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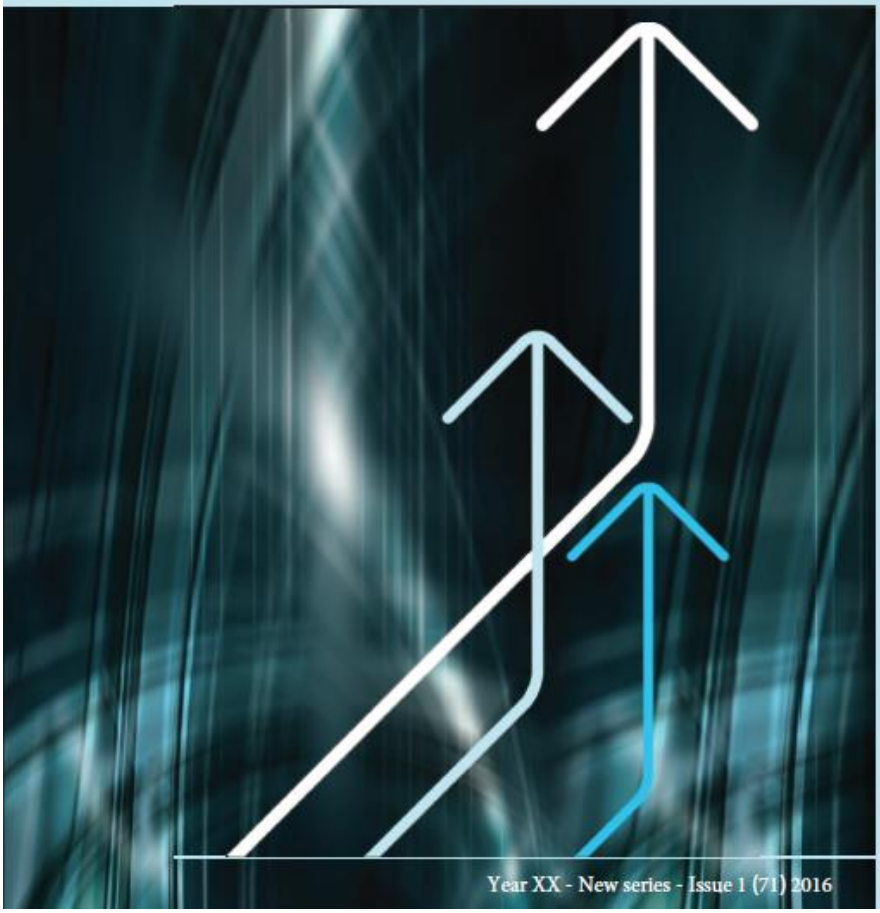
# Financial Studies



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“VICTOR SLĂVESCU” CENTRE FOR FINANCIAL
AND MONETARY RESEARCH

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# FINANCIAL STUDIES

ROMANIAN ACADEMY
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# ANALYSIS OF THE RELATIONSHIP BETWEEN DISCLOSURE QUALITY AND DIVIDEND PAYOUTS FROM THE AGENCY THEORY PERSPECTIVE

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**Abstract**

This study examines the effect of disclosure quality on dividend policy when the level of agency problem is taken into account and empirically tests the outcome and substitution hypotheses.We find evidence consistent with the outcome hypothesis; that is, disclosure quality is positively related to dividend payouts. In addition, high agency cost firms with better disclosure quality are associated with a stronger propensity to pay dividends and larger payouts. The results highlight the important governance role of disclosure quality. This study shows that despite the high agency cost problem, so long as there is high disclosure quality, shareholders can safeguard their interests by demanding higher dividends payouts.

**Keywords:** dividend policy, disclosure quality,agency theory, corporate governance

**JEL Classification:** G34, G35

## 1. Introduction

Agency costs exist in every business whose manager is not an owner or shareholder of the firm. Managers are likely topursue their self-interests rather than maximize shareholder values. As a result, agency costs arise due to the need to monitor managerial actions. Firms that have high agency costs can be problematic and detrimental to shareholders. The aims of this study are to examine the relationship between disclosure quality and dividend policy from the agency theory perspective and to find out if the effect of

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disclosure quality on dividend policy is different for high agency cost firms.

La Porta et al. (2000) study the connection between agency costs and dividends and propose an outcome hypothesis and a substitution hypothesis. The outcome hypothesis posits that dividends are paid because of the pressure from minority shareholders on corporate insiders to disgorge cash. Therefore, dividend policy is the "outcome" of an effective corporate governance system. On the contrary, the substitution hypothesis argues that dividends are paid because insiders who plan to issue equity in the future have the incentive to establish a reputation for decent treatments of minority shareholders. Therefore, dividend payouts in this case can be considered as a substitute governance mechanism.

Prior studies indicate that firms with stronger corporate governance arrangements demonstrate higher levels of disclosure (Chau and Gray, 2002; Cheng and Courtenay, 2006; Wang and Hussainey, 2013). Disclosure as one governance mechanism can discourage managers from expropriating shareholders. The outcome hypothesis suggests that a transparent disclosure environment can reduce agency costs and lead to higher dividend payouts. In contrast, the substitution hypothesis argues that managers in an opaque disclosure environment give higher payouts as they are to establish a reputation for fair treatment.

Prior literature reveals that well-functioning governance mechanisms can ensure dividend payouts are at work, and reports a significant positive association between corporate governance and dividend payouts (La Porta et al., 2000; Mitton, 2004; Adjaoud and Ben-Amar, 2010; Jiraporn et al., 2011). However, some studies find a negative relationship between dividend payouts and corporate governance (Jiraporn and Ning, 2006; Chae et al., 2009; Chang and Dutta, 2012). Recent research documents that corporate governance has an impact on dividend payout. For example, the entrenched control by firm owners results in smaller distributions of dividend payments (Hwang et al., 2013), and the existence of an intra-familial conflict of interest results in a higher propensity to pay dividends (Michiels et al., 2015). Therefore, the effect of disclosure quality on dividend policy is conditional on the level of agency problem inducing from corporate governance.

Our results show support for the outcome hypothesis. Better disclosure quality is associated with a stronger propensity to pay

dividends and larger payouts. High agency cost firms, defined as firms that have below the average corporate governance score and above the average free cash flow level, with better disclosure quality can also effectively reduce the extent of agency problem and force managers to pay out dividends. Overall, the evidence suggests that disclosure plays an important governance role. Shareholders of high agency cost firms are able to use their power to extract dividends and protect their own interests when there is high quality of disclosure.

This paper contributes to the extant literature on dividend policy and disclosure quality in several ways. First, this study differentiates from prior studies by directly considering the level of agency problem in the model (using a dummy variable). High agency cost firms are firms that investors would want to shy away from. Shareholders of such companies would also want to know how to protect their own interests. It is therefore essential to see if the quality of disclosure is important to corporate governance and if it is effective in reducing the extent of agency problems.

Secondly, the impact of disclosure on dividend payouts has received less attention by studies on dividend policy. Prior research has mostly examined the impact of corporate governance on dividend payouts using corporate governance indexes (Jiraporn and Ning, 2006; Chae et al., 2009; Sawicki, 2009; Adjaoud and Ben-Amar, 2010; Jiraporn et al., 2011; Bae et al., 2012) or other governance variables, such as board composition, CEO duality, board size, and ownership structure (Campbell and Turner, 2011; Chen et al., 2011; Chang and Dutta, 2012; Abor and Fiador, 2013; Michiels et al., 2015). Therefore, the effect of disclosure quality on dividend payouts is worth further investigation, especially for high agency cost firms.

The remainder of this paper is organized as follows: First, we review the prior empirical literature on dividend policy and disclosure, and develop the hypotheses tested in this study. Then, we describe the sample and data and specify the models and methods used in the tests. Finally, we present the empirical results and provide conclusions from this study.

## 2. Theoretical Background and Hypothesis Development

La Porta et al. (2000)suggest that in an economy where significant agency problems exist between corporate insiders and outsiders, dividend payouts play an important role. Dividends can be viewed as an “outcome” of an effective corporate governance system

or a “substitute” for weak governance. The outcome hypothesis posits that higher disclosure quality is associated with larger dividends because shareholders are better able to find out the level of excess cash flow and demand for higher payouts. The study by Jiraporn et al. (2011) provides support for the outcome hypothesis. In particular, better governance quality is associated with a stronger propensity to pay dividends and larger dividend payments. Adjaoud and Ben-Amar(2010) also show that firms with stronger governance tend tomake higher dividend payouts. Using a sample of Poland companies,Kowalewski et al. (2008) find that dividend to cash flow ratio is positively associated with Transparency Disclosure Index (TDI), a proxy for corporate governance practices.

On the other hand, the substitution hypothesis suggests that manager of firms with lower disclosure quality will increase payouts to establish a reputation for good treatment of shareholders. Based on the substitution hypothesis, disclosure quality will be negatively associated with dividend payouts. Chang and Dutta (2012) study Canadian firms and find that weaker governance is associated with higher dividends. Chae et al. (2009) also report a negative relationship between dividend payout and corporate governance. The strength of the relationship depends on the relative size of agency costs and external financing constraints.

While dividend payouts provide one way of disciplining managers by preventing managers from wasting the free cash flow on negative NPV projects (Jensen, 1986), disclosure quality also plays a governance role by reducing information asymmetry and increasing transparency that allows shareholders to closely monitor managers. The above review suggests a mixed relationship (i.e., the outcome hypothesis versus the substitution hypothesis) between disclosure quality and dividend policy. Therefore, this study tests the following hypotheses:

*H1: The effect of disclosure quality is related to the propensity to pay dividends.*

*H2: The effect of disclosure quality is related to the level of dividend payouts.*

Moreover, previous studies have reported a relationship between other corporate governance mechanisms and dividend policy. For example, Hwang et al. (2013) report that improving corporate governance enhances payout policies for independent firms over time. Bradford et al. (2013) find that ownership structure has an

impact on dividend policy in China. State-controlled firms pay higher dividends than privately controlled firms. Therefore, to take account of the effect of other governance factors (proxied by a corporate governance score) and the level of agency problem (measured by the level of free cash flow), this study includes a dummy variable for high agency cost firms that have below the average corporate governance score and above the average free cash flow level and tests two additional hypotheses as outlined below. The aims are to examine the interaction effect (between agency problem and disclosure quality) on dividend policy and to find out if the effect of disclosure quality on dividend policy is different when the level of agency problem is considered.

*H3: The effect of disclosure quality on the propensity to pay dividends is different for high agency cost firms.*

*H4: The effect of disclosure quality on dividend payouts is different for high agency cost firms.*

## 3. Data and Method

### 3.1. Sample and Data

The sample is based on firms listed on the S&P/TSX composite index for the period 2009-2012. The disclosure and corporate governance scores are obtained from The Globe and Mail (G&M). The reason for choosing this sample period, 2009-2012, is that there were modifications to composites of the disclosure index. Several criteria were added to the disclosure assessments in 2009 and in 2013. The maximum disclosure score that a company can obtain increased from the initial 10 marks to 12 marks in 2009 and to 13 marks in 2013. To ensure consistency in disclosure measurements, the sample period is constrained to this time period 2009-2012. Accounting and financial data are obtained from the Standard & Poor's Compustat database. Firms that do not have all the required financial and accounting data for the entire period are eliminated from the sample. The final sample consists of 452 firm-year observations.

### 3.2. Empirical Model

To examine how disclosure quality and the disclosure quality of high agency cost firms affect dividend policy, the following two models are developed, a logit model (Model 1) and a random effects panel regression model (Model 2).

$$DIVD_{it} = \alpha_i + \beta_1 DSCORE_{it} + \beta_2 DSCORE_{it} \times AGENCY_{it} + \beta_3 LEVERAGE_{it} + \beta_4 ROE_{it} + \beta_5 CAPEXP_{it} + \beta_6 RETAIN_{it} + \beta_7 FCF_{it} + \beta_8 INDUSTRY_{it} + \varepsilon_{it} \quad (1)$$

$$DIV_{it} = \alpha_i + \beta_1 DSCORE_{it} + \beta_2 DSCORE_{it} \times AGENCY_{it} + \beta_3 LEVERAGE_{it} + \beta_4 ROE_{it} + \beta_5 CAPEXP_{it} + \beta_6 RETAIN_{it} + \beta_7 FCF_{it} + \beta_8 INDUSTRY_{it} + \varepsilon_{it} \quad (2)$$

The dependent variable of Model 1 is the likelihood of a firm paying dividends (*DIVD*) and is set to 1 if the firm pays a dividend,or 0 otherwise. The logit model tests the effect of disclosure quality on the likelihood of dividend payouts and tests if the effect is different for high agency cost firms. The dependent variable of Model 2 is measured by dividend yield (*DIV*), calculated as the ratio of cash dividend per share to stock price per share. A panel regression model is used to examine the relationship between disclosure quality and dividend payouts and tests if the relationship differs for high agency cost firms.

Table 1provides the definitions of all relevant variables used in the analyses. The main variables of interest in this study are disclosure quality (DSCORE) and the interaction of disclosure quality and agency cost (DSCORE x AGENCY). The agency cost is measured by a dummy variable that equals one if the firm has high agency costs, which is defined as having below the average corporate governance score and above the average free cash flow level. The agency costs of free cash flow hypothesis (Jensen, 1986) suggests that firms with abundant free cash are more likely to engage in value-decreasing investment and thus, suffer from greater agency problems.

Other variables that have been suggested by previous studies as having an influence on dividend payouts are also included in our analyses as control variables and are discussed below. Leverage, defined as the ratio of total debt to total assets, is controlled for because debt holders may impose debt covenants on dividends (Jiraporn et al., 2011). Debt can also be considered as a corporate governance mechanism for alleviating the potential free cash flow problem (Setia-Atmaja et al., 2009). Therefore, a negative relationship is expected between leverage and dividend payouts.

**Table 1**

**Variable descriptions**

| Variable | Symbol | Exp Sign | Description |
|---|---|---|---|
| | | **Dependent** | |
| Dividend dummy(Model 1) | *DIVD* | | Dummy variable that equals one if the firm pays a dividend, or 0 otherwise. |
| Dividend yield (Model 2) | *DIV* | | Ratio of cash dividend per share to stock price per share. |
| | | **Independent** | |
| Disclosure quality | *DSCORE* | +/- | Disclosure score is collected from *The Globe and Mail*. This variable ranges from 0 to 12. |
| Agency cost | *AGENCY* | +/- | Dummy variable that equals one if the firm has below the average corporate governance score and above the average free cash flow level, or 0 otherwise. |
| | | **Control** | |
| Leverage | *LEVERAGE* | - | Ratio of total debt to total assets. |
| Profitability | *ROE* | + | Ratio of net income to shareholder equity. |
| Growth opportunities | *CAPEXP* | - | Ratio of capital expenditure to total assets. |
| Retained earnings | *RETAIN* | + | Ratio of retained earnings to total equity. |
| Availability of free cash | *FCF* | + | Ratio of free cash flow (defined as net cash flow from operating activities minus capital expenditures) to book value of assets. |
| Industry dummy | *INDUSTRY* | +/- | Dummy variable that equals one if the firm belongs to the industrial sectors, or 0 otherwise. |

Firm profitability is also controlled for and is measured by return on equity (ROE). Firms with higher profitability have more net income available for distributing cash dividends to shareholders (Chang and Dutta, 2012) and therefore, a positive relationship with dividend payout is expected. Growth opportunities (defined as the ratio of capital expenditure to total assets) proxies for future cash flow needs for investment and operating activities (Adjaoud and Ben-Amar, 2010; Chang and Dutta, 2012). Therefore, higher growth opportunities are expected to be associated with lower dividend payouts. Firms with higher retained earnings (measured by the ratio of retained earnings to total equity) are likely to make higher dividend payouts. Hence, a positive relationship is expected. The agency costs of free cash flow hypothesis proposed by Jensen (1986) suggests that firms may reduce the agency costs of free cash flow by distributing the free cash to shareholders through dividend payments. Thus, this study controls for the availability of free cash using the ratio of free cash flow to book value of assets (where free cash flow is

defined as the net cash flow from operating activities minus capital expenditures). To control for possible variations across industries, we include a dummy variable for industrial sectors.

## 4. Results

### 4.1. Descriptive Statistics

The summary statistics of sample firms are presented in Table 2. The Table shows that most of sample firms are dividend-payers, i.e., 394 firm-years or 87.2%. The average dividend yield and average disclosure score are 2.26% and 8.7 (out of a total score of 12), respectively. Just over a quarter of the sample firms are identified as high agency cost firms, i.e., 122 firm-years or 27%.

Table 3 reports the trend in dividend yields over the sample period. The results show that the majority of sample firms (68%) exhibit a consistent pattern in dividend payouts between 2009 and 2012. Specifically, 37% of firms show a consistent increasing trend in dividend yields, 10% show a consistent decreasing trend and 21% show no changes in dividend yields. As a result, the lag variable of dividend yield will be highly correlated with the dividend yield in the current period and will capture most of the variations in the dependent variable. This will inhibit us from examining the effect of variables that we are interested in on dividend payout policy. Therefore, in this study the lag variable of dividend yield is not included in the models.

**Table 2**

**Descriptive statistics**

| Variable | Mean | Median | S.D. | Min | Max |
|---|---|---|---|---|---|
| DIV (%) | 2.26 | 1.93 | 2.08 | 0.00 | 21.46 |
| DSCORE | 8.72 | 10.00 | 2.97 | 0.00 | 12.00 |
| LEVERAGE (%) | 19.80 | 18.18 | 14.45 | 0.00 | 60.49 |
| ROE (%) | 10.15 | 10.39 | 21.46 | -250.29 | 278.08 |
| CAPEXP (%) | 6.80 | 5.45 | 6.16 | 0.00 | 41.74 |
| RETAIN (%) | 35.82 | 53.52 | 60.31 | -438.62 | 94.45 |
| FCF (%) | 1.96 | 2.07 | 9.60 | -54.72 | 34.04 |
| No. of DIV payers | 394 firm-years | | | | |
| No. of AGENCY firms | 122 firm-years | | | | |

*The sample includes 452 firms-years.*

**Table 3**

**Trend in dividend yields over the sample period**

| Dividend Yield | Rising | Declining | Stable | Varying | Total |
|---|---|---|---|---|---|
| No. of firms | 42 | 11 | 24 | 36 | 113 |
| % of firms | 37% | 10% | 21% | 32% | 100% |

*Dividend yield is the ratio of cash dividend per share to stock price per share*

Table 4 reports two sample t-test results, that is, difference in means for high agency cost firms and for industrial firms. In this study, high agency cost firms are firms that have below the average corporate governance score and above the average free cash flow level. These firms have lower disclosure quality, lower growth opportunities and high free cash flow than other firms, significant at the 1% level. These characteristics reflect problems in high agency cost firms, which have poor disclosure quality, tend to reserve a high level of free cash flow and spend less on capital expenditures. The finding suggests that agency problems have an effect on disclosure quality. Therefore, one objective of this study is to examine the interaction effect of disclosure quality and agency problem on dividend policy. Table 4 also shows that industrial firms have significantly lower dividend yields, lower disclosure quality, lower leverage, lower profitability, lower retained earnings, lower free cash flow and higher capital expenditures. Since industrial firms are significantly different from other firms, this study includes a dummy variable for industrial firms in the models.

**Table 4**

**T-test of difference in means for high agency cost firms and industrial firms**

| Variable | Agency firms (Mean) | Others (Mean) | Difference (t-value) | Industrial firms (Mean) | Others (Mean) | Difference (t-value) |
|---|---|---|---|---|---|---|
| DIV (%) | 2.46 | 2.18 | 1.24 | 1.29 | 3.14 | -10.50*** |
| DSCORE | 6.48 | 9.55 | -10.91*** | 8.16 | 9.23 | -3.87*** |
| LEVERAGE (%) | 18.92 | 20.13 | -0.79 | 15.12 | 24.09 | -6.93*** |
| ROE (%) | 10.06 | 10.19 | -0.05 | 7.97 | 12.15 | -2.08** |
| CAPEXP (%) | 4.58 | 7.63 | -4.77*** | 9.79 | 4.07 | 11.14*** |
| RETAIN (%) | 41.88 | 33.57 | 1.30 | 28.41 | 42.60 | -2.51** |
| FCF (%) | 8.70 | -0.54 | 10.04*** | 0.27 | 3.50 | -3.62*** |
| Obs. | 122 | 330 | | 216 | 236 | |

*Agency firms are firms that have below the average corporate governance score and above the average free cash flow level. Industrial firms include firms in the agriculture, forestry, fishing, mining, construction and manufacturing sectors. ***and ** denote significance at the 1% and 5% level, respectively.*

The correlation analysis is provided in Table 5. Dividend yields are significantly positively related to disclosure quality, leverage, profitability, retained earnings and free cash flow and significantly negatively associated with capital expenditures. The directions of relationship are all consistent with the predictions except for leverage. Results from the correlation analysis suggest that leverage is not a substitute governance mechanism for reducing agency problems. Despite the need to raise debt, firms may insist on paying dividends due to the "stickiness" in dividend payouts that have been reported in previous literature (Guttman et al., 2010; Twu, 2010). The correlation analysis also shows that firm size, measured by natural log of total assets, is significantly related to other explanatory and control variables. Hence, to avoid multicollinearity problem, firm size is not included in our models.

**Table 5**

**Correlation analysis**

| Variable | DIV | DSCORE | Ln(TA) | LEVERAGE | ROE | CAPEXP | RETAIN | FCF |
|---|---|---|---|---|---|---|---|---|
| DIV | 1.00 *** | | | | | | | |
| DSCORE | 0.22 *** | 1.00 | | | | | | |
| Ln(TA) | 0.38 *** | 0.35 *** | 1.00 | | | | | |
| LEVERAGE | 0.24 *** | 0.28 *** | 0.11 ** | 1.00 | | | | |
| ROE | 0.21 *** | 0.13 *** | 0.15 *** | 0.12 *** | 1.00 | | | |
| CAPEXP | -0.34 *** | 0.00 | -0.28 *** | 0.15 *** | -0.11 ** | 1.00 | | |
| RETAIN | 0.14 *** | 0.01 | 0.31 *** | -0.02 | 0.32 *** | -0.18 *** | 1.00 | |
| FCF | 0.10 ** | -0.10 ** | -0.15 *** | -0.08 * | 0.33 *** | -0.35 *** | 0.17 *** | 1.00 |

**, **, *** denote significance at the 10%, 5% and 1% levels, respectively.*

### 4.2. Multivariate Analysis

Table 6 reports the results of a logit regression model and random effects panel model that are used to investigate the relationship between disclosure quality and dividend policy. The dependent variable of the logit model is a dichotomous variable that equals one if a firm pays dividends, or zero otherwise. The results show that firms with better disclosure quality are more likely to pay dividends. The interaction of disclosure quality and high agency cost dummy variable is also significantly positively related with the likelihood of a dividend payout.

**Table 6**

**Analysis of dividend payouts and disclosure quality**

| | Logit Model | Panel Model (Random Effects) |
|---|---|---|
| **Variable** | **DIVD** | **DIV** |
| Intercept | -0.78 | 2.62 *** |
| | (-1.18) | (7.46) |
| DSCORE | 0.24 *** | 0.05 *** |
| | (4.31) | (2.15) |
| DSCORE x AGENCY | 0.18 * | 0.03 * |
| | (1.83) | (1.72) |
| LEVERAGE | 0.05 *** | 0.01 |
| | (2.92) | (1.55) |
| ROE | 0.01 | -0.01 *** |
| | (1.44) | (-3.68) |
| CAPEXP | 0.01 | -0.01 |
| | (0.26) | (-0.82) |
| RETAIN | 0.01 *** | 0.00 ** |
| | (4.48) | (-2.04) |
| FCF | 0.06 *** | -0.01 |
| | (2.69) | (-1.34) |
| INDUSTRY | -0.81 * | -1.72 *** |
| | (-1.76) | (-5.21) |
| McFadden $R^2$ | 0.32 | |
| Log likelihood | -117.48 | |
| Adjusted $R^2$ | | 0.12 |

*The sample includes 452 firms-years. The z-statistics for logit model and t-statistics for panel model are reported in parentheses. *, **, *** denote significance at the 10%, 5% and 1% levels, respectively.*

The result suggests that high agency cost firms with better disclosure quality are more likely to pay out dividends. The findings thus provide support for the outcome hypothesis. Shareholders are able to force managers to disgorge cash in the form of dividends in a more transparent environment. Leverage, retained earnings and the availability of free cash are also significantly positively associated with the propensity to pay dividends.

Moreover, Table 6 reports the results for a panel model where the dependent variable is dividend yields. The results show that disclosure quality and the interaction term (DSCORE x AGENCY) are significantly positively related to dividend yields. Consistent with the results of the logit model, we find support for the outcome hypothesis. The evidence suggests that firms with better disclosure quality and high agency cost firms with better disclosure quality are more likely to pay out dividends and in larger amounts. In addition, consistent with the predictions, firms with higher profitability and retained earnings make larger dividend payouts.

Overall, the results suggest that disclosure quality of a firm is an important part of corporate governance. Better disclosure quality is associated with a stronger propensity to pay dividends and larger dividend payments. This means that managers will have less free cash in hands and are less likely to waste the free cash on value-decreasing investments or on perquisite consumption. The significant findings of the interaction term (DSCORE x AGENCY) in both models also suggest that the likelihood of dividend payout and the level of dividend payout are influenced by whether a firm has high agency problems. High agency cost firms with better disclosure quality are more likely to pay out dividends and pay out greater amounts. This suggests that better disclosure quality can help reduce the agency problem by forcing managers of high agency cost firms to pay dividends. Therefore, this study finds support for the outcome hypothesis and shows the importance of disclosure quality in reducing agency problems.

## 5. Conclusions

When there is a separation of the ownership and control, the agent (or manger) will take actions to maximize his/her own wealth, which may not be in the best interest of the principal. The agency problem is a critical issue to investors as they may shy away from holding a company's stock if they believe that there is a serious agency problem between the management and shareholders. Therefore, the aims of this study are to examine disclosure quality from an agency theory perspective and to test its effect on firms' dividend policy.

La Porta et al. (2000) propose two competing hypotheses regarding the relation between agency costs and dividend policy. One is the outcome hypothesis, which argues that dividends are an outcome of an effective governance regime and therefore dividend payouts would be higher in a transparent disclosure environment. The other is the substitution hypothesis, which argues that dividend payout is a substitute for other forms of governance and would be higher in an opaque disclosure environment. This study finds support for the outcome hypothesis. Better disclosure quality is associated with a greater likelihood of dividend payouts and larger dividend payments. For high agency cost firms, the agency problem can also be reduced through better disclosure quality which is again positively related to the propensity to pay dividends and dividend payouts. In

sum, the results suggest that shareholders can better protect their interests and demand for higher dividend payoutsin a more transparent disclosure environment.

The findings of this study have practical implications for firm managers and shareholders. They show that disclosure quality has an impact on corporate decisions such as dividend payout policy. Future research can examine the relationship between disclosure quality and other corporate decisions such as corporate financing, equity issuance, and takeovers.

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# DOES EARNINGS MANAGEMENT CHANGE AFTER THE ADOPTION OF THE IFRS? EVIDENCE FROM ROMANIA

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**Abstract**

Once that International Financial Reporting Standards are used for individual financial reporting, we expect that companies are going to achieve an increase in the financial reporting due to a higher degree of transparency. The present research tries to emphasize if there is any significant difference between the value of earnings management computed by using the national and the international accounting measures. The research is conducted on Romanian capital market, into the listed companies. The results of the research are mixed. While an improvement in the variability of net profit is observed (both for individual and bootstrapping with replacement analysis), the correlation between accruals and cash flow from operation is more negative (using both estimations techniques). The results on the differences of cash flow from operations also show an increase in the value of earnings management.

**Keywords:** Financial performance, International Accounting regulation, Romanian Accounting Standards

**JEL Classification:** M41, G30

## 1. Introduction

Starting with 2012, the entities that are listed into the Bucharest Stock Exchange have to report their individual financial statements using the international regulation (International Financial Reporting Standards-IFRS). The requirement is mandatory and is based on 881/2012 Order and 1286/2012 Order of the Ministry of

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Finance (they emphasize the need to use the international framework instead of the national one). The new regulation repeals the 1121/2006 Order of the Ministry of Finance according to which the Romanian entities have to report their individual financial statements using both the national (Romanian Accounting Standards- RAS) and the international framework.

This regulation is in line with the regulations imposed for the financial institutions that Romanian banks have to use and it looks at IFRS development at national level. As a fact, the 15/2009 Order of the National Bank of Romania (NBR) enforced financial institutions to report their financial statement using the national and the international accounting framework (one set of financial statements was realized using RAS and another one was realized under IFRS). The entities have also to provide evidence about the difference between the two types of financial statements. According to the 9/2010 NBR order, starting with the beginning of the year 2012, the only accepted way of reporting the individual financial statements is under IFRS. There is also 27/2012 NBR order that considers that the accounting measures should be in accordance with the international regulation.

Regarding the adoption of the new accounting regulation, the literature in the filed provides mixed evidence on their influence on financial performance indicators. Considering these, the purpose of this research is to reveal if some elements that are related with financial performance suffer or not a change after the adoption of the International Financial Reporting Standards.

The rest of the paper is structured as follows: the first section refers to some issues found in the main literature about the switch from national accounting regulation to international accounting framework. The second section presents some information related with the database and the methodology of research, the third section presents an additional analysis considering the research that was conducted. The forth section provides evidence about the results of the research and reveals some discussions on them, while the last part is the part that refers to conclusions and future research activities.

## 2. Literature review

In the main literature there are various approaches on the impact that the switch from national accounting regulation to the international accounting framework has on financial performance of

an entity. Many studies look at the private gains that the managers can get. The results are mixed. On one hand, it is considered that the adoption of the new accounting regulation is going to create higher transparency in financial reporting and thus, the accounting information is going to be improved (Daske, 2006). On the other hand, some marginal differences can be detected as the characteristics of the region or of the country can significantly impact data comparability (CascinoșiGassen, 2014)

The issues related with the abnormal return- the private benefits that the financial managers can gain - look at the earnings management procedures that an entity can use. As a fact, the analysis focus on the fluctuations on net profit volatility, the fluctuations on cash flow from operations and the ratio of them (all measured by residual variance) and the correlation between the residuals of cash flow from operations and the residuals of accruals. Considering this, Barth et. al. (2008) think that the entities that adopt the IFRS as accounting measure for constructing their individual financial statements have lower levels of earnings management, recognize the losses on a longer period of time and the accounting elements have higher value relevance. The results are based on a comparison between the values computed using national accounting regulation and the values computed using the international accounting framework. Similar conclusions were detected by Dimitropoulos et. al (2013) for the Greek companies.

On the other hand, there are also research papers that provide evidence of a negative influence of the international accounting regulation on financial performance. Paglietti (2009) reveals that once the international accounting framework is used by the companies, they have higher values of earnings management, but on the other hand, the value relevance of the accounting elements suffered an improved. The negative influence is also found by Lin et al (2012) who considers that, for German companies, a regress on the mitigation of earnings management is a more common impact. Similar results were found by Callao and Jarne (2010) who analyzed the value of earnings management and who concluded that after the adoption of the international accounting measures, an increase in their value is expected. Morever, the voluntary adoption of the IFRS for individual financial statements do not reveal other conclusions. According to Van Tandeloo and Vanstraelen (2005) the volunatry adopters of the international accounting standards do not have lower

values of earnings management in comparison with the entities that have not adopted them (they still use the national accounting framework). The explanations are related with the flexibility that arises in the implementation of the new regulation (Capkun et. al., 2013) and on the other hand, the negative impact could bedue to the fact that several entities keep on using the national accounting regulation and not the international one.

Regarding the research conducted on Romania, Brad et. al (2014) concludes that there is a mitigation of the earnings management as their in an increase in the net profit volatility, an increse in the ratio between net profit volatility and cash flow from operations volatility and a smaller negative correlation coefficient between accruals and cash flow from operations.

Considering these features, the present research tries to reveal the impact of IFRS adoption on the earnings management using a similar methodology with the one developed by Brad et al. (2014). The methodology differs from the previous one as there are other entities that are used in the analysis and other variables of influence. The present research, provides evidence about the robustness of the results by reestimating them with the boostspraping with replacement procedure.

## 3. Methodology of research

In order to reveal if there is any difference on the value of earnings management computed using the Romanian Accounting Standards and the international ones (IFRS), an analysis was conducted on the entities that the listed into Bucharest Stock Exchange. According to Financial Supervisory Authority, 71 companies have to report their individual financial statements using the IFRS accounting regulation. From them, one company has bonds as the object of trading and one was delisted in 2012 (AZO). We have also excluded the companies that have a negative value of their own capital in 2010, 2011 or 2012. Moreover, the companies that have to report their individual financial statements under IFRS starting from 2013 were also excluded. From the analysis, the companies that had opened their insolvency procedure were also excluded. Considering this, the research is conducted on a sample that contains 54 companies. For each of these entities, the financial information was collected for a three year period of time. As a fact, for 2010 and 2011 the financial information was collected using the RAS framework,

while for 2011 and 2012 the financial information was collected using the IFRS framework.

Regarding the measures of financial information, we collected information related with the value of net profit, the size of the company (measured through the logarithmic value of total assets), the changes in the value of net sales, the changes in the value of debt (both the debt on long term and the debt on short term), the number of stocks that each entity has, the type of the auditor that each company has (the main literature provides evidence that companies that have an auditor from Big 4 report more transparent information in their financial statements) and the effective rate of taxation that each entity has.

In order to provide evidence if there is any significant difference between the values of earnings management from 2010-2011 and the values of earnings management from 2011-2012, we looked at the three main methods of estimation. The first one is focusing on the value of net profit scaled by total assets. The idea is found in other research studies according to which a higher volatility of net profit is related with a lower value of earnings management. Its variability is found by conducting a regression using the value of net profit as dependent variable on several specific individual factors. In order to test the difference, the variability of residuals of the net profit is compared between the two periods of time (each residual series takes into account the accounting measures). The regression on which the residuals are estimated is found in equation (1).

$$\begin{aligned}\Delta NP_i = {} & \alpha_0 + \alpha_1 \times Size_i + \alpha_2 \times Growth_i + \alpha_3 \times \Delta Eissue_i + \alpha_4 \times Debt_i + \\ & + \alpha_5 \times Dissue_i + \alpha_6 \times Turnover_i + \alpha_7 \times Auditor_i + \\ & + \alpha_8 \times Effecive\,tax\,rate_i + \alpha_9 \times CF_i + \varepsilon_i\end{aligned} \quad (1)$$

Where:

$\Delta PN$ is the variability of net profit scaled by total assets.

$Size$ is the size of the company, measured through the logarithmic value of total assets.

$Growth$ is the variability of net sales.

$\Delta Eissue$ is the changes in the number of stocks that the entities has.

$Debt$ is the degree of indebtedness that the company has. It is computed as the ratio between the value of total debts and the value of own capital.

$Dissue$ is the change in the value of debts.

$Turnover$ is the turnover of the company computed as the ratio between net sales and the value of total assets.

$Auditor$ is the type of the financial auditor that the entity has. The variable is a dummy variable. It takes 1 if the financial auditor is from BIG 4.

$Effective\ tax\ rate$ is the effective tax rate that the company has.

$CF$ is the value of cash flow from operations.

$i$ is the index for each entity from our sample.

$\varepsilon$ is the error term ( the residuals on which the variability of indicators is tested).

The second measure that is used for quantifying the earnings management is based on the ratio between net profit fluctuations and cash flow from operations fluctuations as the variability of net profit can be influenced by the variability of cash flow from operations. In order to establish this ratio, the variability of cash flow from operations was tested on individual factors. The method of estimation is as before (in the case of net profit variability).The variability of residuals is found by testing the influence of individual factors on the difference encountered in the value of cash flow from operations, which is considered the dependent variable. This aspect is presented in equation (2):

$$\begin{aligned}\Delta CF_i = {} & \alpha_0 + \alpha_1 \times Size_i + \alpha_2 \times Growth_i + \alpha_3 \times \Delta Eissue_i + \alpha_4 \times Debt_i + \\ & + \alpha_5 \times Dissue_i + \alpha_6 \times Turnover_i + \alpha_7 \times Auditor_i + \\ & + \alpha_8 \times Effective\,tax\ rate_i + \alpha_9 \times CF_i + \varepsilon_i\end{aligned} \quad (2)$$

Where $\Delta CF$ is the variance of cash flow from operations scaled by total assets.

Considering the results found from equation (1) and (2), the ratio between the variability of net profit and the variability of cash flow is computed and is statistically analyzed.

The last measure that is used to quantify the earnings management is based on Spearman correlation coefficient computed between the residuals of cash flow from operations and the residuals

of accruals. The value of accruals is calculated as a difference between the value of net profit and the value of cash flow from operations. There are studies that use the value of net profit before extraordinary items ( Lin et. al, 2012). Considering that the Romanian entities do not report any extraordinary items, we used the value of net profit. Each of these variables (the value of cash flow from operations and the value of accruals) is analyzed on individual factors.

In order to compare the correlation coefficients we use the test developed by Fisher (1921). The test is based on initial transformation of the correlation coefficients (into r variables), on computing the z variable by using the new values and the dimension of each sample and on computing the probability associated with the z variable.

The formulas on which the estimation is conducted (which is the third measure of establishing the earnings management) are presented in equation (3) and (4).

$$CF_i = \alpha_0 + \alpha_1 \times Size_i + \alpha_2 \times Growth_i + \alpha_3 \times \Delta Eissue_i + \alpha_4 \times Debt_i + \\ + \alpha_5 \times Dissue_i + \alpha_6 \times Turnover_i + \alpha_7 \times Auditor_i + \\ + \alpha_8 \times Effective\,tax\,rate_i + \varepsilon_i \quad (3)$$

$$ACC_i = \alpha_0 + \alpha_1 \times Size_i + \alpha_2 \times Growth_i + \alpha_3 \times \Delta Eissue_i + \alpha_4 \times Debt_i + \\ + \alpha_5 \times Dissue_i + \alpha_6 \times Turnover_i + \\ + \alpha_7 \times Auditor_i + \alpha_8 \times Effective\,tax\,rate_i + \varepsilon_i \quad (4)$$

Where $ACC$ is the value of accruals that the company has and $CF$ is the value of cash flow from operations.

**4. Additional analysis**

In order to shed the robustness of the results, all three indicators were also computed using the bootstrapping technique with replacement. The method is based on using non-parametric techniques of estimation as the distribution of residuals is not a-priori known. Using this technique, we can obtain more information about the initial variables. The way it is implemented is based on several steps: selecting a similar number of observations with the one found on initial sample, estimating the regression in order to determine the residuals and computing the variance of the residuals or the

coefficient correlation. The process is repeated 500 times. For each indicator, the mean is afterwards computed and its statistically significant difference is analyzed.

## 5. Results and discussions

The purpose of this research is to provide evidence of any significant difference between the value of earnings management computing by using national and international accounting framework. We considered that a descriptive statistic of the elements can provide additional information related to the variables that are included into the analysis. We choose to provide a comparison between the values in mean, median and in standard deviation that were registered before and after the adoption of the international regulation.

The results about the differences encountered in mean for the independent and dependent variables are presented in Table 1.

The results correlated with the differences in median are revealed in Table 2.

The results that look at the standard deviation are presented in Table 3. In order to observe if there is any difference in the value of the standard deviation measured before and after the adoption of the International Financial Reporting Standards we use the Levene test. Its advantage is that its value is not affected by the fact that the variables do not have a normal distribution.

**Table 1**

**Descriptive statistic of the variables included into the analysis-mean analysis**

| Indicator | Mean | | |
|---|---|---|---|
| | **RAS** | **IFRS** | **p-value** |
| Dependent variables | | | |
| $\Delta PN$ | -0.0062 | 0.0032 | 0.3840 |
| $\Delta CF$ | 0.0085 | 0.0051 | 0.8333 |
| *ACC* | 0.0499 | 0.0411 | 0.7428 |
| *CF* | -0.0291 | -0.024 | 0.4970 |
| Independent variables | | | |
| *Size* | 8.2502 | 8.2623 | 0.9167 |
| *Growth* | 0.0568 | 0.0326 | 0.6553 |
| *Eissue* | 0.1183 | 0.7382 | 0.4051 |
| *Debt* | 0.7453 | 0.9758 | 0.3536 |

| Indicator | Mean | | |
|---|---|---|---|
| | RAS | IFRS | p-value |
| *Turnover* | 0.7938 | 0.6995 | 0.5880 |
| *Dissue* | 0.2882 | 0.6995 | 0.6218 |
| *Auditor* | 0.2777 | 0.3333 | 0.5353 |
| *Effective tax rate* | 0.2149 | 0.1302 | 0.0166** |

*Where ** denotes level of statistical significance at 5%.*

It can be observe that there is a significant difference between the value of effective tax rate measured before and after the implementation of the IFRS.

In Table 2 are presented the differences found in the value of median measured before and after the adoption of the IFRS. It can be observed that there are statistically significant differences in the value of effective tax value and of the growth independent variable, the first one being significant at 10% and the second one at 5%.

**Table 2**

**Descriptive statistic of the variables included into the analysis-median analysis**

| Indicator | Median | | |
|---|---|---|---|
| | RAS | IFRS | Wilcoxon prob. |
| Dependent variables | | | |
| $\Delta PN$ | 0.0002 | 9.41*E-05 | 0.8417 |
| $\Delta CF$ | 0.0087 | 0.0072 | 0.8082 |
| *ACC* | 0.0448 | 0.0352 | 0.7517 |
| *CF* | -0.033 | -0.0233 | 0.5129 |
| Independent variables | | | |
| *Size* | 8.2135 | 8.1983 | 0.8658 |
| *Growth* | 0.0898 | 0.0194 | 0.0965* |
| *Eissue* | 0.0000 | 0.0000 | 0.2468 |
| *Debt* | 0.3608 | 0.4267 | 0.5951 |
| *Turnover* | 0.6145 | 0.5571 | 0.6252 |
| *Dissue* | 0.0495 | 0.0299 | 0.5532 |
| *Auditor* | 0.0000 | 0.0000 | 0.6209 |
| *Effective tax rate* | 0.1724 | 0.1414 | 0.0221** |

*Where ** ,* denotes level of statistical significance at 5% and 10%*

In Table 3, there are significant differences in the value of accruals that the entity had before and after the adoption of the IFRS.

Regarding the independent variable it can be seen that we have statistically significant differences on the variable that looks at the difference of how many stocks a company has. Other significant differences can also be found on the effective tax rate that the company uses. In fact, for the effective tax rate, we have significant differences in mean, median and variance.

**Table 3**

**Descriptive statistic of the variables included into the analysis**

| Indicator | Mean | | |
|---|---|---|---|
| | **RAS** | **IFRS** | **p-value** |
| Dependent variables | | | |
| $\Delta PN$ | 0.0477 | 0.0635 | 0.2177 |
| $\Delta CF$ | 0.0833 | 0.0827 | 0.8723 |
| *ACC* | 0.0664 | 0.0528 | 0.037** |
| *CF* | 0.052 | 0.0861 | 0.9529 |
| Independent variables | | | |
| *Size* | 0.5936 | 0.5983 | 0.9694 |
| *Growth* | 0.2488 | 0.3097 | 0.9896 |
| *Eissue* | 0.4065 | 5.4340 | 0.0894* |
| *Debt* | 0.9343 | 1.5595 | 0.1563 |
| *Turnover* | 1.0511 | 0.7215 | 0.4879 |
| *Dissue* | 1.1560 | 0.8797 | 0.6149 |
| *Auditor* | 0.4521 | 0.4758 | 0.2176 |
| *Effective tax rate* | 0.2179 | 0.1340 | 0.0195** |

*Where ** denotes level of statistical significance at 5%.*

As it can be observed from Table 1, Table 2 and Table 3, we have few differences between the values of dependent and independent variables, considering both the national and the international accounting framework. As a fact, considering these results we are unable to provide a conclusion about the changes that occurred in the value of earnings management.

In Table 4 are presented the results of the analysis conducted for each variable that was considered as a dependent one, such as the variability of net profit, the variability of cash flow from operations and the correlation between accruals and the values of cash flow from operations.

**Table 4**
**Earnings management measured by using the RAS and by using the IFRS**

| Earnings management | RAS | IFRS | p-value |
|---|---|---|---|
| $\Delta PN^*$ | 0.032793 | 0.052137 | 0.0882* |
| $\Delta CF^*$ | 0.066918 | 0.060499 | 0.5510 |
| $\Delta PN^* / \Delta CF^*$ (computed as the ratio between variances) | 0.49004 | 0.86178 | 0.0882* |
| Spearman Correlation of $CF^*$ and $ACC^*$ | 0.016657 | -0.57573*** | 0.000681*** |

*Where ***,* denotes statistically significant at 1% and 10%.*

The sign * associated with dependent variable refers to the variance of the residuals or to the correlation of the residuals.

From Table 2 it can be observed that there are statistically significant differences between the value of earnings management measured by using RAS and the value of earnings management measured by using IFRS. On one hand, a fluctuation on net profit can be found. Regarding the second measure it can be concluded that the variability of net profit is not influenced by the variability of cash flow from operations. As a fact, when we estimate the ratio between the variability of net profit and the variability of cash flow from operations we find that higher variability of this indicator is encountered which could suggest a higher degree of accounting transparency. Regarding the correlation between the cash flow from operations and the value of accruals, it can be concluded that there is no improvement in the value of earnings management, but rather an increase of it. A more negative coefficient suggests an increase in earnings management (accruals are used to create them). The results are contrary to the results found by Brad et al (2014) where an improvement in the correlation coefficient is also detected. As the switch costs from national to international accounting framework are relative high, there is a high probability that the correlation could become significant less negative or more positive in time.

In order to shed the robustness of the results, we conducted additional analysis. This is based on testing the variability and the correlation of the residuals from equations (1), (2), (3) and (4) using the bootstrapping procedure with replacement. The analysis is conducted in Matlab. The results are found in Table 5.

**Tabel 5**

**Robustness of the results by using the bootstrapping procedure**

| Earnings management | RAS | IFRS | p-value |
|---|---|---|---|
| $\Delta PN^*$ | 0.033584 | 0.084473 | <0.0001*** |
| $\Delta CF^*$ | 0.065922 | 0.058970 | <0.0001*** |
| $\Delta PN^* / \Delta CF^*$ (computed as the ratio between variances | 0.50945 | 1.43247 | <0.0001*** |
| Spearman Correlation of $CF^*$ and $ACC^*$ | -0.72092 | -0.73739 | 0.000044*** |

*Where ***,* denotes statistically significant at 1% and 10%.*

The sign * associated with dependent variable refers to the variance of the residuals or to the correlation of the residuals.

From Table 5, it can be seen that there is a fluctuation in all three metrics of earnings management. The results indicate that significant difference can be seen in the mean of net profit fluctuations. For comparison, the mean indicator was used instead of variance as the bootstrapping procedure provides the variance of residuals for estimation that is repeated. The same measure is used for establishing the ratio between fluctuations of net profit and fluctuations of cash flow from operations, even though the fluctuation of cash flow from operations seems to decrease. For both indicators an improvement in the value of earnings management can be observed. For the third metric, the correlation coefficients are statistically significant as we have 27000 observations. A more negative value is sign of an increase of earnings management, thus of more private benefits. The results are partially in accordance with the results found by Lin et al (2012) except that the authors provide evidence of the negative impact on net profit fluctuations and also on the ratio between the net profit fluctuation and cash flow from operations fluctuations.

In conclusion, it could be observed that the results on Romanian market are mixed. While an improve in the variability of net profit is observed ( higher values) and an uncertain results is obtained to the variability of cash flow from operations (uncertain change is observed when the initial sample of 54 companies is used and it is observed a statistically significant decrease when the bootstrapping procedure is applied), a more negative relationship exist between the value of accruals and the value of cash flow from operations, which is a sign of an increase in the value of earnings management.

## 6.Conclusions

The idea of research this study is to reveal if any significant difference were observed between the value of earnings management measured using the RAS framework and the earnings management measured using the IFRS framework and if managers get more private benefits after the adoption of the international regulation. The analysis was conducted on a sample of 54 companies that are listed into the Bucharest Stock Exchange considering that they have to report their individual financial statements using the IFRS accounting measures from 2012.

In order to be in line with the purpose of research, a comparison between the variability of the residuals of net profit, the variability of the residuals of cash flow from operations and the change of the correlation between the residuals of cash flow from operations and the residuals of accruals was tested. The results proved that there are higher values for the residuals of net profit (there is a higher fluctuation of the net profit),while, for the correlation between residuals of cash flow from operations and residuals for accruals lower values are detected (sign of an increase of the earnings management and of more private benefits). For the residuals of the difference of cash flow from operations the results are not statistically significant. Thus, the variability of the ratio between variability of net profit and the variability of cash flow from operations is due to the variability of the net profit.

In order to shed the robustness of the results, the analysis was repeated using the bootstrapping with replacement procedure. The results are partially similar with the results found on individual analysis, except that a decrease in the fluctuation of the differences between cash flow from operations is observed. The correlation coefficient is more negative suggesting an increase in the value of earnings management. The results are partially in accordance with the results found by Lin et al. (2012)

It can be concluded that for some elements (such as the variability of net profit) an improvement in the value of net profit was detected once the companies have to use the international regulation and not the national accounting framework. The results should also take into account that during the transition period from the national accounting regulation to the international accounting measures there are higher cost. The effect of an improvement in the degree of

transparency of the financial information can be detected after a longer period of time.

Regarding the problems of this research, we consider that manual collection of the data could create biased into the results. Moreover, due to the fact the analysis is conducted only on 54 companies there could also encountered biased problems. Further research looks at repeating the analysis considering the two accounting approaches by analyzing the value relevance and by studying the changes that occurred in the value of discretionary accruals that an entity can have.

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# THE FACTORS AFFECTING CREDIT BUBBLES: THE CASE OF TURKEY

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**Abstract**

The Global financial crisis that started in the United Stated and which affected the whole World and especially Europe in a short time shows once again that financial crises occur as a result of bubbles in asset prices or a strong credit growth. Moreover, that bubbles in financial markets are defined as increases in asset prices. Central banks tend to control excess credit expansion and thus ensure stability in financial markets.

The purpose of this study is to analyze the existence of a bubble in the Turkish credit market and the success of the monetary policy by the Central Bank of Turkey to prevent these bubbles in light of ongoing interest debates in Turkey. Monthly real estate loans have been considered for the 1986:01 to 2014:04 period in the credit sector. In this study, Sup Augmented Dickey Fuller and Generalized Sup Augmented Dickey Fuller tests have been used to identify and define bubbles. Thereafter, the factors affecting credit bubbles have been investigated via logit model. From the results of the study, it can be inferred that both the consumer price index and interest rates have negative effects on credit bubbles, while total credit to the nonfinancial private sector and current account balances have positive effects on credit bubbles.

**Keywords:** Bubbles, Sup Test, Explosive Root, Logit Model

**JEL Classification:** G10, E51, C15, C22

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## 1. Introduction

Global financial crises generally occur as a result of bubbles in the credit market. The crisis observed in (2008 in) the United States and Europe has demonstrated once again how important the credit bubbles are. So-called bubbles in the credit markets are considered to result from excessive increases in credit.

Moore, Bynoe and Howard (2010) defined the credit expansion as a sharp and extraordinary growth in real credit, which they associated with the extraordinary growth of private consumption expenditure. These two factors cause inflationary pressure, an increase in the financial sector's fragility and, ultimately, financial crises. Cooper (2009) emphasized that the increasing asset costs gave the creditors a false sense of security, which in exchange lead to the increase in the credits. This in turn, meant that the increase in the credits caused the asset costs to go up. While Mendoza and Terrones (2008) generally defined the credit bubbles as an event in which the economic fluctuations of the credits provided for the private sector grew more than the expansion period itself.

The periods during which the marginal return of the investments made by the individual banks are greater than the marginal return of the investments as perceived by the regulator, emerge as credit bubbles. Thus, the credit bubble can be defined as the situation where the investment expectations of the banks tend to increase beyond what is reasonable (Kashyap and Stein, 2012:79 ). The fundamental disequilibriums in the financial sector cause the credit bubbles (Hessel and Peeters, 2011:11). At the same time, the outcome and price stability promote the formation of the credit bubbles, because this situation causes the market participants to underestimate the amount of risk in the economy.

There are different approaches to the importance of the credits in the implementation of financial policies. In the New Keynesian consensus before the 2008 global financial crisis, monetary aggragates and loans didn't play constructive roles in the monetary policy. That's why the central banks determined the interest rates in accodance with the inflation and output gaps, who were not informed of total credit and money aggragates . After the 2008 global financial crisis, the policymakers, aimining for financial and economic stability, stated that total credits and money aggragates were important information (Schularick and Taylor,2009: 13). The bubbles

in the credit market were regarded as a sign of a financial crisis (Borio and Lowe,2002; Kaminsky and Reinhart,1999).

According to Minsky (1977) and Kindleberger (1978), credit bubbles start with a great shock, while the continued loan supplies initiate the bubbles (Hume and Sentance, 2009:1444). Ahrend et al. (2008) stated that a loose monetary policy causes an increase in the asset costs and leads to a strong credit growth. The contractionary monetary policy is used in order to bring the credit bubbles under control and to curve its consequences. The credit bubbles intesify the divergency between the private and social values of maturity transition operations (Kashyap and Stein, 2012:80).

The aim of this study is to research the existence of bubbles in the Turkish credit market and the success of the policies carried out by the Turkish Republic's Central Bank (TRCB) in the prevention of credit bubbles for the period 1986:01-2014:04. First of all, this study aims to unfold the present situation of the Turkish credit market. Thereafter, studies regarding the relation between monetary policies and credit bubbles are dealt with. In the third section, SADF (sup ADF) and GSADF (Generalized sup ADF), which are right-skewed unit root tests improved by Phillips, are defined in order for the bubbles to be identified (Wu and Yu 2013). Finally, the applications related to the Turkish credit market are investigated. This study aims to make a contribution to literature on the subject; inspecting how the effects of the TRCB's monetary policy on the credit bubbles are dealt with. Moreover, the study elaborates on how the SADF and GSADF tests are used.

## 2. Literature

Due to the enevitable failure in the market where credit bubbles develop, the risks are high. Hence, cautious regulatory measures limiting the credit bubbles should be taken. While Taylor (2007) blamed the disproportionately low policy interest rates for causing the housing bubble, Bernanke (2010), Bean et al. (2010), Turner (2010) and Posen (2009) advocated to the contrary. Theoretical and empirical studies show that the monetary policies play a role in the formation of credit bubbles. Borio and Zhu (2008) called this mechanism a means of risk-taking within monetary policies. According to the available literature, there are two reasons for the low interest rates to give way to taking unreasonably high risks. First of all, Rajan (2005,2006) pointed out that the low interest

rates were promotive for the asset managers and thus increased the grounds for risk-taking behavior, since low interest rates lead to a higher payment. The second mechanism related to how the low interest rates promote a high level of risk-taking behavior are concerned with the rating effect. If financial firms get into debt in the short term and grant a long term loan, the low short-term interest rates increase the net interest margin and the value of the firms. So, the firms expand their capacity in order to raise their leverage and therefore take risks (Adrian and Shin,2009;Adrian,Moench and Shin,2010). Also, the low interest rates increase the guarantee value and in turn make it possible for the credits to multiply. This mechanism is closely-related to the financial accelerator concept of Bernanke and Gertler (1999), and of Bernanke, Gertler and Gilchridt (1999) (Mishkin, 2011:64).

Jimenez et al. (2009) studied the effects of monetary policy on the credit risk by using data from Spanish banks, and found that low interest rates reduced the risk of outstanding loans in the short run but lead to the granting of many more risky loans in the medium term. In the study that they carried out on the banks in the Euro zone, Delis and Kouretas (2010) settled the fact that there was a negative relation between the interest rates and the banks' being likely to take risks. Furthermore, their study posited that the effect of interest rates on risky structures went down for the banks which had much higher equity capital. In the study that they carried out on the banks in Bolivia, Ioannidou, Ongena and Peydro (2009) dealt with the effects of interest rates on the credit risk. They suggested that the decrease in the U.S. federal funds interest rates increased the possibility for the default of bank credits. Adrian and Shin (2008) stated that a tight monetary policy prevented credit bubbles involving the dangerous growth of intermediary balance sheets. From the study in which they dealth with the determiners of asset bubbles in equity shares and property markets, Drescher and Bernhard (2012) inferred that while monetary conditions increased the formation of bubbles, the flexibility of the exchange rate decreased the same tendency. In their study, in which they examined the toll of taking monetary policy risks, Adrian and Shin (2010) emphasized the importance of balance sheet figures in the execution of the monetary policy. The study found that the decreases in policy interest rates increased the net interest margin and the returns in turn, and that the asset growth caused a shift in the loan supply. Turner (2010), stated that the expansionary monetary

policy implemented by the Federal Reserve after 2008 whetted the appetite for risk in global markets, which in itself caused the tight disequilibrium in the market, the low risk premiums and effectively; the asset cost bubbles. Using the financal accelerator DSGE model, Badaru and Popescu (2014) studied what the central bank did when faced with the bubbles. It was asserted that a more aggressive monetary policy showed little success in developing the economy's reaction to the bubbles, and that overexpansion in monetary policies created asset bubbles by increasing the risk premium and the credits themselves.

### 3. Methodology

We consider a time series which is$\boldsymbol{y_t, t = 1, \dots, T}$. Null hypothesis tests whether $\boldsymbol{y_t}$ follows Autoregressive Model AR (1) having unit root through all sample or not. Alternative hypothesis says that $\boldsymbol{y_t}$ moves as at least AR (1) process for some sub-sample. Test statistics is as follows:

$$\boldsymbol{PWY = \sup DF_T} \quad (1)$$

Here, $\boldsymbol{DF_T}$ is standard DF test: in other words, it is $\widehat{\emptyset}$ t ratio in Ordinary Least Squared Error (OLS) regression estimation.

$$\Delta \boldsymbol{y_t = \widehat{\alpha} + \widehat{\emptyset}_{PWY} y_{t-1} + \hat{\varepsilon}_t} \quad (2)$$

Sub-sample period is $\boldsymbol{t = 1, \dots, [\tau T]}$.

Here, $\boldsymbol{\bar{y}_\tau = ([\tau T] - 1)^{-1} \sum_{t=2}^{[\tau T]} y_{t-1}}$and $\boldsymbol{\widehat{\sigma}^2_{PWY} = ([\tau T] - 3)^{-1} \sum_{t=2}^{[\tau T]} \hat{\varepsilon}^2_t}$ (Harvey, Leybourne, Sollis, 2013:4).

In left-tailed unit root tests, the results are generally sensitive towards model specification. Formulating an appropriate hypothesis is especially difficult in the case of the existence of non-stationary series, because to indicate the existence of unit root and alternative hypothesis in which the stationary variable is provided - parameters take different roles under the null hypothesis. Right-tailed unit root tests are especially used in determining explosive time series or slightly explosive time series. For example, Diba and Grossman (1988) have applied right-tailed unit root tests to precisely sampled data to find financial bubbles. Phillips, Wu and Yu (2011b) and Phillps and J.Y. (2011) have suggested applying right-tailed unit root tests to recursive sub-samples. The formulation of null and alternative

hypothesis and regression model specifications are of importance in both left-tailed and right-tailed unit root tests (Phillps, Shi and Yu, 2014: 316- 317).

One of the right-tailed unit root tests is the Sup Augemented Dickey Fuller (SADF) test. This test was developed by Phillips, Shi and Yu (2011). The SADF test is based on recursive estimation of the ADF model, and it is acquired as a sub-value of the corresponding ADF statistic sequence. In this case study, the window size $r_w$expands to 1 from $r_0$ with the result that $r_0$ is the smallest sample window width fraction and 1 is the largest one in the recursion. Initial point $r_1$ is constant at zero and that's why the end point of each sample equals to $r_W$ and changes to 1 from $r_0$ (Phillps, Shi and Yu, 2013: 8).

For each $x_t$time series, ADF test is sensitive to the alternative of exploded root (right-tailed). The following autoregressive specification is estimated with least squared (OLS):

$$\boldsymbol{x_t = \mu_x + \delta x_{t-1} + \sum_{j=1}^{J} \emptyset_j \Delta x_{t-j} + \varepsilon_{x,t}, \qquad \varepsilon_{x,t} \sim NID(0, \sigma_x^2)} \tag{3}$$

For some given values of the lag parameter J, NID is independent and has normal distribution. In unit root tests, the null hypothesis is $\boldsymbol{H_0 = \delta = 1}$ and the right-tailed alternative hypothesis is $\boldsymbol{H_0 = \delta > 1}$. In recursive regressions, the above model is, as a rule, estimated to increase one observation at each try.

$$ADF_r \rightarrow \frac{\int_0^r \widetilde{W} dW}{\left(\int_0^r \widetilde{W}^2\right)^{1/2}} \tag{4}$$

$$sup_{r \in [r_0,1]} ADF_r \rightarrow sup_{r \in [r_0,1]} \frac{\int_0^r \widetilde{W} dW}{\left(\int_0^r \widetilde{W}^2\right)^{1/2}} \tag{5}$$

In the calculation given, W is Standard Browian motion and $\widetilde{\boldsymbol{W}}(\boldsymbol{r}) = \boldsymbol{W}(\boldsymbol{r}) - \frac{\boldsymbol{1}}{\boldsymbol{r}} \int_{\boldsymbol{0}}^{\boldsymbol{1}} \boldsymbol{W}$ is reduced Browian motion (Phillips, Wu and Yu, 2011: 206-207).

As the SADF test, the Generalized Augmented Dickey Fuller (GSADF) test is based on the idea of a recursively running ADF test on sub-samples as well. Instead, sub-samples are more extensive in comparison to the SADF. Also, the GSADF test allows the initial point $r_1$ to vary within a feasible sequence on account of switching the end of point of the regression $r_2$ from r0 to 1. The GSADF statistic is

stated as the largest ADF statistic over all feasible sequences of $r_1$ and $r_2$. GSADF tests as follows (Phillps, Shi and Yu, 2013: 10).

$$GSADF(r_0) = \sup_{\substack{r_2 \in \\ r_1 \in [0, r_2 - r_1]}}^{[r_0, 1]} \left\{ ADF_{r_1}^{r_2} \right\} \quad (6)$$

## 4. Data

In order to analyze the presence of rational bubbles in the credit market, we have looked at domestic credit volume. In addition, export, import, current account balance, credit to private non-financial sector by domestic banks, total credit to households and noncommercial institutions, interbank rate, M2 percent change, consumer price index, production price index, government final consumption expenditure, private final consumption expenditure and gross domestic product data have been examined to determine the impact of monetary policies and macroeconomic indicators on credit bubbles in Turkey. The quarterly data cover the periods between 1986:01 and 2014:04. The data are taken from the FRED database. The variables used in the study are exhibited in Table 1.

**Table 1**

**The Variables Used in the Study**

| **Variables** | **Definition** |
|---|---|
| CREDIT | Total credit volüme |
| LNGDP | Logartihm of GDP |
| CPI | Consumer price index |
| PPI | Production price index |
| LEXPORT | Logarithm of export |
| LIMPORT | Logarithm of import |
| CAB | Percent change of currrent account balance |
| LM2 | Logarithm of M2 money supply |
| INT | Interbank interest rate |
| LGOVEXP | Logarithm of goverment final consumption expenditure |
| LPRIEXP | Logarithm of private final consumption expenditure |
| LNONFIN | Logarithm of total credit to nonfinancial private sector |
| LNONCOM | Logarithm of total credit to household and noncommercial sector |
| BUBBLE | Dummy variable that indicates the dates credit bubble occured |

## 5. Empirical Results

### 5.1. Bubble Estimation

In this study, the bubbles in the Turkish credit market are detected via the GSADF and SADF tests developed by Phillips et. Al. (2013) over the period from 1986:01 to 2014:04. Examining the bubbles in the credit sector is of importance to comprehend the relationship between the credit market and overall economy. The results concerning the Turkish domestic credit volume are exhibited in Table 2. It follows from Table 3 that both the SADF and the GSADF tests exceed their respective 1%, 5% and 10% right-tail critical values. That's why the null hypothesis, which erroneously fails to detect a bubble is rejected. The tests have found evidence of a bubble in the Turkish credit market.

**Table 2**

**The Results of the SADF and GSADF Tests in Relation to CREDIT**

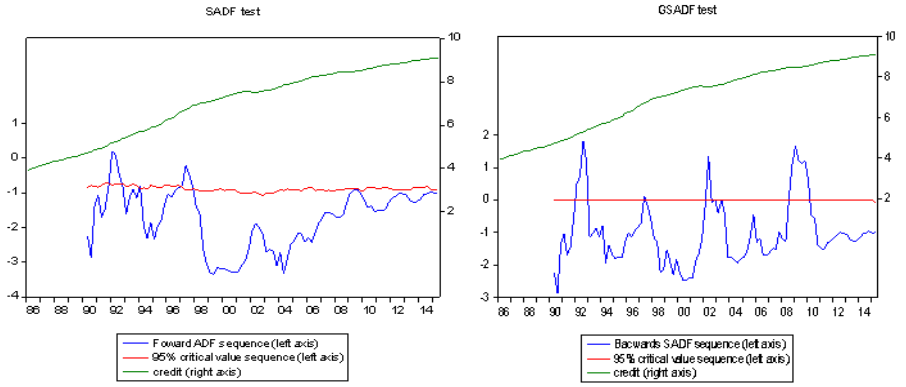
| | **SADF** | **GSADF** |
|---|---|---|
| CREDIT | **0.203542**$^{*}$ | **1.828244**$^{***}$ |
| 90% critical value | 1.094024 | 1.622726 |
| 95% critical value | 0.476741 | 1.196685 |
| 99% critical value | 0.237942 | 0.934863 |

Note: Critical values of both tests are obtained from Monte Carlo simulation with 1000 replications (sample size 301). The smallest window has 35 observations.

So as to detect bubble periods, we compare the data to the reverse SADF and GSADF statistics with the 95 % critical value sequence obtained from Monte Carlo simulations with 1000 replications for each observation. Figure 1 presents results for the date-stamping strategy over the period. According to Figure 1, the presence of a bubble in the Turkish credit market is evident.

**Figure 1**

**Data-Stamping Bubble Periods in the Turkish Credit Market**




### 5.2. Unit Root Test

After determining bubble periods with the help of the SADF and GSADF tests, the effects of monetary policies and macroeconomic variables on credit bubbles are examined using logit model estimation. It should be determined whether or not the series include unit root for logit model estimation. But, the series are adjusted seasonally via moving average before unit root analysis of the series in the study. Then, we investigated the stationary of all variables before starting the analysis. We applied ZivotAndrews structural break unit root test. The results of this test are exhibited in Table 3 (see Annex).

According to the results of the unit root test conducted with trend, constant and trend and constant, only the INT variable is stationary at level. The CPI, PPI, LEXPORT, LIMPORT, LGOVEXP and LPRIEXP variables are stationary at level in terms of unit root test with trend. However, these variables are seen to have constant and trend as the graphs of these variables are examined. Thus, so-called variables can be said not to be stationary. LNONFIN is stationary only for constant and trend at 1% significance level. Examining Table 4, one may find that all variables except for LNONFIN and INT are nonstationary at (this/their/said/listed/test?) level. Therefore, the stationary of so-called variables are first examined for differences and thus the results are exhibited in Table 4 (see Annex).

As is evident in Table 4; all variables are stationary upon examination of first differences.

### 5.3. Correlation Matrix Estimation

The below correlation matrix was formed in consideration to the stationary levels of the variables. In other words, the level values of LNONFIN and INT and the first differences of the other variables are taken into consideration when creating the correlation matrix. The results are as reported in Table 5 (see Annex).

We benefited from the correlation analysis results in order to determine which models to investigate in the study. For this purpose, we recoiled at the sight of high correlation rates between the variables. The high correlated variables are not to be found in the same model. The models are as follows:

**Model 1:** $\mathrm{BUBBLES} = \mathrm{f}(\Delta\mathrm{LNGDP}, \Delta\mathrm{CPI}, \mathrm{LNONFIN}, \mathrm{INT})$

**Model 2:** $\mathrm{BUBBLES} = \mathrm{f}(\Delta\mathrm{LEXPORT}, \Delta\mathrm{LNONCOM}, \Delta\mathrm{LM2}, \Delta\mathrm{LGOVEXP})$

**Model 3:** $\mathrm{BUBBLES} = \mathrm{f}(\Delta\mathrm{LPRIEXP}, \Delta\mathrm{CAB}, \Delta\mathrm{PPI}, \Delta\mathrm{LIMPORT})$

### 5.4. Logit Model Estimation

The logit model estimation results are shown in Table 6, Table 7 and Table 8.

**Table 6**

**Model 1 Estimation Results**

| Variables | Coefficients | Odds Ratio |
|---|---|---|
| C | 17.83973<br>(20.23907) | 6.84e+07 |
| ΔLNGDP | -1.269014<br>(1.101741) | 0.2778546 |
| ΔCPI | -0.025863***<br>(0.010935) | 0.9748754 |
| LNONFIN | 0.717658**<br>(0.717658) | 2.053863 |
| INT | -0.011078*<br>(0.006054) | 0.9894374 |

*, ** and *** represent respectively %10, %5 ve %1 statistical significance levels. The expressions in brackets represent standart errors. Akaike: 0.929716, Hannan-Quinn : 0.977897, LR: 5.603234

Model 1 estimation results show that the CPI and the INT variables negatively affect the probability of any bubbles. The reason is that an increase in interest rates encourages savings and also reduces overconsumption on the part of the consumers. The CPI variable is seen as a factor influencing costs and interest rates. The total credit to the nonfinancial private sector increases the probability of a bubble. However, gross domestic product doesn't have any effect on credit bubbles.

**Table 7**

**Model 2 Estimation Results**

| **Variables** | **Coefficients** | **Odds Ratio** |
|---|---|---|
| C | -8.316005<br>(20.91345) | 0.2130292 |
| ΔLIHR | 0.547628<br>(1.340739) | 5.260196 |
| ΔLNONCOM | -1.053848<br>(0.557715) | 0.7310707 |
| ΔLM2 | 0.705466<br>(0.896905) | 0.0052455 |
| ΔLKAMU | 0.305293<br>(1.279572) | 21.18248 |
| *, ** and *** represent respectively %10, %5 ve %1 statistical significance levels. The expressions in brackets represent standart errors. Akaike: 0.9834421, Hannan-Quinn : 0.980602, LR: 5.057478 | | |

As model 2 isexamined, exports, total credit to households and the non commercial sector, M2 money-supply and goverment final consumption expenditures are evidently not statistically significant. These variables don't affect the likelihood of credit bubbles.

**Table 8**

**Model 3 Estimation Results**

| **Variables** | **Coefficients** | **Odds Ratio** |
|---|---|---|
| C | -0.9597558<br>(.7352295) | 0.3829864 |
| ΔLOZELHAR | -3.866884 | 0.0209235 |

| Variables | Coefficients | Odds Ratio |
|---|---|---|
| | (6.86442) | |
| ΔCAB | 0.2043895** (0.1080756) | 1.226776 |
| ΔPPI | 18.14609 (14.45566) | 7.60e+07 |
| ΔLITH | -0.9129286 (3.501419) | 0.4013471 |
| *, ** and *** represent respectively %10, %5 ve %1 statistical significance levels. The expressions in brackets represent standart errors. Akaike: 0.958075, Hannan-Quinn : 1.006517, LR: 2.912204 | | |

Analyzing Model 3, one finds that while private final consumption expenditures, production price index and imports don't affect credit bubbles, current account balances increase the probability of credit bubbles. This situation can be explained as follows: Deterioration of current account balances lead to an increase of exchange rate risks. Therefore, credit repayment ability can decrease and, thus, the probability of credit bubbles grows.

## 6. Conclusion

This paper examines whether there is a rational case for a credit bubble or not in the Turkish credit sector and analyzes the success of the authorities to prevent these bubbles. It is of importance to define the bubbles in terms of understanding movements in markets and in structures during financial crisis. Besides, the presence of rational bubbles in the credit sector reflects instabilities in the financial system.

Firstly in this study, the existence of credit bubbles in Turkey's credit market is investigated and from the analysis, it can be inferred that a credit bubble is present. Secondly, the factors affecting credit bubbles have been researched and studied. For this purpose, the study benefitted from the logit model. According to the logit model estimation, current account balance (CAB), consumer price index (CPI), total credit to the nonfinancial private sector (LNONFIN) and interest rate (INT) variables significantly affect the likelihood of any credit bubbles. These significant effects are as follows: Consumer price index and interest rates negatively affect the probability of bubbles. The total credit to the nonfinancial private sector increases

the probability of any looming bubbles. Also, deterioration of current account balances lead to an increase in the probabilty of credit bubbles.

Besides, it is obvious that the LNONFIN variable overly affects the likelihood of any credit bubble and this so-called varible has a stimulating effect on existing credit bubbles. Moreover, this study finds that the CPI variable decreases the likelyhood of any credit bubble, and, yet, has little effect on existing credit bubbles. In a similar fashion, the INT variable is a factor that decreases the likelyhood of and any existing credit bubbles. Consequently, it can be said that policy makers take advantage of the INT and CPI variables in order to decrease the occurence of any looming credit bubbles. Similarly, it is believed that credit bubbles can appear or increase in correlation with the LNONFIN variable. Hereby, these findings present policy makers with valuable information to policy makers.

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## ANNEX

**Table 3**

### Zivot Andrews Unit Root Test I(0)

| | Constant | | | Trend | | | Constant and Trend | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variables** | **T** | **Lags** | **Breakpoint** | **T** | **Lags** | **Breakpoint** | **T** | **Lags** | **Breakpoint** |
| **LNGDP** | -4.3066 | 1 | 1994:Q3 | -4.0574 | 1 | 1997:Q4 | -4.6000 | 1 | 1995:Q1 |
| **CPI** | -2.5787 | 9 | 1992:Q4 | -4.3035*** | 9 | 1997:Q3 | -4.00031 | 9 | 1996:Q4 |
| **PPI** | -3.1288 | 7 | 2001:Q2 | -3.6864*** | 1 | 1996:Q2 | -3.4047 | 1 | 1994:Q4 |
| **LEXPORT** | -2.6126 | 0 | 1993:Q4 | -4.7642*** | 0 | 2000:Q4 | -4.2981 | 0 | 2001:Q1 |
| **LIMPORT** | -2.1373 | 1 | 1993:Q1 | -4.2016*** | 1 | 2000:Q2 | -4.1733 | 1 | 1999:Q2 |
| **CAB** | -3.7008 | 10 | 1998:Q3 | -3.4462 | 10 | 2010:Q4 | -4.1521 | 10 | 2009:Q4 |
| **LM2** | -2.6117 | 3 | 1994:Q2 | -3.2773 | 3 | 1999:Q4 | -3.1537 | 3 | 1994:Q2 |
| **INT** | -4.7030* | 2 | 1993.Q4 | -5.2999*** | 2 | 1994:Q2 | -5.7118*** | 2 | 1994:Q1 |
| **LGOVEXP** | -1.8435 | 3 | 1995:Q2 | -4.7283** | 3 | 1999:Q4 | -4.6420 | 3 | 1997:Q2 |
| **LPRIEXP** | -3.5352 | 7 | 1994:Q2 | -4.6050** | 7 | 1998:Q1 | -4.7787 | 7 | 1994:Q2 |
| **LNONFIN** | -2.0859 | 4 | 1994:Q4 | -4.5722 | 4 | 1998:Q1 | -5.0276*** | 4 | 1995:Q4 |
| **LNONCOM** | -4.3755 | 0 | 1993:Q3 | -3.0731 | 0 | 2000:Q2 | -4.1121 | 0 | 1993:Q3 |
| | Critical values for %1, %5 ve %10 significance levels are respectively -5.34, -4.93, -4.58 | | | Critical values for %1, %5 ve %10 significance levels are respectively -4.80, -4.42, -4.11'dir. | | | Critical values for %1, %5 ve %10 significance levels are respectively -5.57,-5.08, -4.82'dir. | | |

**Table 4**

### Zivot Andrews Unit Root Test I(1)

| | Constant | | | Trend | | | Constant and Trend | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variables** | **T** | **Lags** | **Breakpoint** | **T** | **Lags** | **Breakpoint** | **T** | **Lags** | **Breakpoint** |
| **ΔLNGDP** | -10.3341*** | 0 | 1994:Q2 | -6.3234*** | 4 | 2001:Q2 | -6.6813*** | 4 | 1994:Q3 |
| **ΔCPI** | -3.9428*** | 7 | 2003:Q3 | -3.2274** | 7 | 2001:Q3 | -3.9278*** | 7 | 2003:Q3 |
| **ΔPPI** | -8.2175*** | 6 | 1999:Q3 | -7.9999*** | 1 | 2002:Q1 | -8.4098* | 1 | 2001:Q2 |
| **ΔLEXPORT** | -4.8963* | 4 | 2002:Q1 | -4.3743* | 4 | 1994:Q3 | -4.8924* | 4 | 1998:Q2 |
| **ΔLIMPORT** | -9.1378*** | 7 | 1991:Q3 | -9.1247*** | 0 | 1994:Q4 | -9.5187*** | 0 | 1998:Q1 |
| **ΔCAB** | -9.3138*** | 9 | 2001:Q3 | -8.8864*** | 9 | 1993:Q3 | -9.2636*** | 9 | 2001:Q3 |
| **ΔLM2** | -6.0580*** | 2 | 1994:Q2 | -5.4769*** | 2 | 1995:Q3 | -6.3518*** | 2 | 1994.Q2 |
| **ΔLGOVEXP** | -6.5349*** | 2 | 2002:Q1 | -5.5642*** | 2 | 2009:Q3 | -6.3575*** | 2 | 2002:Q1 |
| **ΔLPRIEXP** | -5.2935*** | 4 | 2000:Q2 | -3.9646 | 4 | 2009:Q4 | -5.1661*** | 4 | 2000:Q2 |
| **ΔLNONCOM** | -9.9751*** | 0 | 1992:Q2 | -9.9544 | 0 | 1993:Q4 | -10.472*** | 0 | 1994:Q1 |
| | Critical values for %1, %5 ve %10 significance levels are respectively -5.34, -4.93, -4.58. Δ represents first difference. | | | Critical values for %1, %5 ve %10 significance levels are respectively -4.80, -4.42, -4.11. Δ represents first difference. | | | Critical values for %1, %5 ve %10 significance levels are respectively -5.57,-5.08, -4.82. Δ represents first difference. | | |

**Table 5**

## Correlation Matrix

| | ΔLNGDP | ΔCPI | ΔPPI | ΔLEXPORT | ΔLIMPORT | ΔCAB |
|---|---|---|---|---|---|---|
| **ΔLNGDP** | 1 | | | | | |
| **ΔCPI** | -0.0701 | 1 | | | | |
| **ΔPPI** | -0.1176 | 0.7478** | 1 | | | |
| **ΔLEXPORT** | -0.0508 | -0.1927** | -0.0162 | 1 | | |
| **ΔLIMPORT** | 0.0816 | -0.2589*** | -0.0301 | 0.5040*** | 1 | |
| **ΔCAB** | -0.1623* | -0.0236 | -0.0516 | 0.0185 | 0.1056 | 1 |
| **ΔLM2** | 0.3506*** | -0.3441*** | -0.2620*** | 0.3509*** | 0.3477*** | -0.0346 |
| **INT** | -0.1518 | -0.3274*** | -0.2451*** | 0.5348*** | 0.3991*** | -0.0052 |
| **ΔLGOVEXP** | 0.0944 | -0.2970*** | -0.1990** | 0.4338*** | 0.3988*** | 0.0280 |
| **ΔLPRIEXP** | 0.1373 | -0.3973*** | -0.2547*** | 0.5080*** | 0.6531*** | 0.0713 |
| **LNONFIN** | -0.0857 | 0.6804*** | 0.5065*** | -0.3143*** | -0.4177*** | 0.0130 |
| **ΔLNONCOM** | -0.0814 | -0.1637*** | -0.1086 | 0.0291 | 0.2447*** | -0.0998 |
| | | | | | | |
| | **ΔLM2** | **INT** | **ΔLGOVEXP** | **ΔLPRIEXP** | **LNONFIN** | **ΔLNONCOM** |
| **ΔLM2** | 1 | | | | | |
| **INT** | 0.5401*** | 1 | | | | |
| **ΔLGOVEXP** | 0.4107*** | 0.4562*** | 1 | | | |
| **ΔLPRIEXP** | 0.5291*** | 0.6257*** | 0.5700*** | 1 | | |
| **LNONFIN** | -0.3859*** | -0.4962*** | -0.4715*** | -0.6116*** | 1 | |
| **ΔLNONCOM** | 0.0402 | 0.0010 | 0.1091 | 0.2041*** | -0.0962 | 1 |

*, ** and *** show respectively %10, %5 ve %1 statistical significance levels.

# FORECASTING THE TOTAL INDEX OF TEHRAN STOCK EXCHANGE

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**Abstract**

Development of financial markets and financial instruments is one of the pillars of economic growth and capital accumulation in any countries especially in the developing ones. Capital market works as a substantial tool for development and financing which attracts many investors for purchasing and selling capital. Hence they are seeking for forecasting events and situations of future till can invest with a lower uncertainty. On the other hand total index of stock exchanges accounted for a precursor one in economics which we expect following improvement in index of capital market, the economic growth will improve and we face condition of recession after its decrease. Thus the importance of exact prediction of this index is redoubled. In this paper we forecast the index by applying ARIMA and Neural Network and then we achieve the minimum and maximum of total index by using FARIMA. Indeed the main aim of this research is to imply this point that these three methods are complementary to each other in decision making of investors and economic policy makers.

**Keywords:** Forecasting, Stock price index, Tehran Stock Exchange, Fuzzy ARIMA, Neural Network.

**JEL Classification:** C45, C53, C58, G17.

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## 1. Introduction

Physical capital accumulation is one of the necessary requirements for economic growth and through financial markets can accelerate the capital accumulation. Financial markets are important for every country especially the developing ones because of their contribution in gathering wanderer resources through savings in national economy, optimization and redirecting the flow of financial resources.

Stock market is one of the most important kinds of financial markets. Various factors such as political and economy conditions of the countries influence on the progress of the stock market. One of the critical issues for growing Stock market is to attract more capital and for absorbing more capital, sufficient conditions should be provided to encourage micro and macro investors to invest on Stock Exchange and one of these conditions is reducing the risk of investing. A main criterion for evaluation of the growth of Stock Exchange is the total index, and in case of prediction of total index the risk of buying and selling of shares will reduce and minimize for shareholders. Due to the importance of the prediction of total index which is accounted for as a leading indicator in economy, different methods are proposed that in this research three recognized of them are investigated. One of the prevalent methods is the prediction of time series model introduced by Box-Jenkins which is usually showed as ARIMA and this method is applied when definite, adequate and at least 100 or 150 data exist. A main hypothesis behind ARIMA is that future values of time series have a clear and specific functional relationship with the past and current values of time series and net errors of the model. Another method investigated in this study is Artificial Neural Network (ANN) Model which is a non-linear method and is appropriate for identifying complicated relationships between variables. Neurons are the smallest units of information processor that they are the performance basis of Neural Network. Finally the third method is Fuzzy Autoregressive Integrated Moving Average (FARIMA) used in uncertainty conditions when definite and adequate data does not exist. Indeed fuzzy method expresses the complexities and ambiguities in a mathematical form and provides the basis for an analysis to indefinite (fuzzy) variables of the environment. In many studies about prediction always comparison has been made between two models that one of them was ARIMA method; however, the aim

of this research is to present a suitable prediction model for the total index of Tehran stock Exchange and also a maximum and minimum value of intended variable in considered period. According to this the concepts of ARIMA time series, Fuzzy ARIMA and Artificial Neural Network have been explained in next section the return on share price index of Stock Exchange predicted by these methods and finally results of the models have been analyzed.

## 2. Review of research

Time series forecasting is an important area of forecasting in which past observations of the same variable are collected and analyzed to develop a model describing the underlying relationship. The model is then used to extrapolate the time series into the future. This modeling approach is particularly useful when little knowledge is available on the underlying data generating process or when there is no satisfactory explanatory model that relates the prediction variable to other explanatory variables several models have been suggested for time series forecasting, that are generally divided to linear and nonlinear models.

One of the most important and widely used linear time series models is the Auto Regressive Integrated Moving Average (ARIMA) model that has enjoyed fruitful applications in fore casting social, economic, engineering, foreign exchange, and stock problems. Second class of time series forecasting is nonlinear time series models. Artificial neural networks are one of these models that are able to approximate various nonlinearities in the data and are flexible computing frameworks for modeling a broad range of nonlinear problems One significant advantage of the ANN models over other classes of nonlinear model is that ANNs are universal approximates, which can approximate a large class of functions with a high degree of accuracy. No prior assumption of the model form is required in the model building process. Instead, the network model is largely determined by the characteristics of the data. Commonly used network models include multi-layer perceptron (MLP), Radial Basis Function (RBF), Probabilistic Neural Networks(PNNs) and General Regression Neural Networks(GRNNs) Single hidden layer feed forward network is the most widely used model form for time series modeling and forecasting accuracy is one of the most important factors to choose the forecasting method, and regardless numerous time series forecasting models, the accuracy of time series

forecasting is fundamental to many decision processes and hence the research for improving and diagnosing the effectiveness of forecasting models has been never stopped.

First time Tseng (2001) applied the combination of Fuzzy and ARIMA models for prediction of dollar price against Taiwan currency. He could show this new method not only presents more exact prediction but also determines the best and the worst condition.

Shabani (2010) in a thesis with the subject of forecasting the price index of Tehran Stock Exchange has analyzed and compared the various linear and non-linear methods in prediction of share price index of stock exchange. In this research two patterns of using past values of share price and applying variables such as exchange rate and oil price accompanied by lagged terms of exchange index. The results indicate neural network model based on lagged total index has lower errors relative to GARCH.

Moreover neural network model with the inputs of lagged share price index, exchange rate and oil price had a better prediction in comparison to a neural network model with the only lagged share price index as an input. Monajjemi et al. (2009) in a paper with the title share price forecasting in stock exchange market by fuzzy neural network and genetic algorithms and its comparison to artificial neural network achieved to this result that share price prediction by fuzzy neural network and genetic algorithms reduce estimation error of share price relative to artificial neural network technique and it is a suitable method for forecasting. Mehrara et al. (2009) in a research with the subject of modeling and prediction of Tehran Stock Exchange Index and determining effective variables by neural network model obtained to this result that among macroeconomic variables in Iran, the variables such as cost of land, housing cost with two months lag, consumer price index, monetary base with a lag, lagged house rental rate and finally global price of crude oil with a lag are the effective and important variables in modeling of price index and cash return of Tehran Stock Exchange.

Thus among alternative assets in Iran's economy, it seems housing is a serious competitor for share in assets market. In other words transformations in the housing market could have an impact on stock market. In Relevance to FARIMA limited studies have been conducted in Iran, and among them we can point to Khashe'i and Bijari (2010) and Maleki (2010) on Exchange rate and global gold respectively.

**3. Theoretical Foundations of ARIMA, Neural Network and FARIMA**

In this research the prediction of stock price index will be performed by three methods of ARIMA, FARIMA and Neural Network and in this section advantages and disadvantages of each method will be reviewed.

Box-Jenkins (1976) is a conventional method in forecasting of economic variables. The basic hypothesis in this method is that current values of the variable is related to the past values and behavior of the variable in future can be predicted by its behavioral pattern in past. Indeed time series method is a basic method for other ones; however, this method has some defects too amongst its need to large number of data, about 100 to 150. Box-Jenkins method includes four steps:

1. Experimental identification of the model structure
2. Estimation of the unknown parameters of the model
3. Identifying the precision of fitting of the model
4. Forecasting by selected model (Johnston, 2009).

In ARIMA model it is assumed that the net error term is a stochastic variable with normal distribution of zero mean and $\delta^2$variance and independent of the observations.

In this method by combination of two phenomena of Autoregressive and Moving Average, the ideal model is made. The purpose of autoregressive is dependence of the variable to its past values in previous periods. In Moving Average section, studied variable is a function of the moving average of the values of prediction errors in current and past periods which it is called white noise too. (Gujarati, 2009).

In classical methods of time series study like Box-Jenkins method and ARIMA it is assumed that the studied time series is produced through a linear process. (Houshmand et al., 2008).

From the advantages of this common method can point to its analysis capability with great details, high explaining power and easy deployment. ARIMA time series models are suitable for forecasting in a condition that data are sufficient and exact and they can present fine predictions; although, this method has some defects amongst the need to large number of data and also since in real environment information are always changing and considering uncertainty and Imprecise in real and unknown environments, it is not simple to

predict with much data thus applying fuzzy method can solve this problem to some extent. Another method is the Artificial Neural Network which is based on determined lagged by ARIMA model and are estimated by using activity functions and the number of neurons in hidden layer and the error of prediction will be calculated. In fact this method is an appropriate supplementary for forecasting financial variables.

Artificial Neural Network models have different kinds; however, their total structure is similar and all have some components which are the same in all of them and it is pointed to as follows:

*1. Layers*

Input layers:

There are units in the number of explaining variables in this layer which everyone includes the data of one explaining variable.

Hidden layers:

There are units of information processor in this layer that have a very effective role on correct learning (estimation) of the model.

Output layer:

The processing of sent information from hidden layer will be performed in this layer. The number of units of this layer is as number of endogenous variables.

*2. Activity (Transfer) Function*

Every processor unit in hidden and output layers uses determined mathematic function for information processing who are called activity or transfer function.

*3. Connectors*

Different layers and neurons of neural network will be connected in order to send received information and signals to each other. Each of the connectors that connect the neurons has special weight indicating relative importance of the output of every neuron in calculating the value of next neuron output. Actually these weights form network memory and the main aim of designing neural network is to estimate them which prediction is made based on these weights (Kia, 1983).

One of the important characteristic of neural networks is their ability in learning and generalization. Learning process (training) of a neural network is achieved through adjustment of weights according to the connections among neurons and learning process is performed in two ways of supervised and unsupervised (AsghariOskoi, 2002).

Although neural networks are not comparable with natural neural system, they have some features which it distinguishes them where they need to learn a linear or nonlinear mapping. These capabilities include: learning, capability to use as a corporate memory, storage and addressable memory, the ability to generalize and training, and the impairment, resilience and the tolerance of errors (Monajemi et al., 2009).

To resolve some other defects of ARIMA, Fuzzy ARIMA is proposed. This method is suitable for situations that data are not sufficient and also for understanding the minimum and maximum of the variable. Two time series models of ARIMA and Fuzzy ARIMA are complementary to each other and since results of FARIMA are presented in a range around real data, prediction errors are lower than ARIMA which the results are given as definitive numbers, because in definitive condition if the result was wrong, the error would be 100% while the error in fuzzy condition is a number between 0 and 1. Two basic parameters in FARIMA are *P* and *C* which are the values of parameters and their developed around the center respectively and generally model takes advantage of the minimizing total ambiguities (which is equal to the sum of single extensions of any fuzzy parameters of the model).

In this regression model, the target is to find fuzzy coefficients which minimize fuzzy output extent for all data set. Equation (1) represents the target function of regression model which should be minimized

$$Minimize \quad S = \sum_{i=1}^{p}\sum_{t=1}^{k} c_i \left|\phi_{ii}\right|\left|W_{t-i}\right| + \sum_{i=p+1}^{p+q}\sum_{t=1}^{k} c_i \left|\rho_{i-p}\right|\left|a_{t+p-i}\right| \qquad (1)$$

$$subject.to \quad \sum_{i=1}^{p}\alpha_i W_{t-i} + a_t - \sum_{i=p+1}^{p+q}\alpha_i a_{t+p-i} + (1+h)\left(\sum_{i=1}^{p} c_i\left|W_{t-i}\right| + \sum_{i=p+1}^{p+q} c_i\left|a_{t+p-i}\right|\right) \geq W_t \qquad t = 1,2,..k$$

$$\sum_{i=1}^{p}\alpha_i W_{t-i} + a_t - \sum_{i=p+1}^{p+q}\alpha_i a_{t+p-i} - (1+h)\left(\sum_{i=1}^{p} c_i\left|W_{t-i}\right| + \sum_{i=p+1}^{p+q} c_i\left|a_{t+p-i}\right|\right) \leq W_t \qquad t = 1,2,..k$$

$$c_i \geq 0 \qquad for\, i = 1,2,..., p+q$$

Since there are two restrictions for every data set, while there are *m* numbers of data sets, there are *2m* restrictions (Khashei and Bijari, 2007). From the advantages of Fuzzy ARIMA is that we can use the benefits of both methods of ARIMA and Regression Fuzzy simultaneously that include:

1) Determine the best and worst possible positions for correct and more accurate decisions.

2) The need to fewer observations in comparison to ARIMA model.

**4. Data and empirical results**

The applied variable for prediction of the return on share price index, is the return on share price index in Tehran Stock Exchange over the weekly period of March 22, 2004 to January 18, 2012 and it is totally 147 data.

ARIMA model:

Firstly the ARIMA model is identified as ARIMA (1,1,2) that the coefficients in this model are as below:

$$D\big(LOG\ (y_t)\big) = 0.008101 - 0.861672y_{t-1} + 1.160113\varepsilon_{t-1} + 0.344865\varepsilon_{t-2} \quad (2)$$

*Artificial Neural Network model:*

According to estimated ARIMA model in previous section and significance of the coefficients of first order autoregressive, network input is the return on share price index and network output is the return on share price index.

In neural network model, part of the data is considered as training set and others as results test. If performance in test set was weak, network combination or training parameters should change and as long as performance is satisfactory, the network is trained. In this research 80 percentages of data are used for training and the rest for testing the results.

The number of unit of information processors usually is determined regarding to try and by error method and the status leads to the minimum value in evaluation criteria such as Mean Square Error (MSE) and Root Mean Square Error (RMSE). In this research, after testing various numbers of units of information processors and network training, finally the number of units of information processors in considered.

Following the network structure design, input and output variables are introduced to the network and 80 percentages of data (118 data) are used in test section. Finally prediction of share price index is done. Results of models of time series and Artificial Neural Network are as following. Table (1) shows that every four evaluation index in Artificial Neural Network are lower than ARIMA(1,1,2);

therefore prediction power of ANN method is more than ARIMA(1,1,2) in this research.

**Table 1**

**Results of Predictions by Models of Time Series and Artificial Neural Network**

| *U-THEIL* | *MAE* | *MSE* | *RMSE* | Model |
|---|---|---|---|---|
| 0.591748 | 0.016221 | 0.000428 | 0.020684 | *ARIMA(1,1,2)* |
| 0.529194 | 0.013210 | 0.000304 | 0.017436 | *ANN* |

*Source: finding of study*

In addition to the above four criteria, to ensure correct selection of model, two tests of Granger-Newbold (1976) and Diebold-Mariano (1995) are performed. Since it is important to assess the accuracy of economic forecasts, spread of statistical methods for comparing different methods of prediction accuracy is essential. The zero hypotheses is based on the equality of forecast accuracy based on two different methods to predict one variable (Hearvy, 1997). The base of these statistical methods is on statistical prediction errors and fundamental assumptions of this approach include:

a) Forecast errors are normally distributed with zero mean

b) Forecast errors are not correlated

c) Forecast errors are contemporaneously uncorrelated (Anders, 2010)

The first step for Granger-Newbold test is to form the sequence of forecast errors of ARIMA and ANN models which $e_{1t}$ is the prediction error of ARIMA and $e_{2t}$ is that of neural network model.

Now by using sequences of forecast errors of two models, variables of $x_t = e_{1t} + e_{2t}$ and $z_t = e_{1t} - e_{2t}$ are formed. Statistic of this test is as below:

$$t = \frac{r_{xz}}{\sqrt{\frac{(1-r_{xz}^2}{(H-1)}}} \qquad (3)$$

In equation (3) $r_{xz}$ indicates correlation between $z_t$ and $x_t$ H is the number of observations. The value of test statistic obtained from

Granger-Newbold test equals to 1.11 which in confidence level of $\alpha = 0.05$is not significant; hence $H_0$ hypothesis cannot be rejected.

Diebold-Mariano test is another method for comparing the prediction power of models and is performed when 3 hypotheses of three above hypotheses are violated. For calculating statistic of Diebold-Mariano test initially with assumption that by increasing the size of error, losses resulting from the prediction error grows at a rapid pace, so we consider it once in second and once in fourth power of prediction errors and calculate the sequence of $d_t$.

$$d_t = e_{1t}^2 - e_{2t}^2 \tag{4}$$

In this step we test autocorrelation among sequence components of $d_t$ using Liang-Box statistic and because there is no autocorrelation among components of $d_t$ sequence, DM-statistic is calculated through $t = \frac{\bar{d}}{\sqrt{\text{var}(\bar{d})}}$

The result of Liang-Box test shows that $d_t$ sequence or the same squared forecast errors of neural network and ARIMA does not have autocorrelation. The mean of $d_t$ sequence or in other words

$\bar{d}$ equals to $6.54803 \times 10^{-5}$ and variance estimation is $7.76442 \times 10^{-8}$.

The value of statistic is 1.265 which at the confidence level of 0.05 is not significant, thus $H_0$ hypothesis cannot be rejected.

Now we consider $d_t$ sequence in fourth power of prediction errors that is calculated as following:

$$d_t = e_{1t}^4 - e_{2t}^4 \tag{5}$$

Here also Liang-Box test shows $d_t$ sequence has no autocorrelation, thus we calculated mean, variance and DM-statistic as before.

The mean of $d_t$ sequence is $1.87946\times10^{-7}$, variance is $8.461\times10^{-13}$ and DM is 1.1 which it is not significant at the confidence level of 0.05 therefore $H_0$ hypothesis cannot be rejected. Thus the prediction power of both models is the same and does not have any difference.

Results of FARIMA forecast that is explained in previous section, is as follows for share price index of Tehran Stock Exchange over the considered period:

**Step 1:** for creating FARIMA model, at first the last 50 data among 150 data which are applied in time series and neural network prediction are separated and then the coefficients of this model comes in the form of fuzzy. ARIMA model for 50 data is as following:

$$r_t = -0.0005 + 0.798018 r_{t-1} - 0.9612\varepsilon_{t-1} \quad (6)$$

**Step 2:** we acquire the domain of coefficients by writing the limitations (restrictions) and minimizing the target function as:

$$MinS = \sum_{i=1}^{p}\sum_{t=1}^{k} C_i\,|w_{t-i}\|\varphi_{ii}| + \sum_{i=p+1}^{p+q}\sum_{t=1}^{k} C_i\left|\rho_{i-p}\right\| \alpha_{t+p-i}| \quad (7)$$

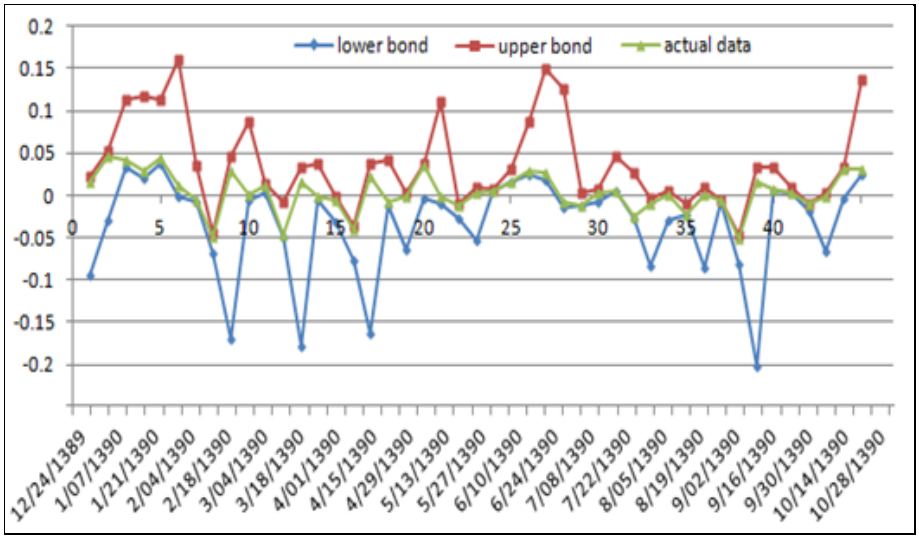
$$MinS = 0.115C_1 + 0.104C_2 \quad (8)$$

$$D\big(LOG(INDEX)\big) = -0.0005 + 0.798{,}0.18 y_{t-1}(-0.962{,}2)\varepsilon_{t-1} \quad (9)$$

FARIMA model produces a regression upper than real data regression and a regression lower than that which they are known as upper bound and lower bound. These two bound create a domain that the real data regression will place between them. Upper and lower bound of FARIMA and real data models have been plotted.

**Figure 1**

**Real Data and Upper and Lower Bound of FARIMA**




*Source: finding of study*

Advantage of using this model on determining these two bounds is to specify the best and worst possible conditions for decision makers in financial markets. Also more reliable decision field would be created rather than non-fuzzy regressions, because prediction is fuzzy instead of zero and one prediction.

**Step 3:** neglecting those data that have placed on upper and lower bounds, 24th, 25th and 41th data had this condition and by removing them, below results obtained:

$$r_t = -0.0005 + 0.798r_{t-1} - 0.9622\varepsilon_{t-1} \quad (10)$$

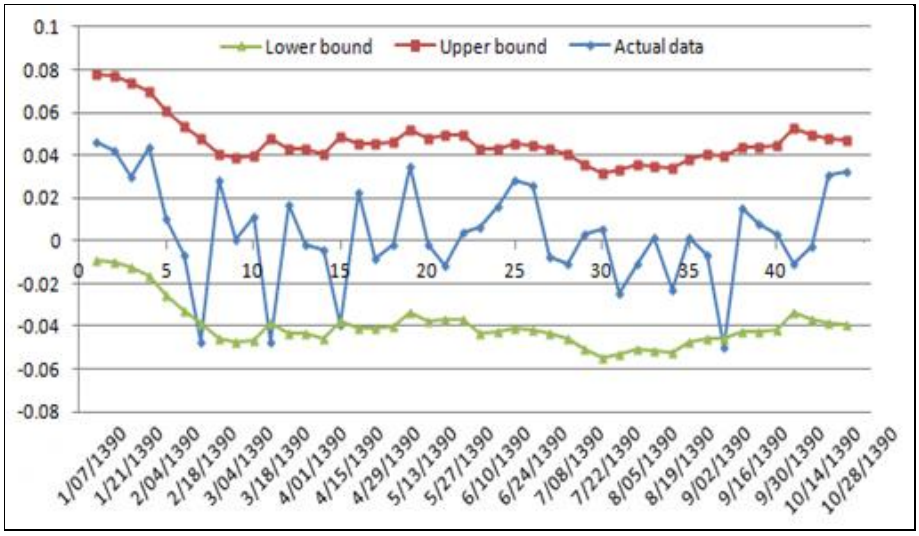
Comparison of predicted results from ARIMA and FARIMA models:

In below figure the domain of ARIMA model which is plotted with actual data has been shown:

As can be observed in four points real values are out of this domain while if we draw the domain of FARIMA model with real values, all values would be between two bounds.

**Figure 2**

**The Domain of ARIMA Model with Real Data**




*Source: finding of research*

## 5. Conclusion

According to RMSE, U-THEIL, MAE and MS E criteria, results of different methods for forecasting of share price index of Tehran Stock Exchange indicate Neural Network model has a better performance in predictions with abundant numbers of data rather than ARIMA model; however, based on Granger-Newbold and Diebold-Mariano that have a test statistic with t-distribution, prediction power of ARIMA and Neural Network does not have any significant difference together and since statistical methods have more accuracy than mathematical formulas, the end result is the prediction power parity of these two models in forecasting return on share price index.

FARIMA results consider ARIMA errors as fuzzy and advantages in predictions with limited data in FARIMA model caused this model presented an appropriate tool to forecast. Although it should be noted that FARIMA model is very sensitive to the fluctuations of data and this subject is more probable in large data which their changes are higher. Indeed in this paper we tried by hybrid methods of time series, neural network and fuzzy, improve the forecasting of time series model. Actually investors and economic

policy makers will achieve the prediction of share price index by using ARIMA and Neural Network models and they obtain maximum and minimum return in Stock market through FARIMA method.

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# MACROECONOMIC DETERMINANTS OF STOCK MARKET DEVELOPMENT: EVIDENCE FROM BORSA ISTANBUL

**Yılmaz BAYAR, PhD***

**Abstract**

Stock markets have experienced significant improvements especially during the past 30 years, fostered economic growth and become one of the important leading indicators for the economies. Economic growth, saving rate, banking sector development, trade openness, foreign direct investments, institutional quality and stock market liquidity are found to be major determinants behind stock market development in the literature. This study investigates major macroeconomic determinants of stock market development in Turkey during the period 2005:Q1-2015:Q3 using ARDL cointegration, Toda and Yamamoto (1995) causality test and regression analysis. We also found that both economic growth and stock market liquidity had positive impact on stock market development in the long run, while inflation had negative impact on stock market development in the long run.

**Keywords:** Macroeconomic Variables, Banking Sector, Stock Market, Time Series Analysis, Turkey

**JEL Classification:** G15, G21, C22

## 1. Introduction

Financial and economic globalization have accelerated as of World War II, many countries gradually removed barriers on the flows of goods, services and capital among countries. There have been significant increases in world stock market capitalization widely accepted as an indicator of stock market development during financial globalization process as of 1980s. Global stock market capitalization increased to about 114% of world GDP in 2007 from about 27% world GDP in 1975 as seen in Chart 1. Global stock market capitalization

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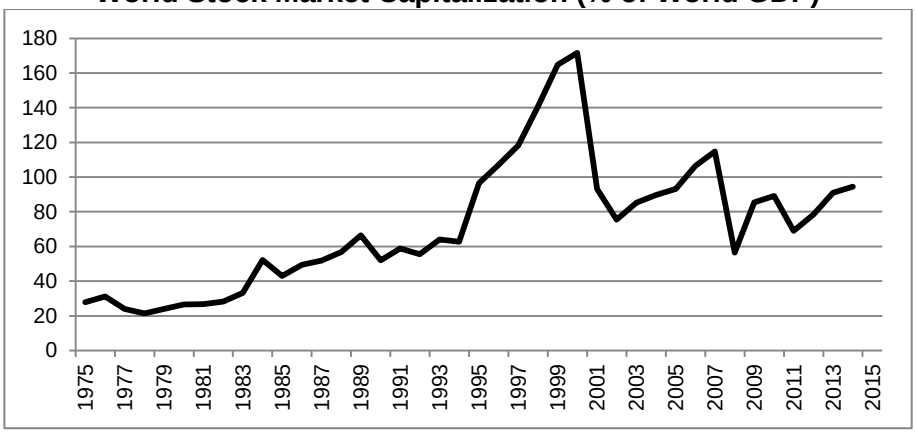
was about 94% of world GDP as of 2014, although late financial crises led substantial contractions in global stock market capitalization.

**Chart 1**

**World Stock Market Capitalization (% of World GDP)**




*Source: World Bank, 2016*

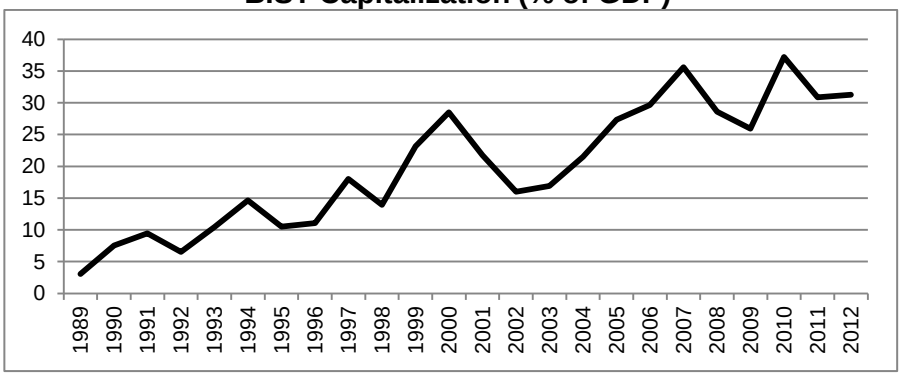
Significant increases in global stock market capitalization and trading volume directed the researchers to determine the impact of stock market development on the economy and investigated the major determinants of stock market development. The studies about the impact of stock market development on the economy traced to 1990s, while the studies about impact of financial development on the economy dated back to 1900s (See Schumpter (1911)). In one of the leading studies, Levine (1991) suggested that stock markets have potential to affect economic growth positively through making firm ownership tradable and enabling investors to diversify the unsystematic risk. On the other hand Levine and Zervos (1996) also asserted that stock markets may have impact on economic growth by contributing to the saving mobility, liquidity, risk diversification, firm control and acquisition of knowledge about firms. The empirical studies about the impact of stock market development on the economic growth generally verified that stock market development has had positive impact on the economic growth (See Levine and Zervos (1998) Ngare et al. (2014) and Pradhan et al. (2015)).

Turkish stock market belatedly followed the trend in global stock markets. Establishment of a modern stock market was realized

in July 1991 with Capital Market Law No. 2499 in 1981 in Turkey, while the root of Borsa Istanbul (BIST) dated back to 1866. Then, Legislative Decree no. 91 of 26 December 1985 concerning securities exchanges was issued. Finally Istanbul Stock Exchange Market went into action on 26 December 1995. Istanbul Stock Exchange Market and Istanbul Gold Exchange combined gathered under the same roof of Istanbul Stock Exchange Market on April 2003. Later, Derivatives Exchange Market and BIST Derivatives Market were combined under the umbrella of BIST in the context of struggles for transforming Istanbul to a financial center on August 2013 (BIST, 2016a). Frequently experienced financial crises and political instability during late 1980s and 1990s hindered the development of BIST. BIST capitalization as a percent of GDP raised the levels above 30% together with provision of economic and political stability in 2000s when compared to the past as seen in Chart 2.

**Chart 2**

**BIST Capitalization (% of GDP)**




*Source: Čihák et al., 2012*

In this study, we examined the impact of major macroeconomic variables on BIST development by benefiting time series analysis. We evaluated that this study will be one of the pioneering studies on BIST development considering the literature and therefore, contributed to the literature by filling the gap in this area. The rest of the study is organized as follows: Section 2 discusses the empirical review about the determinants of stock market development, Section 3 gives information about data and econometric methodology used in the study and Section 4 conducts

empirical analysis and presents major findings. Finally the study is concluded with Section 5.

## 2. Literature Review

The positive impact of stock market development on economic growth and rapidly increasing value of stock markets forwarded the researchers to determine the fundamental determinants of stock market development. The empirical studies have generally focused on the impact of institutional and macroeconomic factors on stock market development and found that economic growth, saving rate, banking sector development, trade openness, foreign direct investments, institutional quality and stock market liquidity had positive impact on stock market development ((see Garcia and Liu (1999), Claessens et al. (2001), El-Wassal (2005), Naceur et al. (2007), Law and Habibullah (2009), Yartey (2010), Raza et al. (2015)); while government budget deficits, inflation and interest rate had negative impact on stock market development (see Naceur et al. (2007), Kurach (2010), Cherif and Gazdar (2010), Nguyen and Hanh (2012)).

Calderon-Rossell (1991) was one of the leading studies about the determinants of stock market development and suggested that economic development and stock market liquidity were major determinants of stock market development. Then extensive studies have been conducted on the determinants of stock market development by adding further institutional and macroeconomic variables to the model of Calderon-Rossell (1991).

In one of these studies, Garcia and Liu (1999) investigated the impact of major macroeconomic variables on stock market development in 15 developed and developing countries during the period 1980-1995 by using panel regression and found that real income level, saving ration, banking sector development and stock market liquidity had positive impact on stock market development. On the other hand Claessens et al. (2001) examined the relationship between foreign direct investments and stock market development in 77 countries during the period 1990-2000 using panel regression and found that foreign direct investments had positive impact on stock market development.

In another study, El-Wassal (2005) examined the impact of major macroeconomic variables on stock market development in 40 emerging market economies during the period 1980-2000 using panel

regression and found that economic growth, financial liberalization and international portfolio investments had positive impact on stock market development. Naceur et al. (2007) investigated the impact of major macroeconomic variables on stock market development in 12 Middle Eastern and North African countries benefiting from unbalanced panel data analysis and found that saving rate, banking sector development and stock market liquidity had positive impact on stock market development, but inflation had negative impact on stock market development. On the other hand, Billmeier and Massa (2007) examined the impact of institutions, remittances and natural resources on stock market development in 17 Middle Eastern and Center Asian countries during the period 1995-2005 and found that institutional quality and remittances had positive impact on stock market development and stock market capitalization was determined by oil prices in the resource-rich countries.

Law and Habibullah (2009) investigated the impact of institutional quality and openness on both banking sector development and stock market development in 27 countries including G-7, European, East Asia and Latin America during the period 1980-2001 using dynamic panel regression and found that real GDP per capita, trade and financial openness and institutional quality had positive impact on stock market development. On the other hand Adam and Tweneboah (2009) investigated the relationship between foreign direct investments and stock market development in Ghana during the period January 1991-April 2006 using Johansen cointegration and found that foreign direct investments had positive impact on stock market development. Yartey (2010) also investigated the institutional and macroeconomic determinants of stock market development in 42 emerging market economies during the period 1990-2004 using dynamic panel regression and found that GDP per capita, gross domestic investment, banking sector development, private capital inflows and stock market liquidity had positive impact on stock market development.

Kurach (2010) examined the factors affecting stock market development in 13 Central and Eastern European countries during the period 1996-2007 using panel regression and found that stock market liquidity and EU membership had positive impact on stock market development, but government budget deficits had negative impact on stock market development. Cherif and Gazdar (2010) also investigated the institutional and macroeconomic determinants of

stock market development in 14 Middle Eastern and North African countries during the period 1990-2007 using panel regression and found that saving rates, banking sector development and stock market liquidity had positive impact on stock market development, but interest rate had negative impact on stock market development.

Nguyen and Hanh (2012) examined the impact of major macroeconomic variables on stock market development in 6 South Asian countries during the period 1980-2008 using panel regression and found that economic growth, saving rate, banking sector development and stock market liquidity had positive impact on stock market development, while inflation and financial crises had negative impact on stock market development. On the other hand Aduda et al. (2012) investigated the determinants of Nairobi stock market development during the period 2005-2009 using regression analysis and found that GDP per capita, domestic savings, banking sector development, stock market liquidity and institutional quality had positive impact on stock market development. Raza and Jawaid (2012) investigated the relationship among economic growth, foreign capital inflows and stock market development in 18 Asian countries during the period 2000-2010 using cointegration test based on ARDL (autoregressive distributed lag) bounds test and Toda and Yamamoto (1995) causality test and found that economic growth had positive impact on stock market development in the long run, but foreign direct investments had negative impact on stock market development in the long run. Furthermore, the results of Toda and Yamamoto (1995) causality test indicated that there was bidirectional causality both between stock market development and foreign direct investments and between stock market development and economic growth.

El-Nader and Alraimony (2013) investigated the fundamental determinants of stock market development in Jordan during the period 1990-2011 using Johansen cointegration and variance decomposition and found that banking sector development, domestic investment, consumer price index and stock market liquidity had positive impact on stock market development, while nominal GDP and net remittances had negative impact on stock market development. On the other hand Zafar (2013) examined the impact of major macroeconomic variables on stock market development in Pakistan during the period 1988-2008 using regression analysis and found that foreign direct investments and trading volume had positive impact on stock market development, while real interest rate had

negative impact on stock market development. Evrim-Mandaci et al. (2013) also examined the impact of macroeconomic variables on stock market development in 30 developed and emerging market economies during the period 1960-2007 using panel regression and found that foreign direct investments, remittances and banking sector development had positive impact on stock market development.

Ayaydın et al. (2013) examined the impact of institutional and macroeconomic factors on stock market development in 39 developing countries during the period 2000-2011 using panel regression and found that institutional development, GDP, banking sector development and foreign direct investments had positive impact on stock market development, while inflation had negative impact on stock market development. On the other hand Yemelyanova (2013) examined the impact of major macroeconomic and institutional factors on stock market development in 8 Central and Eastern European countries during the period 2002-2011 using panel regression and found that domestic investment, stock market liquidity and institutional quality had positive impact on stock market development, but inflation had negative impact on stock market development. Malik and Amjad (2013) investigated the impact of foreign direct investments on stock market development in Pakistan during the period 1985-2011 using Johansen cointegration and Granger causality test and regression analysis and found that foreign direct investments had positive impact on stock market development

Şükrüoğlu and Temel-Nalin (2014) investigated the impact of major macroeconomic variables on stock market development in 19 European countries during the period 1995-2011 using dynamic panel regression and found that income, saving rate and stock market liquidity had positive impact on stock market development, while inflation and monetarization rate had negative impact on stock market development. On the other hand Raza et al. (2015) examined the impact of foreign direct investments and economic growth on stock market development in Pakistan during the period 1976-2011 using cointegration test based on ARDL bounds test and error correction model and rolling window estimation method and found that foreign direct investments, remittances and economic growth had positive impact on stock market development in short and long run. Finally Zhou et al. (2015) investigated the impact of major macroeconomic variables on stock market development in Cameroon during the period 2006-2011 using regression method and found that foreign

direct investments, private capital flows and stock market liquidity had positive impact on stock market development.

## 3. Data and Econometric Methodology

We will examine the impact of economic growth, inflation, trade openness, banking sector development and stock market liquidity on stock market development in Turkey during the period 2005:Q1-2015:Q3 period using cointegration test based on ARDL bounds test, Toda and Yamamoto (1995) causality test and regression analysis.

### 3.1. Data

Empirical studies generally have used real GDP, real GDP per capita, growth rate of real GDP per capita, domestic investments, domestic saving rate, inflation, real interest rate, financial crises, trade and financial openness, foreign direct investment inflows, international portfolio investments, remittances, banking sector development and stock market liquidity as major macroeconomic determinants of stock market development in the literature. However, some studies also have used political stability and institutional development as determinants of stock market development. This study investigates the impact of economic performance, macroeconomic stability, banking sector development, trade openness and stock market liquidity on stock market development in Turkey. Therefore, we used stock market capitalization as a proxy for stock market development. On the other hand we took growth rate of real GDP as a proxy for economic performance, consumer inflation rate as a proxy for macroeconomic stability, sum of export and import as a percent of GDP as a proxy for trade openness, domestic credits provided to private sector by the banks as a proxy for banking sector development and stock market turnover ratio as a proxy for stock market liquidity. The variables used in the study, their symbols and data sources were presented in Table 1.

**Table 1**

**Variables Used in the Study, Their Symbols and Sources**

| Variables | Symbols | Source |
|---|---|---|
| BIST Capitalization (% of GDP) | SMC | BIST (2016b) |
| Growth Rate of Real GDP (%) | GRW | TSI (2016a) |
| Consumer inflation rate (%) | INF | TSI (2016b) |
| Trade Openness (Sum of Export and Import as % of GDP) | TOPEN | TSI (2016c) |
| Domestic credits to private sector by deposit banks, development and investment banks and participation banks (% of GDP) | DCRD | CBRT (2016) |
| Stock Market Turnover Ratio (%) | TRNV | BIST (2016b) |

We benefited from Eviews 9 and Gauss 10 software packages for econometric analyses.

### 3.2. Econometric Methodology

We benefited from time series and regression analysis to investigate the relationship between major macroeconomic variables and stock market development. The series should be stationary to reflect a significant and real relationship among the variables in time series analyses. Furthermore, integration level of the variables is important for selection of cointegration and causality tests. So first we analyzed the stationarity of the variables by ADF (Augmented Dickey Fuller) unit root test developed by Dickey and Fuller (1981) and the unit root test by Phillips vePerron (PP) (1988). The results of unit root tests indicated that some variable were I(0) and the others were I(1) (see the results of unit root test in Empirical Analysis section). Widely used cointegration tests such as Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990) cointegration tests in the literature require that all the variables have the same integration level. But cointegration test based ARDL bounds test developed by Pesaran and Shin (1995) and Pesaran et al. (2001) enables us to investigate the long run relationship among the variables with different integration levels. Therefore, we examined the long run relationship among the variables by cointegration test based on ARDL bounds test. Another advantage of this cointgeration test is that it yields statistically more reliable results relative to the traditional

cointegration tests, because this approach uses unconstrained error correction model. However the critical values of the test were determined only for variables with I(0) or I(1). So ARDL cointegration test cannot be used in case that there is a variable with I(2) among the variables (Pesaran et al., 2001). Then we investigated the causality among the variables using Toda and Yamamoto (1995) causality test, a modified version of Granger (1969) causality test. Finally, we examined the impact of major macroeconomic variables on the stock market development by using regression analysis.

## 4. Empirical Analysis

### 4.1. Results of Unit Root Tests

The stationarity of the variables were tested by ADF (1981) and PP (1988) unit root tests and the results were presented in Table 2. The results of unit root tests indicated that INF and TRNV were stationary at the level, while SMC, GRW, TOPEN and DCRD were not stationary at the level. However, SMC, GRW, TOPEN and DCRD became stationary after first-differencing.

**Table 2**

**Results of ADF (1981) and PP (1988) Unit Root Tests**

| Variable | ADF (1981) | | PP (1988) | |
|---|---|---|---|---|
| | Cons. | Cons.+Trend | Cons. | Cons.+Trend |
| SMC | -2.597747 (0.1014) | -2.990718 (0.1468) | -2.597747 (0.1014) | -3.133611 (0.1120) |
| d(SMC) | -6.010778 (0.0000)*** | -5.937951 (0.0001)*** | -5.995209 (0.0000)*** | -5.919127 (0.0001)*** |
| GRW | -3.128458 (0.0322)** | -3.092632 (0.1215) | -2.381942 (0.1528) | -2.332128 (0.4083) |
| D(GRW) | -5.096416 (0.0001)*** | -5.036844 (0.0010)*** | -5.050705 (0.0002)*** | -4.987464 (0.0012)*** |
| INF | -6.676511 (0.0000)*** | -6.863443 (0.0000)*** | -10.00027 (0.0000)*** | -11.43239 (0.0000)*** |
| D(INF) | -6.924382 (0.0000)*** | -6.827510 (0.0000)*** | -22.39924 (0.0001)*** | -21.92212 (0.0000)*** |

| Variable | ADF (1981) | | PP (1988) | |
|---|---|---|---|---|
| | **Cons.** | **Cons.+Trend** | **Cons.** | **Cons.+Trend** |
| TOPEN | -2.507874 (0.1208) | -3.279154 (0.0837)* | -2.389788 (0.1506) | -3.220229 (0.0944)* |
| d(TOPEN) | -7.106275 (0.0000)*** | -7.033628 (0.0000)*** | -11.39183 (0.0000)*** | -11.33890 (0.0000)*** |
| DCRD | 2.452962 (1.0000) | 0.703454 (0.9995) | 3.366074 (1.0000) | 1.726709 (1.0000) |
| d(DCRD) | -5.335725 (0.0001)*** | -5.981391 (0.0001)*** | -5.329710 (0.0001)*** | -5.967918 (0.0001)*** |
| TRNV | -4.722258 (0.0004)*** | -4.691867 (0.0026)*** | -4.736817 (0.0004)*** | -4.698959 (0.0026)*** |
| d(TRNV) | -6.643457 (0.0000)*** | -6.573285 (0.0000)*** | -13.28951 (0.0000)*** | -12.99296 (0.0000)*** |

### 4.2. ARDL Cointegration Test

We used ARDL cointegration test to investigate the long run relationship among the variables, because some variables were I(0) and the others were I(1). First optimal lag length was found to be 4 considering the information criteria. Then ARDL bounds test was conducted and we found there was serial correlation in our model. So we re-estimated the model one more time with the first differenced values of the variables and the results were presented in Table 3. The results of bounds test indicated that F statistics was higher than upper bound critical values. So we rejected the null hypothesis (there was no cointegration relationship among the variables) and we concluded that there was cointegrating relationship among the variables. Moreover, there was no serial correlation and heteroscedasticity problems and our error term exhibited a normal distribution with regard to the results of diagnostic tests.

**Table 3**

**Results of ARDL Bounds Test**

| Estimated equation $=SMC = f(GRW, INF, TOPEN, DCRD, TRNV)$ | | |
|---|---|---|
| F-statistics | 11,4317 | |
| Optimal lag length | [4, 2, 4, 3, 4, 3] | |
| Significance level | Critical values | |
| | Lower bound | Upper bound |
| 1% | 3.41 | 4.68 |
| 5% | 2.62 | 3.79 |
| 10% | 2.26 | 3.35 |
| **Diagnostic Tests** | **Statistics** | |
| $R^2$ | 0.957508 | |
| $Adjusted\ R^2$ | 0.857072 | |
| F-statistics | 9.533546 (0.000200) | |
| Breusch-Godfrey Serial Correlation LM Test | 1.793162 (0.4080) | |
| Breusch-Pagan Godfrey Heteroscedasticity Test | 20.55732 (0.7170) | |
| Jarque-Bera Normality | 2,371459 (0,305523) | |

We also estimated long run coefficients of the model after we found a long run relationship among the variables and the results were presented in Table 4. The long run coefficients showed that economic growth and stock market liquidity had positive impact on stock market development, while inflation had negative impact on stock market development.

**Table 4**

**Long Run Coefficients of ARDL (4,2,4,3,4,3) Model**

| **Dependent variable: DSMC** | | |
|---|---|---|
| **Variables** | **Coefficient** | **t statistics (Prob.)** |
| **DGRW** | **0.590500** | **4.474731 (0.0008)** |
| **DINF** | **-3.538513** | **-3.412340 (0.0052)** |
| DDCRD | -0.271973 | -1.533639 (0.1511) |

| | | |
|---|---|---|
| DTOPEN | 0.066856 | 0.055113 (0.9570) |
| **DTRNV** | **0.7489731** | **3.425186 (0.0050)** |
| Constant | 0.593799 | 1.993387 (0.0695) |

We also estimated short run coefficient of ARDL model and the results were presented in Table 5. The coefficient of error correction model was found to be negative and statistically significant. The coefficient indicated that 27% of long run disequilibrium was corrected in one period (3 months).

**Table 5**

**Short Run Coefficients of ARDL (4,2,4,3,4,3) Model**

| Variable | Coefficient | t-Statistic | Prob. |
|---|---|---|---|
| D(DSMC(-1)) | 1.109933 | 3.554934 | 0.0040 |
| D(DSMC(-2)) | 0.813818 | 3.084216 | 0.0095 |
| D(DSMC(-3)) | 0.557935 | 2.638279 | 0.0216 |
| D(DGRW) | 1.015057 | 3.337673 | 0.0059 |
| D(DGRW(-1)) | -0.764131 | -3.124938 | 0.0088 |
| D(DINF) | -1.697989 | -3.200387 | 0.0076 |
| D(DINF(-1)) | 2.095047 | 3.071151 | 0.0097 |
| D(DINF(-2)) | 2.384259 | 3.499635 | 0.0044 |
| D(DINF(-3)) | 0.962602 | 1.842124 | 0.0903 |
| D(DDCRD) | 0.527391 | 3.140846 | 0.0085 |
| D(DDCRD(-1)) | -0.125645 | -0.546005 | 0.5951 |
| D(DDCRD(-2)) | 0.923500 | 2.495049 | 0.0282 |
| D(DTOPEN) | -1.087743 | -1.241951 | 0.2380 |
| D(DTOPEN(-1)) | 2.173151 | 2.860158 | 0.0143 |
| D(DTOPEN(-2)) | 0.707699 | 0.712051 | 0.4900 |
| D(DTOPEN(-3)) | -2.444642 | -2.379796 | 0.0348 |
| D(DTRNV) | -2.076767 | -4.094949 | 0.0015 |
| D(DTRNV(-1)) | 0.956726 | 3.163827 | 0.0082 |
| D(DTRNV(-2)) | 0.425690 | 1.399551 | 0.1870 |
| **ECM(-1)** | **-0.270759** | **-6.630004** | **0.0000** |

### 4.3. Toda and Yamamoto (1995) Causality Test

We used Toda and Yamamoto (1995) causality test to analyze the causality among the variables and the results were presented in Table 6. The results of causality test showed that there was unidirectional causality from both TOPEN and DCRD to SMC. On the other hand there was unidirectional causality from SMC and TOPEN to GRW and from INF to TRNV. So trade openness and banking sector development had significant impact on the explanation of stock market development.

**Table 6**

**Results of Toda and Yamamoto (1995) Causality Test**

| Null hypothesis | Prob. |
|---|---|
| GRW does not Granger cause of SMC | 0.1184 |
| INF does not Granger cause of SMC | 0.4448 |
| **TOPEN does not Granger cause of SMC** | **0.0366** |
| **DCRD does not Granger cause of SMC** | **0.0064** |
| TRNV does not Granger cause of SMC | 0.5630 |
| **SMC does not Granger cause of GRW** | **0.0614** |
| INF does not Granger cause of GRW | 0.3639 |
| **TOPEN** does not Granger cause of **GRW** | **0.0341** |
| DCRD does not Granger cause of GRW | 0.2182 |
| TRNV does not Granger cause of GRW | 0.7093 |
| SMC does not Granger cause of INF | 0.8342 |
| GRW does not Granger cause of INF | 0.6768 |
| TOPEN does not Granger cause of INF | 0.2854 |
| DCRD does not Granger cause of INF | 0.3509 |
| TRNV does not Granger cause of INF | 0.9011 |
| SMC does not Granger cause of TOPEN | 0.5075 |
| GRW does not Granger cause of TOPEN | 0.2669 |
| INF does not Granger cause of TOPEN | 0.7640 |
| DCRD does not Granger cause of TOPEN | 0.1427 |

| Null hypothesis | Prob. |
|---|---|
| TRNV does not Granger cause of TOPEN | 0.5745 |
| SMC does not Granger cause of DCRD | 0.9326 |
| GRW does not Granger cause of DCRD | 0.6631 |
| INF does not Granger cause of DCRD | 0.2583 |
| TOPEN does not Granger cause of DCRD | 0.8600 |
| TRNV does not Granger cause of DCRD | 0.4849 |
| SMC does not Granger cause of TRNV | 0.5864 |
| GRW does not Granger cause of TRNV | 0.2273 |
| **INF does not Granger cause of TRNV** | **0.0449** |
| TOPEN does not Granger cause of TRNV | 0.3709 |
| DCRD does not Granger cause of TRNV | 0.1986 |

### 4.4. Regression Analysis

Finally, we conducted regression analysis to see the impact of major macroeconomic variables on stock market development. We estimated the regression equation with first differenced values of the variables, because estimated regression equation with level values of the variables was found to include serial correlation. Furthermore, we used a dummy variable to see the impact of 2008 global financial crisis and 2009 Eurozone sovereign debt crisis on stock market development. The results of regression analysis were presented in Table 7. We reached similar findings with results of causality test. According to the results, banking sector development and trade openness had positive impact on stock market development and financial crises had no significant impact on stock market development. Furthermore, there was no serial correlation and heteroscedasticity problems and our error term exhibited a normal distribution with regard to the results of diagnostic tests.

**Table 7**

**Results of Regression Analysis**

| **Dependent Variable: DSMC** | | |
|---|---|---|
| **Variable** | **Coefficient** | **t statistics (Prob.)** |
| DGRW | 0.115100 | 0.580540 (0.5653) |
| DINF | -0.153998 | -0.453817 (0.6528) |
| **DDCRD** | **0.385097** | **2.033630 (0.0496)** |
| **DTOPEN** | **1.879174** | **2.325616 (0.0260)** |
| DTRNV | -0.142483 | -0.497443 (0.6220) |
| DUMMY | 3.006565 | 1.428557 (0.1620) |
| C | -0.713520 | -0.979220 (0.3342) |
| **Diagnostic Tests** | | **Statistics** |
| $R^2$ | | 0.306073 |
| $Adjusted\ R^2$ | | 0.187114 |
| F-statistics | | 2.572926 (0.035963) |
| Breusch-Godfrey serial correlation LM test | | 0.313904 (0.8547) |
| Breusch-Pagan Godfrey heteroskedasticity test | | 6.950778 (0.3254) |
| Jarque-Bera Normality test | | 5,587528 (0,061190) |
| Ramsey Reset Test | | 0.160009 (0.6917) |

## 5. Conclusion

In this study, we investigated major macroeconomic determinants of stock market development in Turkey. In this context, we benefited from cointegration test based on ARDL bounds test, Toda and Yamamoto (1995) causality test and regression analysis to see the impact of major macroeconomic determinants on stock market development in Turkey during the period 2005:Q1-2015:Q3. Our findings indicated that there was long run relationship among the variables. The long run cointegrating coefficients indicated that economic growth and stock market liquidity had positive impact on stock market development, while inflation had negative impact on stock market development. Moreover, both causality test and regression analysis showed that trade openness and banking sector

development had significant impact on stock market development in the short run. Our empirical findings are consistent with the general trend in the empirical literature and expected signs considering the predictions of theoretical literature. Therefore, our findings implied that banking sector development and stock market development are complementary in the short run, while macroeconomic stability, economic growth and stock market liquidity have positive impact on stock market development in the long run.

Stock markets have potential to affect economic growth positively by providing long run capital for the productive investments and contributing to saving mobility, liquidity and risk diversification. Our finding, causality from stock market development to economic growth, also verified this prediction. On the other hand extensive empirical studies have found that economic growth also has had positive impact on stock market development. Therefore, stock market development and economic growth feedback each other. Policymakers should follow or implement policies which raise macroeconomic stability, banking sector development, stock market liquidity considering the interaction between economic growth and stock market development. Further empirical studies can be focused on interaction channels between stock market development and economic growth to see how these two variables affect each other in detail.

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# EFFICIENCY OF THE ALGERIAN BANKS IN THE POST LIBERALIZATION PERIOD

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**Abstract**

This study investigates the efficiency of the banks in Algeria during the period of 2000-2012. For this end, the efficiency of fifteen banks is estimated using Data Envelopment Analysis model. Furthermore, the technical efficiency is decomposed to determine the pure technical and scale efficiencies of the Algerian banks. Based on the intermediation approach it is assumed that bank uses two inputs; total deposits and interest expenses, and produces three outputs; total loans, interest income and non-interest income.

The findings indicated that on average, the technical efficiency of the Algerian banks has improved during the period of study. The Algerian banks have achieved a high pure technical efficiency with an average equals 95%, while the scale efficiency is the main source of the banks technical inefficiency. In addition, the majority of the banks tend to operate at constant return to scale or decreasing return to scale.

**Keywords:** Efficiency, Data Envelopment Analysis, Algerian Banking System.

**JEL Classification:** C14, G21, G28

## 1. Introduction

In last two decades, the banks efficiency has received an increasing attention among researchers regarding to the importance of the banking efficiency. For the policymakers, the banking efficiency allows evaluating the impact of the adopted reforms and policies on the banking sector performance. Moreover, banking efficiency is an

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important indicator for the success of individual banks and the industry as a whole, in which only the efficient banks can maintain their position in market characterized by increasing competition and rapid technologies advances.

The banking efficiency measures the banks' ability for maximizing their outputs level without additional inputs, or minimizing their inputs level without reducing their outputs. Farrell (1957) developed a measure of the efficiency relying on the linear programming LP. This measure was built on the concept of relative efficiency which implies comparing the position of Decision Making Unit (DMU) with the best production frontier. In the literatures, there are two methods for measuring the banking efficiency; nonparametric method and parametric method. Among nonparametric models there is Data Envelopment Analysis (DEA). The principle of DEA is "envelops" "data" observations in order to construct a "frontier" that is used to analyze the DMUs' performance (Charnes, Cooper and Rhodes 1978). However, Liu, Lu, Lu, & Lin (2013) have conducted a survey about DEA applications from 1978 to 2010. They found that there is a pattern of technology-adoption process by researchers in DEA application, as they tend to adopt new developed models. They revealed that DEA model has been applied mainly in banking and health care fields for efficiency evaluation.

The Algerian banking system has passed through many stages. Thus, Algeria has inherited a well developed banking system from the French colonial, but this system had hampered the achievement of the development programs planned by the Algerian state. After that, the banking system has been dominated by the state to ensure the required financing of its investment programs and the stated-owned-enterprises. The economic crisis of 1986 has pushed the Algerian government to adopt important economic reforms in which the banking system development was the pillar of these reforms. Hence, the banking reforms of 1990 had a significant impact on the Algerian banking system, where these reforms have allowed liberalizing the banking sector from the state intervention. Furthermore, the reforms have encouraged opening the banking sector to privet investment to increase the competition level in the banking sector and improving the banks' performance. Based on the aforementioned, the study seeks to investigate the efficiency of the Algerian banks during the post-liberalization period 2000-2012.

## 2. Efficiency Definition

A general definition of efficiency was provided by the economist Vilfredo-Pareto: "A Pareto optimum is welfare maximum defined as a position [in an economy] from which it is impossible to improve anyone's welfare by altering production or exchange without impairing someone else's welfare." (Cooper, Seiford& Tone, 2006), this definition is known as “Pareto optimality” in Welfare economics. After that, Koopmans (1951) has extended the Pareto optimality concept to the production efficiency concept. He provided a formal definition for the unit technical efficiency: “a producer is technically efficient if an increase in any output requires a reduction in at least one other output, or an increase in at least one input, or if a reduction in any input requires an increase in at least one other input or a reduction in at least one output”. In other words, the production’ unit is efficient if and only if it is not possible to improve any input or output without worsening any other input or output. Accordingly, the inefficient unit is a unit that could improve its input or output levels without deterioration other input or output.

In the literatures, many authors define efficiency as ratio between output and input, and do not make any differences between efficiency and productivity. On the contrary, Lovell (1993) describe the efficiency of a production unit as the ratio of observed output produced from given input to maximum potential output obtained from the same input, or the ratio of minimum potential input required to produce the given output to the observed input required to produce the same output. Therefore, the efficiency is a distance between the quantity of output and input of production unit, and the quantity of output and input of the best firms in the industry.

Farrell (1957) was the first that involved qualitative developments on efficiency concept. He developed a measure of the technical efficiency by using the linear programming LP model using the following concept; the efficiency is the amount of waste that can be eliminated without worsening any input or output. Cooper, Seiford& Zhu (2011) have defined the full efficient units; those units that could not improve output levels without expand input levels and could not reduce input levels without contract output levels. Therefore, an efficient unit uses strictly less of input or produces strictly more of an output, thus it uses no more inputs to produce no less output.

The efficiency can be estimated based on two orientations; Output-Orientation and Input-Orientation efficiency. The Output-Orientation efficiency means that DMU is Pareto-efficient if it is not possible to raise anyone of its output levels without lowering at least another one of its output levels and/or without increasing at least one of its input levels. The Input-Orientation efficiency means that the DMU is Pareto-efficient if it is not possible to lower anyone of its inputs levels without increasing at least another one of its input levels and/or without lowering at least one of its output levels (Thanassoulis, 2001).

Banker, Charnes& Cooper (1984) have differentiated between the pure technical efficiency and the scale efficiency. Pure technical efficiency measures the technical efficiency that is free from any scale efficiency. The researchers have revealed that if there are differences between technical efficiency and pure technical efficiency scores for a particular DMU, this indicates the existence of scale impact that can be measured by scale efficiency. Scale efficiency provides information about DMU's efficiency difference between the optimal size and the current size. This measure allows determining the gains from adjusting the scale size by operating at optimal size.

### 3. Model specification

The principle of DEA is "envelops" "data" (observation) in order to construct a "frontier" that is used to analyze the DMUs' performance. The originality of DEA model is backed to (Charnes et al., 1978) which built a model on the efficiency's approach of (Farrel, 1957). Farrel has attempted to develop methods for evaluating productivity for any productive organization. After that, he generalized his work to address the concept of efficiency. DEA constructs the best-practice frontier or piecewise linear obtained from the observed data set and depicts the distance between DMU and the frontier. Efficiency score ranging between zero and one, where DMUs those producing on the frontier are efficient and their scores are one, while DMUs those producing inside the frontier are inefficient and their scores are less than one (Thanassoulis, 2001). Speaking broadly, DEA technique defines an efficiency measure of production unit by its position relative to frontier of the best performance calculated mathematically by the ratio of weighted sum of outputs to weighted sum of inputs of different DMUs.

Charnes et al. (1978) proposed a model based on input-orientation and under constant returns to scale assumption, the model is known (CCR) model. They assumed that there are *N* DMUs (j = 1,2,…..,N) use *m* inputs to produce *n* outputs. DMUj use amount *xij* of input *i* to produce amount *yrj* of output *r* , where $xij \geq 0$, $yij \geq 0$ , and each DMU has at least one positive input and one positive output value.

$$\theta^* = \min \theta$$

Subject to

$$\begin{aligned} &\sum_{j=1}^{N} x_{ij}\lambda_j \leq \theta x_{io} \qquad i = 1,2,\dots\dots\dots,m \\ &\sum_{j=1}^{N} y_{rj}\lambda_j \geq y_{ro} \qquad r = 1,2,\dots\dots\dots,n \\ &\lambda_j \geq 0 \qquad\qquad j = 1,2,\dots\dots\dots,N \end{aligned} \tag{3.1}$$

Where, $\theta$ is the efficiency score and $\lambda$ is the weight of $DMU_j$. When (3.1) linear programming problem is solved *N* times the efficiency score of each DMU is obtained. According to (Farrell 1957) definition, DMUs with $\theta$< 1 are inefficient, while DMUs with $\theta$ = 1 are efficient units and lie on the best production frontier. To treat the slack problem some studies proposed the use of two-stage approach, where the first stage focus on minimizing the value $\theta$ and in second stage fixing the value of $\theta^*$ after maximizing the slacks according to the following linear program:

$$\min \theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{n} s_r^+\right)$$

Subject to

$$\begin{aligned} &\sum_{j=1}^{N} x_{ij}\lambda_j + s_i^- = \theta x_{io} \qquad i = 1,2,\dots\dots\dots,m \\ &\sum_{j=1}^{N} y_{rj}\lambda_j - s_r^+ = y_{ro} \qquad r = 1,2,\dots\dots\dots,n \\ &\lambda_j \geq 0 \qquad\qquad j = 1,2,\dots\dots\dots,N \\ &s_i^-,\ s_r^+ \geq 0 \end{aligned} \tag{3.2}$$

Where, *s*- is input slacks variable that measures any excess of inputs, and *s*+ is output slacks variable that measures any excess of outputs. $\varepsilon > 0$is non-Archimedean element defined to be smaller than any positive real number. According to Farrell definition, If DMU*o* has $\theta^*$=1 and $s_i^{-*} = s_r^{+*} = 0$, then this DMU*o* is fully efficient. If $DMU_O$ has $\theta^*$=1 and $s_i^{-*} > 0$, $s_r^{+*} > 0$, then this DMUo is weakly efficient, because DMUo is efficient but there is additional saving potential in inputs and opportunity for expansion of outputs (Cooper et al., 2011).

In the practice, the assumption of CRS is not valid because not all firms operate on the optimal size. In real world, the firms are operating in imperfect competition environment, or in regulated industry, or they are subjected to financial constraints. These factors might prevent the firms to operate at the optimal scale. Therefore, it is important to adjust the CRS assumption because the model under CRS assumption would lead to biased measures of technical efficiency that is violated by the scale efficiency. Hence, many researchers have interested to find solution to this situation, such as (Banker et al., 1984). They proposed DEA model that takes in account Variable Return to Scale (VRS) situations, this model is known as BCC model. (Banker et al., 1984) modified the CCR linear programming problem by adding additional constraint $\sum_{j=1}^{N} \lambda_j = 1$ that ensures that each DMU is benchmarked against DMUs of similar size. The input-orientation efficiency is expressed as follows:

$$\min \theta - \varepsilon \left( \sum_{i=1}^{m} s_i^- + \sum_{r=1}^{n} s_r^+ \right)$$

Subject to

$$\begin{aligned}
&\sum_{j=1}^{N} x_{ij}\lambda_j + s_i^- = \theta x_{io} \qquad i = 1,2,\dots\dots\dots,m \\
&\sum_{j=1}^{N} y_{rj}\lambda_j - s_r^+ = y_{ro} \qquad r = 1,2,\dots\dots\dots,n \\
&\sum_{j=1}^{N} \lambda_j = 1 \\
&\lambda_j \geq 0 \qquad\qquad j = 1,2,\dots\dots\dots,N
\end{aligned} \tag{3.3}$$

Scale efficiency is the ratio of technical efficiency under CRS to the pure technical efficiency under VRS. Scale efficiency is calculated indirectly by decomposing technical efficiency into two components; pure technical efficiency and scale efficiency (Sufian& Abdul Majid, 2007), as follows:

$$TE = PTE * SE \quad (3.4)$$

**4. Data and Sample**

The study used annual data of 15 commercial banks operated in Algeria during the period 2000-2011. These banks are selected from 20 banks agreed by the central bank of Algeria until 2011. The number of the selected banks is limited to 15 regarding to the availability of data of these banks during the period of the study, where the most excluded banks are newly established banks. The banks sample information is presented in the appendix. The bank-specific data has been sourced from Bank-scope database, which is a worldwide database of the banks data. The period of the study is selected based on the fact that during this period the banking sector in Algeria has witnessed numerous changes among these changes the openness of the banking sector to the entry of the foreign banks. Therefore, it is interesting to investigate the efficiency of banks in Algeria during this period.

**5. Inputs and Output Specification**

Measuring the banks efficiency requires identifying the inputs and outputs of the banks. Despite the increasing interest in studying the banking efficiency, there is no consensus among the researchers about specific inputs and outputs of the banks. The selection is determined based on the definition of the bank firm and its activities, and the availability of data about the inputs and outputs. According to Sealey& Lindley (1977) there are two popular approaches for selecting the banks inputs and outputs variables; the production approach and the intermediation approach.

*a. Production Approach:* initiated by the contribution of (Benston 1964), this approach focuses on the bank's operational activities. It defines a bank as producer of services for customers. The bank uses input includes physical variables such as labor and physical capital to produce loans and deposits. Under this approach, inputs are measured by physical units and outputs are measured by

the number of the transactions or the documents during a period of time.

*b. Intermediation Approach:* according to this approach the bank is a financial intermediary between depositors and borrowers. It uses labor and capital to transform the collected funds (deposits) into loans and other assets (investment) (Sealey and Lindley 1977). This approach classifies the deposits as inputs, while the production approach treats the deposits as an output variable; also the production approach includes the operational costs, while the intermediation approach considers the operational costs as financial costs.

For this study, the intermediation approach is used. The banks are considering as multi-product firms that use two inputs and produce three outputs, Following to, (Sufian& Abdul Majid, 2007), (Akhtar 2010), (Yahya, Muhammad & Abdul Hadi, 2012). The inputs are ($X_1$) Total deposits, ($X_2$) Interest expenses, while outputs include ($Y_1$) Total loans which include loans to customers, loans and advances to banks, ($Y_2$) Interest income, ($Y_3$) Non-interest income. The table 1 presents the descriptive statistics of banks inputs and outputs.

**Table 1**

**Descriptive Statistics of Inputs and Outputs (Million DA)**

| **All years** | **Mean** | **S.D.** | **Maximum** | **Minimum** |
|---|---|---|---|---|
| **Inputs:** | | | | |
| Interest expenses | 4366.619 | 3330.714 | 11879.55 | 1744.4 |
| **Outputs:** | | | | |
| | 208321.1 | 79879.62 | 348779.4 | 92744.4 |
| Interest Income | 11333.63 | 3476.048 | 19113.5 | 7206 |
| | 3084.169 | 2028.798 | 6250.7 | 695.1 |

## 6. Empirical Results and Discussion

This section presents the results of efficiency measure of Algerian banks during the period (2000-2012). The study used the DEA method based on the input-orientation because banks have a control on their inputs and they can take decision about the appropriate amount of inputs used to generate specific amount of outputs.

**Table 2**

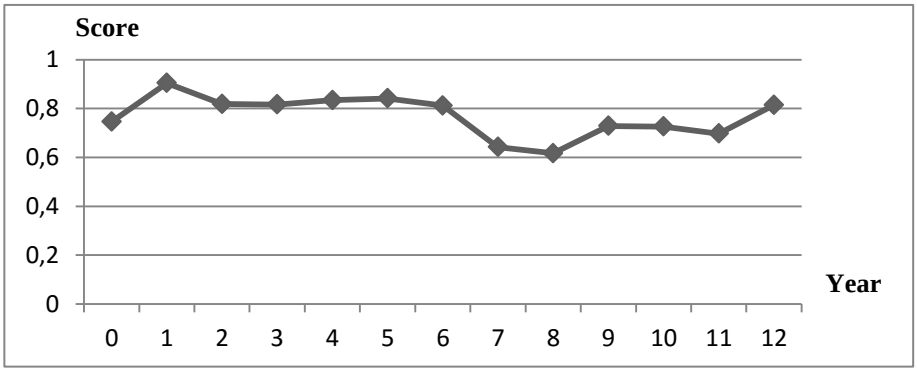
**Technical Efficiency of Algerian Banks (2000-2012)**

| Panel | Efficient Banks | Mean | Maximum | Minimum | S.D |
|---|---|---|---|---|---|
| **2000** | 02 | 0.74 | 1 | 0.37 | 0.240 |
| **2001** | 04 | 0.90 | 1 | 0.66 | 0.151 |
| **2002** | 02 | 0.81 | 1 | 0.61 | 0.170 |
| **2003** | 04 | 0.81 | 1 | 0.58 | 0.186 |
| **2004** | 04 | 0.83 | 1 | 0.52 | 0.173 |
| **2005** | 05 | 0.84 | 1 | 0.54 | 0.185 |
| **2006** | 05 | 0.81 | 1 | 0.44 | 0.200 |
| **2007** | 02 | 0.64 | 1 | 0.39 | 0.188 |
| **2008** | 03 | 0.61 | 1 | 0.31 | 0.263 |
| **2009** | 04 | 0.72 | 1 | 0.37 | 0.245 |
| **2010** | 04 | 0.72 | 1 | 0.41 | 0.223 |
| **2011** | 05 | 0.69 | 1 | 0.4 | 0.237 |
| **2012** | 05 | 0.81 | 1 | 0.41 | 0.216 |
| **Average** | 04 | 0.76 | | | |

Table 2 presents a summary of the bank technical efficiency' scores under constant of return scale assumption for each year from 2000 to 2012. The general view reveals that technical efficiency of the Algerian banks have progressed during the period of the study, in which the technical efficiency mean moved from 0.74 in 2000 to 0.81 in 2012. The progression of the technical efficiency can be decomposed into four stages as the figure 1.

**Figure 1**

**Technical Efficiency of Algerian Banks during (2000-2012)**



First stage from 2000 to2001, it is characterized by the increase of technical efficiency to reach the point of 0.90, which is the maximum score during all the period of the study. Second stage from 2001to2006, it is characterized by the stabilization of the technical efficiency above the value of 0.80. Third stage from 2006 to2008, the technical efficiency has witnessed a decline by 20 percent. In this stage the Algerian banks realized the lowest score during the study period with 0.61. Fourth stage from 2008 to 2012, technical efficiency started retrieving its previous level above 80 percent.

By analyzing each year alone, in 2000, Algerian banks have exhibited technical efficiency of 0.74, which suggests that the Algerian banks on average have wasted 26 % of inputs when transforming the deposits to loans according to the intermediation approach. In 2001, the technical efficiency score of Algerian banks increased by 22 % to reach 0.90, which is the highest score during the period of the study. This result suggests that the Algerian banks on average used their inputs more efficiently, where they have reduced the level of the waste in the inputs to reach 10 %. This improvement may be explained by the reforms adopted by the government and the beginning of the entry of foreign banks which helps to improve the performance of banking sector in Algeria.

In 2002, the technical efficiency declined to 0.81. The same banks BBA and ABC, which are foreign banks, have maintained their positions as the pest performers with technical efficiency score 100%. BDL bank, which is a public bank, is the worst performer with score of 0.61. From the year of 2002 to 2006, the Algerian banks have exhibited a stabilized technical efficiency, in which it fluctuated between 0.81 and 0.84. In this period, the foreign banks performed well comparing to the public banks, where all the efficient banks in this period were foreign banks, in which 04 banks in 2003, 04 banks in 2004, 05 banks in 2005 and 05 banks in 2006. While, always the lowest efficiency score was registered by a public bank. In 2007, the technical efficiency deteriorated by 21 % to reach 0.64 with just two efficient banks TBA and FDB, while the lowest score of efficiency was registered by CPA bank with 0.39. The deterioration of the Algerian banks' efficiency has continued in 2008 to reach 0.61, which is the worst score during all the period of the study. SBA bank was the worst performer with score equals 0.31.

However, the international financial crisis might affect indirectly the financial system in Algeria because the decrease of the

global demand caused by the crisis led to a contraction in hydrocarbons exportations and consequently a reduction in the country's revenues and this affected negatively the performance of the public banks. In addition, the international financial crisis has affected the Algerian banking system through the foreign banks operated in Algeria, where those banks have transactions with their parents' banks abroad. After that, the Algerian banks have improved their technical efficiency. In 2012, the technical efficiency of the Algerian banks has retrieved their previous level above the level of 0.8.

The overall technical efficiency was decomposed into pure technical efficiency and scale efficiency by relaxing the constant return to scale assumption and estimating the DEA model under the variable return to scale.

**Table 3**

**Pure Technical Efficiency of Algerian Banks (2000-2012)**

| Panel | Efficient Banks | Mean | Maximum | Minimum | S.D |
|---|---|---|---|---|---|
| **2000** | 04 | 0.84 | 1 | 0.46 | 0.211 |
| **2001** | 05 | 0.91 | 1 | 0.71 | 0.141 |
| **2002** | 05 | 0.94 | 1 | 0.79 | 0.093 |
| **2003** | 06 | 0.95 | 1 | 0.75 | 0.098 |
| **2004** | 09 | 0.95 | 1 | 0.72 | 0.087 |
| **2005** | 10 | 0.98 | 1 | 0.9 | 0.032 |
| **2006** | 09 | 0.96 | 1 | 0.82 | 0.062 |
| **2007** | 08 | 0.90 | 1 | 0.62 | 0.124 |
| **2008** | 12 | 0.97 | 1 | 0.79 | 0.061 |
| **2009** | 13 | 0.98 | 1 | 0.82 | 0.048 |
| **2010** | 12 | 0.97 | 1 | 0.78 | 0.058 |
| **2011** | 13 | 0.98 | 1 | 0.85 | 0.051 |
| **2012** | 09 | 0.99 | 1 | 0.93 | 0.022 |
| **Average** | 09 | 0.95 | | | |

Table 3, generally, shows that the Algerian banks have exhibited a high pure technical efficiency score during the study period. The mean of the pure technical efficiency did not fall under the level of 0.84, thus the waste in the employed inputs did not exceed than 16 % in the worst years. In 2012, the Algerian banks on average

have realized a good efficiency where they have used their inputs efficiently, in which they have wasted only 1% of the employed inputs. Likewise, in 2012, all banks were fully efficient except one bank that has realized a score of 0.93.

Concerning the Scale efficiency the table 4 reveals that the Algerian banks have exhibited high scale efficiency score in the beginning of the period, and then the mean has deteriorated gradually. The decline of scale efficiency of the Algerian banks during this period may be due to the intensification of the competition in Algerian banking sector regarding to the deregulation of banking activities and the entry of foreign banks. Thus, the competition has pushed mainly the public banks to increase their size of operations by opening more branches and diversifying their services, and consequently, reduce their operating cost by operating at a large size. Therefore, the Algerian banks and mainly the public banks have displayed increased scale inefficiency because most of those banks have operated at inappropriate size.

**Table 4**

**Scale Efficiency of Algerian Banks (2000-2012)**

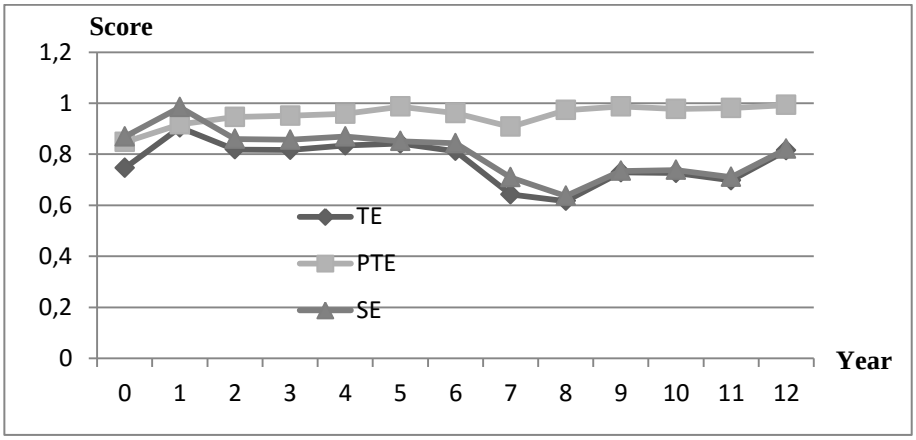
| Panel | Efficient Banks | Mean | Maximum | Minimum | S.D |
|---|---|---|---|---|---|
| **2000** | 02 | 0.87 | 1.00 | 0.76 | 0.100 |
| **2001** | 05 | 0.98 | 1.00 | 0.93 | 0.028 |
| **2002** | 02 | 0.86 | 1.00 | 0.73 | 0.118 |
| **2003** | 04 | 0.86 | 1.00 | 0.58 | 0.156 |
| **2004** | 05 | 0.87 | 1.00 | 0.65 | 0.157 |
| **2005** | 06 | 0.85 | 1.00 | 0.59 | 0.177 |
| **2006** | 05 | 0.84 | 1.00 | 0.44 | 0.189 |
| **2007** | 02 | 0.71 | 1.00 | 0.46 | 0.180 |
| **2008** | 03 | 0.64 | 1.00 | 0.31 | 0.269 |
| **2009** | 04 | 0.73 | 1.00 | 0.41 | 0.237 |
| **2010** | 04 | 0.74 | 1.00 | 0.46 | 0.209 |
| **2011** | 05 | 0.71 | 1.00 | 0.40 | 0.234 |
| **2012** | 05 | 0.82 | 1.00 | 0.41 | 0.216 |
| **Average** | 04 | 0.80 | | | |

The figure 2 shows that the values of the average of the overall technical efficiency of the Algerian banks are less than the

scale and pure technical efficiencies average during all the years of the study. In addition, the average of the scale efficiency is less than the average of the pure technical efficiency.

**Figure 2**

**Overall Technical, Pure Technical and Scale Efficiencies of Algerian Banks during (2000-2012)**




This implies that the overall technical inefficiency in Algerian banks is mainly attributed to scale inefficiency rather than the pure technical inefficiency. This suggestion relative to the scale inefficiency as a major source of overall technical inefficiency is consistent with the findings of the following studies (Wheelock et Wilson 1999), (Isik et Hassan 2002) and (Sufian et Habibullah 2012).

The dominant effect of scale inefficiencies on the technical Algerian banks indicates that most Algerian banks have been operated at non-optimal scale of operations. In other words, the fundamental problem of the Algerian banks is the under-utilization of inputs, rather than managerial best practice. Since the scale inefficiency is the major source of banks inefficiency, it is important analyzing the nature of return to scale of the Algerian banks. As has been mentioned before, a bank can operate at CRS, in which the increase in inputs results in the outputs increase by the same percentage of the inputs increase. The study has followed the method of (Coelli, Rao &Batesse, 1998) to identify the nature of returns to scale.

Table 5 reports the nature of return to scale of Algerian banks. In general, the Algerian banks tend to operate at CRS or DRS. In

2000, two banks have operated at the correct-scale, while the other have operated at DRS. In 2001, all banks have succeeded to operate at the optimal scale in except of one bank that has operated at DRS. Thereafter, most of the Algerian banks have operated at DRS, and the other have operated at CRS. However, quite few banks have exhibited an IRS.

Concerning the banks operating at DRS, these banks have experienced diseconomies of scale by increasing their size to be larger than the optimal size, thus, the increase of their outputs were smaller than the increase in their inputs. According to McAllister & McManus (1993) the small banks have generally exhibited IRS, while the large banks tend to exhibit DRS and at best time at CRS. Hence, most of the Algerian banks mainly the public banks are large banks and this may explain the DRS of the Algerian banks. On other hand, Burki&Niazi( 2006) have found that the majority of the state-owned banks exhibit DRS confirming to the extra cost incurred by them. They have revealed that, after the period of reforms and as a consequence of competition, the state-owned banks were meeting excess demand for financial services by producing more than the optimal scale.

**Table 5**

**Nature of Returns to Scale (2000-2012)**

| | **Bank CRS** | **Bank DRS** | **Bank IRS** |
|---|---|---|---|
| **2000** | 02 | 05 | 00 |
| **2001** | 06 | 01 | 00 |
| **2002** | 02 | 04 | 01 |
| **2003** | 04 | 04 | 00 |
| **2004** | 05 | 06 | 01 |
| **2005** | 05 | 07 | 00 |
| **2006** | 05 | 08 | 01 |
| **2007** | 02 | 11 | 01 |
| **2008** | 03 | 12 | 00 |
| **2009** | 04 | 10 | 00 |
| **2010** | 04 | 10 | 01 |
| **2011** | 05 | 10 | 00 |
| **2012** | 05 | 05 | 00 |

## 7. Conclusion

The purpose of this thesis was investigating the efficiency of Algerian banks during the period of 2000-2012. The study has demonstrated that the banking reforms adopted by the Algerian government in the early nineties has contributed in enhancing the banks efficiency. On average the Algerian banks have realized a level of 76% technical efficiency, which is more than the technical efficiency level of MENA banks that realized scores ranged between 70% - 73% on average (Olson and Zoubi 2011).

The Algerian banks have achieved a high pure technical efficiency with an average equals 95%, and in the worst situations the pure technical efficiency score did not decline under the level of 84%. In addition, the Algerian banks have displayed 80% as score of scale efficiency. However, the increasing of competition in Algerian banking sector regarding the entry of foreign banks has forced the banks to increase their operations size by opening more branches. Thus, this made the banks operating at inappropriate scale which has caused these banks exhibit scale inefficiency. The main source of the banks technical inefficiency is the scale inefficiency which implies that the banks' failure to operate at the optimal scale is the fundamental problem of the Algerian banks.

The Algerian banks should adopte new technologies such as computerazing the banking opeartions which allows benefitting from the economies of scale and scope and consequently reducing the scale inefficiency. On other hand the foreign banks have realized high performance comparing to the public banks because the foreign banks did not subject to any governmental pressure in determinng their credit policies and rules. Therefore, the public banks should be more liberal in choosing their management styles and credit rules in manner increasing the banks profitability and reducing the nonperforming loans.

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