hazard hypotheses for targeted banks and banking system. It also responds to the questions whether bank cost efficiency makes the foundation of banks' capital position and risk-taking and also whether there is an evidence of relationships between capital and risk-taking in line with moral hazard hypothesis.

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## 1. Introduction

Current Albanian banking system has his roots in 1992 after the collapse of a centralized economy. In 1992 Albanian banking system started its operation in two levels. In 2015 there are 16 banks operating in Albania which provide services like: deposits, accounts, transfers, loans, e-banking, etc. in a competitive environment. Banking sector is the main pillar of financial intermediation in Albania and a very important service industry. During 2014 assets of banking sector constitute 91.7% of Gross Domestic Production and 5 banks (out of 16) that dominate this sector account for 68.4% of system credit portfolio and 73.4% of deposits. Being such a dominant part of the financial system makes its efficiency very crucial. In terms of providing country's financial services, banking system has a monopoly position. The second component of the financial system is still in developing phase. Banking assets constitute for more than 95 percent of financial system's assets. They work according to the traditional business model and based on this they ensure simple financial structure and offer plain products and services. Their activity is exercised in a stringent and conservative regulatory environment strictly supervised by Bank of Albania. Furthermore, efficient bank operation contributes to financial stability and ensures higher-quality services at low costs for enterprises and households. In this context, analyzing the efficiency and its determinant factors is important for both supervisory authorities and bank management. The first ones use it for the designation of regulatory framework while the second for drawing their business plans. In the frame of European banking industry, the process of financial integration is associated by the debate on the benefits of strengthened competition on credit markets and greater efficiency. Increase of competition in the banking sector forces banks to operate closer to the efficiency production function or in other words, closer to the "best practice". Besides this, competition is linked with risk-taking. Increased competition reduces the market power, decreases their charter value and so may lead banks to greater risk-taking. Regulators have tried to address this possible incentive of taking higher risks by capital requirements and appropriate supervision. Capital adequacy has taken a prominent role in the prudential regulatory process.

Regarding these developments, there are a number of studies on the impact that capital, business models and operating efficiency have on bank risk. The recent credit crisis rises up the necessity of analyzing bank risk in the frame of enhanced bank efficiency and lower bank capital. Based on this, it is very important to assess firstly the impact of efficiency on bank risk. It can happen that because of low levels of efficiency, banks have the incentive to improve their performance by neglecting intensive monitoring of credit. From another perspective, changes on bank risks may influence backwards the efficiency levels. An increase on bank risk may lead to a decline on efficiency (cost efficiency) which results in reduction of credit screening.

Secondly, it is very important to assess the impact that bank capital has on the relation between risk and efficiency. The level of capital might affect this relation. For instance, because of moral hazard problems banks might increase the incentives of lowering capitalization and undertake more risks that mean higher non-performing loans in the future. In the case of well-capitalized banks moral hazard problems may be lower and they can be both more efficient and prudent than low capitalized ones. In the frame of capital costs, which are higher in the case of highly capitalized banks, maximization of revenues through increase of risk-taking level has to be taken in consideration.

The Albanian financial system is based mainly on the banking sector. Non-bank financial sector is left in shadow and intermediation through it continues to be weak and unstructured. Based on this and also on the fact that banks in Albania stand in a monopoly sector position, the competition within financial system in Albania is more an intra sectorial rather than inter sectorial one. Albanian banking system has undergone 20 years of restructuring and during this period of time none of the banks has gone out of market. The study of bank sector efficiency makes it possible to find out what are the reasons for this. It is because of the system's high efficiency or because it has been paid more attention to protection than efficiency. Studying the relationship between risk-taking, capital levels and efficiency in the case of Albanian banking system is very important. While there are studies on the relationship between capital and risk for the Albanian banking system, to my knowledge, there is no study on the impact that

efficiency has to this relation. This paper's analysis all possible variables to be used for the estimation of cost efficiency, bank capital and risk-taking.

The objective of this work is to make an overview of literature (theoretical and empirical one) on the importance of efficiency on capital and risk-taking in the case of Albanian banking system and vice-versa, how efficiency is influenced by changes on risk-taking behavior because of capital regulation. It also aims to determine the variables that are going to be used in the model. *Section two* gives an overview of related literature, firstly on the relation between risk and capital and secondly on the influence that efficiency might have on this relation. The third section makes an analysis of the variables that are going to indicate efficiency, risk-taking and bank capital. Since the theory provides conflicting predictions to this relationship, the only way to examine it for the Albanian banking system is by an empirical analysis that is going to be presented on subsequent research papers. *Session three* introduces the main hypotheses for the relationship between risk and capital and also discusses the methodology and data selected for the upcoming empirical research, and in session 4 conclusions.

## 2. Related literature

Based on the theoretical literature, capital regulation is very important because it controls the risks taken by banks and also their solvency. The protection system of financial safety net may have negative effects on bank risk-taking incentives and for this reason they cannot be considered as an accurate tool of prudential regulation. The most important role, among the different tools used for prudential purposes, has been played by capital adequacy regulations. However, in regard to the optimal design of capital adequacy regulation and its effects to bank risk-taking, theoretical literature gives contradictory results. This means that there is no plain answer on whether higher capital ratios reduce bank's risk taking level. On the other hand, capital adequacy regulation has to be synchronized with other regulatory and market instruments. Market discipline is very important when we come to the point of bank risk-taking and capital strength. If depositors are well informed they will require returns based on the risk taken over by bank. On the other side, banks will hold more capital to keep down insolvency risk. The situation is not the same when these depositors profit from tools of safety net or underestimate systemic risk. If this is the case, the increase on bank risk is not accompanied with the increase on capital hold for solvency risk.

There are many theories on the relation between capital and risk. They use different financial models to evaluate this relation. The option pricing model introduces the idea that equity maximization value is connected with the maximization of the option value of deposit insurance, increase of leverage and of the asset risk. According to this: an increase on deposit liability is not associated with payment of default risk premium; increase of asset risk leads to the increase of managerial effect of this action; increase of leverage (decrease of equity capital) leads to the increase of managerial benefit from the increase of asset risk. If bank behavior tends to increase the deposit insurance the relation between capital and risk is going to be negative, whereas if the increase of the risk appetite dominates bank behavior the relation between risk and capital is positive.

The early empirical literature that examines the effect of bank capital regulations on bank behaviour, Peltzman (1970), Mayne (1972) were focused on the effectiveness of financial regulation and more precisely on the impact that flat rate deposit insurance has on incentives for excessive risk-taking by bankers at the expense of the Federal Deposit Insurance Corporation. Results from these studies show that bank manager's target capital ratios were not affected by the requirements of the banking capital regulation and furthermore they suggest controlling the other factors to limit risk-taking.

The introduction of the first Basel Accord (1988) on bank capital, initiated a number of studies on the effects of bank capital regulations. Ediz et al., (1997) found a positive influence of capital adequacy regulation on the increase of capital ratios although there has not been any shift to the riskier assets for their portfolios and off-balance sheet exposures.

Kwan and Eisenbeis (1997) were the first who made a connection between empirical literature on bank capital regulation and studies related to bank efficiency. Following Hughes and Moon (1995), they emphasized the importance of efficiency when analyzing the relationship between bank capital and risk. Their theoretical arguments were followed by studies that find bank risk-taking and moral hazard incentives determined by both efficiency and bank capital. Furthermore, in case of a banking system with different ownership structures, it is important to study if this relationship (capital-risk-efficiency) is influenced by this factor (ownership structure). This is what Goddard et

al., (2001), studied for European banking. Jansen and Meckling (1976) suggested that lack of capital market discipline has a negative impact to the owner's control over the management and it gives to the managers the possibility of pursuing their own agenda and neglecting the issue of efficiency.

Altunbas, Carbo, Gardener & Molyneux (2007), examined in their study the relationship between capital, risk and efficiency in European banking for the period 1992-2000. According to the results of empirical evidence banks with more capital tend to be less efficient and also the ones to take on excessive risk while they didn't find any incentive to take on more risk in case of inefficient European banks. The results show a positive relationship between risk and capital level and the positive influence that financial strength of the corporate sector has in reducing capital levels and bank risk-taking. In the case of commercial and saving banks there are no major differences in this relationship while co-operative banks capital levels are inversely related to risks. According to Fiordelisi, Marques-Ibanez & Molyneux (2010) efficiency reduces risk-taking and capital improves efficiency.

Above mentioned literature represents the relationship between bank cost efficiency, capital and risk-taking and we find out that risk-taking is positively affected by bank regulation, capital and deposit insurance. On the other hand, risk is negatively affected by bank size, managerial ownership, capital and loan growth.

### 3. Hypotheses, model and data

#### 3.1. Main hypothesis between capital and risk

Moral hazard problems coming up from the existence of a financial safety net, agency problems and the effects of regulatory actions are very important when analyzing the relationship between capital and risk. Main hypothesis on the relation between capital, risk and efficiency will be based on the contribution of these factors.

The moral hazard hypothesis that arises in case of agency problems: Based on this hypothesis the relationship between capital and risk is negative. In case of high leverage position, capital decrease will be accompanied by increase on their risk level and that shows a negative relation between risk and capital.

According to Modigliani and Miller theory firm's earning power and the risk of its underlying assets lays down its market value. According to the basic idea of this theorem it doesn't make any difference whether investments of a firm are financed by equity or debt. This applies in terms of complete financial markets and perfectly informed depositors about bank's risk to failure. Since the contribution of Modigliani and Miller (1958), researchers have studied how to reach an optimal capital structure by implications of deviations from the frictionless world that they assumed in their theory. Later, Jensen and Meckling (1976) brought the concept of "agency theory". They emphasize the conflict of interest between different contracting parties, principals and agents that are shareholders (owners), managers and equity holders. Since their seminal work, a vast literature can be found on explanations given to the nature of these conflicts of interests and also on the methods to solve them. According to Jansen and Meckling (1976), the agency relationship can be defined as a contract between the principal and the agent. The entire cost of failure on pursuing goals is hold by managers while they can have only a fiction of the benefits.

The moral hazard is present in the case of deposit insurance with full cover. This kind of deposit insurance does not reflect the asset risk and in this way banks have the incentives to increase riskiness of their portfolio. Benson et al. (1986) and Kane (1985) has analyzed the way how fixed-rate insurance stimulates risk-taking by banks. Merton (1977) and other authors have studied moral hazard due to deposit insurance. The extreme case of its implication is in zombie banks (Kane 1989).

Gorton and Rosen (1995) argue that managers will tend to take on more risks in periods of an unhealthy banking industry. Better capitalized banks have less moral hazard incentives.

The contribution of regulators and supervisors influences a positive relationship between capital and risk. According to their requirements the increase of bank's risk-taking level has to be followed by the increase of the capital hold to cover these risks. Required additional capital buffer in case of banks with higher level of risks enables them to avoid the costs of issuing equity at short notice.

Bank efficiency level may impact future bank risk. Furthermore, decline in efficiency will lead to an increase in bank's risk. It is supposed to be a negative relationship between risk and efficiency in case of exogenous events. Such events increase problem loans, increase risks and in respond banks have to pay additional costs and managerial efforts. According to this an increase in bank risk is expected to decline cost efficiency.

Summarizing all above, risk, capital and efficiency are all interrelated and the modelling of the relationship between capital and risk has to involve bank efficiency.

### 3.2. Methodology and data

The discussions on efficiency are based on the stochastic efficient frontier production methodology developed by Aigner et al (1997). Cost efficiency can be defined as a measure to evaluate whether bank costs come from the best practices related to costs, best combination of inputs out of all possible ones for production of the same output at the same conditions. Estimation of cost efficiency can be through non-parametric and parametric techniques. Non-parametric techniques in cost efficiency estimation require techniques of linear programming. Meanwhile, based on parametric techniques cost efficiency derives from a cost function wherein variable costs depend on input prices, quantity of output variables, random error and inefficiency. Based on duality theory, in certain conditions (e.g exogenous prices or out of managerial control, and optimal behavior of producer), characteristics of production function (economies of scale or economies of scope) can be indirectly drawn from the use of cost or profit function. Based on Aigner, Lovel and Schmit (1997) and Meeusen and Broeck (1977) cost function of a firm is:

$$TC_b = C(Q_i, P_j, \varepsilon_b) \quad b=1, \dots, n \quad (1)$$

Where  $C_b$  is bank total operational cost,  $Q_i$  represents the vector of quantity of bank output variables,  $P_j$  is the vector of prices of bank input variables,  $\varepsilon_b$  represents the compound random error.

Compound random error term consists of two parts as presented below:

$$\varepsilon_b = u_b + e_b \quad (2)$$

Where,  $u_b$  refers to the endogenous factors while  $e_b$  refers to the exogenous factors that influence bank production cost. In this way, term  $u_b$  shows an increase on bank production cost because of the inefficiency factor which may result from an error in management. As such we can mention the irrational use of the quantity of inputs for given prices. On the other side, the second component of compound random error,  $e_b$ , represents a contemporary increase or decrease on bank costs as the result of random factors that flows from mistakes on data's, on measurement of unexpected or uncontrolled factors. As such we can mention time, strikes, wars and other factors that are not influenced by changes on the methods of management.

To make easy the measurement,  $u_b$  and  $e_b$  are supposed to be separable from the other part of the cost function and both sides of the equation (1) can have a logarithmic form:

$$\ln TC_b = f(Q_i, P_j) + \ln u_b + \ln e_b \quad (3)$$

Where  $f$ , represents the form of cost function and  $e_b = \ln u_b + \ln e_b$  represents components of the error term. It is the last part of the equation that makes the difference between parametric and non-parametric techniques of efficiency, the way how we decompose the error term. Non-parametric approach are based on the assumption that there is no error coefficient and in this way every deviation from the best way of combination of inputs to produce in an efficient way the outputs is considered as part of inefficiency. Meantime, parametric techniques are based on the assumption that inefficiency has an asymmetric design which in most of the cases is half normal while random errors has a symmetric distribution, in most of the cases normal standard.

Estimation is conducted using a maximum likelihood procedure. The efficiency model is written as follows:

$$\begin{aligned} \ln(TC) = & \sum_{i=1}^2 \alpha_i \ln Q_i + \sum_{j=1}^3 \beta_j \ln P_j + \frac{1}{2} \left[ \sum_{i=1}^2 \sum_{j=1}^2 \delta_{ij} \ln Q_i \ln Q_j + \sum_{i=1}^3 \sum_{j=1}^3 \lambda_{ij} \ln P_i \ln P_j \right] + \\ & + \frac{1}{2} \left[ \sum_{i=1}^2 \sum_{j=1}^2 \delta_{ij} \ln Q_i \ln Q_j + \sum_{i=1}^3 \sum_{j=1}^3 \delta_{ij} \ln P_i \ln P_j \right] + \sum_{i=1}^3 \sum_{j=1}^2 \rho_{ij} \ln P_i \ln Q_j + e \end{aligned}$$

Banks will be considered as multi production firms, 2 outputs and 3 inputs. Input vector is compound by: (1) price of funds  $p_1$ ; (2) price of labour,  $x_2$  and (3) price of physical capital,  $x_3$ . Output vector, based on the assumption that it represents the real portfolio of products and services of banks that operates in Albania, is compounded by: (1) total loans,  $q_1$ ; (2) other earning assets,  $q_2$ .

This study is based on previous empirical findings that consider bank efficiency as a key component for bank management while investigating the relationship between cost efficiency, risk-taking and bank capital. A system of equations will be used to enable estimation of their interrelationships. The modelling framework is based on various approaches suggested by Shrikes and Dahl (1992) Kwan and Eisenbeis (1997) and Altunbas et al. (2007). Table 1 presents the empirical model for the three-stage last squares to estimate the relationship between efficiency, capital and risk-taking.

Table 1 Empirical Model of the Three-Stage Least Square (3SLS)

Depencand Variable	Model	
EFFICIENCY (EFF)	$EFF = \alpha_0 \text{ETA} + \alpha_1 \text{LTA} + \alpha_2 \text{LASSET} + \alpha_3 \text{LDR} + \alpha_4 \text{RISK} + \alpha_5 \text{PERSTEX} + \alpha_6 \text{FIXTAS} + \alpha_7 \text{CIR} + \alpha_8 \text{EGRW} + \alpha_9 \text{CORRUPT} + \alpha_{10} \text{FREE}$	Equation (1)
CAPITAL (ETA)	$ETA = \alpha_0 \text{LTA} + \alpha_1 \text{EFF} + \alpha_2 \text{LASSET} + \alpha_3 \text{RISK} + \alpha_4 \text{OBSA} + \alpha_5 + \alpha_6 \text{CIR} + \alpha_7 \text{FIXTAS} + \alpha_8 \text{ROA} + \alpha_9 \text{EGRW} + \alpha_{10} \text{CORRUPT} + \alpha_{11} \text{FREE}$	Equation (2)
RISK-TAKING (LTA)	$LTA = \alpha_0 \text{ETA} + \alpha_1 \text{EFF} + \alpha_2 \text{LASSET} + \alpha_3 \text{RISK} + \alpha_4 \text{ROA} + \alpha_5 \text{PERSTEX} + \alpha_6 \text{DEPTA} + \alpha_7 \text{OBSA} + \alpha_8 \text{EGRAW} + \alpha_9 \text{CORRUPT} + \alpha_{10} \text{FREE}$	Equation (3)

Equation 1 in Table 1 employs cost efficiency (EFF) as dependant variable. Table 2 gives explanations on the independent variables that are going to be used for its estimation.

Table 2 Independent variables of capital (ETA)

Indicator	Description
ETA	Equity to total asset
LTA	Loan to total asset
LASSET	Logarithmic asset size
LDR	Loan deposit ratio
RISK	Loan losses provision to total loan
PERSTEX	Personnel exp. to total expenses
FIXTAS	Fixed asset to total asset ratio
CIR	Cost to income ratio
EGRW	Annual economic growth
CORRUPT	Corruption index
FREE	Economic freedom index

Equation 2 in Table 1 employs Bank capital as dependant variable. Table 3 gives explanations on the independent variables that are going to be used for its estimation.

Table 3: Independent variables of capital (ETA)

Indicator	Description
LTA	Loan to total asset
EFF	Cost efficiency
LASSET	Assets Logarithm
RISK	Loan losses provision to total loan
OBSA	Off-balance sheet activities to total asset
CIR	Cost to income ratio
FIXTAS	Fixed asset to total asset ratio

ROA	Return on asset
EGRW	Annual economic growth
CORRUPT	Corruption index
FREE	Economic freedom index

Equation 3 in Table 1 employs Bank risk-taking level as dependant variable. Table 4 gives explanations on the independent variables that are going to be used for its estimation.

Table 4: Independent variables of risk-taking (LTA)

Indicator	Description
ETA	Equity to total asset
EFF	Cost efficiency
LASSET	Logaritmimi i asetëve
RISK	Loan losses provision to total loan
ROA	Return on asset
PERSTEX	Personel exp. to total expenses
DEPTA	Deposit to total asset
OBSA	Off-balance sheet activities to total asset
EGRW	Annual economic growth
CORRUPT	Corruption index
FREE	Economic freedom index

The Albanian financial system is based mainly on the banking sector. Non-bank financial sector is left in shadow and intermediation through it continues to be weak and unstructured. Based on this and also on the fact that banks in Albania stand in a monopoly sector position, the competition within financial system in Albania is more an intra sectorial rather than inter sectorial one. Table 5 shows the share of each segments of financial system to GDP. As indicated in this table the Albanian financial system is dominated by banking system. Albanian banking system has undergone 20 years of restructuring and during this period of time none of the banks has gone out of market. The study of bank sector efficiency makes it possible to find out what are the reasons for this. Studying the relationship between risk-taking, capital levels and efficiency in the case of Albanian banking system is very important. While there are studies on the relationship between capital and risk for the Albanian banking system, to my knowledge, there is no study on the impact that efficiency has to this relation.

Table 5: Share of financial segments to GDP (2008-2014)

Licencing and Supervisory Authority	Financial system	2008	2009	2010	2011	2012	2013	2014
Bank of Albania	Banking sector	76.7	77.5	80.9	84.7	89.6	90.5	91.7
	Non-bank institutions	1.7	2.2	2.7	2.5	2.7	2.5	2.7
	SLAs and their Unions	0.7	0.8	0.8	0.7	0.8	0.8	0.8
Albanian Financial Supervisory Authority	Insurance Companies	1.4	1.5	1.4	1.5	1.6	1.6	1.7
	Pension funds		0.01	0.01	0.01	0.02	0.03	0.04
	Investment funds					1.21	3.7	4.5
Financial intermediation		80.5	82.01	85.81	89.41	95.93	99.13	101.44

The Albanian banking sector has undergone many changes that have influenced developments on banking sector per group-bank. Banks are classified in three main groups G1, G2, G3. Criteria's for such classification have been: ownership of bank capital and size of bank assets.

The criterion of capital ownership is used till 2003 yr. According to this criterion banks were classified as:

- a. Banks with state capital (G1)
- b. Banks with common capital (G2)



c. Banks with private capital (G3)

In 2004 yr. banking sector is totally owned by private stockholders and this changes the criterion used on classifying banks. From this year onwards the structure of banking sector is determined by the size of bank assets. Based on the ratio of bank assets market value by banking sector total value of assets, banks can be part of three main groups:

- a. Banks that own less than 2% of the total value of banking sector assets (G1-group of small banks)
- b. Banks that own more than 2% but less than 7% of total value of banking sector assets (G2 – middle size banks)
- c. Banks that own more than 7% of total value of banking sector (G3 – group of big banks)

#### 4. Conclusions

Albanian financial systems is dominated and identified by banks because its assets account for more than 95 percent. Its role is very important to the economic stability and soundness. Relied on theoretical and empirical approaches there are studies on the relationship between risk and capital for the Albanian banking system and also on the dynamics of bank efficiency either for the whole banking system or for individual banks that are part of it. Theoretical studies are not conclusive on the effect that more stringent capital requirements have on bank efficiency. Capital requirements enhance financial stability and improve bank efficiency by using larger capital as buffer and by lowering moral hazard. There are also arguments that higher capital requirement may enhance excessive risk-taking. Most empirical evidences suggest that more stringent capital regulation may lead to lower riskiness of bank assets because it reduces bank's exposure to systemic risk. On the other hand, there are studies that don't find strong the linkage between capital requirement and bank risk. Banks can respond to higher risk-weighted capital requirements by raising equity, cutting down lending or reducing asset risk. The way how banks choose to respond to capital requirements really matters. Each of these alternatives gives different impact to the economic growth. What is the way that banks operating in Albania react to higher risk-weighted capital requirements and the impact that their choice will have to the economic growth will be the object of following papers. The theoretical and empirical literature presented in this paper will support their assessments and explanations of regressions that might be found. The relation between risk and capital is found to be positive and simultaneous. The analysis of the efficiency cost shows the presence of inefficient banks in Albania. While analyzing the relationship between capital and risk, it is very important to take in consideration bank efficiency. The level of bank efficiency is very important to and determines both capital and risk. Nevertheless, the capital regulation and risk-taking behavior influenced by it has its impact to efficiency. It can either increase or decrease efficiency. Based on literature, there are five different approaches concerning measurement of banking output. The determination of the independent variables for estimation of X-efficiency in case of Albanian banking system is going to be according to the asset (intermediation) approach which considers loans and other assets as bank outputs while deposits and other liabilities are bank inputs. Relying to previous theoretical and empirical literature a three stage model will be used for a set of 16 banks for the period 2002-2014. *First*, the regression of efficiency and variables indicating risk and capital will be analyzed, *second* capital is regressed against variables indicating efficiency and risk and *in the third stage* risk-taking is regressed against variables indicating efficiency and capital. This model will help on answering the questions whether bank cost efficiency is making the foundation of banks' capital position and risk-taking and also whether there is an evidence of relationships between capital and risk-taking in line with moral hazard hypothesis.

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