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The Impact of Corporate Governance on the Cost of Equity for Russian Companies in the Ohlson Model

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Abstract

The purpose of this paper is to identify key indicators of corporate governance that affect the market value of Russian companies. To this end, we examine the possibility of modifying the Ohlson model of evaluating stock price dynamics in public companies, by adding corporate governance variables that may affect market value.

The study consists of the following stages: the key points of the Ohlson economic model are described, empirical works that demonstrate corporate governance as a factor in assessing the value of companies are presented, and the significance of the modified Ohlson model for the Russian market is evaluated.

The novelty of our methodology is represented in the prioritisation of our "other information" parameter, which is a combination of forecast analytical data and corporate governance indicators. Through analysis of panel data, we estimate differences in the predicted net profit indicator, calculated as the average of analyst forecasts for an individual company for a financial year, and the actual net profit. Corporate governance is represented by the percentage of board members holding professional certificates and licenses, the average term of board of directors members, the share of independent members on the board of directors, the share of independent members in the audit committee, the proportion of women on the board of directors, and the size of the board of directors.

Our results indicate dependence of share prices on the dynamics of the book value of equity, abnormal profits, the share of board members holding professional qualifications, the difference between the actual net profit and the forecast net profit of companies, and the level of gender diversification in the board of directors. The results of our analysis of deviations in average stock prices are comparable to the findings of existing literature examining the markets of Europe, Latin America and Africa.

Keywords: Ohlson model, valuation, corporate governance, board of directors, fixed effects model, emerging markets

Introduction

When investors create their investment portfolios the share proportion varies depending on their attitude to risk. Shares from the investment portfolio may have a greater rate of return than government and corporate debt securities. Optimisation of the risks related to shares as a financial assets class is of importance. Consequently, a multivariate analysis is necessary to assess stock prices in the investor's portfolio.

The purpose of the present research paper is to define the key indicators of corporate governance which influence the market value of Russian companies by means of modifying the Ohlson model.

To achieve the above purpose, we addressed the following tasks:

1) identification of the key points of the Ohlson economic model;
2) consideration of empirical evidence of research papers which demonstrate corporate governance as a factor of assessing the value of companies (including those related to the Ohlson model);
3) adaptation of the Ohlson model to the Russian market on the basis of available information.

The methodological foundation of this study is the academic paper by J. Ohlson Earnings, titled 'Book Values and Dividends in Equity Valuation'. In that paper, the author considers the influence of financial and "other" information on dynamics of stock prices of public companies. The overwhelming majority of the studied academic papers which tested the Ohlson model confirm the validity of its application and are indicative of research relevance.

Theoretical problem definition. The traditional approaches to company valuation are the income (cash flow discounting model), comparative (market multiplier method), and cost approaches. Each of them has its limitations and drawbacks which result in inconsistency of assessments due to the fact that it is difficult to forecast future cash flows, difficult to find analogues, and to take into consideration only retrospective information. In addition to the above approaches, alternative methods have been developed. One of them is the Ohlson model, which considers actual market data. It is based on calculations presented in financial statements and takes into consideration the key future changes of indicators. The interrelations presented in the research belong to the study of corporate finance theory, and in particular to corporate governance issues (agency conflicts, for instance), accounting theory, and preconditions which lay the foundation of the equity capital cost estimation model.

The empirical component is integrated in the paper by means of analysis of a well-balanced data panel by comparing the evaluations of model coefficients to deterministic (fixed) and random effects and pooled regression.

The "other information" variable is a combination of complementary factors: forecast analytical data and corporate governance indicators.

The academic novelty of the paper consists in the fact that its empirical study was the first to reveal the influence of corporate governance on stock prices of public companies incorporated in Russia by modifying the Ohlson model.

A conclusion was made that there is a *direct* dependence of share prices on the dynamics of the book value of equity, abnormal profits and the share of board members holding professional certificates and licenses. At the same time an *inverse* dependence of share prices on the difference between the forecast net profit and the actual net profit of companies and on the level of gender diversification in the board of directors was shown.

This paper consists of three sections: literature review, methodological approach and empirical evidence.

Literature Review

Corporate governance, in the broadest sense, is understood as a system of relationships between a company's management, its board of directors, shareholders and other concerned parties aimed at pursuing the same interests[1]. In this context it is important to take into consideration not just the exercising but also the separation of property rights and rights of corporate operations control. One paper describes an existing divergence of interests of shareholders and managers in corporate governance theory which has an indirect impact on the increase of costs for delegation of powers in the company [1]. Corporate governance may be used to settle conflicts in the principal – agent context. Corporate governance mechanisms are divided into internal mechanisms (control of operations by the board of directors, distribution of shares among managers, managers' remuneration depending on financial performance) and external ones (corporations law, arrangement of corporate control, and financial markets regulation) [2].

In foreign practice, there are the Anglo-US, German, and Japanese corporate governance models. In the Anglo-US model the board of directors plays the key role, the company's interests and its shareholders' interests are of the same importance, and the operations management is delegated to managers as "agents". The German model is characterised by a rather highly concentrated equity holding structure. Banks play an important role in this model by performing control through their representatives in the board of directors. In the Japanese corporate governance model government plays a significant part, equity is concentrated in the hands of institutional investors and the board of directors is of almost no importance [3]. In their turn, Russian researchers also paid attention to the agency conflicts problem and proposed the method of financial management quality evaluation for oil and gas corpora-

[1] Letter of the Bank of Russia of 10.04.2014 No. 06-52 / 2463 On the Corporate Governance Code.

tions as an instrument of their prevention by means of analysis of an interdependent indicators' complex and use of three information bases. It should be noted that final assessments are made according to two scenarios (growth and crisis), thus, providing higher adaptivity against the background of economic fluctuations [4].

Various aspects of corporate governance are widely used in the papers dedicated to corporate finance. Applying econometric models, foreign and Russian researchers study the influence of corporate governance factors on the system of senior managers' remuneration, equity value, efficiency of companies etc.

It was revealed in the paper dedicated to American companies (5,530 observation points within the period of 1991 to 2012) that as long as the board of directors grows larger, and the share of independent members and women on the board of directors increases, the percentage of the shares held by the board of directors decreases, and duties in several boards of directors are performed simultaneously, the use of non-financial indicators of operations as indicators of senior management remuneration is encouraged [5].

The role of women on boards of directors has been studied in a series of foreign papers. In particular, a major study was carried out on the basis of data from 87 academic papers (published in 1987–2015) in 20 *countries* (approximately 27 thousand companies) [6]. The factor of women on the board of directors was measured by the following parameters: proportion of women, and number of women or a certain number of women on the board of directors. The corporate governance quality, defined by the external rating, gender diversification of human resources, share of charity expenses, and presence of the code of ethics, was used as a dependent variable. The regression analysis of the random effects model established that an increase of the number of women on the board of directors on average results in improvement of the corporate governance quality, and it is greater in the companies located in the countries with a higher level of shareholder protection and a more pronounced level of gender equality.

Influence of the share of independent members of the board of directors on corporate performance is considered against the background of the presence of women on the board of directors [7]. After the authors applied the generalised method of moments to analyse data from 3,876 companies from *47 countries* (13 companies were from Russia) they made the conclusion that companies with a greater number of women on the board of directors show a higher Tobin's Q and return on assets. Therefore, independent members of the board of directors play no significant role in this issue until the board of directors becomes diversified from the gender point of view.

Ambiguity of evaluation of influence of the share of independent directors on the board on Tobin's Q is also observed in the Swedish market [8]. The common effect of increasing the share of independent board members was negative, while a significant amount of directors included in the selection were simultaneously involved in similar business. That could produce a negative impact on corporate performance due to risks of information leakage and intra-industry competition.

From the perspective of the considered topic, the research dedicated to the importance of adding a description of the personal qualities of members of the board of directors to the analysis of corporate governance draws attention [9]. Using data from the Italian market (93 companies for 2014–2016) the authors manually gathered the following information on board members: nationality, education, foreign training, acquired qualifications, and industry experience. Then they built two regression models with fixed effects (dependent variable – Tobin's Q). They concluded that nationality and education had no influence on the model, however, an increase of Tobin's Q was explained by the fact that the board of directors has more directors with business qualifications and experience in strategic consulting.

Early research for Russian companies was based on revealing the dependence between the corporate governance score and market value [10; 11]. In the opinion of a range of authors, the corporate governance factor has been playing a rather significant role in the assessment of Russian companies' performance [12]. Later papers reveal more novel approaches. Regardless, the paper studies the influence of the share of independent directors on the board, the percentage of shares held by management and government participation in equity on Russian companies with diversification and focusing strategies. It was discovered that diversified companies increase government ownership of their shares, and the share of independent directors on the board facilitates growth of their value [13].

In view of the experience of Russian studies in assessing the influence of corporate governance on the equity value of countries from emerging regions, Latin America is also of interest [14]. Applying an approach which takes into consideration companies' exposure to country risk (lambda approach) the authors of the cited study calculated equity values in 90 companies from Brazil, Mexico, Chile, Colombia, and Peru. The variables which describe corporate governance comprised three author's indexes: disclosure, the board of directors, shareholder rights, and ownership structure. The first index is made on the basis of the information on the standard used to disclose corporate financial statements, whether the auditor belongs to the Big Four, whether remuneration of the senior management is disclosed, whether a clean audit report has been obtained, and whether information is available in other languages. The second index structure is indicative of a continuous operation of the audit committee, the possibility of overlapping of the executive director's position with that of the chairman of the board of directors, the number of board of directors' members, the share of independent members in the board of directors, and simultaneous membership of several directors in the board for more than two years. The third index takes into consideration

the fact of whether majority shareholders own more than 70% of voting stocks, whether non-voting stocks amount to less than 20% of corporate capital, whether companies issue only voting shares, whether distribution of voting shares is proportionate to the number of shares held by a majority shareholder, and whether an institutional investor owns an equity share exceeding 5%. The regression analysis revealed a stable dependency between the corporate governance quality and capital cost in Latin America. A study of the effect produced by the above indexes on company value showed that disclosure has the greatest impact, the second index is significant at a 10% level, and the third index is insignificant, while the determination coefficient amounted to 0.40.

Along with classical approaches to evaluation (income, comparative, cost approach) there are alternative ones which comprise the Ohlson model. In 1995 James Ohlson provided theoretical and methodological provisions of the model which characterised the determinants of corporate market value change [15]. The evaluation of equity value is performed by means of analysis of information taken from financial statements and other relevant data. The reference condition is no opportunity to resort to arbitration and risk-neutral investors with homogeneous expectations.

The assertion that the corporate market value may be calculated by contraction of expected dividend flows as per the public securities rate is accepted as one of the three prerequisites:

$$P_t = \sum_{\tau=1}^{\infty} \frac{E_t\left[\tilde{d}_{t+\tau}\right]}{\left(1+r_f\right)^{\tau}}, \quad (1)$$

where P_t – the corporate market value at the moment t;

d_t – amount of net dividends paid at the moment t;

r_f – risk-free interest rate (as a non-stochastic variable);

$E[.]$ – expectation operator at the moment t.

The second prerequisite (of clean surplus relation) exemplifies the fact that, provided the data presented in financial statements is complete, the book value of equity in the current period is equivalent to the book value of the previous period and net profit and dividends of the current period:

$$bv_t = bv_{t-1} + x_t - d_t, \quad (2)$$

where bv_t – equity book value;

x_t – net profit for the period of (t – 1, t);

d_t – net dividends paid as at the moment t.

The abovementioned variable corresponds to the book value of net assets calculated as a difference between corporate assets and liabilities.

At the same time, it is important to define the abnormal profit (x_t^a) which equals the difference between the amount of net profit and equity book value of the previous period for the discount rate:

$$x_t^a = x_t - r_d \bullet bv_{t-1}. \quad (3)$$

The discount rate is the rate based on the CAPM methodology with a known Beta coefficient, company and market profitability.

Based on the information above, one can make the conclusion that resolutions related to current and expected dividend payouts and the amount of the current and future profits are independent.

The third prerequisite describes characteristics of abnormal profits and may be presented as follows:

$$\tilde{x}_{t+1}^a = \omega x_t^a + \nu_t + \tilde{\varepsilon}_{1,t+1}; \quad (4.1)$$

$$\tilde{\nu}_{t+1} = \gamma \nu_t + \tilde{\varepsilon}_{2,t+1}, \quad (4.2)$$

where ν_t – "other information" indicator: data collection not included in the current financial statements but influencing future statements;

γ – constant parameter for ν_t ($0 \le \gamma < 1$);

ω – parameter of abnormal profits constancy ($0 \le \omega < 1$);

$\tilde{\varepsilon}_{t,t+1}$ – chance observation errors with zero variance.

Approximation of the "other information" parameter is one of the key objectives of this research. The definition of "other information" comprises information not taken into consideration in the current financial statements, which nevertheless has a significant influence on the successive statements [16]. The general wording urged researchers to perform approximation calculations. In a series of papers, the authors devise the "other information" parameter by use of analysts' consolidated forecasts concerning profits and net income of a future period, by adding abnormal dividends, various multipliers, macroeconomic and industry-specific control variables. Other authors ignore the "other information" for simplification purposes [17; 18].

See below a review of empirical research of the Ohlson model for the last few years, including adding of corporate governance factors.

The academic novelty of the paper [19] resides in the fact that the authors include corporate governance indicators in the Ohlson model in the Taiwanese market and its explanatory power in forecasting quoted prices for 219 nonfinancial companies. The corporate governance is expressed through 11 variables which comprise a proportion of shares held by the board members, majority shareholder's ownership share, the percentage of shares owned by individual persons, the right of the largest voting shareholder, and the percentage of voting shareholders concerning cash flows. Cointegration of the market value and book value with abnormal profits not taking into consideration corporate governance amounts to 48%, and if this parameter is taken into consideration it may be 99%.

The influence of corporate governance on the market value of companies in the Ghanian market was studied in paper [20]. The variables characterising corporate governance comprise the size of the board of directors, overlapping of the executive director's position with that of the board of directors' chairman, and the percentage

of independent directors on the board. The smaller the board of directors, the higher the company's market value is. A joint appointment of the same person to the position of the executive director and the chairman of the board of directors results in growth of the quoted price. Independence of the board members has no significant impact on the company value. The determination coefficient of the obtained model amounted to 0.67.

A major study (over 1,000 companies for 8 consecutive years) of the Ohlson model was dedicated to Latin American markets [21]. In spite of ignoring the "other information" variable and the replacement of abnormal profits with net profit, the authors make the conclusion that the Ohlson model explains dependence of share prices on regressors in Mexico, Chile, Bermuda and Cayman Islands; with certain limitations – i.e. in Brazil, Panama and Peru – and does not explain it in the markets of Venezuela, Colombia, and Argentina.

The empirical testing of corporate governance influence on the corporate market value in the Brazilian market is described in paper [22]. The research methodology comprises panel data analysis for 90 companies between 2004 and 2010 (630 observation points). The authors compared various models and the random effects model turned out to be the optimal one. Corporate governance, expressed through the following approximating indicators, influences the shares' market value: ownership structure (government- or family-owned with over 35% held by the dominant shareholder), and percentage owned by the largest shareholder. The family and government ownership structures are considered to be the most acceptable ones from the point of view of value because such companies have the highest level of information control. The implementation of corporate governance factors in the Ohlson model increases the determination coefficient from 0.42 to 0.49.

Expressing the "other information" through the Piotroski score which is a statistically significant indicator in the model and characterises corporate financial standing was an ingenious solution offered in the paper, testing the Ohlson model in the Mexican market from 2005 to 2011 [23]. The absolute and relative value of return on assets, amount of operational cash flow, dynamics of gross profit margin, asset turnover, credit leveraging, and day-to-day liquidity take on a binary value. The regressors comprise the Piotroski score for the current and previous periods and the last year's stock price with a 3 months' lag.

The authors revealed a difference in the explanatory power of the equity book value and earnings per share as of the reporting date depending on the rate of return of Chinese companies [24]. Low profit companies showed a low determination coefficient which reached the maximum level (over 40%) at an average profitability. The authors also indicate an interrelation of regressor coefficients: high profit companies get profit from share performance which exceeds the equity book value, and with the maximum determination coefficient the difference between them is minimal.

The paper cited at [25] offers an interpretation of growth of the capability of financial indicators to explain the dynamics of the market value by transfer of Canadian companies to IFRS. It was established that implementation of IFRS resulted in growth of the determination coefficient from 55 to 76%. In addition, the authors verified the model for stability excluding from the selection financial organisations and confirmed their conclusions which were similar for European analogues.

The "other information" parameter is described by human capital indicators for the *Turkish* market from 2004 to 2014 [26]. Human capital comprises expenses per an employee which consist of a salary, bonuses and other social payments, and earnings per an employee. The authors found out the following dependency: the reason for change of share price by 0.003 and 0.151 monetary units may be dynamics of earnings and expenses for employees per 1,000 monetary units.

The Kuwaiti market is unique, due the requirement that two external audit organisations are required to conduct a company audit [27]. According to this requirement the authors used the auditor composition as the "other information" parameter. Their conclusions seem obvious: the biggest adjusted determination coefficient (63%) was obtained for companies whose statements had been audited by two 'Big Four' auditing companies, and the smallest – for those companies whose statements had been audited by two local auditors.

Dynamics of the market value of Chinese companies tends to be affected by historical (amount of annual dividends, net profit, equity book value) as well as forecasting information (expected dividends) [28]. The author at [28] makes the conclusion that in spite of a high adjusted determination coefficient (79%) the Ohlson model may bring forward revaluation of the corporate market value.

A recent comparison of indicators from interim and annual financial statements against the background of verification of the Ohlson model was performed focusing on the RSA market [29]. In spite of the fact that these indicators comprise only the basic parameters offered by Ohlson, it should be noted that the relevant specifications indirectly measure the level of investors' confidence in the audited annual reports. In the model specification (which uses interim indicators) net profit is shown to be insignificant due to within-year fluctuations, unlike in the specification which uses indicators from annual reports where the model itself and evaluations of coefficients of all regressors are of significance.

In the Turkish market, the transfer to IFRS triggered research on the influence of profit and net assets on stock prices from 2001 to 2008 [30]. The selection was divided into two sub-selections: before and after implementation of IFRS. In the pooled regression model, the adjusted determination coefficient from the second selection surpassed the results of the first one (57 and 32%). So, the authors made the conclusion that IFRS has a positive impact and it is correct to use financial indicators from such statements for testing the Ohlson model.

In research [31] the key parameter of corporate governance is the percentage of women in the top levels of management of 411 German public companies. Among other variables are included the share of board members having financial education, the share of independent board members, size of the board of directors, and membership of external auditors in the Big Four (Deloitte, KPMG, EY, PWC). A positive significant (at a 1% level) influence on the corporate market value is exerted by the share of women in top management, the size of the board of directors and membership of external auditors in the Big Four. In its turn the share of the board members with financial education and share of independent board members were insignificant. The determination coefficient of the tested model amounted to 0.31.

The presence of influence of corporate governance on the corporate market value from ten developed European countries is shown in paper [32]. There were 18,746 observation points for the period of 2001 to 2013. Corporate governance is expressed via the dummy variable, which characterises the company's presence in the Dow Jones Sustainability Index Europe. The influence of corporate governance was significant for the region, and the determination coefficient amounted to 0.84. However, the authors emphasise that there were inter-country differences: a company's presence in the abovementioned index turned out to be significant only in Germany and Sweden. This paper is noteworthy due to the large scale of analysed data, however, it is possible to improve the chosen approximating indicator by using internal corporate governance mechanisms.

In the SAR market, corporate governance plays an important role in company value assessment [33]. A lot of data used for analysis consisted of financial statements of 90 public companies from 2002 to 2014. The variables of corporate governance are comprised of data on the size of the board of directors, the share of independent board members, number of meetings of the board of directors within a year, level of gender and race differentiation in the board of directors, a joint appointment of the same person to the position of the executive director and the chairman of the board of directors. At a 1% significance level, the corporate market value grows due to enlargement of the board of directors, increase of the number of the board meetings in a year and level of gender and race differentiation in the board of directors. The determination coefficient of the obtained model amounted to 0.69.

A comparative analysis between countries was conducted from the point of view of testing the Ohlson model for the markets of China, Japan and South Korea [34]. The cluster analysis for the three markets showed a statistical significance of the model and all regressors. In the context of the markets the biggest determination coefficients are observed for the companies from South Korea, the smallest – for those from China. Evaluation of the net profit coefficient is the biggest in comparison to other regressors for the three markets, and the book value of equity for the Chinese market takes the negative sign and this is an unexpected conclusion.

The transfer of companies to IFRS was also of relevance for the authors of the paper describing the markets of France, Belgium and Germany as the most conservative ones from an accounting point of view [35]. The selection was divided into two sub-selections: before and after implementation of IFRS. An insignificant growth of the determination coefficient from 37.5 to 39.3% was observed. On this basis, the authors made the conclusion of a positive influence of the procedure of transfer to IFRS.

On the basis of the analysed publications, we can make the conclusion that testing of the Ohlson model is of much academic interest, while corporate governance plays an important role in the issue of corporate value evaluation. Therefore, considering this phenomenon from the point of view of the Russian equities market is highly important.

Research Methodology

The financial information on the companies available for analysis was taken from the Compustat[2] data base. Empirical analysis is based on observing a series of terms which comprise the criteria for selection. Financial organisations are not considered because components of their balance sheets are in marked contrast to those of non-financial organisations. In accordance with Ohlson's paper, on an annual basis the equity book value should exceed 0 for each company within the considered time horizon. Individual discount rates calculated on the basis of CAPM were used for evaluation of abnormal profits.

In order to make a well-balanced data panel, the studied assembly of companies comprises only those companies with the quoted market price of shares available within the period of observations. Initially there were 68 public companies incorporated in Russia, however, after filtering with the I/B/E/S system this number reduced to 44. At the final stage of making the final selection, in order to prevent the possible heteroscedasticity, the financial variables were normalised to the number of shares in circulation. So, we obtained an aggregate of 31 observed companies.

Testing was conducted for a well-balanced data panel which was possible, in spite of gaps in the initial data, due to application of the multiple imputation method. In this method, the missing data is restored several times, then it is integrated within the tested model specification [36]. Historical observations range from 2011 to 2018 (2008–2010 were excluded because a lot of companies showed a negative book value of equity). So, for the purpose of analysis of a well-balanced data panel, we present 248 observation points.

[2] Data base of Compustat S&P Global. URL: https://www.spglobal.com/marketintelligence/en/?product=compustat-research-insight (available as of January of 2020, reference date: 15.03.2020).

Table 1. Descriptive statistics of the tested variables

Variable	Number of observations	Mean value	Standard deviation	Minimum	Maximum
P	248	25.65	3.65	0.01	275.07
Bv	248	18.98	2.93	0.04	107.48
Abpr	248	3.22	1.31	–2.94	22.27
Foni	248	5.85	1.48	0.06	11.21
Bss	248	41.85	2.87	25.56	82.00
Abt	248	4.84	0.32	1.22	9.20
Ibm	248	35.21	2.77	5.56	93.75
Aci	248	72.16	1.73	20.00	100.00
Bgd	248	7.44	0.98	0.00	25.00
Bsz	248	7.55	0.11	5.00	16.00

Source: compiled by the author.

Table 2. Correlation matrix of variables

Variables	P	bv	abpr	foni	Bss	abt	ibm	aci	bgd	bsz
P	1.00									
Bv	0.61	1.00								
Abpr	0.42	0.32	1.00							
Foni	0.56	0.22	0.67	1.00						
Bss	0.19	0.15	–0.06	–0.04	1.00					
Abt	0.12	0.37	0.01	0.16	0.08	1.00				
Ibm	0.02	–0.03	–0.01	–0.03	0.03	0.01	1.00			
Aci	0.02	–0.06	–0.04	–0.09	–0.06	–0.19	0.39	1.00		
Bgd	0.18	0.12	0.24	0.26	–0.12	–0.17	–0.01	–0.07	1.00	
Bsz	0.09	0.11	0.20	0.22	–0.18	–0.03	0.13	0.12	0.33	1.00

Source: compiled by the author.

Our analysis of panel data is justified because this analysis method is the leading one in the studied papers from the point of view of the testing of the Ohlson model. Additionally, the panel data (when compared to time series and cross selection) shows a high aggregation, efficiency, a larger number of degrees of freedom and a smaller indicators collinearity [39; 40]. From the Stata econometric package, we obtained assessments of coefficients in fixed (deterministic) effects models and random effects models, and in the pooled regression applying a common least-square method.

We should mention that the "other information" parameter is a combination of complementary factors: forecasting analytical data and corporate governance indicators. In particular, the first one is evaluated as a difference between the forecasting net profit indicator calculated as the arithmetic mean of analysts' forecasts for a certain company for a financial year downloaded from I/B/E/S[3] system and the actual net profit of companies. In its turn, corporate governance comprises the following parameters:

1) percentage of board members holding professional certificates and licenses;
2) average term of board of directors members;
3) share of independent members on the board of directors;
4) share of independent members in the audit committee;
5) proportion of women on the board of directors;
6) size of the board of directors.

[3] Data base Institutional Brokers' Estimation System Thomson Reuters. URL: https://financial.thomsonreuters.com/en/products/data-analytics/company-data/ibes-estimates.html (available as of January 2020, reference date: 15.03.2020).

The specification of the tested model is indicative of the following dependency:

$$P_t = a + \alpha_1 bv_t + \alpha_2 abpr_t + \alpha_3 foni_t + \alpha_4 bss_t + \\ + \alpha_5 abt_t + \alpha_6 ibm_t + \alpha_7 aci_t + \alpha_8 bgd_t + \alpha_9 bsz_t + e_t, \quad (5)$$

where P_t – company share price at the end of the 4th month following the end of the financial year;

bv_t – book value of net assets per individual share;

$abpr_t$ – abnormal profit per individual share;

$foni_t$ – difference between the anticipated net profit indicator and actual net profit of companies per individual share;

bss_t – percentage of board members holding professional certificates and licenses;

abt_t – average term of board of directors members;

ibm_t – share of independent members on the board of directors;

aci_t – share of independent members in the audit committee;

bgd_t – proportion of women on the board of directors;

bsz_t – size of the board of directors;

a – intercept regression term;

e_t – chance observation errors.

Descriptive statistics and a correlation matrix for the tested variables are presented in Tables 1 and 2 respectively.

On the basis of the research cited at [37; 38] the influence of regressors on prices in the fourth month following the end of the year were evaluated. There are two justifications for the above time period: first, the data verified by auditors is more trustworthy and actually it takes approximately four months to make an auditor's opinion after verification of annual financial statements. Second, the literature review above confirms that in most cases, prices for the fourth month are used to test the Ohlson model, i.e. the prices in April were taken for Russian companies.

At the final stage of testing, the most relevant model specification is chosen on the basis of the results of econometric tests, and a comparison of standard errors evaluations and also the extent of deviation from the actual price of shares in April of 2019 is estimated.

Empirical Evidence

The research studies cited at [37; 38] present coefficients with certain stability parameters of abnormal profits and "other information" for the Russian market (Table 3) which are statistically significant and differ from 0 and 1 (extremal values). The abovementioned parameters allow to adjust the model statistically to the Russian equities market.

Table 3. Autoregressive stability parameters of abnormal profits and "other information" for the Russian market

Evaluated dependence	Parameters value
$\tilde{x}^a_{t+1} = \omega_0 + \omega_1 x^a_t + \tilde{\varepsilon}_{1,t+1}$	$\omega_1 = 0.67^{***}$
$\tilde{v}_{t+1} = \gamma_0 + \gamma_1 v_t + \tilde{\varepsilon}_{2,t+1}$	$\gamma_1 = 0.96^{***}$

For reference: * p<0.05; ** p<0.01; *** p<0.001.

Source: compiled by the author.

Table 4 represents a comparison of evaluations of coefficients when analysing data by means of an ordinary least-square method (pool), fixed effects model (fe) and random effects model (re).

Table 4. Regression coefficients for the Russian market

Variables	pool	Fe	re
bv	–0.679*	0.192**	0.679**
abpr	0.214	1.011**	0.214*
foni	1.623***	–2.235***	–1.624***
bss	–0.097	0.223*	1.097
abt	–1.114	0.943	–1.114
ibm	0.058	–0.021	0.058
aci	0.287	–0.079	0.288
bgd	0.494*	–1.037**	–2.495*
bsz	–5.059*	3.581	–5.059*
cons	10.582	13.823	11.582

For reference: * p<0.05; ** p<0.01; *** p<0.001.

Designations: bv – book value of equity; abpr – abnormal profits; foni – difference between the forecast net profit indicator and actual net profit of companies; bv, abpr, foni were taken per a share; bss – percentage of board members holding professional certificates and licenses; abt – average term of board of directors members; ibm – share of independent members on the board of directors; aci – share of independent members in the audit committee; bgd – proportion of women on the board of directors; bsz – size of the board of directors; cons – intercept regression term.

Source: compiled by the author.

Use of the multiple imputation provides robust estimators for restoring the variables. At the same time, taking into consideration the proximity of observation points in space and time for other variables standard errors of the model were replaced with robust Newey-West consistency estimates resistant to autocorrelation.

Table 5. Deterministic (fixed) effects model

Variables	Coefficient evaluations	Newey-West errors	t	P>|t|
bv	0.192**	0.471	1.10	0.008
abpr	1.011**	1.697	0.21	0.007
foni	–2.235***	1.216	–2.53	0.000
bss	0.223*	0.197	0.90	0.041
Abt	0.943	2.738	0.77	0.632
Ibm	–0.021	0.139	–0.54	0.828
aci	–0.079	0.082	–2.17	0.387
bgd	–1.037***	0.486	–0.95	0.000
bsz	3.581	2.344	2.06	0.452
cons	13.823	3.371	1.78	0.115

For reference: Prob > F = 0.0000.

Designations: bv – book value of equity; abpr – abnormal profits; foni – difference between the forecast net profit indicator and actual net profit of companies; bv, abpr, foni were taken per a share; bss – percentage of board members holding professional certificates and licenses; abt – average term of board of directors members; ibm – share of independent members on the board of directors; aci – share of independent members in the audit committee; bgd – proportion of women on the board of directors; bsz – size of the board of directors; cons – intercept regression term.

Source: compiled by the author.

The conducted tests led to the conclusion that the fixed effects model is the most adequate one out of the three presented models. The Wald test proved an edge over the pooled regression (p-level < 0.01). In its turn, the Haussmann test rejected the random effects model (p-level < 0.01).

The following tested variables turned out to be significant: the book value of equity; abnormal profits, difference between the forecast net profit indicator and actual net profit of companies; percentage of board members holding professional certificates and licenses; and proportion of women on the board of directors (Table 5). We conclude that an average term of board of directors members, share of independent members on the board of directors, share of independent members in the audit committee and size of the board of directors have no impact on share prices dynamics.

The conducted analysis led to the conclusion that share prices of the studied Russian companies is co-directional to the dynamics of the equity book value, abnormal profits, and the percentage of board members holding professional certificates and licenses. Additionally, an inverse dependence between share prices and the difference between the forecast net profit indicator and actual net profit of companies was revealed. The interpretation may be as follows: the more accurate analysts' forecasts on the amount of net profit, the less the difference with its actual value is, i.e. when the amount of corporate net profit surpasses the forecast value the share prices are higher. The negative sign of the coefficient of proportion of women on the board of directors should be explained with a reserve concerning the industrial composition of the selection: 77% of studied companies belong to extractive industries. This may indicate that in the case of such companies, the market preferred a lower level of gender diversification in the board of directors. Evaluations of obtained regression coefficients are significant at the level of $p < 0.001$, when the difference between the forecast net profit indicator and actual net profit of companies is (–2.24), proportion of women on the board of directors is (–1.04). Further, when the equity book value is (0.19), abnormal profits are (1.01) they are significant at the level of $p < 0.01$. The coefficient of the percentage of board members holding professional certificates and licenses is (0.22) and significant at the level of $p < 0.05$.

The calculated evaluations of coefficients allow us to plug data of financial indicators from statements for 2019 financial year into the regression equation and obtain the estimated value of share prices of the studied pool of companies for the Ohlson model (Table 6).

Table 6. Deviations from actual share prices, in %

Company	Not taking into consideration CG	Taking into consideration CG
Acron	–28.2	–26.0
Alrosa	–31.8	–9.7
Joint-Stock Financial Corporation System	–33.8	–22.1
Aeroflot	–30.3	–14.4
Bashneft	–28.2	–18.6
Gazprom	–11.6	–16.6
Evraz	15.8	13.2
Inter RAO	–12.2	–16.1
Lukoil	–12.2	–7.2
M Video	–21.9	–26.1
Magnit	–8.0	–7.7
Megafon	–17.8	–3.1
Mechel	20.3	–9.8
Magnitogorsk Iron and Steel Works	3.0	3.8
MTS	4.1	8.9
NLMK	–12.9	–7.9
Novatek	8.5	13.3
Nornickel	–7.3	–3.6
Polyus	–7.8	6.3
Rosneft	–10.3	–2.6
Rosseti	–8.1	–12.4
Rostelecom	–29.5	–19.3
RusHydro	–14.6	2.8
Severstal	8.9	2.8
Surgutneftegas	–23.4	–21.8
Tatneft	–37.1	–8.1
Uralkali	–24.2	–30.5
Phosagro	–4.6	–4.6
Cherkizovo	6.3	2.9
Enel	–21.9	–34.9
Unipro	–4.9	–17.8
On average	*–12.1*	*–9.3*

Source: compiled by the author.

For the studied pool of companies the Ohlson model underestimates the equity capital value of Russian companies by 12.1% (when not taking into consideration corporate governance). The testing of the complete model allowed to reduce the difference up to 9.3%. This may be caused by considering the corporate governance factors.

Conclusion

Corporate governance plays an important role in the financial decisions of companies. An adequate evaluation of this factor allows for a reduction in investors' uncertainty. In this paper, a modified model initially offered by James Ohlson was used to assess the company value.

The purpose of this research was to identify key indicators of corporate governance which influence the market value of Russian companies by modifying the Ohlson model. The tasks which helped to achieve the purpose were solved during the research.

The Ohlson model assigns primary importance to corporate performance indicators described in financial statements, however, it provides an opportunity to modify that by approximating the "other information" parameter. The author studied the influence of a combination of complementary factors: forecast analytical data, and corporate governance indicators.

Empirical results show a co-direction of Russian companies' share prices with dynamics of the equity book value, abnormal profits, and percentage of board members holding professional certificates and licenses. At the same time, share prices show an inverse dependence on the difference between the forecast net profit indicator and the actual net profit of companies and on the level of gender diversification in the board of directors.

When stock prices' estimated values were compared according to the modified Ohlson model to their actual values in 2019, it was found that adding corporate governance factors allowed researchers to reduce underestimation from 12.1 to 9.3%.

The obtained results are comparable to those papers which study emerging European markets of Europe, Africa, and Latin America.

This research is the first one of this kind performed for the Russian equities market. As such, there is room for development of the methodology. For further research in this vein, we would like to recommend an analysis of alternative combinations for evaluation of the "other information" parameter, and increase of the number of studied companies and periods.

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Stock Price Reactions to Publications of Financial Statements: Evidence from the Moscow Stock Exchange

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Abstract

This paper analyses the effects of financial statements on the efficiency of the Russian stock market. Specifically, we analyse the impact of financial reporting on stock prices of the firms listed on the Moscow Stock Exchange. By means of the widely used event study method, which dates back to Ball and Brown [1], we analyse how corporate news publication affects stock prices.

Our research analyses 1000 samples, each consisting of 30 events, independent of the underlying stocks/firms and analyses the relation between the behaviour of the share prices and the release of the firms' annual, quarterly, and unscheduled financial statements. We use the daily stock price data of 56 components of the Russia Trading System Index from the years 2014 to 2020 in order to analyse the relation between the behaviour of the shares' prices and the releases of the firms' annual, quarterly, and unscheduled financial statements.

Using an ordinary least squares market model, we estimate the market parameters and especially the so-called normal returns, i.e. benchmark values. With this, we calculate the abnormal returns, i.e. the price changes caused by the events cf. [1; 2]. We perform several statistical tests for non-Gaussian distribution of these abnormal returns and find that there is a significantly non-Gaussian relationship between the publication of financial statements and the prices of the shares, which should not be the case in an efficient market [2].

Our results indicate that stock price volatility on the publication of financial statements may be caused by some information asymmetry, and demonstrate that the Russian stock market responds significantly to new information. Thus, we discuss recommendations to improve the information content of financial statements in Russia. This means analysts and fund managers can use new information to predict future stock returns and, thus, construct profitable portfolios.

Keywords: market efficiency, financial statements, Russian stock market, emerging markets, event study method, stock price reactions

Introduction

A vibrant capital market attracts foreign capital and provides access to capital for firms seeking to raise funds. The Russian capital market has experienced tremendous growth, signposted particularly by the mass privatisation of state enterprises in the 1990s, the merging of the two main Russian exchanges in 2011 to form the MOEX, and Russia's accession to the world trade organisation in 2012. Various reforms have been undertaken in the financial sector, including the partial adoption of international financial reporting standards (IFRS) in 2012 and a continuous review of the Russian Accounting Standards (RAS). These steps have been taken to increase market efficiency, attract investors, and steer growth in the Russian financial sector.

Information disclosure in Russia operates under unique circumstances, as will be discussed later in detail. Note that, firstly, the Russian stock market is relatively young compared to other major stock markets. Secondly, the government is a large shareholder in several major Russian firms. And thirdly, industrial firms make up a significant part of the Russian economy (cf. Figure 1). Thus, investigating the efficiency of the Russian stock market under these unique circumstances is a very relevant topic.

This study examines the behaviour of stock prices around the release of annual, quarterly, and unscheduled financial statements for companies listed in the Moscow Stock Exchange, and more precisely the ones in the Russian Trading System Index (RTS Index). By testing the efficiency of the Russian stock market, i.e., by testing whether publicly available information is included in the stock prices, we seek to understand whether traders can make abnormal profits on the publication of unscheduled, quarterly, and annual financial statements. In an inefficient market, new information is not reflected in stock prices immediately, making it possible that predictable price movements can occur in the market. Analysts try to use fundamental and technical analysis to predict which stocks are over- or undervalued, which may lead to excessive trading, high volatility, and overall unstable financial markets. However, this prediction is only possible in an inefficient market, cf. [2].

We will also seek to identify promising procedures, forms, and requirements for financial statements that ensure adequate information to financial market participants to decrease the difference between the fundamental value and the market value. This study can inform researchers, policymakers, and investors as to how the market responds to publication of annual, quarterly, or other financial statements.

The remainder of the work is organised as follows: we present the review of the literature on stock market reactions to the publication of financial statements. We discuss the Russian economic environment, provide information on the methodology applied in the study outlining data and study procedures, i.e. the event study method. We test the hypothesis that abnormal returns arise upon the publication of annual, quarterly, and unscheduled financial statements. We discusses the results, while concludes with a summary of our key findings as well as recommendations for further studies.

Literature Review

In this section, we provide an overview of market efficiency studies, i.e. on studies analysing stock market reactions to the publication of financial statements. Further, we will provide background information on Russia's economic environment.

An Overview on Stock Market Reactions to the Publication of Financial Statements

Fama [3] defined an effective market as one in which all new information is always fully reflected in stock prices. Fama [2] discusses the quick adjustment of prices to new information in efficient markets within one trading day. Any slower reaction would indicate some inefficiency. In efficient markets, all reactions should average out such that it is neither possible to predict future market movements, nor to construct profitable portfolios. We note that the level of efficiency of financial markets varies from country to country. For developed financial markets it is reported that they respond fast to new information. Numerous studies have been made testing market response to different announcements such as earnings announcements, dividends announcements, takeover announcements, and publications of financial statements. Fama, Fisher, Jensen, and Roll [4] investigated 940 stock splits in the New York stock exchange and concluded that a stock market adjusts itself to reflect new information. Other studies, which include Ball and Brown [1], Khanal and Mishra [5], as well as Kothari [6], confirmed that markets respond to earnings and dividends announcements. A suitable methodology to analyse market efficiency is utilised by Jones and Bacon [7], who use the event study method to study earnings announcements in 50 randomly selected firms.

Stock price reactions to the publication of financial statements have been investigated extensively, especially in developed markets. Opong [8] examined the effects of preliminary financial reports on stock prices in the UK. Even though the UK is a developed country, the study finds a significant response on the publication of annual financial statements. Other studies in developed markets include the works of Ball and Brown [1], Beaver [9], Foster [10], and May [11] in the United States and the works of Brookfield and Morris [12] as well as Firth [13] in the UK.

Researchers and analysts investigate whether annual, quarterly, and unscheduled financial statements contain any new information [1; 4; 14]. The publication of annual, quarterly or other financial statements might send signals to investors: positive signals cause a rise in stock prices, while negative signals have the opposite effect. In efficient

markets these responses happen quickly and average out, i.e., there is no trend in these stock price reactions. Note also that in general, steady or rising stock prices indicate good corporate governance whereas declining stock prices indicate poor governance.

Although various literature has documented, an abnormal change in stock prices on the publication of financial statements in developed and emerging markets [1; 3; 14], research pertaining the Russian financial market are presently few. Menike and Wang [14] investigated stock price reactions to publications of financial statements for companies listed on the Colombo Stock Exchange (Sri Lanka). The study notes that abnormal returns are positive upon the announcement of annual reports, but they are not significant. Rajakulanajagam [15] also investigated stock market reactions to annual financial statements of companies listed on the Colombo Stock Exchange. The study records abnormal returns of stock prices surrounding the publication of financial statements. Choi, Choi, Myers, and Ziebart [16] investigate financial statement compatibility and informativeness on stock prices and found that compatibility improves informativeness and helps investors predicting future prospects. Hayati [17] arrives at the same conclusion in Indonesia. The studies show a relationship between financial statements and stock prices. Berezinets, Bulatova, Ilina, and Smirnov [18] use the event study method to examine the reactions of exchange-listed Russian firms that regularly pay dividends to their dividend announcements in the post-financial crisis years from 2010 to 2014. They find that markets react negatively to dividends that are both too high and too low. In contrast, we are not interested in the consequences of the financial crisis and do not focus on dividend announcements, but study all announcements. Moreover, we use a more recent data set, which can make a big difference in the young Russian market. Volkov and Sevostyanov [19] also use data from the past-crisis period (from 2009 to 2012) and find no relation between the announcement of financial statements and stock price dynamics. Naidenova and Novikova [20] analyse the reactions of Russia's public companies' stock prices to sanctions against Russia. Garanina and Kormiltseva [21] investigate whether international accounting standards have an influence on the efficiency of the Russian market. However, we seek to understand whether the publication of all financial statements nowadays (from 2014 to 2020) affects the prices of shares listed on the Moscow Stock Exchange – and whether different types of events have a different influence on the stock price dynamics. Table 1 makes a summary of literature on stock prices' reactions to different kinds of news.

Table 1. An overview of selected literature on the effect of various events on stock markets with only a few publications concerning the Russian market

Event type	Author	Country	Conclusion
Stock splits	Fama, Fisher, Jensen, and Roll (1969) [4]	United States	Stock market adjusts to reflect new information
Earning announcements	Jones and Bacon (2007) [7]	United States	Significant abnormal returns emerge on the day of the announcement
	Kothari (2004) [6]	United States	Discount rate shocks explain a significant fraction of aggregate stock returns
	Beaver (1968) [9]	United States	The behaviour of the price changes supports the conjecture that earning reports possess information content
Dividends announcements	Khanal and Mishra (2017) [5]	United States	Significant abnormal returns emerge on the day of the announcement
	Berezinets, Bulatova, Ilina, and Smirnov (2015) [18]	Russia	Markets react negatively to both too-high and too-low dividends
Publication of financial statements	Dsouza and Mallikarjunappa (2016) [22]	India	There is strong evidence that the Indian stock market is inefficient
	Rajakulanajagam (2015) [15]	Sri Lanka	Abnormal returns of stock prices surround the publication of financial statements
	Menike and Wang (2013) [14]	Sri Lanka	Abnormal returns are positive upon announcement of annual reports but are not significant
	Hayati (2010) [17]	Indonesia	Compatibility improves the informativeness and helps investors predict future prospects

Event type	Author	Country	Conclusion
Publication of financial statements	Naser and Nuseibeh (2002) [23]	Saudi Arabia	Financial statements shape investors' decisions
	Opong (1996) [8]	United Kingdom	Stock prices adjust rapidly to the publicly available information
	Brookfield and Morris (1992) [12]	United Kingdom	Stock prices adjust rapidly to the publicly available information
	Firth (1981) [13]	United Kingdom	Stock prices adjust rapidly to the publicly available information
	Foster (1977) [10]	United States	Markets react to quarterly earnings announcements
	May (1971) [11]	United States	There is information in quarterly announcements
	Ball and Brown (1968) [1]	United States	The study finds a significant response on publication of annual financial statements
	Choi, Choi, Myers, and Ziebart (2018) [16]	United States	The compatibility of financial statements improves the informativeness
	Volkov and Sevostyanov (2014) [19]	Russia	There is no relation between financial statements and stock price dynamics for data of the past-crisis period
	Garanina and Kormiltseva (2013) [21]	Russia	There is no difference of the Russian market efficiency for different accounting standards
Sanctions	Naidenova and Novikova (2018) [20]	Russia	The imposition and prolongation of sanctions results in a significant fall in share prices

Background Information on the Russian Economic Environment

Russia's financial market is unique in several ways. Firstly, the Moscow Exchange is relatively young compared to other major stock markets such as the NYSE, which was established in 1792, the London Stock Exchange, which was established in 1773, or Tokyo Stock Exchange established in 1878. This is because Russia started the transition from a command economy to a market economy in the 1990s. Financial markets that have existed for decades have the advantage of well-established rules and regulations as well as investors' confidence which has been developed over many years. Thus, investigation instruments for information disclosure in Russia that lead to an efficient capital market that promotes sustainable growth is a very relevant topic.

Secondly, the government owns a significant amount of shares in several major Russian firms, such as 38.4% of Gazprom shares as of 31 December 2019 [24] and 61.7% of RusHydro shares as of 31 December 2020 [25]. Moreover, the capital structure of some Russian firms contains very few free-floating shares that can be traded in the market. For example, only 20.7% of NLMK shares are available for public trading as of 17 December 2020 [26] and 43% of Mechel Pao shares [27]. Government ownership of significant shares has both advantages and disadvantages. It can be argued that it guarantees government bailing in case the firm underperforms. Also, the government is unlikely to introduce unfavourable policies that disadvantage its own corporations. On the other hand, low free float leaves few shares in the hands of private investors. Hence, it is of interest to investigate the efficiency of the Russian financial market under these unique circumstances.

Thirdly, industrial firms make up a significant part of the Russian economy and are estimated to provide up to 31.1% of Russia's GDP, as of the first quarter of 2019[1]. The main Russian exports are oil and oil products, gas, coal, and wheat. Firms in the industrial sector create a higher risk of polluting the environment. These firms also require a huge initial investment that is long-term focused. In addition, these firms have foreign stakeholders, either as customers or investors. Reporting must pay special attention to the specifics of the industrial sector and the raw material markets.

[1] URL: https://ac.gov.ru/files/publication/a/23445.pdf, p.4 (Accessed 15 February 2021).

Table 2. Companies listed in the RTS index between 2014 and 2020 that are incorporated in our analysis

Code	Name (Eng)	Sector	Industry
AFKS	AFK SISTEMA, Ordinary shares	Communication services	Telecom services
AFLT	JSC AEROFLOT, Ordinary shares	Industrials	Airline
AGRO	ROS AGRO PLC, DR (Issuer The Bank of New York Mellon Corporation)	Consumer defensive	Farm products
AKRN	JSC Acron, Ordinary shares	Basic materials	Agricultural inputs
ALRS	AC ALROSA, Ordinary shares	Basic materials	Other precious metals and mining
CBOM	CREDIT BANK OF MOSCOW, Ordinary shares	Financial services	Banks, regional
CHMF	Severstal, Ordinary shares	Basic materials	Steel
DSKY	Public Joint Stock Company Detsky Mir	Consumer cyclical	Department stores
FEES	FGC UES, JSC, Ordinary shares	Utilities	Utilities, regulated electric
FIVE	X5 Retail Group N.V., DR (Issuer The Bank of New York Mellon Corporation)	Consumer defensive	Gorcery stores
GAZP	GAZPROM, Ordinary shares	Energy	Oil & gas integrated
GLTR	Globaltrans Investment PLC, DR (issuer - Citibank N.A. (NYC))	Industrials	Railroads
GMKN	OJSC MMC NORILSK NICKEL, Ordinary shares	Basic materials	Metals and mining
HHRU	HeadHunter Group PLC, DR (issuer JPMorgan Chase Bank, N.A.)	Industrials	Staffing and employee services
HYDR	JSC RusHydro, Ordinary shares	Utilities	Utilities, renewables
IRAO	JSC Inter RAO, Ordinary shares	Utilities	Utilities, regulated electric
LKOH	OAO LUKOIL, Ordinary shares	Energy	Oil & gas integrated
LNTA	Lenta Ltd., DR (Issuer Deutsche Bank Luxembourg S.A)	Consumer cyclical	Department stores
LSRG	OJSC LSR Group, Ordinary shares	Real estate	Real estate, development
MAGN	OJSC MMK, Ordinary shares	Basic materials	Steel
MAIL	Mail.ru Group Limited, depository receipts of foreign issuer	Technology	Software, infrastructure
MFON	Megafon, Ordinary shares	Communication services	Telecom services
MGNT	OJSC Magnit, Ordinary shares	Consumer defensive	Discount stores
MOEX	Moscow Exchange, Ordinary shares	Financial services	Financial data & stock exchanges
MSNG	MOSENERGO, Ordinary shares	Utilities	Utilities, independent power producers
MTLR	Mechel OAO, Ordinary shares	Basic materials	Steel
MTSS	MTS OJSC, Ordinary shares	Communication services	Telecom services
MVID	OJSC Company M.video, Ordinary shares	Consumer cyclical	Specialty retail

Code	Name (Eng)	Sector	Industry
NLMK	NLMK, Ordinary shares	Basic materials	Steel
NMTP	PJSC NCSP, Ordinary shares	Industrials	Marine shipping
NVTK	JSC NOVATEK, Ordinary shares	Energy	Oil & gas E&P
OZON	Ozon Holdings PLC, DR (issuer - The Bank of New York Mellon)	Consumer cyclical	Internet retail
PHOR	PhosAgro, Ordinary shares	Basic materials	Agricultural inputs
PIKK	PIK Group, Ordinary shares	Real estate	Real estate, diversified
PLZL	PJSC Polyus, Ordinary shares	Basic materials	Gold
POGR	Petropavlovsk PLC, shares of a foreign issuer	Basic materials	Gold
POLY	Polymetal International plc, Ordinary shares	Basic materials	Other precious metals & mining
QIWI	QIWI PLC, DR (Issuer The Bank of New York Mellon Corporation)	Financial services	Credit services
RNFT	PJSC RussNeft, Ordinary shares	Energy	Oil & gas E&P
ROSN	Rosneft, Ordinary shares	Energy	Oil & gas integrated
RSTI	JSC Russian Grids	Utilities	Utilities, regulated electric
RTKM	Rostelecom, Ordinary shares	Communication services	Telecom services
RUAL	United Company RUSAL Plc, Shares of a foreign issuer	Basic materials	Aluminum
SBER	Sberbank, Ordinary shares	Financial services	Banks, regional
SBERP	Sberbank, Preferred shares	Financial Services	Banks, regional
SFIN	PJSC SFI, Ordinary shares	Industrials	Rental & leasing services
SNGS	Surgutneftegas, Ordinary shares	Energy	Oil & gas integrated
SNGSP	Surgutneftegas, Preferred shares	Energy	Oil & gas integrated
TATN	TATNEFT, Ordinary shares	Energy	Oil & gas integrated
TATNP	TATNEFT, Preferred shares	Energy	Oil & gas integrated
TCGN	Technology General Corporation	Industrials	Specialty industrial machinery
TRMK	Trubnaya Metallurgicheskaya Kompaniya, Ordinary shares	Basic materials	Steel
TRNFP	Transneft, Preferred shares	Energy	Oil & gas midstream
UPRO	OAO E.ON Rossiya, Ordinary shares	Utilities	Utilities, independent power producers
VTBR	JSC VTB Bank, Ordinary shares	Financial services	Banks, regional
YNDX	Yandex N.V.	Communication services	Internet content & information

Finally, Russia partially adopted IFRS in 2012 and started the process of reconciling RAS to IFRS. Most firms prepare two different reports for the same reporting period. There exist significant differences between these two standards. The existence of two standards at the same time creates room for voluntary IFRS adoption. After starting the adoption of IFRS in 2012, IFRS became mandatory for banks, public listed companies, and firms preparing consolidated financial statements [28]. However, stand-alone statements should be prepared in accordance with RAS. These complexities in regulations allow the two standards to exist. Furthermore, some industrial firms publish integrated reports that are future-oriented. These reports contain, among others, financial information, a firm's growth strategy, and a policy towards the environment. However, there is no legal framework to guide the preparation of integrated reports, nor are they mandatory.

Statistical Analysis

The objective of this research is to examine the behaviour of stock prices around the release of annual, quarterly, and unscheduled financial statements for companies listed in the Moscow Stock Exchange. More specifically, we do not focus on the prices themselves (as the comparison of absolute values is not meaningful) but consider the returns of the stocks. To this end, we propose the following hypotheses, which will be tested with different kinds of statistical tests.

Hypothesis 1 (H1): There are no abnormal returns surrounding the release of financial statements (annual, quarterly, and unscheduled).

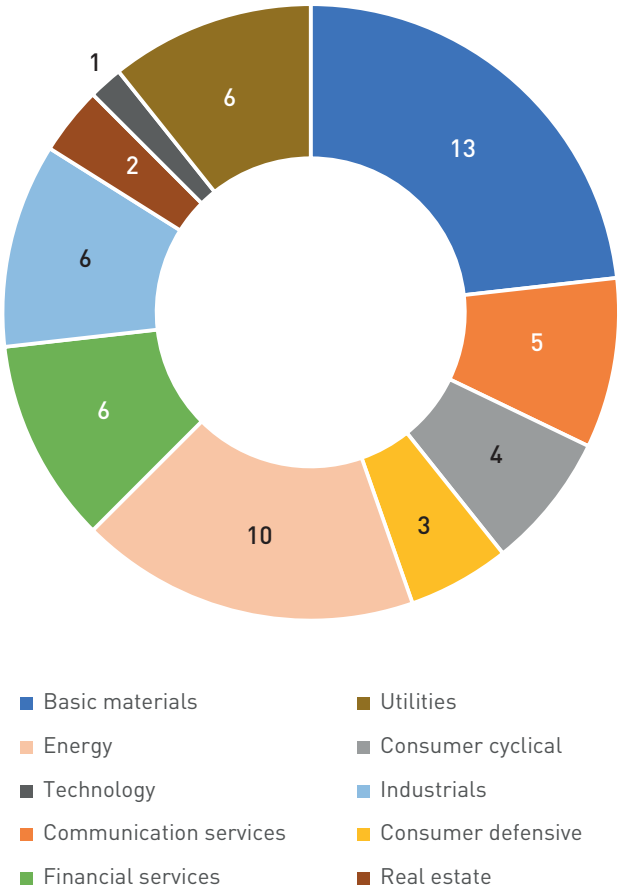
Hypothesis 2 (H2): There are no abnormal returns surrounding the release of scheduled financial statements (annual and quarterly).

Hypothesis 3 (H3): There are no abnormal returns surrounding the release of quarterly financial statements.

Sample Selection

For our analysis, we obtain the daily stock prices of 56 companies that were present somewhen in the RTS index between 2014 and 2020 from Yahoo finance. Within this time frame, there have been changes to the composition of the index, which consists of at most 50 companies at a time. Note that we did not use all firms that were listed in the RTS index in this time frame because of the availability of the data or the duration of the firms' listing in the index. Hence, we analysed the firms given in Table 2. Note that we consider only those stock prices being within the time frames that the firms were listed in the index. In addition to the stock prices, the respective annual, quarterly, and unscheduled statements are obtained from the companies' own websites. We use the data from seven years (2014 to 2020) to analyse the relation between the behaviour of the share prices and the releases of the firms' annual, quarterly, and unscheduled financial statements with help of an event study method. This kind of method is used in related work as well, e.g., [1; 4; 5]. The respective industry sectors the companies belong to are given in Table 2 and the distribution of the companies among the industry sectors is depicted in Figure 1[2]. Concerning the events, we have a total of 1401. Among the events, there are 315 annual statements and 918 quarterly statements, which we both denote as scheduled events. The remaining ones are unscheduled events and integrated reports.

Figure 1. Industry sectors of the firms included in the analysis



Event Study Methodology

In our analysis, we distinguish between the different types of statements published by the firms we study. That is, we consider all available events for our event study, we consider scheduled events only (i.e. all quarterly and annual events), and finally, we further reduce our event set to only quarterly events. We then compare the results of these three analyses. There are clearly few annual, independent events in the data, since the annual announcements of the firms often happen around the same point of time. Therefore, we could only use a very small sample size, which possibly leads to unreliable results in the case of annual events. Independent of the event sets

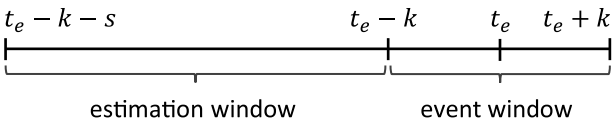
[2] Information from Yahoo Finance as of December 2020.

mentioned above, for each event we then define an event window where the point in time of the event is t_e. In our analysis, we set $t_e = 0$. The event is surrounded by a pre- and post- phase of length k that consist of points in time $t_{pre} \in \{t_e - k, \ldots, t_e - 1\}$ and $t_{post} \in \{t_e + 1, \ldots, t_e + k\}$, respectively, so that the period surrounding each event can be examined [29]. The event window therefore is $T_e = (t_e - k, \ldots, t_e - 1, t_e, t_e + 1, \ldots, t_e + k)$. In our analysis, we set $k \in \{3, 7, 10, 12\}$ and therefore get an event window size of 7, 15, 21, or 25. Note that $k = 10$ is the standard window size used in the literature, cf. [29]. Thus, we consider the k days immediately preceding the event day, the event itself, and k days immediately following it. When 'days' are mentioned, we always mean trading days. In Section 3.3, we use $k = 10$, i.e. the standard event window size. Analyses for other event window sizes and the corresponding discussions can be found in Section 3.4.

Note that we do not distinguish between different kinds of news (good news, bad news). When we would come to the conclusion that the Russian market is efficient, we would have to analyse the different event types as inefficient artifacts could have averaged out. When we conclude that the market is not efficient (and this is indeed the case), a distinction of different types of news is not necessary. However, also in this second scenario, a distinction would be interesting in order to see how good or bad news affects the efficiency in both absolute and relative terms concerning market expectations. However, this is beyond the scope of this work.

In addition to the event window, we also define an estimation window of length $s > 20$ directly preceding the event window. The estimation window is intended to show the normal performance of an asset, whereas the event window shows the presumably abnormal behaviour around the event. According to MacKinlay [29], we set the estimation window to $s = 120$ which is approximately the time between two half-yearly announcements. However, we do not discount that there are other events in the estimation window as we also have, among others, quarterly announcements. Of course, in this way the estimation window does not fully reflect only normal behaviour, but as the length of the estimation window is distinctly larger than that of the event window, such effects average out fairly. Figure 2 schematically shows the timeline for our event study.

Figure 2. Timeline for the event study



For our analysis, we assume an approximately affine linear dependency between the returns of the RTS index, i.e. the market portfolio, and any stock that is part of the index, as suggested by MacKinlay [29]. For this, we set up the following linear regression model:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}, \quad (1)$$

where $R_{i,t}$ is the return of the i th asset at time t, $R_{m,t}$ is the return of the market index at time t, and $\varepsilon_{i,t}$ is an error term with $\mathrm{E}\left[\varepsilon_{i,t}\right] = 0$ and $\mathrm{Var}\left[\varepsilon_{i,t}\right] = \sigma_i^2$. When p_t is the value of an asset at time t, then the return at t is $R_t = \frac{p_t - p_{t-1}}{p_{t-1}}$.

The parameters α_i and β_i are to be estimated through the regression using ordinary least squares (OLS) [30].

Note that we use this model, which is also known as the 'Market Model' (MM), because it is standard in the literature, see [1; 29]. As an alternative, one could use the Capital Asset Pricing Model (CAPM), however, the CAPM is very similar to the MM despite the MM having more degrees of freedom, namely in the CAPM the intercept is set to the risk free interest rate. Consequently, it is unlikely that the CAPM reduces the modelling errors, cf. [31–33]. Another alternative were multi factor models, e.g., the three factor model of Fama and French [34]. However, the risk factors for the Russian market are not readily available (see [35]). Thus, we rely on the most common choice in event studies: the Market Model – as outlined below. However, we mention that for future research both a detailed theoretical analysis of the difference between the MM and the CAPM, as well as the calculation of the Russian risk factors for multi factor models seem to be fruitful projects, but a study of both are beyond the scope of this work.

The estimation of the parameters α_i and β_i is done with the data of the estimation window. The normal returns are then defined as the values predicted by the model with the respective index values as input. The awaited difference between the predicted and the actual stock returns are attributed to the events, at least to a certain part. Of course, it is likely that there are discrepancies between predicted and actual values when dealing with statistical models, but these discrepancies should be Gaussian distributed. A non-Gaussian distribution of the discrepancies indicates a perceptible influence of the events. The estimations of the parameters α_i and β_i are as follows:

$$\hat{\beta}_i = \frac{\sum_{\tau=t_e-k-s}^{t_e-k-1} \left(R_{i,\tau} - \hat{\mu}_i\right)\left(R_{m,\tau} - \hat{\mu}_m\right)}{\sum_{t_e-k-s}^{t_e-k-1} \left(R_{m,\tau} - \hat{\mu}_m\right)^2} \quad (2)$$

and $\hat{\alpha}_i = \hat{\mu}_i - \hat{\beta}_i \hat{\mu}_m, \quad (3)$

where $\hat{\mu}_i = \frac{1}{s} \sum_{\tau=t_e-k-s}^{t_e-k-1} R_{i,\tau}$

is the average return of asset i in the estimation window and

$$\hat{\mu}_m = \frac{1}{s} \sum_{\tau=t_e-k-s}^{t_e-k-1} R_{m,\tau}$$

is the average return of the index in the estimation window. The estimated variance of the model's error term is

$$\hat{\sigma}_i^2 = \frac{1}{s-2} \sum_{\tau=t_e-k-s}^{t_e-k-1} \left(R_{i,\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m,\tau}\right)^2. \quad (4)$$

With the estimated returns $\hat{R}_{i,\tau} = \hat{\alpha}_i + \hat{\beta}_i R_{m,t}$, the (estimated[3]) abnormal returns for stock i in the event window are

$$AR_{i,\tau} = R_{i,\tau} - \hat{R}_{i,\tau} = R_{i,\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m,\tau} \quad (5)$$

for $\tau = t_e - k, \ldots, t_e + k$. Under the respective hypothesis, these are Gaussian distributed:

$$AR_{i,\tau} \sim N\left(0, \sigma^2\left(AR_{i,\tau}\right)\right).$$

When performing the regression and estimating the model parameters, we draw events from all relevant events in our dataset, where the estimation windows of these N events may not overlap. This is important to ensure that the abnormal returns are in fact Gaussian distributed under the respective hypothesis.

For the N sampled events, we can calculate the average abnormal return (also: mean abnormal return; AAR) for every period $\tau \in \{t_e - k, \ldots, t_e + k\}$ [4]:

$$\overline{AR}_\tau = \frac{1}{N}\sum_{i=1}^{N} AR_{i,\tau}. \quad (6)$$

These, again, can be aggregated over arbitrary time intervals $[\tau_1, \tau_2]$ within the event window to cumulative average abnormal returns (CAARs) through

$$\overline{CAR}(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} \overline{AR}_\tau, \quad (7)$$

where $t_e - k \le \tau_1 \le \tau_2 \le t_e + k$. With this notation, it is $\overline{AR}_\tau = \overline{CAR}(\tau, \tau)$. For these two average values, AARs and CAARs, their variances are

$$\mathrm{Var}\left(\overline{AR}_\tau\right) = \frac{1}{N^2}\sum_{i=1}^{N} \sigma_i^2 \quad (8)$$

or, respectively,

$$Var\left(\overline{CAR}(\tau_1, \tau_2)\right) = \sum_{\tau=\tau_1}^{\tau_2} Var\left(\overline{AR}_\tau\right). \quad (9)$$

For a second, alternative way of calculating Equations (7) and (9) see [29]. Because the event windows of the sampled events do not overlap, the CAARs fulfill

$$\overline{CAR}(\tau_1, \tau_2) \sim N\left(0, Var\left(\overline{CAR}(\tau_1, \tau_2)\right)\right)$$

under the respective hypothesis (in case of all events, under **H1**). When calculating the variance in Equation (8), σ_i^2 is substituted by its sample counterpart given in Equation (4). The test statistics for checking the hypotheses stated at the beginning of Section 3 are:

$$\theta(\tau_1, \tau_2) = \frac{\overline{\mathrm{CAR}}(\tau_1, \tau_2)}{\left(Var\left(\overline{CAR}(\tau_1, \tau_2)\right)\right)^{1/2}}. \quad (10)$$

Using θ, the hypotheses can be rewritten:

Hypothesis: $\theta \sim N(0,1)$.

Alternative: $\theta \nsim N(0,1)$.

We perform several statistical tests that check these hypotheses. The results, as well as preliminary insights into the data that support the approach described above, are given in the next subsection.

3.3. Data Analysis and Results

Before we draw samples for our analysis, we perform data cleansing procedures in a preparatory step, i.e., we skip all events with not enough history (no full estimation window), and with missing prices in the estimation and event window. After this, for 56 stocks and an event window size of 21 ($k = 10$)k there remain 1,359 events in total which we call effective events, and of them 1,193 scheduled events, 889 quarterly announcements and, accordingly, 304 annual announcements. A summary of the number of events is depicted in Table 3. In our program, we set $N = 30$.

Table 3. Summary of the events (for event window size of 21)

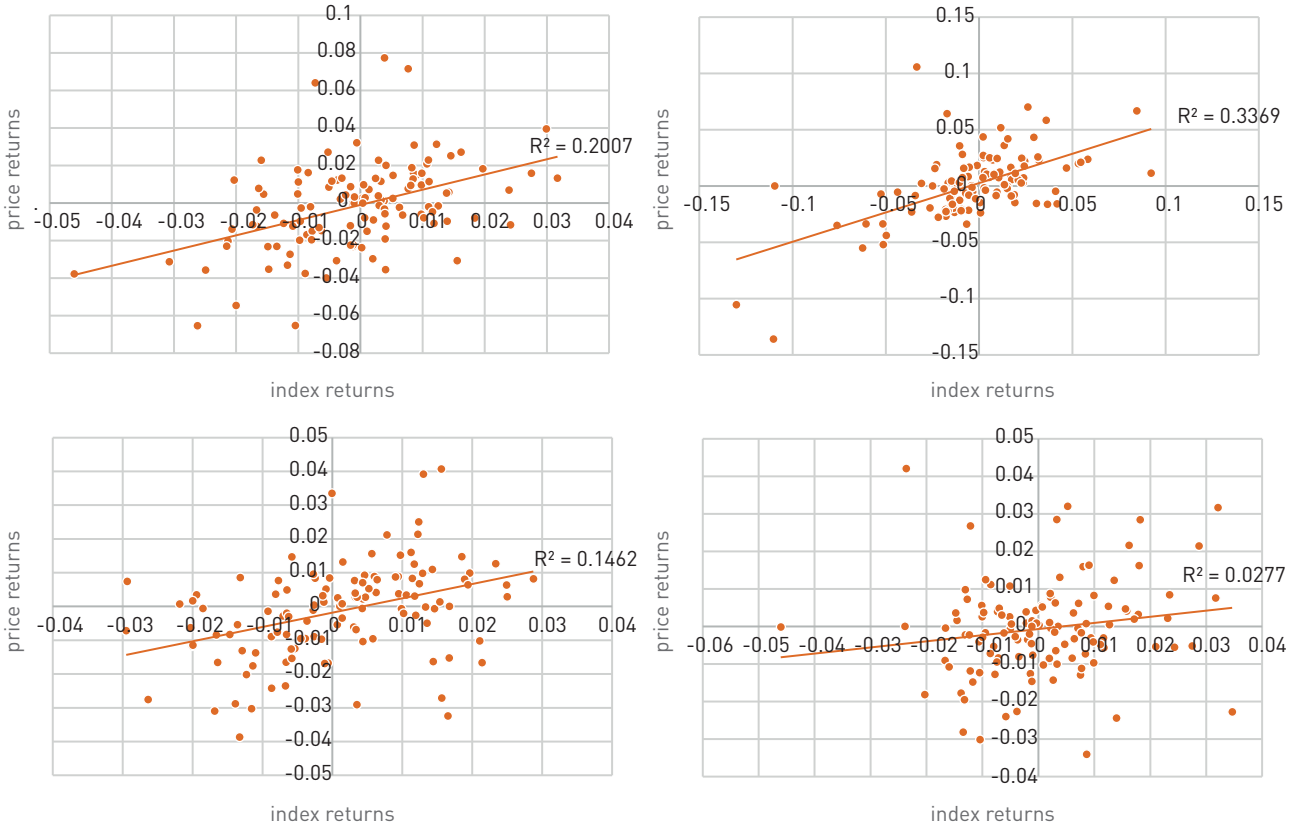
	All	Annual	Quarterly	Scheduled
Events	1401	315	918	1233
Effective events	1359	304	889	1193

To back the assumption of an affine linear dependency between the stock returns and the index returns as stated in Equation (1), we provide four examples in Figure 3 showing the index returns plotted against the price returns in the estimation window of four events, i.e., there are 120 data points per graph. We see that the data is more or less scattered along a linear pattern. Of course, especially for the last scatterplot (bottom right), a linear dependency is debatable (in particular when taking into account its R-squared of 0.0277), but for the majority it may be accepted since the scatterplots are football-shaped. An outlier treatment is not performed here.

[3] In fact, a more appropriate notation would be $\widehat{AR}_{i,\tau}$, but since these values are averaged in the next step, which is marked with a bar sign, the hat sign is omitted to keep the notation simple.

[4] Recall that these points in time (for different events) are not the same from an absolute point of view but are shifted so that they match relatively.

Figure 3. Scatterplots showing sample index returns mapped against stock returns of the estimation window of four events with R-squared given in the top right corner of each plot



To see that the events indeed have a certain influence on the returns, we present six graphs in Figure 4 showing the AARs (Equation (6)) of six exemplary events and the corresponding CAARs (Equation (7)) where $\tau_1 = t_e - k = -10$. Looking at the samples in the first row, the announcements seem to cause peaks in the AARs at the event period that also cause peaks in the CAARs. However, the drops of the AARs after the event eventually lead to a drop of the CAARs as well so that the CAARs are 0 after about 5 trading days after the event. Perhaps the news turned out not to be as good as assumed before the announcement.

The samples in the second row show serious drops of the AARs at the event period that lead to drops of the CAARs. The news announced at time $\tau = 0$ seem to be bad news as after the announcement the CAARs remain more or less at the lower level (left-hand side) or even drop further (right-hand side), caused by negative AARs. In both cases, it may be that the published results did not meet the market expectations where, especially in the right case, a gap in information before the event may cause the drop of the CAARs after the event.

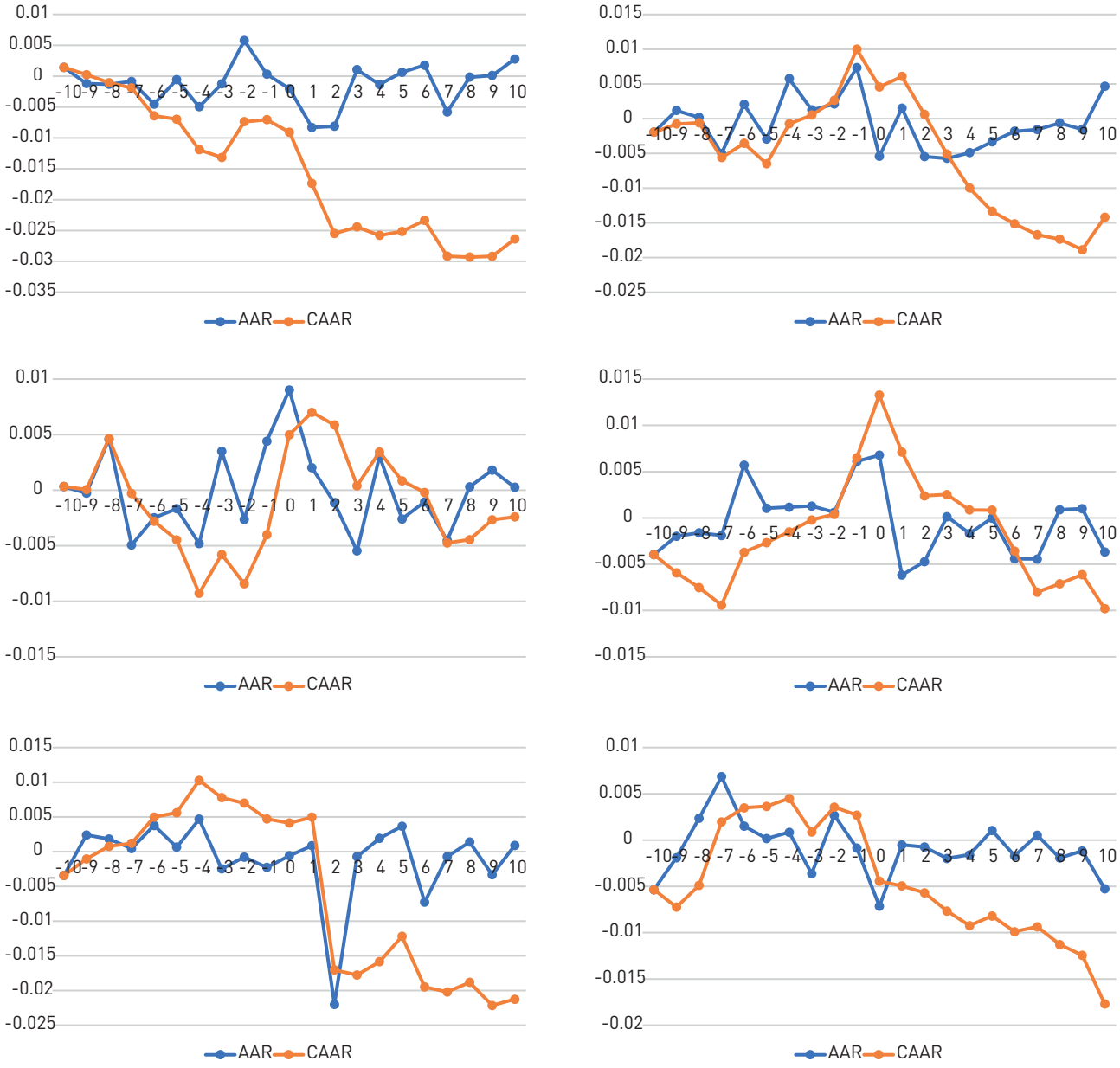
The graphs in the third row do not show exceptional peaks or drops of the AARs directly at the event period. Instead, the graph on the left-hand side shows a drop of the AAR already starting a few days before the announcement perhaps because the market expects the news to be bad. This drop again causes a drop of the CAAR that does not recover from the AAR's steady decrease around the event period. For the graph on the right-hand side it seems to be the case that the AAR is quite unsteady before the announcements and gets quite stable two days after the event. However, as it is constantly negative, it causes a steady drop of the CAAR. Perhaps the market was not sure about the quality of the information before it was announced and then it took two days for the price to fully reflect the market's reaction.

The impression that the events have a certain influence on the returns of stocks as seen in the graphs in Figure 4 is now backed by the results of several statistical tests that check the test statistic θ for (non-)Gaussian distribution. In fact, we conduct all tests for 1000 samples, each consisting of 30 events, in order to get more robust results. The figures are shown for only one sample. Note that in our case, for an event window length of 21 each sample consists of 231 values since $(\tau_1, \tau_2) \sim N(0,1)$ is tested for all $\tau_1 \le \tau_2 T_e$ and $\sum_{i=1}^{21} = 231$.

At first, we draw a normal Q-Q plot for one exemplary case shown in Figure 5, and notice that towards the edges, the values deviate clearly from the theoretical line. This could, in the exemplary case, indicate a right-skewed distribution (fat tails at the right, thin tails at the left). Second, we draw a kernel density plot for the same exemplary case, i.e., we construct a density out of the discrete values of the example using the Gaussian kernel shown as the red line in Figure 6 and compare the resulting density with the density of the standard Gaussian distribution (blue line).

For the kernel density, we set the bandwidth to 0.60[5]. We see that the two densities differ clearly. In particular, the assumption of being right-skewed drawn from the Q-Q plot (for this data sample) is backed by the kernel density plot.

Figure 4. Graphs showing six examples, i.e. six events, of mean abnormal returns (red lines) and associated cumulative abnormal returns (blue lines)



[5] A bandwidth of 0.60 results in the heights of the two curves being approximately the same.

Figure 5. Q-Q plot of the test statistic for one example indicating a right-skewed distribution

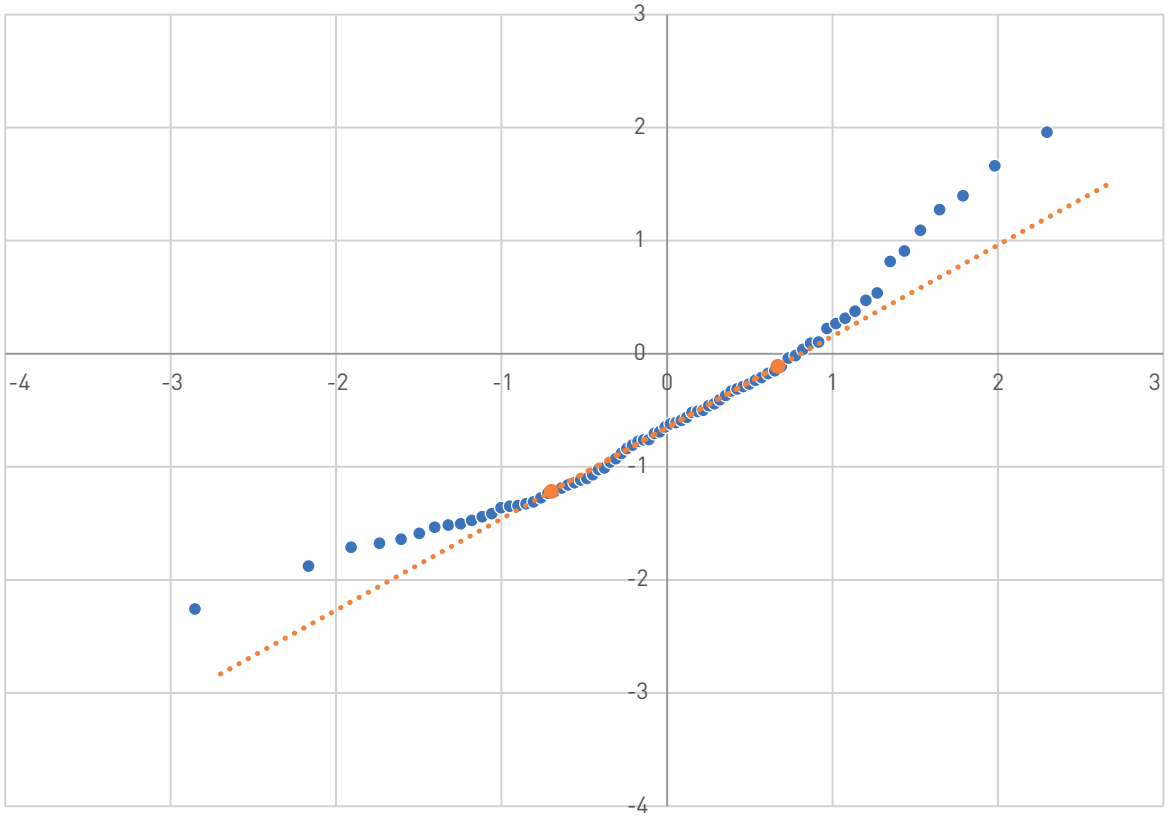
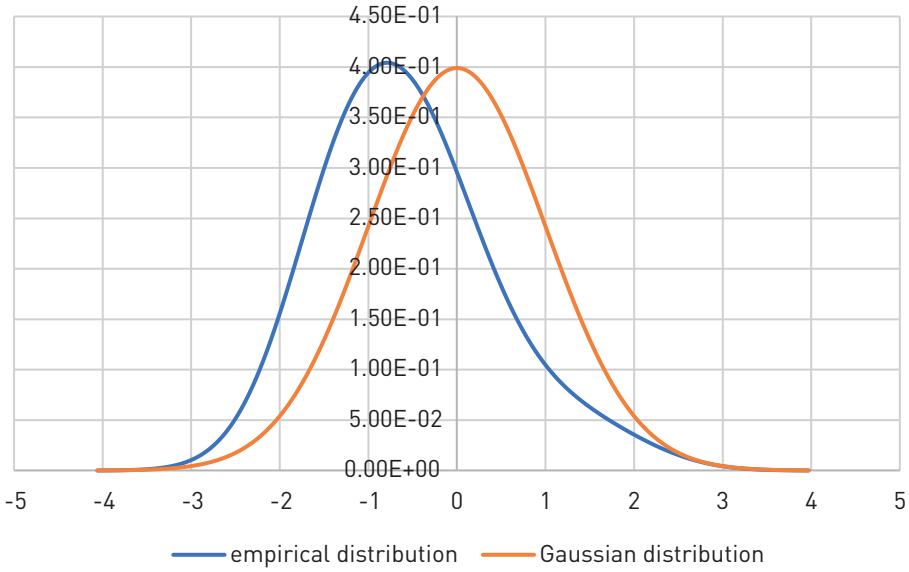


Figure 6. Kernel density plot (red) and Gaussian curve (blue) for one example that clearly differ indicating a non Gaussian distribution of the example



For the next step, we perform seven statistical tests for checking whether the test statistic θ is Gaussian distributed (standard normally distributed). We conduct the Kolmogorov-Smirnov test, the Lilliefors test, the Anderson-Darling test, the Jarque-Bera test, the Cramér-von Mises test, the D'Agostino-Pearson test, and the Shapiro-Wilk test. We perform all seven tests in R using the packages 'nortest' (Lilliefors, Anderson-Darling), 'tseries' (Jarque-Bera), 'goftest' (Cramér-von Mises), and 'PoweR' (D'Agostino-Pearson). The Kolmogorov-Smirnov test and the Shapiro-Wilk test are basic functions of R (in its stat-package).

For our 1000 samples (each consisting of 231 values and 30 events) we check whether the p-values of the tests are greater than or equal to a significance level of $\alpha = 5\%$ (which would mean that **H1** may not be rejected) and count these cases. In turn, in all other cases when the p-value is below 5%, **H1**, i.e. a standard normal distribution of the abnormal returns, may be neglected. The results are shown in Table 5.

Table 4. Number of cases supporting **H1** resp. the Alternative with a significance level of 5%

	H1	Alternative
Kolmogorov-Smirnov	30	970
Lilliefors	0	1000
Anderson-Darling	224	776
Jarque-Bera	298	702
Cramér-von Mises	27	973
D'Agostino-Pearson	261	739
Shapiro-Wilk	191	809

The differences in the results probably stem from the different statistical powers of the tests. For example, the Anderson-Darling test is known to be more sensitive than the Kolmogorov-Smirnov test. However, in our tests at most about a quarter of the samples are rated to be standard normally distributed (more specifically, it cannot be disputed that the data is standard normally distributed) which means in turn that in about at least three quarters of all samples, the cumulative abnormal returns are not Gaussian distributed with a mean of zero. This indicates some abnormal effect in the returns.

For all 1,000 Monte Carlo runs, each consisting of 30 events we additionally check for the significance of the linear regression models, more specifically we test the hypothesis as to whether the slope component $\hat{\beta}$ (see Equation (2)) of each model is 0 or whether it is not 0. In summary, we get the results presented in Table 4. For our 30,000 linear regression models, in 17,884 cases the hypothesis that $\hat{\beta}$ is 0 can be discarded with a significance level of 0.1%, in additional 2,682 cases it can be discarded with a significance level of 1% and in additional 2,728 cases with a significance level of 5%. This means that for about four fifths of all events, the market model seems to be adequate. Note that within the 30,000 linear regression models, some of them may appear more than once since in every Monte Carlo run, we randomly select 30 events independently of the previous runs.

Table 5. Significance of the linear regression market models

Significance level	$\alpha \leq 0.1\%$	$0.1\% < \alpha \leq 1\%$	$1\% < \alpha \leq 5\%$	rest ($\alpha > 5\%$)
# of cases	17884	2682	2728	6706

Before we conduct a more thorough discussion of the results in Section 4, we will provide a few remarks concerning the experiment and the data. As Figure 4 suggests, there are different effects of the events on the returns. But since we aggregate the returns over 30 arbitrary events, it may be the case that the effects average out leading to the result that **H1** is not neglected (that the events do not seem to have any influence) for such a sample. Put differently, our study may underestimate the non-Gaussian distributions, i.e. the inefficiencies. This could be prevented when classifying the events into different categories (like "good news" and "bad news") as, for example, done by MacKinlay [29] and aggregating within the classes. Such an approach is intended for future work and needs a thorough investigation of each event and the market's expectations before that event. Furthermore, instead of the linear regression model used to assess the normal returns (taking the not so good R-squared values into consideration), there are other possibilities for doing this; some (e.g., constant mean return model, factor model) are mentioned by MacKinlay [29]. The assessment of the normal returns is crucial for the whole event study approach. But also here, the method partly depends on the quality and the availability of the input data.

To analyse whether the results are driven by certain event types, we limit the set of all events to sets of events of certain types, namely to scheduled events (quarterly and annual events, hypothesis **H2**) and to quarterly events (hypothesis **H3**). Considering solely annual events or unscheduled events is not possible, as there are too few events of those types in the event set. Regarding the hypotheses **H2** and **H3,** we get the results shown in Table 6. For the scheduled events and the quarterly ones, we use the same input parameters (like estimation and event window size) as for the event study with events of all types. For a better comparability, we additionally show the results for **H1**.

Table 6. Number of cases supporting **H1, H2** or **H3** with a significance level of 5%

	H1	H2	H3
Kolmogorov-Smirnov	30	33	37
Lilliefors	0	0	0
Anderson-Darling	224	224	188
Jarque-Bera	298	306	273
Cramér-von Mises	27	30	39
D'Agostino-Pearson	261	285	253
Shapiro-Wilk	191	218	178

We observe that the scheduled events support the hypothesis that the returns are normally distributed than it is the case for all events slightly more often. The values are

not much higher than when regarding all events. Also, for the scheduled events, the market is still not efficient. When only regarding quarterly events, the results are mixed. Two tests indicate that the quarterly announcements make the market even more efficient, whereas four tests indicate that the quarterly announcements lead to an even more inefficient market. The interpretation of the quarterly announcements' results is difficult, especially when considering the different statistical powers of the tests. Following the statistical properties of the different tests that state that the Anderson-Darling test is one of the most selective tests when testing for a Gaussian distribution (where the Jarque-Bera and Shapiro-Wilk tests are of a similar power), we might come to the conclusion that the quarterly announcements lead to a less efficient market than all scheduled events. Conversely, this means that the annual announcements are those events that mainly contribute to the efficiency of the Russian market.

Results for Varying Window Sizes

To analyse the influence of the window size on the results, we additionally conduct the analyses for other window sizes, namely 7 ($k = 3$), 15 ($k = 7$) and 25 ($k = 12$). The results of these analyses together with the results of window size $k = 10$ are summarised in Table 7.

Table 7. Number of cases supporting **H1** with a significance level of 5% with an event window of size 7, 15, 21, and 25

	H1, 7	H1, 15	H1, 21	H1, 25
Kolmogorov-Smirnov	278	79	30	21
Lilliefors	0	0	0	0
Anderson-Darling	885	403	224	127
Jarque-Bera	936	525	298	209
Cramér-von Mises	255	75	27	23
D'Agostino-Pearson	880	458	261	201
Shapiro-Wilk	855	374	191	130

According to Fama [2], stock price adjustments at the time of an announcement are expected in an efficient market. Thus, a reduced estimation window size should lead to a lower support of the hypothesis **H1** as the relative weight of the abnormal behaviour at the time of an event increases. However, our analysis finds that the smaller the event window gets, the more often **H1** cannot be rejected. This is one indication that the Russian market is inefficient because the abnormal behaviour is not observable at the event date but either too early or too late. Further, there is a technical issue why **H1** is less rejected in an inefficient market when the event window gets smaller. The smaller the event window gets, the more likely it is that an abnormal behaviour preceding the event is part of the estimation window. Then this abnormal behaviour is part of the learned market model and the behaviour within the event window is not recognised as abnormal.

Discussion of the Results

Our results indicate that it is possible for a trader to buy/sell securities before the event and make a profit out of accumulated abnormal returns. We observe three different reactions to events. Firstly, a drop in the AARs indicating that the market was expecting better news than they received. Secondly, a rise in the AARs indicating that the information was received well in the market, and thirdly a case where the publication does not seem to have any effect on stock prices. Statistical tests confirmed that stock prices respond to the publication of annual, quarterly, and other financial statements. In particular, scheduled publications seem to lead to a slightly more efficient market than all publications (scheduled and unscheduled ones). Regarding annual and quarterly announcements, we cannot point to a clear difference as the statistical tests give ambiguous results. Future research may also take the work of Alderson and Betker [36], Marks and Musumeci [37] as well as Aktas, de Bodt, and Cousin [38] into account.

These results are consistent with those of Dsouza and Mallikarjunappa [22], Rajakulanajagam [15], and Ball and Brown [1]. However, Dsouza and Mallikarjunappa [22] use a mean-adjusted model, a market-adjusted model, and an OLS market model. They observe three different types of news, namely: good news, bad news, and neutral news. They use a 'Run' test, a 'Sign' test, and a 't-test' for statistical significance and find AARs to be insignificant under the mean adjusted model, while CAARs are significant. This means that the market does not absorb new information quickly. Rajakulanajagam [15] argues that the reaction on day zero showing the response of stock prices on publication of financial statements is an indication of market efficiency, because the market reacts quickly to this new information, cf. [2]. However, our results indicate CAARs that extend beyond the event day in the case of good news or bad news which is inconsistent with the efficient market hypothesis (EMH) [3; 4]. Hence, our results are in line with Ball and Brown [1], who find that earning figures contain very useful information that is not reflected in stock prices immediately.

These results contradict those of Brookfield and Morris [12], Firth [13], Foster [10], May [11], and Opong [8] who conclude that stock prices adjust rapidly to the publicly available information, consistent with the EMH. Firth [13] investigates the information content of financial statements and concludes that both annual and interim financial reports contain substantial information, which is quickly absorbed in the market. Foster [10] observes that a market's reaction to earning announcements appears

to be concentrated on a two days trading period. These results seem to suggest that developed capital markets absorb new information quickly, whereas emerging markets do not.

For an efficient allocation of resources in the capital market, it is necessary to reduce the information asymmetry and improve procedures, forms, and requirements for financial statements that ensure an adequate information flow to financial market participants in order to decrease the difference between the fundamental and the market value. A possible area of improvement would be the refinement of reporting standards. While it is clear that IFRS and RAS are significantly different, further research is needed to assess whether reporting standards (or at least different reporting schemes) have a significant impact on market efficiency. Besides this, the enforcement of the standards by authorities and a mandatory versus a voluntary adoption are other areas that need investigation.

Reporting must respond to the needs of Russian industrial firms. These firms have to invest in long-term projects that reap benefits in the long run (see Section 2.2). Short-term periodical reporting may not be appropriate for long-term plans, which is why future-oriented integrated reports may be more suited to address the needs of Russian industrial firms. However, further research on this is necessary, too.

Conclusion

This study investigates the effects of financial reporting on stock prices of the firms listed on the Moscow Stock Exchange. Our research analyses 1000 samples, each consisting of 30 events, independent of the underlying stocks/firms and analyses the relation between the behaviour of the share prices and the release of the firms' annual, quarterly, and unscheduled financial statements. We use an ordinary least squares market model to estimate market parameters and calculate abnormal returns. These abnormal returns and cumulative abnormal returns are then aggregated across firms for each date in the event window. For all time intervals, the aggregation over time should be Gaussian distributed when assuming no abnormal effect of the events on the prices. This is analysed graphically with Q-Q plots and kernel density estimators, as well as with statistical hypotheses tests. To get more robust results, we analyse 1000 samples and count the cases supporting a (non-) Gaussian distribution. Additionally, we perform comparability tests for the type of events (scheduled, quarterly) and robustness tests for the length of the event window.

We find that in the majority of cases there is a significantly abnormal relationship between the publication of financial statements and the price of the shares. The results show that the Russian stock market responds significantly to new information. This means analysts and fund managers can use new information to predict future stock returns and, thus, construct profitable portfolios. There is a possibility of generating abnormal returns using publicly available information, which indicates that the Russian financial market is to some degree inefficient, which might lead to instabilities. Steps have to be taken to reduce information asymmetry, thereby reducing the difference between the fundamental and the market value of securities. We argue that the inefficiency in the market is a result of an information asymmetry. This asymmetry can be reduced by improving the information content of financial statements in Russia.

Following Choi, Choi, Myers, and Ziebart [16] and Hayati [17] the compatibility and informativeness of financial statements must be increased. It might be useful to investigate the differences concerning the information content and the compatibility between financial statements in Russia and in some developed markets that are assumed to be efficient.

This study raises several questions for further investigation. Firstly, Russia adopted IFRS in 2012 and started the process of reconciling RAS to IFRS. The majority of Russian firms have to prepare RAS statements parallel to IFRS statements. Thus, a future research could investigate whether there is a difference between the two standards' influences on the efficiency of the Russian stock market. Secondly, financial reporting must pay special attention to the specifics of the industrial sector and the raw material markets. Future research may investigate the adequacy of future-oriented integrated reports in meeting the needs of Russian industrial firms. Thirdly, Fama and French [39] investigate effects of several parameters such as the size of the firm, book to market equity, and the earning to price ratio on average stock returns. We recommend analysing the effect of these or similar variables on the Russian market.

Disclaimer

The opinions in this report expressed by Michaela Baumann are her own and not necessarily those of her employer. Michaela Baumann's employer does not guarantee the accuracy or reliability of the information provided herein.

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Conceptual Framework for Financial Reporting: Problems and Prospects

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Abstract

The objective of this paper is to define the theoretical basis and clarify the fundamental concept of the Conceptual Framework for Financial Reporting (CFFR). This is because the theoretical basis for CFFR has not been properly defined, and the articulation of the fundamental concept in the document does not correspond to its actual meaning. In clarifying, we will analyse these attributes from a critical perspective and propose an alternative articulation.

We apply a research method widely used in the USA based on semiotics, which construes accounting as a business language and requires analysis of the key accounting concepts from three viewpoints: syntactic, semantic and pragmatic. Two different theories form the theoretical basis for CFFR: the organisation theory and the residual equity theory. We further propose that the articulation of the fundamental concept of "objective of financial reporting" is self-contradictory, which is aggravated by the fact that the document deals with users of financial reporting and their objectives.

We identify major drawbacks in both theories. The organisation theory requires specific financial reporting which is incompatible with standardisation, and the residual equity theory is extremely difficult to understand and is not completely satisfactory for any of its user groups. These drawbacks and inaccuracies occlude understanding of CFFR and financial reporting.

As a result, we propose that it is advisable to do the following when developing the next version of CFFR:

- define the uniform theoretical basis in CFFR clearly;
- use the proprietary theory as the uniform theoretical basis;
- the definition of financial reporting oriented to informational needs of company owners should be the fundamental concept of CFFR.

This will enable CFFR and financial reporting to be simpler understand and the primary needs of all user groups will be satisfied.

Keywords: Conceptual Framework for Financial Reporting, objective of financial reporting, understandability of financial reporting, financial reporting users, proprietary theory, organisation theory, residual equity theory

Introduction

Conceptual Framework for Financial Reporting: History and Purpose

In March 2018 the London International Accounting Standards Board (IASB) published the document 'Conceptual Framework for Financial Reporting' (translated into Russian as «Концептуальные основы представления финансовых отчетов»[1])[1] (hereinafter "CFFR-2018"). It is the fourth edition of this document. The first edition was developed in the USA by the Financial Accounting Standards Board (FASB). It was developed in stages, and published in six consecutive chapters (SFAC1–SFAC6)[2] between 1978–1985. In 1989 the London Board published the second edition of this document (with minor modifications) titled the 'Framework for the Preparation and Presentation of Financial Statements' [2]. The third edition, titled 'Conceptual Framework for Financial Reporting' was issued in 2010 [3]. We apply the latter title in this paper for all editions of this document because it has been used three times and is the shortest. A lot of research papers have studied issues related to CFFR, for example those by S.A. Zeff [4] and T.N. Malafeeva [5].

CFFR was designated for development of a high quality standards system based on a set of unified theoretical points: First FASB described CFFR as a "constitution, a coherent system of interrelated objectives and fundamentals that can lead to consistent standards and that prescribes the nature, function, and limits of financial accounting and financial statements" [6, p. 376].

Thus, CFFR is a theoretical framework for the standardisation process, and at the same time is an international version of the financial accounting theory. The fact that convergence of IFRS and GAAP started with the development of a consolidating edition of CFFR is indicative of this document's importance. "A joint conceptual framework project of IASB and FASB started in 2002 as a direct result of the Norwalk Agreement, according to which the Boards agreed to develop together the future general standards… Obviously, the general conceptual foundation is a prerequisite for such work" [7, p. 497–498].

The latest edition of CFFR received widespread criticism: "The International Accounting Standards Board (IASB) published the latest edition of its Conceptual Framework in March 2018. The IASB would not claim that they are at "the end of all our exploring" [6, c. 374]. "The latest edition will not be the latest one. We can hear again: There you go again!... The IASB developers are unlikely to welcome the idea of continuing their work. After all the time and effort spent on CFFR they may feel "lightheaded" at the idea that they have to start all over again" [6, p. 399].

However, the authors of CFFR-2018 (art. SP1.4) leave open the possibility of working on a new edition: "The Conceptual Framework may be revised from time to time on the basis of the board's experience of working with it." Given the foregoing, we hope that this paper will help to improve and add value to such an important document.

Problem Defining

There is no doubt that the CFFR authors followed some theory, or a combination of theoretical concepts which we will refer to as the 'theoretical basis'. Unfortunately, this basis is not described even once in the CFFR text. However, the first article of this document defines the fundamental concept and asserts that "other aspects of the Conceptual Framework … flow logically" [1, art. 1.1]. If this is true, defining the theoretical basis is unnecessary, as it may also be inferred from the fundamental concept.

However, an analysis of the fundamental concept raises doubts that such a conclusion is justified. First, its formal denomination – 'the objective of financial reporting' appears inappropriate. In fact, only subjects endowed with intelligence and willpower may have objectives. Reporting (financial or non-financial) may have contents, purposes, and functions. Several famous authors [8, p. 151; 9, p. 9; 10, p. 11] have criticised the use of this phrase but it was never changed. Second, the objective (of submitting) financial reporting in all CFFR editions actually implied the financial reporting of users, and their objectives. In other words, both terms describing the fundamental notion, the previous and the new one, fail to render its meaning.

The research objective and method. The objectives of the paper are: a) to identify the theoretical basis which CFFR authors followed and its inherent drawbacks; b) to analyse the fundamental concept from a critical point of view; c) to offer an alternative theoretical basis and an alternative fundamental concept.

The paper applies the method adopted by US accountants[3] derived from semiotics (study of signs) and which has been applied successfully in recent decades. This method implies interpretation of accounting as a business language, and requires analysis of the key accounting concepts from three viewpoints: syntactic (for technical correspondence to language rules), semantic (from the point of view of meaning) and pragmatic (from the point of view of practical consequences of the use of the pertinent concept) [8, p. 97–98; 11, p. 19].

[1] CFFR 2010 and 2018 have the same title: Conceptual Framework for Financial Reporting and are translated as «Концептуальные основы финансовой отчетности». This is the translation of CFFR-2010, as given by the Russian Ministry of Finance in 2014. Despite efforts, the author found it impossible to get an explanation (even from translators of this document) as to why the same title of CFFR 2018 had been translated in a different way.

[2] SFAC – statements of financial accounting concepts.

[3] US accountants are acknowledged leaders of the philosophy of global accounting, and made arguably the greatest contribution to development of all CFFR editions.

The Main Research Findings

Two separate theories are used as the theoretical basis of CFFR: the 'organisation' theory [12, p. 5] and the 'residual equity' theory which is a compromise between the organisation theory and the proprietary theory [11, p. 483]. The organisation theory was used to define the fundamental concept of CFFR, the residual equity theory – to identify the elements of financial reporting.

The use of two theories may be explained, for example, by the fact that the American version of CFFR was developed in phases: in 1978 the first chapter (SFAC1) was published, defining the fundamental concept – the objective of financial reporting; in 1980 the third chapter (SFAC3) was published, defining the financial reporting elements [13, p. 142]. Subsequently, in 1985 SFAC3 was replaced with SFAC6. There are reasons to believe that SFAC1, SFAC3 and SFAC6 were not just developed in different time periods, but were also written by different specialists. Issuers of the three international CFFR editions were wary of addressing the initial theoretical foundations and only clarified and developed derivative concepts [6, p. 375; 14, p. 461; 15, p. 238]. In spite of its self-contradictoriness the denomination of the fundamental concept – "the objective of financial reporting" was not reviewed either.

From the syntactic point of view the term "objectives of financial reporting" fails to meet the requirements of scientific language: as stated earlier, only subjects endowed with intelligence and willpower may have objectives, whereas reporting (financial or non-financial) may have contents, purposes, and functions. From the semantic point of view, "objectives of financial reporting" in CFFR are understood as financial reporting users and their objectives. The latter point is an implication of the organisation theory, which superseded the proprietary theory in the USA in the 1970s, exactly at the period of the final stage of SFAC1 development. According to the organisation theory, financial reporting users are divided into groups pursuing different objectives and having equal rights to getting the reporting in the format which facilitates achievement of their objectives. Each user group needs special financial reporting, with its forms and procedure for calculating the key indicators in accordance with its underlying theoretical basis. As such, before we deal with types of financial reporting it is necessary to define the user group for which such a reporting style is intended. This logic resulted in the fact that the objectives of financial reporting users, labelled for whatever reason (probably, for brevity) as the "objective of financial reporting" became the fundamental concept of CFFR.

It is, in principle, unacceptable to use two different theories for development of the same document. The authors should base their work on one theory. It is impossible to apply the organisation theory for this purpose, as it requires making reporting of several types which is incompatible with standardisation. The residual equity theory requires one type of reporting intended to satisfy, as far as possible, the needs of all user groups. This theory is compatible with standardisation but does not meet in full the interests of any of the user groups and is an intricate prospect.

It is reasonable to define in the opening section of CFFR the theoretical basis for the concepts of this document. The proprietary theory is preferable as the theoretical basis of CFFR. It is well-known (especially in the USA), simple, and implies making the financial reporting intended to satisfy the interests of company owners. Thus, the proprietary theory fully meets the interests of the main group of financial reporting users. Besides this, according to many scientists (and in the opinion of this author) the theory which satisfies the needs of owners meets the *main* interests of all other user groups. On the basis of this reasoning the definition of financial reporting intended to meet owners' interests should be the fundamental concept of CFFR.

In the second section (after the introduction) two main theories of US accountants are analysed (the proprietary theory and the organisation theory), as well as the compromise theories based on them. In the third – to fifth sections the fundamental concept of CFFR is analysed and the main theoretical contradiction of the whole document is identified. In the sixth section the author's approach to choosing the theoretical basis of CFFR is stated. The final section briefly describes the conclusions and limitations of the paper.

Theoretical Views of US Accountants

Two competing theories, popular in the USA, greatly influenced the development of CFFR and the choice of its fundamental concepts: the proprietary theory and the organisation theory.

The Proprietary Theory and the Organisation Theory

In the 19th century, the main users of accounting reports were company owners. Predictably, in the first accounting theory developed in the American milieu in 1841, the field was considered from the owners' point of view. An American accountant, T. Jones [16], was its author. The theory was outlined rather vaguely, applying the terms of accounting records. Following in his footsteps, B.F. Foster [17] and Swiss accountants F. Hügli [18] and J.F. Schär [19] offered a similar theory, using terms of accounting records and formulating it in a slightly different way. This theory was articulated in 1927 by applying terms of financial reporting in the USA by H. Hatfield [20], and in Russia – by K. Tsygankov [21] at the beginning of the 21st century.

In English-speaking countries this theory is called the proprietary theory. According to it, the principal users of financial reporting are company owners [22, p. 196–197]. Reporting items are made from the point of view of owners and are intended to measure and analyse their welfare expressed in the following balance equation:

Assets – Liabilities = Equity (Net Assets or Property).

Assets are considered as money and property at the owner's disposal, and accounts payable are considered as the owner's liabilities to lenders. According to H. Hatfield "accounts payable are negative assets while equity in the initial accounting equation is the owner's net welfare" [cit. ex 11, p. 480]. When a company is founded, equity equals the sum of the amount invested by the owner. Equity subsequently changes due to profit and expenditure and the owner's transactions (additional equity infusions and withdrawn dividends).

In accordance with the proprietary theory, profit is anything increasing the owner's welfare, and expenditure is anything reducing it. We shall here point out that the pertinent definitions describe *owner's welfare* instead of *corporate equity*. Dividends withdrawn by owners reduce corporate equity but are not expenditures, because they do not reduce owner's welfare[4]. For the same reason, equity infusions which increase corporate equity (but not owner's welfare) are not considered to be profit [11, p. 480–481]. This theory was named so because it focused on owner's welfare instead of the company or its equity.

On the cusp of the 19th and 20th centuries the organisation theory was formulated in the US, which competed with the proprietary theory. Defenders of the organisation theory considered it inadmissible (and likely unethical) to separate owners from other users of financial reporting, e.g. lenders, business partners, employees, and government [22, p. 201]. Moreover, whenever possible, they understated the leading role of company owners. They considered a company as an independent entity, and a "business interested in its (own) survival. In order to survive, a company should comply with legislation and maintain good relations with providers of debt capital and equity. Attracting capital providers, hence, gaining profit, is necessary for survival but it is not the only corporate objective" [ibidem]. Reporting items are considered in this theory from the company point of view.

Corporate assets belong to the company, not its shareholders; both debt capital and equity capital are corporate liabilities. Consequently, the balance formula appears as follows:

Assets = *Liabilities*. (2)

The place of profit in organisation theory is occupied by added value, represented by the difference between the market value of manufactured products and the cost of off-loaded goods and services. Thus, all company employees, owners, creditors, and the government (through the taxation system) are recipients of a part of the company's added value. "This added value is a "pie", divided among *all* participants who have contributed to its 'making'" [11, p. 224]. All these groups are equal users of financial reporting. For each group, its own financial reporting is rendered with regard to its set of items, its own procedure for calculation, and hence, its own theory. So, before dealing with financial reporting, its contents and theory, it is necessary to define the users for which it is intended. Consequently, the fundamental concept of CFFR should be defining of its users.

Compromise Theories

In the competition of two theories, the organisation theory prevailed. R. Mattessich [23, p. 29–30] thinks that it took place in the latter half of the 20th century. C. Van Mourik is of the same opinion: "The proprietary theory was a popular topic in magazines from the 1930s to the 1960s… But since the 1970s the proprietary theory has been collecting dust in accounting theory textbooks, or dropped out of view from the majority of scientists" [22, p. 193]. Issuers of CFFR-2010 pointed out the directly preferability of the organisation theory: The boards[5] decided that corporate financial reporting should be prepared from the point of view of the company instead of the point of view of its owners or a certain proprietary class" [12, p. 5].

However, the proprietary theory lives on as a part of the theories which are a compromise between the proprietary theory and the organisation theory. At present, FASB and IASB uphold the residual equity theory" [11, p. 486] which is "a kind of compromise between the proprietary theory and the organisation theory" [11, p. 483][6]. Compromise theories imply making one type of reporting oriented to the interests of several user groups.

One of the first compromise theories was offered by W. Paton, who thought that reporting should be made for two user groups: owners (shareholders) and bond holders. "The profit and loss statement should be drawn up in a way that shows the "net profit" accrued by all capital providers: shareholders as well as bond holders. Therefore, interest payments referred to documents of indebtedness should be indicated in the same way as dividends: as distribution of profits, and not expenditure when profits are gained. Interest is the lenders' profit" [cit. ex: 4, p. 268–269]. S. Zeff made the following comment: "Today everybody thinks that interest charges should be indicated in the profit and loss statement as expenditure. Nevertheless, Paton's position is justified if we define net profit as investors' revenue and equity securities and debt securities" [4, p. 269].

In the post-war years, the securities which combine functions of equity and debt instruments were offered. The reference cited at [11, p. 479] presents a table showing the types and characteristics of such securities: preferred share, convertible preferred share, convertible bond, warrant, share subject to right of return etc. In total, the table

[4] In this case the owners take assets from one pocket and put into another.

[5] The development of CFFR-2010 was a joint project of the London IASB and the American Financial Accounting Standards Board (FASB).

[6] Unfortunately, the description of this most important theory takes only a page and a half in the huge monograph of the leading American theorists [11, p. 483–484].

represents 13 types of securities which differ in six parameters. It is possible that since the year of the publication of the table (1992) new securities have been introduced. This means that attempts to keep pace with the increasing variety of securities types and interests of the users behind them will complicate theories.

Let us show the complexity of the residual equity theory through the following example. As per CFFR-2018 art. 4.63: "Equity is a residual share in total corporate assets after deducting all company liabilities"[7]. In our opinion, this definition is as self-contradictory as that of the "objective of financial reporting". In fact, the result of deduction (including the deduction of liabilities from assets) is difference, not a share. Share is a relative index, while equity is an absolute index. The term "residual share" is not used in any science. Finally, the decisions taken by users are economic ones - equity is one of the most important economic concepts, while the definition contains not a spark of economic content.

The colleagues with whom we consulted failed to explain the meaning of this definition- everybody assumed that it was a mistranslation. However, the translators of CFFR into Russian asserted that the translation was correct. We have no reason to doubt this, because the authenticity of the translation was affirmed by IASB.

In the opinion of C. Van Mourik, the theoretical basis of CFFR is not clear enough even to the authors of this document: "The joint project of IASB and FASB aims at the updating and convergence of the existing conceptual frameworks of FASB and IASB. In their draft project related to the objective of financial reporting, the boards added the following comment: "The boards decided that corporate financial reporting should be prepared from the point of view of the company, instead of the point of view of its owners or a certain proprietary class". Comments of concerned parties showed that the boards have no idea of the differences between these two approaches and in the final edition the reference to these theories will probably be excluded. If even the setters of the standard makers had no clear understanding of these theories it would be reasonable to conduct a thorough analysis casting some light on previous discussions" [22, p. 192].

Criticism of the Organisation Theory

At first sight, the organisation theory is very attractive. It implements the idea of equality of all user groups: no single group is preferred over others, and each group has its own reporting which takes into consideration interests of such group to the maximum extent.

In our opinion, the theory's drawbacks are of no less importance. First, it is incompatible with standardisation which renders it inadmissible for CFFR makers. Second, it significantly complicates the theory, terminology and understanding of financial reporting. Let us turn our attention to the latter.

Accounting in the USA is proudly called a business language. At the same time, they acknowledge that the language quality leaves room for improvement. "FASB is constantly working upon elimination from the balance-sheet of the items which have no clear meaning content. However, in spite of all FASB efforts many accounting concepts still have no semantic content" [11, p. 483].

One such concept – "profit" according to SFAC 1 (par. 43) is the "fundamental concentration of financial reporting" [cit. ex: 11, p. 203]. However, CFFR editions offer no definition of profit. One of the reasons is the organisation theory, which originated five various concepts of profit: added value, corporate net profit, investor's net profit, shareholders' net profit, and ordinary shareholders' net profit [11, p. 227–228]. Each profit concept has its own method of calculation, of indicating in reporting and interpretation of this indicator. This impedes understanding of the essence of profit, even to professionals: "The greatest difficulty in discussing alternative methods of the accounting of profit is that the authors, as a rule, fail to indicate the profit concept which they use" [11, p. 229–230].

A rhetorical question arises: if the meaning of the most important reporting indicators is not clear enough even to professionals, how it is possible for users to grasp such meaning. Indeed, do users need a theory which complicates understanding of financial information so much, and hence, complicates taking a sound economic decisions?

In our opinion, the organisation theory just makes semblance of equality presenting, for example, income of employees in the reporting, together with owners' dividends. At the same time, the amount of employees' income and their actual status will still differ from the income and status of owners. On the other hand, understandability of reporting for users (all users) in this case diminishes significantly along with the quality of economic decisions taken without understanding.

Another factor impeding understanding of CFFR is that its fundamental concept, for unfathomable reasons[8], is called 'defining the objective of financial reporting' instead of 'defining users'. This is shown below, in a detailed analysis of this concept.

Syntactic Analysis of the Fundamental Concept of CFFR 2018

1.1. "The objective of ~~submitting~~ financial reporting forms a fundamental basis for the Conceptual Framework. Other aspects of the Conceptual Framework … flow logically from the above objective" [1].

Note that the second word of the above definition, which is crossed out, was added by the translator. This word is not used in the original text and we are still discussing the "objective of financial reporting". We mentioned above

[7] The same definition is given in all previous CFFR editions.

[8] The identification of these causes requires a separate research study involving English speakers.

that the translator also added the word "submitting" to the document title as well. We shall not conjecture the cause of this translator's decision. Let us analyse the wording of the original text of all CFFR editions since 1978.

Analysis. In the first paragraph of CFFR the following is stated clearly: the concept of the "objective of financial reporting" is the fundamental one, all other aspects of this document flow logically from it. However, from our point of view, the word combination "objective of financial reporting" does not meet the requirements of scientific or even everyday language. Probably, it is an oxymoron such as "vest sleeves". The issue is that any reporting (as well as any documents, instruments and other inanimate objects) don't and cannot have objectives. Subjects endowed with intelligence and willpower may have objectives.

Russian scientists with whom the author shared this opinion after some doubt agreed but presumed that it was a translation error. However, an analysis of foreign sources led the author to the conclusion that, most likely, the error was made in the original text. This is confirmed by the opinion of famous theorists, English speakers and supporters of the English-American accounting school: "In the strict sense financial reporting cannot have objectives; only people who require making reports and using them have objectives"[9] [8, p. 151]. D. Solomons[10] emphatically avoided the wording "objectives of financial reporting" and replaced it with "functions of financial reporting" [9, p. 9]. In 1988 according to S. Zeff [4, p. 302], Australian authors G.P. Whittred and I.R. Zimmer declared the following: a) financial reporting has no objective: it has functions" and b) "the function of financial reporting is agency cost reduction" [10, p. 11].

So, reporting can have functions, contents and purpose. While objectives pertain to reporting users. It is shown below that the next CFFR articles implied users.

Semantic Analysis of the Fundamental Concept of CFFR-2018

The objective of ~~submitting~~[11] general purpose financial reporting – to provide financial information about the reporting entity that is useful to existing and potential investors, lenders, and other creditors in making decisions about providing resources to the entity". Those decisions involve:

(a) buying, selling, or holding equity and debt instruments;

(b) providing or settling loans and other forms of credit;

(c) exercising rights to vote on management's actions.

In fact, art. 1.2. describes reporting users and the decisions taken by them on the basis of reporting. The users are existing and prospective investors, lenders and other creditors (for brevity we will call them "users").

1.2. The decisions described in article 1.2 depend on the returns that they expect from an investment in those instruments; for example dividends, principal and interest payments, or market price increases. Expectations about their returns depend on their assessment of the amount, timing of future net cash inflows to the entity and on their assessment of how efficiently and effectively the entity's management and governing board have discharged their responsibilities to use the entity's resources. They need information which allows them to make such an assessment.

This article also describes users, more specifically, the expectations of users regarding their investments. Shareholders count upon dividends and increase of share market price, and creditors count upon repayment of the principal and payment of interest.

1.3. In order to perform the assessment described in art. 1.3 users need the following information:

(a) the economic resources of the entity, claims against the entity and changes in those resources and claims; and

(b) how efficiently and effectively the entity's management and governing board have discharged their responsibilities to use the entity's economic resources.

This article describes the contents of reporting generally and uses uncommon terms. Only chapter 4 states that economic resources of the entity are understood as its assets, and claims concerning such resources – e.g. liabilities, and changes in those resources – e.g. income, expenditures and other capital changes.

1.4. Many users cannot require reporting entities to provide information directly to them and must rely on general purpose financial reports. Consequently, they are the primary users to whom general purpose financial reports are directed.

This article describes users again. Everybody who cannot require a company to furnish additional information and can rely only on general purpose financial reports are primary users. First of all, such users are represented by small investors and creditors.

So, the semantic analysis of the first two CFFR paragraphs shows that the "objective of financial reporting" is actually understood to mean financial reporting users. This is an implication of the organisation theory: each user group

[9] "According to M. Mathews and M.H.B. Perera, the accounting theory has been chosen by a cohort from the American Accounting Association as an example of an internationally-oriented program of accounting study. The course program was made available to approximately five hundred colleges and universities all over the world" [8, p. 11].

[10] For around two decades, D. Solomons was a leading maker of CFFR in the USA and England, an author of SFAC2. D. Solomons is on S. Zeff's short list of professionals, called "the intellectual backbone of CFFR" by this historian [4, p. 313].

[11] The word we have crossed out was added by the translator and is not used in the original text of CFFR-2018 (in English).

has its reporting, theory and terminology. It rules out the possibility of standardisation of reporting. The solution to this problem is defined in art. 1.8:

1.8. Individual primary users have different, and possibly conflicting, information needs and desires. The Board, in developing financial reporting standards, will seek to provide the information set that will meet the needs of the maximum number of primary users.

According to art. 1.8, one "information set" is made for all users, in spite of their "different, and possibly conflicting, information needs", i.e. one type of reporting which meets the needs of each user group as much as possible. It is a solution to the standardisation problem and, at the same time, negation of the organisation theory and interpreting users as the fundamental basis of CFFR.

The Main Contradiction of CFFR

Our above semantic analysis of the first few articles of CFFR indicates that two different theories are used as the theoretical basis of CFFR: the organisation theory [12, p. 5] and the residual equity theory [11, p. 483]. The organisation theory is used to state the fundamental concept of CFFR, and the residual equity theory is used to define the elements of financial reporting in chapter 4 of CFFR-2018. It is the main contradiction of CFFR.

Obviously, the conceptual framework of financial reporting should rest on a uniform theoretical basis. It is impossible to use the organisation theory for this purpose: it requires several types of reporting, which is a process incompatible with standardisation. The residual equity theory is compatible with standardisation to the same extent as the proprietary theory. Let us try to solve the problem of choice between these two theories on a pragmatic basis.

Pragmatic Approach to Choosing the Theoretical Basis of CFFR

In our opinion, in choosing the basic theory (and corresponding reporting) we should be guided by two criteria:

1. Understandability of financial reporting and its theory for users.

2. The orientation of reporting and theory, in the first place, to the information needs of users which plays a pivotal role in a company and bear the greatest risks in case of bankruptcy.

Let us substantiate these criteria.

Understandability of Financial Reporting as the Main Qualitative Characteristic

Let us ask the question: which qualitative characteristic of financial reporting is of most importance? At various times, this question has been answered differently. In the opinion of the authors of CFFR-1989, the main qualitative characteristic of reporting is its understandability for users.

"25. The main quality of information presented in financial reporting is its understandability for users".

Note that the reporting should be comprehensible *for users, not professionals*. There is a corollary here: reporting is made for users, not accountants, i.e. for the persons and entities which take risk-related economic decisions on the basis of reporting.

However, CFFR-2010 and CFFR-2018 state another point of view. In these editions, all qualitative characteristics are divided into two categories: a) fundamental and b) enhancing. The fundamental characteristics are relevance and faithful representation. Less important second-rate characteristics which just make financial information more useful are comparability, verifiability, timeliness and understandability:

2.4. Financial information should be relevant and faithfully represented in order to be enhancing. Comparability, verifiability, timeliness and understandability of financial information makes it more enhancing.

As we can see, understandability in CFFR-2018 (as well as in CFFR-2010) is defined as a second-rate qualitative characteristic and is the last in the list. The main qualitative characteristic of financial reporting is considered to be its relevance, i.e.:

2.6. "… the capability to have a significant impact on the decisions taken by users".

Based upon art. 2.4, even incomprehensible financial information is useful if it is relevant and faithfully represented. This does not seem right. In our opinion, information which is incomprehensible to its recipient is akin to information noise, not information; it impedes decisions instead of helping to take them. An attempt to take decisions on the basis of "incomprehensible information" may be a success only incidentally. Therefore, the word "*significant*" we have underlined in art. 2.6 should be replaced with "*correct*". So, the main qualitative characteristics of financial reporting will be faithful representation and understandability.

The requirements to understandability of financial reporting are of special relevance because according to art 1.5 of CFFR 2018, their primary users are the persons and entities which cannot require reporting entities to provide information directly to them. They comprise individual persons who have purchased at least several shares or bonds, and who probably have no experience in business activities or economic education. Financial reporting should be comprehensible to such users as well.

Probably, the makers of CFFR 2010 and 2018 considered this objective unattainable, but did not declare it. One way or another, instead of trying to make financial reporting more comprehensible, they downgraded understandability. In CFFR-2010, among qualitative characteristics, understandability is transferred from the first position to the last. CFFR-2018 made another step towards it: item "(f) assist users of financial reporting in interpretation of the information presented in financial reporting" which was in CFFR-1989 and CFFR-2010 was withdrawn from the 'Purpose and Status' section.

As a result, CFFR-2018 (art. SP1.1) is intended only for professionals: standard makers and persons who draw

up reports, while users for whom financial reporting is made are left to interpret the data at their own discretion. However, users are recommended to resort to consultants (art. 2.36). In such cases small investors and creditors will be users of paid consulting services instead of financial reporting. Besides this, it is possible that consultants will also experience problems interpreting reporting data. This can be seen by an example.

In 1999 the Accounting Standards Board (ASB) of Great Britain published the first edition of its national CFFR, titled 'Statement of Principles for Financial Reporting'. The chairman of ASB, D. Tweedie explained the change of the title as follows: "The title Conceptual Framework will be confusing for many accountants who have not studied the accounting theory" (cit. ex: 4, p. 307). Apparently, the accounting theory as it is introduced in Great Britain is so difficult to understand even for professionals, that the words "theory" or "conceptual framework" perplex them.

In order to make reporting comprehensible for users, not just professionals, it is necessary to introduce changes in the theoretical basis. The case here is that makers of all three CFFR international editions were under the strong influence of their American predecessors and, as they admitted, introduced only superficial changes: "The initial FASB's project for making CFFR was not planned properly, alternatives were not considered thoroughly enough, and in reviews defects of the initial CFFR idea migrated to new editions uncorrected" [6, p. 375].

In our opinion, it is necessary to go back to the 1989 statements: a) CFFR, among other things, is intended to assist users in interpretation of financial reporting data and b) understandability is the main qualitative characteristic of financial reporting. Although in CFFR-1989 these were just declarations. Below we offer some actions to implement them.

Owners as the Principal Users of Financial Reporting

According to our reckoning, company owners should be considered the principal users of financial reporting. Owners are participants of partnerships, ordinary shareholders, (i.e. the persons who bear the greatest risks in case of business failure) and who receive remuneration by a leftover principle. Preference shareholders are not owners because they bear less risks. Moreover, any bond holders and other creditors are not considered owners. Let us articulate some arguments for this statement.,

First, owners play the most important role in corporate activities. They establish a company, sign agreements with managers and assign them the parameters of their job duties. They are the main force of the national and global capitalist economy.

Second, owners are one of the most numerous user groups because the majority of entities are partnerships. In the USA, out of 4.9 million entities, only 17 thousand traded shares publicly (and could issue securities with functions of both equity and debt instruments) [15, p. 231]. As for other companies, their owners are mainly the ones who need their reporting. Ordinary shareholders of the companies listed in the stock exchange are also owners.

Third, according to widespread opinion, reporting which meets owners' needs also meets the main needs of other user groups. It is indicated, for example, in the report made by the research group of M. Trueblood (1973) which formed the basis for SFAC1, that: "Information needs of investors and creditors are almost identical. Both groups are concerned with the company's ability to generate cash flows [cit. ex: 4, p. 284].

A similar opinion is expressed in CFFR-1989 (art. 10): "As long as investors are capital providers for a company, furnishing the information which meets their needs will also meet the majority of needs of other financial reporting users". Therefore, investors are understood as subjects contributing risk capital (art. 9 (a)), not suppliers and other trade creditors. In 1999, the first edition of British CFFR asserted the following: "Financial reports focused on investors' interests meet common interests of all users related to financial indicators and financial status of a company" [24, art. 1.11].

Let us substantiate this opinion. As noted above, owners get remuneration by a leftover principle, i.e., they are the last ones after all other reporting users entitled to it. Consequently, what is good for owners is good for other users. The owners' remuneration comprises dividends paid if profit has been generated and sufficient liquidity has been achieved. Fulfillment of these two conditions guarantees remuneration to all other users of reporting.

Proprietary Theory as the Theoretical Basis of CFFR

The proprietary theory matches both criteria: it is directed to the principal users of financial reporting and is the simplest to understand. An extended rationale of the latter thesis may be subject to a separate detailed research. Here, we will restrict ourselves to one argument. Historians are of the unanimous opinion that accounting was created by owners to meet their needs. Therefore the proprietary theory is a natural accounting theory, while all other theories are artificial and are essentially adaptations of accounting to functions extrinsic to it.

Also noteworthy is the fact that recognising the proprietary theory as the theoretical basis of CFFR does not require significant innovation, all it takes is going back to a well-known theory.

Conclusions

There is a reason that the Conceptual Framework for Financial Reporting is difficult to understand even for professionals. Neither edition of CFFR states the theoretical basis on which the provisions of the documents rely. Instead, readers are offered to base their understanding upon the fundamental concept of CFFR defined in the first paragraph. It is asserted that all other CFFR aspects flow logically from this concept. However, the syntactic analysis of the denomination of this concept, the "objec-

tive of financial reporting", revealed its self-contradictoriness. The semantic analysis showed that this denomination does not correspond to the concept meaning. So, from the very beginning readers are misled and deprived of the clues to a coherent study of the document.

In this paper, we attempt to define the theoretical basis and actual fundamental concept of CFFR, and analyse them from a critical point of view, and offer an alternative.

The research findings led to the conclusion that CFFR makers relied on two different theories: the organisation theory and the residual equity theory. The organisation theory was used to define the fundamental concept of CFFR, and the residual equity theory – to identify the elements of financial reporting. This is the main contradiction of CFFR.

The identification of causes of such inconsistency requires a separate research. Whatever be the causes, the current state of things is unacceptable. We support the opinion of representatives of the American Accounting Association (AAA) who, in order to eliminate CFFR drawbacks, offer "… to start with constructing a most general accounting theory, and then, on its basis, develop CFFR and individual standards" [15, p. 238]. We would like to add that it is reasonable to state the basic theory in the first chapter of CFFR and interpret it as a logical beginning of this document. Additionally, we presume that instead of making a new theory, one should resort to the well-known proprietary theory.

The advantages of the proprietary theory are its simplicity, its orientation to the interests of the main user group – company owners, and its capability to meet information needs of all other user groups. In this case, the fundamental concept of CFFR should be the definition of financial reporting directed towards owners' interests.

Implementation of the above propositions will significantly enhance the understandability of CFFR, and the financial reporting and quality of economic decisions taken by all user groups.

These propositions are open to discussion; and we will be glad for commentary on them.

Limitations

This paper looks at the causes of use of the term "objectives of financial reporting" in CFFR, and does not study at all the reasons for the prevalence of the organisation theory in the US. The main reason is the limited length of this paper. In our opinion, a detailed analysis of each of the above problems will require at least one large research paper.

Other causes include the complexity of the above problems and the insufficient attention paid to them by English-speaking authors. So, in the monograph by E. Hendriksen and M. van Breda [11] consisting of almost 600 pages, the organisation theory and hybrid theories are described on only one or two pages. An equally large monograph by M. Mathews and M. Perera [8] does not mention this theory at all.

As for the term "objectives of financial reporting" S. Zeff [4] paid the most attention to it, but he merely mentioned the time of its first use, and the existence of criticism, without stating the reasons for the controversial wording and his own opinion. The majority of authors take no notice of the self-contradictoriness of this term, or criticism against it, or its inconsistency with the meaning of the concepts which it describes.

The above reasons motivated our focus in this paper on the critical analysis of historically-developed provisions of CFFR.

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Impact of Digitalisation on Corporate Finance in the Agro-Industrial Complex

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The presented model allows us to forecast with a sufficient degree of confidence (deviation not exceeding 10%) a probable value of the digitalisation index of dairy cattle breeding for 10 prospective economic entities of the Novosibirsk Region (Table 7). Consequently, the organisations which plan 'chipping' of their dairy herd may consider the digitalisation index of dairy cattle breeding a reasonable reflection of an attractive business format for them.

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Abstract

The purpose of our paper is to examine the interrelation between digitalisation indicators of dairy industry government regulation and economic efficiency, using large corporations of Novosibirsk Region as an example. We propose to identify an integrated system approach to evaluating the influence of state programs related to digitalisation of the dairy industry on industry performance.

A system-wide transition to digital technology in the infrastructure of dairy industry regulation is nearly totally absent from academic research. The existing literature considers the influence of state programs and policies on the industry and proposes various performance indicators. However, it is uncertain how industry digitalisation may affect these performance indicators.

To address this gap in the literature, we propose a hypothesis of dependency between digitalisation indicators and performance indicators of dairy corporations. The basis of the methodology is the calculation of a digitalisation index used to assess the efficiency of government support of the industry corporations. In order to substantiate the hypothesis, we apply a correlation and regression analysis and established interrelations between the offered criteria (digitalisation index and share) and operating performance of dairy industry economic entities.

Our results indicate general consistent patterns and interrelations between digitalisation of state regulatory programs and the performance of dairy industry corporations. Our statistical analysis reveals digital technology as a tool of government has a significant impact on business performance. The offered digitalisation criteria and patterns of performance efficiency are indicative of the possibility to manage the digitalisation process based upon preset parameters of business performance.

Our research will be of interest to specialists developing state programs and policies applying digital technology, directors of dairy companies, and scientists who conduct research in related fields, who may use our approach for evaluating and forecasting performance in the dairy industry, accounting for the impact of government regulation.

Keywords: financial stability, dairy industry, government regulation, digitalisation, correlation and regression analysis, forecasting

Introduction

Recent decades have been characterised by a global trend towards increased interest in food security and the government's role in providing such security. On the basis of a review of literature in the area, we identified the following important aspects of the authors' research: the influence of factors on food security via the interrelation between armed violence and food supply chain [1]; via evaluation of influence of extractive industries [2]; via assessment of quality of government regulation and government efficiency [3]; via influence of government regulation on development of dairy industry [4], and the influence of food security itself on key indicators of national security such as public health care [5].

One of the key spheres of food security is supplying food to public including dairy products [6]. Dairy products, as a nutritious source of protein, fat, micronutrient elements, prebiotics and probiotics, make a substantial contribution to food security and human health [7]. So, the primary objective of any government is the provision of sustainable development and proper functioning of companies engaged in this industry. In spite of the fact that the dairy industry exists in every state, its state and development level differ significantly from country to country. Developed economy countries such as European countries, USA, India, China, New Zealand, Australia are the leaders in this sphere. The main milk producer among them is the USA which accounts for 25% of the total output [8]. In this market segment Russia is 6th, and its share in the total milk output is approximately 8%. The state and further development of dairy subcomplex are subject to a significant government influence. Analysis of the scientometric database of the Russian Index of Science Citation (RISC) showed lack of attention to issues of dairy industry government regulation (less than 3%) and digitalisation in particular (0.15%). Analysis of the scientometric database WoS yields similar results. It also gives little, although more than RISC, attention to issues of dairy industry regulation (a little over 5%) and digitalisation in particular (0.2%) while dairy subcomplex regulation under conditions of digitalisation is described in just four papers. Exponential growth of interest to publications dedicated to dairy subcomplex regulation against the background of digitalisation was revealed.

Heavy demands are placed on the system of government regulation, and one of them is its efficiency. In the scientific literature, a lot of research is related to evaluation of state programs and policies [8–11]. However, the interrelation between government influence and efficiency of industry development under the circumstances of digitalisation has been insufficiently studied [12].

In our opinion, there is no doubt that study of influence of the state digitalisation policy on the state and development of dairy corporations is of academic interest. In our research we tried to generalise the accumulated experience and offer a common approach to evaluation of digitalisation influence on performance of dairy corporations.

We presume that results of our research and the ones similar to it will be interesting to specialists developing state programs and policies applying digital technology, directors of dairy companies, and scientists who conduct research in this and related fields.

Literature Review

Assessment of the State of the Dairy Industry

Dairy industry development trends in Russia are dubious. So, in the past few decades milk production in Russia has showed a downward trend, while its efficiency has grown (Table 1).

Table 1. Main performance indicators of agricultural organisations for 2000–2018 (according to Rosstat)

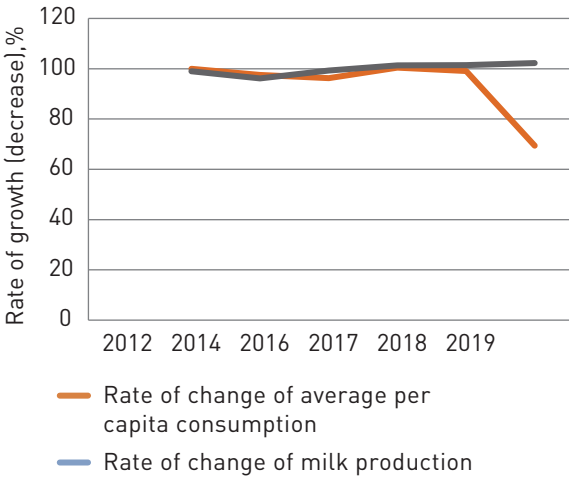
Indicator	Year					
	2000	2014	2015	2016	2017	2018
Number of cattle, million heads	16.5	8.5	8.4	8.4	8.3	8.1
Number of cows	6.5	3.4	3.4	3.4	3.3	3.3
Raw milk production, millions of tons	–	30	29.9	39.8	30.2	30.6
Milk production (except raw milk), thousands of tons	–	–	–	5430	5301	5382
Butter and butter pastes, thousands of tons	–	–	–	251	270	267
Cheese, thousands of tons	–	–	–	450	454	467
Condensed milk products, millions of conventional tins	–	–	–	842	837	806
Milk products for infant food, thousands of tons	–	–	–	229	285	313

Indicator	Year					
	2000	2014	2015	2016	2017	2018
Consumption of concentrated feed per 1 liter milk	0.31	39	0.4	0.4	0.4	0.41
Milk output per 1 cow, kg	2502	4021	4134	4218	4368	4492
Milk sales, millions of tons	16.1	19.4	19.8	20.3	21	21.5
Milk vendibility (share of sales of production)	81.6	93.7	94.2	94.5	94.7	94.8
Number of agricultural organizations, total, thousand, including:	27.7	5.9	5.2	5	5.2	5.2
Number of profit-making organisations, thousands	13.7	4.3	4	3.9	4	3.8
Share of profit-making organizations, %	49.3	73.6	77	77.7	75.6	73.8
Product profitability in cattle breeding, %	1.4	18.3	15.4	9.8	12	12.8
Profitability of milk and milk products, excluding budget subsidies, %	–	23.7	19.5	18.5	25	14.5
Profitability of milk and milk products including budget subsidies, %	–	33.3	26.6	28.2	32.3	23.9

A decrease in raw milk production of more than 40% is caused by cow livestock reduction in agriculture. Reduction in the size of dairy herds resulted in a decrease of cattle stock and, consequently, the decline of production in the meat industry. Research conducted by Russian scientists discovered a trend of outstripping rate of cattle head count decline in comparison to milk yield per head of livestock which they correctly transpose to all Russian regions [13]. Within the reviewed period milk output per cow increased by 1.8 while the cattle stock decreased more than twice. What is conspicuous, is the dramatic reduction in the number of agricultural organisations, from 28,000 in 2000 to 5,000 in 2018, but still the share of revenue-earning enterprises grows. The industry state may be evaluated as unstable. Some indicators (for example, milk and dairy products output, product profitability) show an ambiguous trend: growth periods are followed by declines and vice versa. According to Table 1, due to budget subsidies the product profitability is higher on average by 7–8%. Self-production of milk increases but at the same time the structure of agricultural production changes by way of decrease of the milk share.

The dairy industry in Russia, as well as in other countries, is susceptible to government regulation. But along with this, the problems the government solves are different. So, in China and Brazil intensive growth of milk production is encouraged by price control and capital indemnification, in EU, USA and Canada restraint policy is implemented to solve the problem of milk excessive production, and independent quality inspection is applied at all stages of the production process. In Russia, milk producers' subsidising policy is carried out at the federal and regional levels in the form of concessional lending offered by PJSC SberBank and PJSC Russian Agricultural Bank, compensatory and stimulating subsidising (subsidies for development of genetic and pedigree infrastructure, recovery of a part of capital expenditure), and concessional leasing. The current policy of government support of dairy industry implemented in recent years resulted in increase of raw milk output while consumption of dairy products decreased, which is shown in Figure 1 [14].

Figure 1. Dynamics of production of per capita milk consumption in Russia for 2012–2019, %



Government support is based on a corresponding legal framework comprising state programs as well as laws and regulations which regulate the dairy industry. The problem in the system of industry government support

consists in nonconformance of the criteria for programs' efficiency evaluation to the indicators embodied in them. One such indicator is the level of milk and dairy products self-production, which is 84% at present, while the established key indicator amounts to at least 90%. The following key indicators of implementation of the program for development of agriculture and regulation of markets of agricultural products, raw materials and commodities for 2013–2020 were established: growth of livestock products output (in comparable prices) by 20.8%, growth of the index of physical volume of capital investments in agriculture by 36%, rise in profitability of agricultural organisations by at least 10–15% (taking into consideration subsidies). However, the above indicators are not performance indicators and, consequently, they cannot be used as criteria for evaluating the efficiency of state programs.

A. Panyshev and O. Katlishin specified in their paper the problem of assessing the influence of a certain state program on dairy industry development [8]. The approaches to evaluation of government influence on the dairy industry are studied in papers by Russian [12; 15; 16] and foreign authors [17–19]. The search for and substantiation of the optimal way of government regulation of producers and consumers of dairy products are described in the paper by E. Twine [20]. J. Tricarico et al. [11] speak of the possibility of public-private partnership in regulation of the dairy industry. Y. Chen and X. Yu assessed the influence of subsidies on competitiveness of the Chinese dairy industry [18]. The literature review is indicative of the problem of efficiency of state programs aimed at supporting and developing the dairy industry.

On the basis of our review of academic papers [6; 8; 13] in this paper we make an attempt to systemise the problems of low efficiency of state programs regulating corporations in the dairy subcomplex. Unlike the existing research, we idnetify innovative problems which have to be addressed.

The problems of low efficiency of government programs intended to support and develop the dairy industry may be systematised as follows (Figure 2).

Figure 2. Key problems of low efficiency of state programs in the dairy subcomplex

Economic	• insufficient government support; • problems of concessional lending; • a large amount of counterfeit dairy products; • input intensity of the industry; • problems of effective coopertaion of dairy producers and distribution network
Political	• monopolisation by foreign companies of the dairy industry
Technology-related	• low efficiency of use of modern feeds; • outdated technology in milking operation; • high degree of manufacturing equipment wear; • capacity bottleneck.
Investment-related	• low attractiveness of the industry to private investors
Innovative	• an extremely low use of modern technology for collection and processing of data on the state of dairy herd; • insufficient digitalisation of dairy production

Government Regulation of the Industry under the Conditions of Digitalisation

Academic literature has not yet accumulated a sufficient amount of research on dairy industry government regulation against the background of digitalisation. The majority of research is *ad hoc* and non-systemic. Absence of a consistent approach impedes evaluation of influence of government regulation digitalisation on operations of dairy entities and, as a consequence, the assessment of the efficiency of state programs and policies in this economic sector.

So, scientists study various aspects of digitalisation issues: investment-related [21], manufacturing [22], and financial [23]. Digitalisation of corporations is considered as an essential prerequisite for government regulation of the dairy industry [24].

A successful digitalisation of the dairy and other AIC industries depends to a great extent on the level of digital infrastructure built in a country. We presume that nowadays one of the components which characterise efficiency of state programs implemented in the industry should be the level of its digitalisation. The strategy of agricultur-

al-industrial and fisheries industry complex development for the period up to 2030 defines one of six goals – AIC digital transformation. This associates with the national goal to speed up implementation of digital technology in the economy and the social sector. It is assumed that it may be achieved due to implementation of the AIC state program and the national project Digital Economy of the Russian Federation.

Figure 3. Problems hindering digitalisation of the agro-industrial complex

Lack of financial resources to implement ICT	• a bipolar economy evolved in the agricultural sector: • one side is represented by highly profitable enterprises with a wide access to high performance technology (most often agroholdings); • the other side is represented by enterprises on the edge of payback which use outdated technology
Shortage of skilled personnel	• In Russia there are half as many IT specialists engaged in agriculture than in the countries with a traditionally highly developed AIC; • The Russian agricultural sector needs approximately 90,000 IT specialists
Absence of digital infrastructure	• underdevelopment of digital infrastructure in rural areas; • digital inequality between town and countryside
Imperfection of legal regulation of ICT development	• the issues of development of the system of government information support in agriculture are governed by art. 17 of Federal Law of December 29, 2006 No. 264-FZ On Agricultural Development which needs improvements and adaptation to the current situation
Consequences of imperfection of legal regulation of ICT development	• a weak policy of agricultural protectionalism; • poor cooperation of milk and dairy product manufacturers; • difficulties in their cooperation with processing companies and distribution networks

Source: compiled by the authors on the basis of [25–28].

Solving the problems (Figure 3) which impede AIC digitalisation, including the dairy industry, is a part of the national goal of an integrated development of rural areas which comprises the necessity to develop (taking into consideration the spatial development of the country) the pattern of AIC industries' and organisations' arrangement and specialisation arrangement on the basis of a multilevel integrated information space applying current digital technology[1].

In order to provide government support to AIC, an Analytical Center is established in the Ministry of Agriculture of the Russian Federation. It builds up a digital technology and a solutions portfolio for AIC, and provides a more efficient informing of farmers on new opportunities, technology, and existing practices. Russian academic literature offers the main areas of improvement of parameters of dairy industry regulation via its digitalisation. A.V. Glotko et. al [29] outlined the methodological framework for dairy industry modeling, applying digital technology, and showed the possibility to define the necessary amount of government financing to achieve the targeted indicators of the dairy industry at any regulation level by means of inverse forecasting. S.E. Terentyev et. al [30] described the implementation of cross-platform technology into manufacturing processes, the building of new business models of enterprises' market interaction on the basis of add-on applications for solving various practical problems as a prerequisite for development of the innovative mechanisms of the dairy industry. E.V. Zakshevskaya et. al offer a series of government regulation measures to overcome the problems structured in Figure 4. However, the possible ways of solving the above problems fail to comprise an important modern area of dairy subcomplex digitalisation which may mitigate and even eliminate the majority of identified problems.

[1] Digital Transformation of Russian agriculture: official publication – M.: Federal State Funded Research Institution Rosinformagrotech, 2019. ISBN978-5-7367-1495-7

Figure 4. Problems of development of the dairy subcomplex and measures of state regulation to overcome them

Development problems	• a weak policy of agricultural protectionism; • poor cooperation of milk and dairy product manufacturers; • difficulties in their cooperation with processing companies and distribution networks; • a long investment cycle; • a low operating efficiency of manufacturing; • no well-established approach to control of livestock breeding, quality of used materials (bull semen, supplement feeds etc.) and manufactured milk
Regulation measures	• restoration of stock breeding in cattle breeding; • investments in construction of drying equipment to even out the seasonal factor; • strengthening of protectionist measures and targeted government support of milk producers; • increase of state control of price volatility in the markets of feed, fuels, electricity and other resource markets; • development of the transport, social and engineering infrastructure in rural areas to attract skilled personnel

Source: [27].

The majority of papers on the regulation of the dairy subcomplex are dedicated to indicators of dairy stock farming as the basic parameters which define its development level. In particular, papers by A. Voitko [31; 32] describe some aspects of dairy stock farming development in Russia using the Stupinsky District of the Moscow Region as an example. He considers the issues of modernisation and enhancement of the industry efficiency by means of providing government regulation of production and sales of agricultural products. Digital technology will provide an opportunity to forecast the necessary extent of government support, its target orientation and eliminate intermediaries which assist in selling it.

Papers by N.I. Strekozov et. al are dedicated to the study of the problems in the dairy sector of AIC. They emphasise that [33] the existing situation in the Russian dairy market raises certain difficulties for using competitive advantages of Russian corporations. It is mainly related to underperformance of government regulation in solving the top-priority problems in this multicommodity system [34]. The existing model of economic relations between all players of the Russian dairy market does not provide an optimal accord of interests of the dairy subcomplex partners. A price imbalance between the agricultural and servicing sectors of the dairy subcomplex caused a conundrum: on the one hand, agricultural corporations find it very difficult to sell their products (milk vendibility for all categories of entities does not exceed 65%), and on the other hand, there is a milk deficiency in the retail market where demand is unsatisfied [28]. The end links of the product promotion chain – an agricultural producer and retail buyer – are either forced to agree to the dictated terms and suffer losses, or reduce their share in the internal food market, which is the main cause for continuing reduction in livestock number and milk and dairy products consumption per capita. In terms of Russian cattle breeding the main impediment in development is low profitability of the industry [35]. Digitalisation of government regulation of price formation processes and product promotion from the producer to the end consumer is necessary in order to solve these problems of the dairy subcomplex. Consequently, we may identify the main aspects which need digitalisation of the dairy subcomplex in the first instance:

Sale of dairy products over the internet, applying electronic commerce systems [36].

Use of cloud technology for cooperation and integration of economic entities in the virtual environment [37].

Evaluation of Corporations Readiness for Digitalisation

Dairy stock farming develops according to the scenario of the industries with rising expenses [38]. Reduction in expenses is possible mainly due to efficient development of innovative technology in the areas of manufacture, management, marketing, and logistics. Improvement of the ways of government support implies an increase of agricultural output with a simultaneous decrease in customer prices, which will make food affordable to the general public.

After analysis of the Russian experience of government regulation of dairy subcomplex digitalisation, we made an attempt to structure the problems of the enterprises of this industry and to offer ways of their solving. The obtained results are systematised in Table 2.

Table 2. Problems of state regulation of digitalisation of the dairy subcomplex and ways to overcome them

Problems	Ways to overcome the problems
Insufficient attention to the issues of government regulation of the dairy industry in scientometric bases	Analysis of results applying digital technology of scientometric bases and statistics
Lack of financial resources to implement ICT Shortage of skilled personnel Absence of digital infrastructure Imperfection of legal regulation of ICT development	Necessity to develop (taking into consideration spatial development of the country) the pattern of AIC industries' and organisations' arrangement and specialisation arrangement on the basis of a multilevel integrated information space applying current digital technology
Insufficient genetic potential of livestock's productive capabilities	Noncontact remote measurements using digital technology
Assessment of personnel qualification, exterior and noncontact measurements	Possibility to apply the comparative analysis, scientific classification, systematisation, theoretical generalisation and statistical methods
Evaluation of the state of a regional dairy market	Possibility to use digital technology as the most important resource of government regulation
Assessment of automation and robot automation of economic entities	Development of digital technology which improves accuracy of data analysis, automation not just for operational staff but for specialists as well
Assessment of the potential of dairy farming and the dairy industry	Development of digital technology aimed at vendibility improvement of the produced milk
Development of economic entities	Development of the mathematical apparatus of digital technology which defines prospective lines of development
Making a regional program for development of all areas of activities	Development of the mathematical apparatus of influence of regulation on dairy subcomplex performance
Formation of state policy and regulation measures	Development of the mathematical apparatus of forecasting the necessary extent of government support
Evaluation of government regulation efficiency	Digitalisation of government regulation of the processes of price formation and product promotion from the manufacturer to the customer
Cost reduction	Development of the mathematical apparatus of cost optimisation
Innovative modernisation	Bank of the best available technology and mechanisms based on simulation modeling

As we see in Table 2, several key aspects of the problems of digitalisation of government regulation in the dairy subcomplex may be defined: information, financial, personnel-related, and selection aspects. Solving of the problems requires application of mathematical tooling and digital technology.

So, according to the academic literature, problems in the digitalisation of the economy are studied in papers by Russian and foreign authors but in spite of the number of these papers some issues have not been covered in full. In particular, the economic science has not developed a consistent approach to study of influence of government regulation on performance of dairy subcomplex enterprises under the conditions of digitalisation.

The performed research is based on the data concerning one of the largest constituent entities of the Russian Federation – the Novosibirsk Region. This constituent entity has been chosen for several reasons. First, the Novosibirsk Region ranks among top 10 regions of the Russian Federation according to the three key indicators: cow population, output and milk sale and consumption per capita. The Novosibirsk Region is the location of a large-scale livestock

industry, and overall, local enterprises manufacture 80% of milk and 83% of meat. Second, in 2018 the Novosibirsk Region was the 18th in the country by dairy cow production and its share in all-Russian milk output amounted to 2.4%. As long as our research is dedicated to dairy industry digitalisation we think it is necessary to confirm that the region chosen for analysis is ready for such transformation. Study of innovative development of the Novosibirsk Region on the basis of the Russian regional innovative index is indicative of moderate incremental dynamics: so, within the period of 2014 – 2019 the Novosibirsk Region went up in the rating from the 41st to the 8th position and became a part of the first group of constituent entities of the Russian Federation which index deviates from the leader's index (Moscow) less than 20%. Besides, it is necessary to emphasise that the region occupies the 3rd position in the quality of innovative policy. Affiliation to the first group, according to the Russian regional innovative index, is all the more important because this constituent entity lacks social and economic conditions for innovative activity (index of 38). On the basis of the results of the National Investment Climate Index, the Novosibirsk Region is steadily in the top 20 and is the 19th for the past two years. As for dynamics and current development of digital life the Novosibirsk Region is in the first of the four groups which is characterised by strengthening leadership with high current indicators and high dynamics, i.e. it develops quicker than the leader (Ekaterinburg) and its digital life index is above the average.

Thus, the chosen constituent entity of the Russian Federation has several characteristics most important for research: a pronounced specialisation of cow population (milk production), a high level of productivity, and a high level of prerequisities for the implementation of digital technology in government regulation of the industry (as well as in the activity of the corporations which form this industry).

Research Methodology

A preliminary analysis revealed the following main fields of high-priority research.

1) Development of criteria for assessment of the digitalisation level of economic entities (organisations, districts, regions) of the dairy subcomplex.
2) Defining possible interrelations between the offered criteria and operating profit of economic entities.
3) Development of the methods of preliminary evaluation of efficiency of the procedure of economic entities' digitalisation depending on the offered evaluation criteria.

In order to study the offered fields of research, we suggested the following hypotheses.

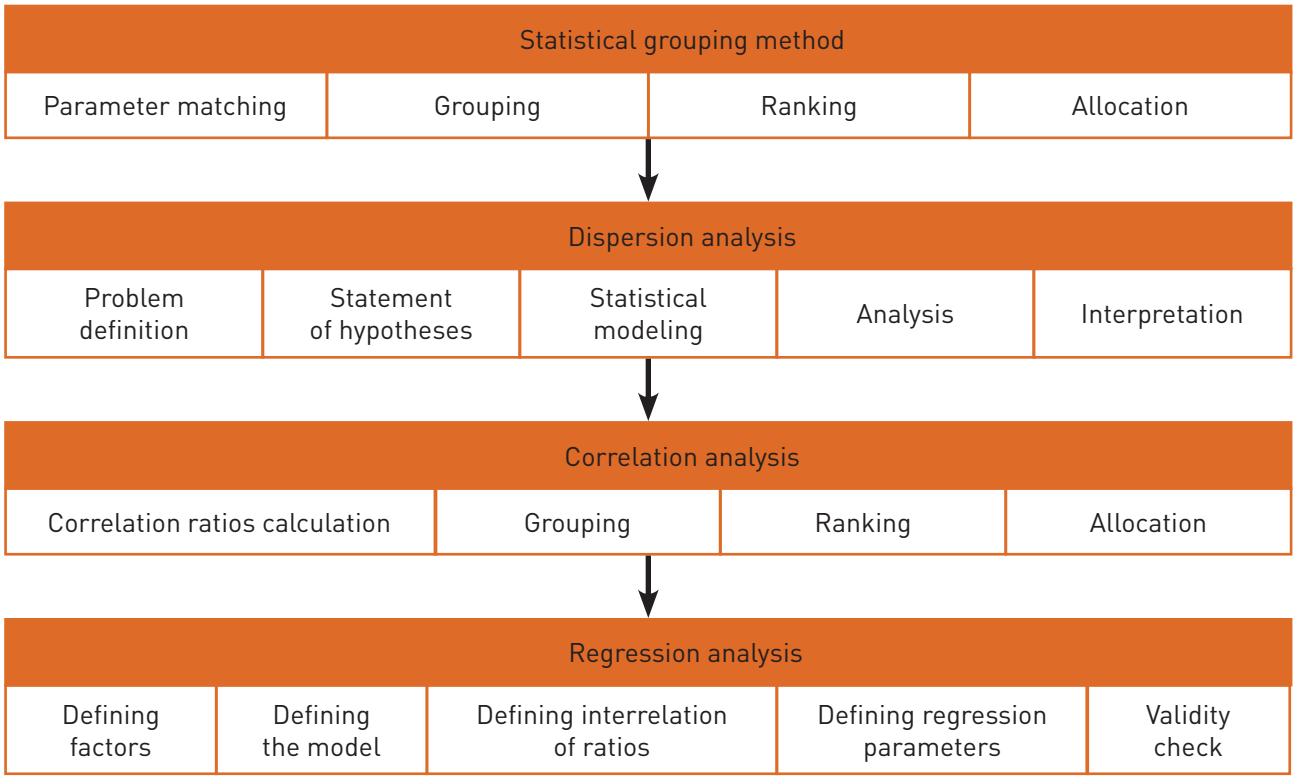
1) As long as the academic community offered various criteria for assessment of the digitalisation level of countries and organisations (Figure 5) development of such criteria is possible for the milk industry as well.

Figure 5. The criteria of digitalisation

BCG (Boston Consulting Group) [39; 40]	• I_1 – subindex Infrastructure development • I_2 – subindex Online expenses • I_3 – subindex User engagement
Country Digitalisation Index (E-Government Development Index) [41]	• I_1 – subindex Web presence of government authorities • I_2 – subindex Telecommunication infrastructure • I_3 – subindex Human capital
Digital Spillover (Free goods of the digital economy) [42]	• I_1 – subindex Speeding up of knowledge transfer • I_2 – subindex Innovation in business • I_3 – subindex Productivity improvement
N.A. Stefanova Evaluation of efficiency of the digital economy [43]	• I_1 – subindex Readiness to networked economy • I_2 – subindex Readiness to electronic commerce • I_3 – subindex Readiness to e-government • I_4 – subindex Readiness to society informatisation
Small and medium business digitalization index (Business Digitization Index, BDI) [44]	• I_1 – subindex Information transfer channels • I_2 – subindex Information storage channels • I_3– subindex Use of Internet for sales • I_4 – subindex Information security • I_5 – subindex Digital training
Business Digitalisation Index (Institute of Statistic Studies and Economics of Knowledge) NRU HSE [45]	• I_1 – subindex Broad Band Internet • I_2 – subindex Cloud services • I_3 – subindex RFID technology • I_4 – subindex ERP systems • I_5 – subindex Electronic sales using special forms on a site/ extranet, EDI systems

Source: developed by the authors on the basis of [39–45].

Figure 6. Statistical analysis algorithm with classification of methods



Source: developed by the authors.

Table 3. Characteristics of precision (precision) animal husbandry in the Maslyaninsky district of the Novosibirsk region, heads

Company	Monitoring of livestock products quality	Electronic database of production process	Identification and monitoring of certain herd individuals	Monitoring of herd health
Sibirskaya Niva LLC	8391	18 699	17 025	17 025
Sibirskiy Pakhar, LLC	423	–	–	–
Head of KFH Gerasimov A.I., Individual entrepreneur	160	–	–	–
Gasimov Ch.R.O., Individual entrepreneur	20	–	–	––

If there exist criteria for evaluation of the digitalisation level of dairy subcomplex economic entities, there may be a functional relationship with performance indicators of economic entities and a possibility to define efficiency of the digitalisation process using them.

We used the data from the sites of Novosibirskstat[2], Ministry of Agriculture of the Novosibirsk Region[3] and related publications as sources of initial information. Statistical analysis was applied as methods of evaluation of the situation in AIC. Its algorithm is presented in Figure 6.

[2] Territorial body of the Federal State Statistics Service for the Novosibirsk Region, Ministry of Agriculture of the Novosibirsk Region. URL: https://novosibstat.gks.ru/

[3] Ministry of Agriculture of the Novosibirsk Region. URL: https://mcx.nso.ru/

On the basis of the results of previous research (Figure 5) we offer to introduce criteria of evaluation of the informatisation level of dairy subcomplex economic entities in order to define their readiness to transformation into the digital economy. We accepted as analogues the last two criteria indicated in Figure 5. Due to a specific character of the industry it is problematic to apply the above indices to all economic entities of the dairy subcomplex because other digitalisation criteria are used (Table 3).

It should be noted that the characteristics listed in Table 3 may be applied in economic entities in their entirety as well as partially and also may differ or concur in number.

Taking into consideration industry characteristics, we attempted to perform an integral evaluation of the level of expansion of digital technology in dairy cattle breeding using the following two parameters: digitalisation share and index. The first indicator characterises the share of an economic entity among all entities participating in digitalisation of dairy herd, while the second one characterises the four indicators of the rate of adaptation to digital transformation by the level of use.

In view of the necessity of defining the influence of the industry corporations' digitalisation established in state programs on corporations' performance, we used the correlation and regression analysis approach.

Research Results

Development of Criteria for Evaluation of the Corporations' Digitalisation Level

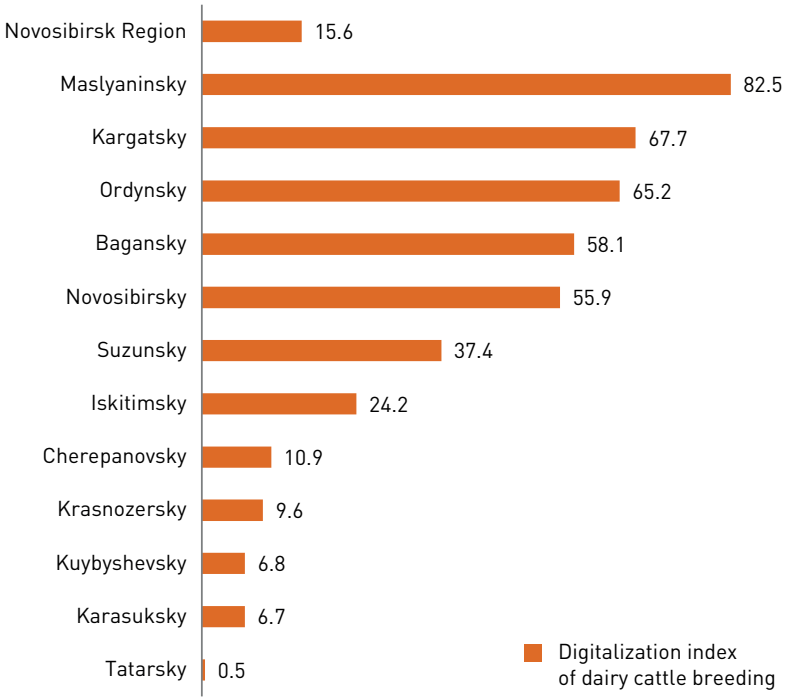
On the basis of the objective stating that it is necessary to develop criteria for evaluation of the digitalisation level of economic entities, conditions and limitations imposed when achieving this can assume hypothetically that there is an interrelation between digitalisation indicators and performance indicators of dairy industry corporations. We applied the correlation and regression analysis to verify this hypothesis (Figure 6).

For integral evaluation of the expansion level of digital technology in dairy cattle breeding we offer to use two parameters: digitalisation share and index of dairy cattle breeding.

Development of the Corporations Digitalisation Index

The first indicator characterises the share of an economic entity among all entities participaring in digitalisation of dairy herd, while the second one characterises the four indicators of the rate of adaptation to digital transformation by the level of use. See the examples of calculation of the offered digitalisation indicators for the districts and economic entities of the Novosibirsk Region in Figures 7-10.

Figure 7. Index of digitalisation of dairy cattle breeding in the Novosibirsk Region by districts

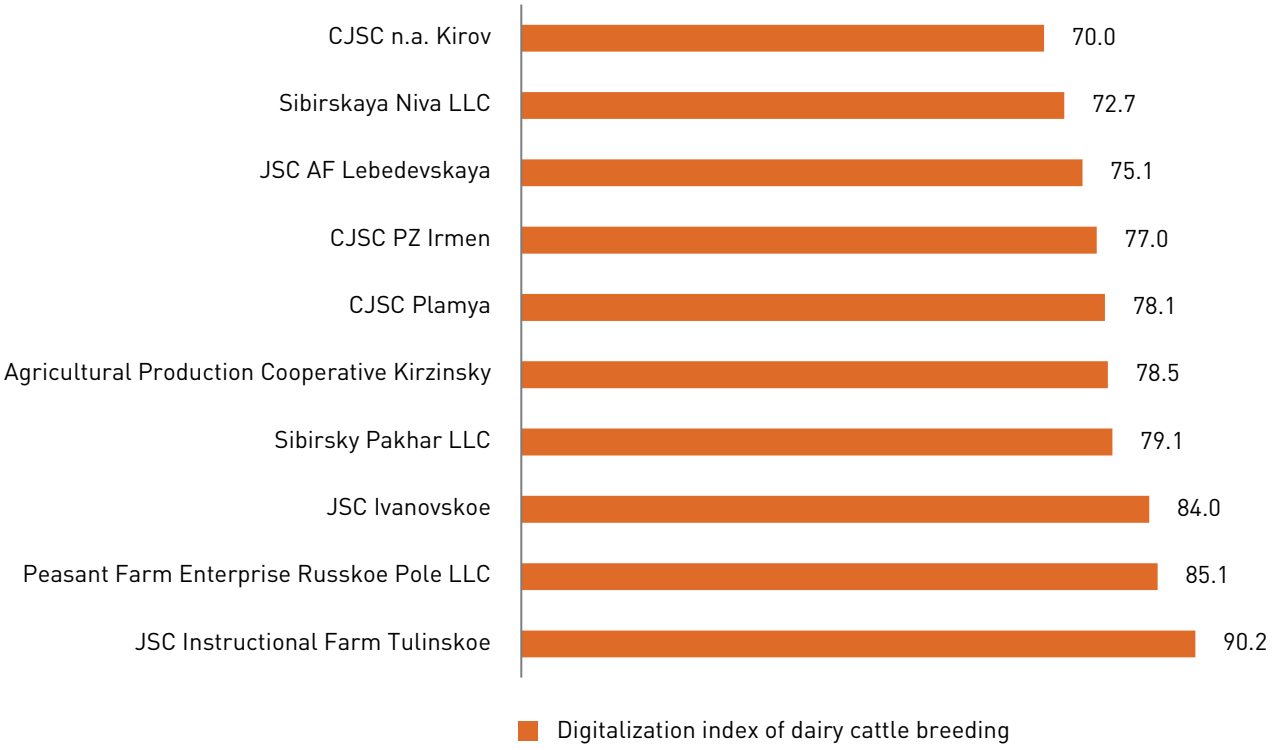


Source: developed by the authors.

The data from Figure 7 is indicative of a low rate of adaptation to digital transformation of the dairy industry in Novosibirsk Region. Thus, digitalisation covers less than 50% - just 12 districts of the region out of 29. The index in Figure 8 shows that in general in the Novosibirsk Region 15.6% of dairy herd administration has been digitalised, with Maslyaninsky district as the leader with 82.5%, and Tatarsky district is an outsider with a digitalisation index of less than 1%. A wide distribution of the obtained index values (82%) is indicative of a significant differentiation of the digitalisation level even in the districts where it is conducted.

The digitalisation index of dairy cattle breeding is calculated in a similar way for corporations (Figure 8).

Figure 8. Index of digitalisation of dairy cattle breeding in the Novosibirsk Region by companies



Source: developed by the authors.

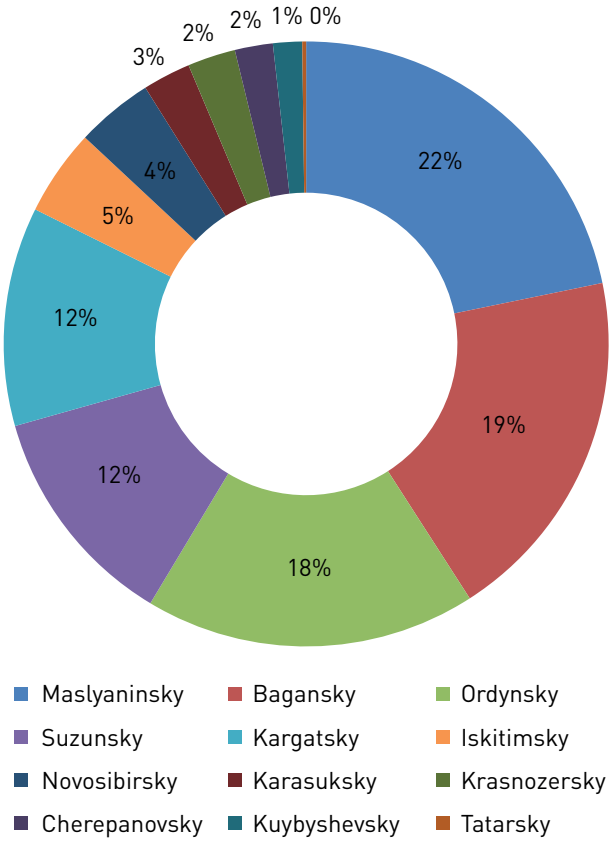
The digitalisation index of dairy cattle breeding with a breakdown into corporations demonstrated in Figure 8 confirms the assertion expressed above on insufficient digitalisation of the industry. The figure shows the top 10, where over 70% of dairy herd of the entity is digitalised. Over half of these 10 largest corporations – milk producers - failed to achive the digitalisation index level of 80% and just one corporation - Instructional Farm Tulinskoe LLC has a digital index exceeding 90%.

Development of Digitalisation Share of Economic Entities of Dairy Cattle Breeding

The second indicator of the integral evaluation which characterises the share of an economic entity among all entities participating in digitalisation of dairy herd is shown in Figures 9–10.

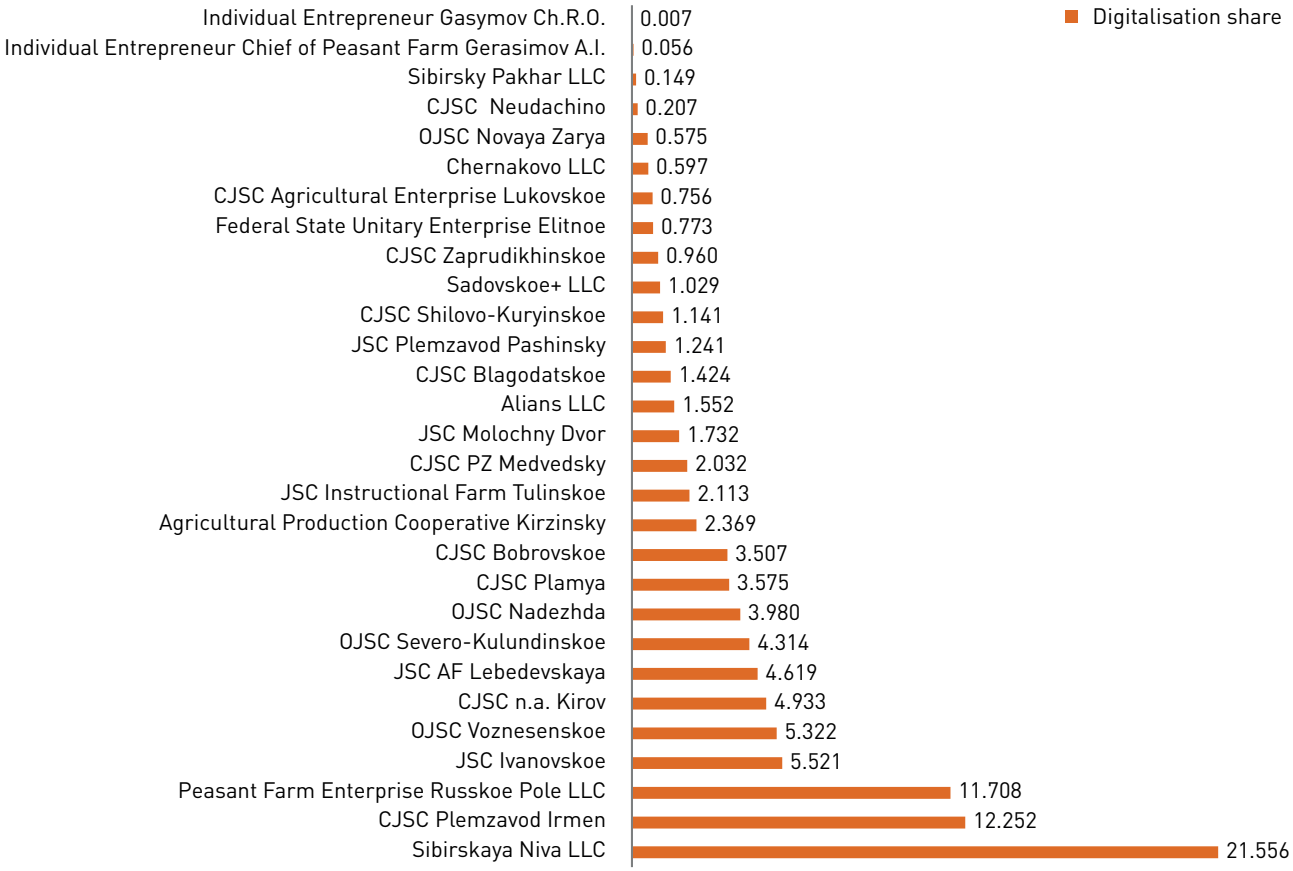
The indicated data confirms the conclusions made earlier. So, by the digitalisation share, the top three is comprised of the same districts of the Novosibirsk Region as by the digitalisation index: Maslyaninsky, Kargatsky, Ordynsky. The digitalisation share in these districts exceeds 65%. As we see from Figure 9, only in five out of 12 districts is more than half of dairy cattle breeding digitalised. In the remaining seven districts the digitalisation share is less than 40% and in four districts out of these seven the share is below 10%, which is indicative of the districts' unpreparedness to digital transformation.

Figure 9. Share in digitalisation of dairy cattle breeding in the districts of the Novosibirsk Region



Source: developed by the authors.

Figure 10. Share in digitalisation of dairy cattle breeding by corporations in the Novosibirsk Region



Source: developed by the authors.

29 economic entities implement digitalisation of dairy cattle breeding, including two individual entrepreneurs, out of 10 districts of the Novosibirsk Region. Moreover, the top three accounts for almost a half of the share in digitalisation of dairy cattle breeding.

Financial Standing of AIC Companies

An opportunity to establish relations between financial parameters and digitalisation indicators offered by the authors is of special interest. Comparative characteristics of financial indicators of ten economic entities in the Novosibirsk Region with digitalisation parameters are presented in Table 4.

The indicators listed in Table 4 in comparison to industry average values are declarative of an ambiguous character of financial standing of dairy corporations of the Novosibirsk Region. So, by financial soundness indicators, Novosibirsk corporations are less sound (the equity to total assets ratio is less than the industry average indicator, while the leverage ratio is greater) which indicates a higher financial risk level. However, with profitability indicators the situation is reverse: return on assets and return on equity exceed the industry average value. The presented data shows a top five of corporations – leaders in the key financial indicators (their values exceed the industry average value). They comprise CJSC Plemzavod Irmen, CJSC n.a. Kirov, Agricultural Production Cooperative Kirzinsky, CJSC Plamya and Sibirsky Pakhar LLC. Such enterprises as Sibirskaya Niva LLC (GK EcoNiva - Agro-Industrial Complex Holding), Peasant Farm Enterprise Russkoe Pole LLC, CJSC Agricultural Firm Lebedevskaya are in a difficult financial position due to a high financial dependence and insufficient working capital, but regardless, these companies are profitable. In spite of different financial situations all corporations are to some extent involved in digitalisation.

Let us conduct a correlation analysis of comparative characteristics of financial indicators in Table 5.

Table 4. Comparative characteristics of financial indicators of 10 economic entities of the Novosibirsk Region with digitalisation parameters

	Parameter	CJSC Plemzavod Irmen	Sibirskaya Niva LLC (GK EcoNiva - AIC Holding)	Peasant Farm Enterprise Russkoe Pole LLC	JSC Agricultural Firm Lebedevskaya	JSC Ivanovskoe	CJSC n.a. Kirov	APC Kirzinsky	CJSC Plamya	JSC Instructional Farm Tulinskoe	Sibirsky Pakhar LLC	Industry average values of indicators[4]
Y1	Revenue, rub	2 495 091	2 023 843	1 463 589	736 546	318 942	262 026	214 501	214 151	131 625	50 641	–
Y2	Cost of sales, rub	2 071 171	1 732 180	1 353 470	714 861	301 978	261 485	206 056	207 748	118 680	45 464	–
Y3	Profit on sales, rub	406 496	289 214	–1969	21 685	16 964	541	2759	1764	12 945	5177	–
Y4	Net profit, rub	486 133	62 982	26 975	1426	43 194	24 015	18 529	16 139	18 502	11 185	–
Y5	Equity capital, rub	3 286 493	445 131	43 654.5	166 726	498 340	317 857	218 268	318 205	17 044	82 064	–
Y6	Autonomy coefficient	0.95	0.04	0.01	0.10	0.72	0.88	0.78	0.83	0.34	0.97	0.56
Y7	Financial leverage ratio	0.06	21.68	172.01	9.07	0.40	0.14	0.29	0.20	1.96	0.03	0.31
Y8	Noncurrent assets, rub	1754369	6214146,5	5 531 414.5	1 105 065	392 536	160 567	143 958	129 053	785	33 812	–
Y9	Share of non-current assets,%	50,55	61,55	73.24	65.79	56.44	44.24	51.24	33.73	1.55	39.97	–
Y10	Current assets, rub	1716231	3882333	2 021 256	574 566	302 914	202 355	137 011	253 563	49 702.5	50 786	–
Y11	Share of current assets,%	49,45	38,45	26.76	34.21	43.56	55.76	48.76	66.27	98.45	60.03	–
Y12	Total asset value, rub	3470600	10096479,5	7 552 670.5	1 679 631	695 449	362 922	280 969	382 616	50 487.5	84 598	–
Y13	Ratio of own circulating assets	0,89	-1,49	–2.72	–1.63	0.35	0.78	0.54	0.75	0.33	0.95	0.37
Y14	Net profit sales margin,%	19,48	3,11	1.84	0.19	13.54	9.17	8.64	7.54	14.06	22.09	10.2
Y15	Return on equity,%	14,79	14,15	61.79	0.86	8.67	7.56	8.49	5.07	108.55	13.63	22
Y16	Return on assets,%	14,01	0,62	0.36	0.08	6.21	6.62	6.59	4.22	36.65	13.22	8.9
Y17	Digitalisation share,%	12,252	21,556	11.708	4.619	5.521	4.933	2.369	3.575	2.113	0.149	–
Y18	Digitalisation amount, heads	34752	61140	33 208	13 100	15 660	13 992	6720	10 140	5992	423	–
Y19	Digitalisation index of dairy cattle breeding, %	77,0	72,7	85.1	75.1	84.0	70.0	78.5	78.1	90.2	79.1	–

[4] According to the site: https://www.testfirm.ru/otrasli/01/

Table 5. Correlation analysis of comparative characteristics of financial indicators of 10 economic entities of the Novosibirsk Region with digitalisation parameters

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19
Y1	1.00	1.00	0.88	0.73	0.69	–0.32	0.33	0.74	0.49	0.85	–0.49	0.79	–0.41	–0.14	–0.05	–0.25	0.87	0.87	–0.23
Y2	1.00	1.00	0.85	0.70	0.66	–0.36	0.37	0.77	0.52	0.86	–0.52	0.81	–0.46	–0.18	–0.05	–0.28	0.88	0.88	–0.23
Y3	0.88	0.85	1.00	0.84	0.83	0.00	–0.13	0.44	0.18	0.69	–0.18	0.53	0.01	0.19	–0.15	–0.01	0.73	0.73	–0.31
Y4	0.73	0.70	0.84	1.00	0.99	0.31	–0.12	0.10	0.08	0.31	–0.08	0.18	0.24	0.44	–0.10	0.14	0.38	0.38	–0.13
Y5	0.69	0.66	0.83	0.99	1.00	0.37	–0.19	0.05	0.10	0.26	–0.10	0.12	0.29	0.43	–0.20	0.09	0.35	0.35	–0.19
Y6	–0.32	–0.36	0.00	0.31	0.37	1.00	–0.58	–0.71	–0.34	–0.57	0.34	–0.67	0.93	0.76	–0.39	0.20	–0.50	–0.50	–0.18
Y7	0.33	0.37	–0.13	–0.12	–0.19	–0.58	1.00	0.69	0.49	0.41	–0.49	0.60	–0.77	–0.46	0.37	–0.32	0.36	0.36	0.31
Y8	0.74	0.77	0.44	0.10	0.05	–0.71	0.69	1.00	0.59	0.94	–0.59	0.99	–0.80	–0.52	0.12	–0.44	0.89	0.89	–0.10
Y9	0.49	0.52	0.18	0.08	0.10	–0.34	0.49	0.59	1.00	0.51	–1.00	0.57	–0.62	–0.50	–0.53	–0.88	0.51	0.51	–0.40
Y10	0.85	0.86	0.69	0.31	0.26	–0.57	0.41	0.94	0.51	1.00	–0.51	0.97	–0.60	–0.38	–0.01	–0.38	**0.98**	**0.98**	–0.26
Y11	–0.49	–0.52	–0.18	–0.08	–0.10	0.34	–0.49	–0.59	–1.00	–0.51	1.00	–0.57	0.62	0.50	0.53	0.88	–0.51	–0.51	0.40
Y12	0.79	0.81	0.53	0.18	0.12	–0.67	0.60	0.99	0.57	0.97	–0.57	1.00	–0.74	–0.48	0.07	–0.42	0.94	0.94	–0.16
Y13	–0.41	–0.46	0.01	0.24	0.29	0.93	–0.77	–0.80	–0.62	–0.60	0.62	–0.74	1.00	0.78	–0.20	0. 47	–0.54	–0.54	–0.07
Y14	–0.14	–0.18	0.19	0.44	0.43	0.76	–0.46	–0.52	–0.50	–0.38	0.50	–0.48	0.78	1.00	0.06	0.60	–0.37	–0.37	0.22
Y15	–0.05	–0.05	–0.15	–0.10	–0.20	–0.39	0.37	0.12	–0.53	–0.01	0.53	0.07	–0.20	0.06	1.00	0.72	–0.05	–0.05	**0.77**
Y16	–0.25	–0.28	–0.01	0.14	0.09	0.20	–0.32	–0.44	–0.88	–0.38	0.88	–0.42	0.47	0.60	0.72	1.00	–0.38	–0.38	0.58
Y17	0.87	0.88	0.73	0.38	0.35	–0.50	0.36	0.89	0.51	**0.98**	–0.51	0.94	–0.54	–0.37	–0.05	–0.38	1.00	1.00	–0.29
Y18	0.87	0.88	0.73	0.38	0.35	–0.50	0.36	0.89	0.51	**0.98**	–0.51	0.94	–0.54	–0.37	–0.05	–0.38	1.00	1.00	–0.29
Y19	–0.23	–0.23	–0.31	–0.13	–0.19	–0.18	0.31	–0.10	–0.40	–0.26	0.40	–0.16	–0.07	0.22	**0.77**	0.58	–0.29	–0.29	1.00

Development of Methods for Preliminary Evaluation of Companies' Digitalisation Efficiency

The correlation analysis showed that financial indicators, except for net profit, equity, ratios, shares and profitability are closely correlated (correlation ratio R >0.7) with the extent of digitalisation, especially current assets (R = 0.98). The digitalisation index of dairy cattle breeding showed a strong relationship only with return on equity (R = 0.77) and no relationship at all with the extent of digitalisation (R = –0.29). We can assume that the offered digitalisation parameters do not duplicate, but rather complement each other. The strength of relationship between return on equity and digitalisation index is to a greater extent caused by dependency on the asset turnover ratio and leverage (over 0.5) than on return on sales (a little over 0.2). The obtained results confirm our hypothesis and suggest that there is a dependency of assets utilisation efficiency and financial risk on the digitalisation index in dairy cattle breeding.

The interrelation of the digitalisation index of dairy cattle breeding with return on equity with a relative accuracy of less than 10% (Table 6) which is fewer than the admissible value of 15% may be presented as the following regression equation:

$$Id = 0.17 \times ROE + 74.258. \quad (1)$$

Discussion of Results

Analysis of mathematical model (1) showed that corporations of the Novosibirsk Region which chip their dairy herd have a minimum digitalisation index of dairy cattle breeding of 74%, which deviations with the ratio of 0.17 depend on return on equity, which in its turn, is related to the velocity of assets circulation and leverage.

Table 6. Checking the adequacy of the relationship between the dairy cattle digitalisation index and return on equity

Parameter	CJSC Plemzavod Irmen	Sibirskaya Niva LLC (GK EcoNiva - AIC Holding)	Peasant Farm Enterprise Russkoe Pole LLC	JSC Agricultural Firm Lebedevskaya	JSC Ivanovskoe	CJSC Kirov	APC Kirzinsky	CJSC Plamya	JSC Instructional Farm Tulinskoe	Sibirsky Pakhar LLC
Return on equity,%	14.79	14.15	61.79	0.86	8.67	7.56	8.49	5.07	108.55	13.63
Digitalisation index of dairy cattle breeding (estinated), %	76.77	76.67	84.77	74.40	75.73	75.54	75.70	75.12	92.73	76.58
Digitalisation index of dairy cattle breeding (actual), %	77.0	72.7	85.1	75.1	84.0	70.0	78,5	78.1	90.2	79.1
Absolute deviation, %	–0.225	4.007	–0.373	–0.696	–8.295	5.583	–2.818	–3.002	2.570	–2.541
Relative deviation, %	–0.29	5.,51	–0.44	–0.93	–9.87	7.98	–3.59	–3.84	2.85	–3.21

The presented model allows us to forecast with a sufficient degree of confidence (deviation not exceeding 10%) a probable value of the digitalisation index of dairy cattle breeding for 10 prospective economic entities of the Novosibirsk Region (Table 7). Consequently, the organisations which plan 'chipping' of their dairy herd may consider the digitalisation index of dairy cattle breeding a reasonable reflection of an attractive business format for them.

Conclusion

In this paper we have considered the influence of government digitalisation policy on the state and development of corporations of the dairy industry. We have revealed an integrated system approach to evaluation of influence of state programs related to digitalisation of the dairy industry on corporations' performance, as exemplified by economic entities of the Novosibirsk Region.

The research results are indicative of general consistent patterns and interrelations between components of digital technology provided for in state programs and performance of dairy industry corporations. The statistical analysis (Figure 7) allows to assert that digital technology which is a part of government regulation of the dairy industry implemented in corporations has a significant impact on business performance. The offered digitalisation criteria and revealed consistent patterns of their interrelation with performance and expected efficiency, in their turn, are indicative of the possibility to manage the digitalisation process based upon preset parameters of business performance and the possibility to forecast the key indicator – the digitalisation index on the basis of a derived regression equation.

The research makes a contribution to development of theoretical approaches to evaluation of influence of state programs on business performance in the dairy industry. This is performed under the conditions of the digital economy, by means of development of a common methodology of evaluation of influence of government regulation on the performance of the dairy industry. The basis of the methodology is the calculation of a digitalisation index used to assess the efficiency of government support of the industry corporations. The practical value of our presented research consists in the possibility to use the offered approach for evaluation and forecasting of performance of dairy industry corporations, taking into consideration the impact of government regulation via the offered digitalisation parameters.

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Conceptual Problems in the Use of Risk-Adjusted Discount Rate for Risky Negative Cash Flows

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Abstract

This paper examines the risk adjusted discount rate (RADR) method for evaluating risky nonconventional projects, which has been hotly debated over the last century [1]. Economists face the contradiction of using the NPV rule to evaluate projects with different levels of risk. According to the theory of investments, the higher the project risk, the greater the return for the investor. Therefore, an increased discount rate is used to evaluate a riskier project, as a result, the project's NPV decreases and the project is deemed less attractive or even unprofitable for investment. However, the NPV of a nonconventional investment project may increase through increasing the discount rate, and then the investor, following the NPV rule, will choose a riskier project out of two projects with the same yield. That does not correspond to the hypothesis about rational investor behavior.

We continue the study of the RADR method. Recently, published works [2–4] have proposed a solution to the debatable RADR problem. The GNPV method was used for evaluating risky nonconventional projects. We will evaluate these aspects of the recent literature. We examine the fallacy of the main arguments (to maintain value additivity and preclude arbitrage) justifying the application of a single rate to discount risky opposite sign cash flows. The future cash flows are estimated independently of the transactions preceding them, which seems illogical, so a risk penalty formula which adjusts the discount rate applied to risky negative cash flows is applied. The risk penalty is determined depending on the risk premium in the case of symmetric and asymmetric distribution of cash flow values.

Our results are applicable to a diverse range of business applications, including but not limited to well-known asset pricing models, short position analysis, determining fair insurance premiums, and calculating appropriate RADRs for public private partnerships.

Keywords: nonconventional projects, net present value (NPV), risk, risk adjustment discount rate (RADR), negative cash flows, risk premium, risk penalty

Introduction

The risk adjusted discount rate method (RADR) applied to stochastic negative cash flows when evaluating nonconventional projects was a matter of a serious argument over several decades [5]. According to investment theory, the higher the project risk, the more return, and to achieve this an investor is required. Therefore, in order to evaluate a riskier project, an increased discount rate is applied. As a result, the project NPV decreases, and the project is perceived as less attractive or even unfavorable for investment. However, the NPV of a nonconventional investment project may increase instead of decreasing along with discount rate growth. In such a case, an investor following the NPV rule will choose a riskier project out of two projects with equal profitability. Such a choice contradicts the hypothesis of rational investor behavior.

In relation to this, two positions were expressed regarding risk adjustment of discount rate for stochastic negative cash flows. The first position states that the RADR, applied to a future risky cash flow, is independent on whether the flow is positive or negative, and the RADR increases along with growth of cash flows risk. The second position states that the RADR applied to future stochastic cash flows of equal risk is different for positive and negative cash flows. The rate increases for positive cash flows and decreases for negative cash flows as they become riskier. In other words, supporters of the first position assert that the same rate should be applied to evaluation of opposite sign cash flows of equal risk. Supporters of the second position affirm that different rates should be applied to assess random positive and negative cash flows of equal risk.

The main arguments of the first position supporters are as follows: a single rate is necessary to preclude arbitrage [6; 7]; the NPV loses additivity at different rates [8; 9]; as risk grows a negative premium may approximate the RADR to –1, as a result, and the present value of negative cash flows will be infinite [10]. Their opponents attribute the difference in adjustment of discount rates to the different nature of opposite sign cash flows, and consequently to other risks of negative cash flows [11]; to an inverse correlation of negative cash flows and the market rate [12; 17]; and to different approaches to risk identification and mitigation: decrease of the expected benefit or increase of estimated costs [18; 19].

The problem of adjustment of the discount rate for stochastic negative cash flows has been unsolved for a long time. For a significant period of time no references were made to it, as if the problem did not exist. Consequently, there were controversial recommendations in the financial literature concerning adjustment of the discount rate applied to random negative cash flows. Managers had no idea when a positive or negative risk premium should be used and how it was calculated [20].

The contradiction is a result of a standard application of the methods developed to assess investments to evaluation of risky loans. Economists know very well that in order to evaluate loans one has to reverse the nonequality sign in the IRR rule intended to assess investments ($IRR > d$, where d is the discount rate), because for investments IRR is a return while for a loan, it represents an interest rate. "When we lend money, we want a high rate of return; when we borrow money, we want a low rate of return" [21]. Consequently, if IRR has different economic substance for investments and loans, it should be compared to different discount rates distinguished in economic substance. The NPV uses a single discount rate called 'opportunity cost of capital'. In the evaluation of nonconventional projects, this rate is at the same time the rate of return and cost of capital. Thus, capital is lent and placed at the same rate, and this causes problems for the evaluation of nonconventional projects. Recently the generalized net present value (GNPV) method has been offered which uses two different rates to discount investments and loans which form a nonconventional project [22; 23]. The financial rate is used to attract funds for project financing while the reinvestment rate is used to invest them. Thereby, the GNPV method by default implies that in case of risk adjustment the financial rate is to be increased, while the reinvestment rate is to be reduced [2]. Thus, the GNPV method solves the problem of the RADR for evaluation of random negative cash flows.

This paper pursues several objectives: 1) to show the fallacy of old arguments justifying the same way of changing RADR in case of assessment of risky cash flows with opposite signs; 2) to define the risk penalty value on the basis of the risk premium, in order to change RADR relative to a risk-free rate when evaluating random negative cash flows; 3) to sort out the controversial recommendations offered in manuals concerning the RADR method in respect to assessment of risky nonconventional projects.

The paper has the following structure. The first section defines our identified problem and gives a brief review of the relevant background research in the field. The second section discusses old arguments justifying the single approach to adjustment of the discount rate applied to risky opposite sign cash flows - we will prove that these arguments are fallacious. In the third section, we derive a formula of risk penalty to define the RADR applied to stochastic negative cash flows in case of symmetric and asymmetric distribution of their values. We compared the values of risk penalty calculated by the obtained formula and presented in paper [2]. We presented a case describing use of the RADR method. Finally, in the conclusion, we summarize the main results.

Problem Statement

Let us remember the RADR problem which emerges in evaluation of nonconventional projects in uncertain environments. William Beedles [24] considered a nonconventional project with three cash flows: $ –5,000; $111,500 and $–6,600. Let us assume that the first and second cash flows are completely certain while the last one takes on a value of $–6,200 or $–7,000 with a probability of 50/50. According to the investment theory, uncertain cash flows

should be discounted at the risk adjustment rate. Assuming such a rate is 9%, then the project NPV will be $–4.63. Let us suppose that in a similar project a random distribution of the third flow value of $–6,600 shows a greater dispersion being the mean of the two possibilities of $–5,200 and $–8,000 occurring with a probability of 50/50. This flow has higher risks, and therefore it should be discounted at an increased rate. If we take, for example, a rate of 11% the project NPV will be $+3.65. The result looks counterintuitive, because the project value should not grow as the risk increases. The remarkable thing is that this result did not strike Beedles as unusual. The role of the project NPV acquires more importance in the range of (0-15%) and achieves the maximum at the discount rate of 15%. He made the conclusion that the RADR method should not be used to assess nonconventional projects and offered to apply the certainty equivalent method (CE) in this case.

The CE method is considered to be an approach alternative to the RADR in the evaluation of risky investments. According to the CE uncertain expected cash flows are replaced with their certainty equivalents (guaranteed cash flows) and are discounted at a risk-free rate. Specialists consider the CE method to be more correct from the theoretical point of view than the RADR but the majority of companies apply the RADR more often [25; 26].

J. Miles and D. Choi [6], as supporters of the single approach to RADR adjustment, strongly criticized Beedles' offer to apply the CE method pointing out that it did not conform to the value additivity principle and arbitrage probability. R. Ariel [7] expanded on their arguments concerning the RADR method. However, there is an error in their reasoning which will be discussed in the following section.

According to the hypothesis of a rational investor who avoids risk, the project value should decrease as uncertainty increases. Therefore, performing risk adjustment, the discount rate should be increased for inflows, and reduced for outflows relative to a risk-free rate. A lot of economists hold to this view [11–19]. However, a decrease of the rate in case of riskier negative cash flows contradicts the investment theory (greater risk requires greater return). In order to eliminate this contradiction, it was proposed to evaluate the risk level of project cash flows separately and depending on the risk level, and use different rates. For example, M. Ehrhardt and P. Daves [11] offered to consider cash costs at the end of a nonconventional project as nonoperating flows of another nature and smaller risks. However, first, the offer to consider closure costs as non-operating and, consequently less risky, is not totally correct [2]. Second, the adjusted rate will anyway be risk-free to a greater extent (because the risk premium is positive), hence, the risk outflows cost will exceed similar risk-free outflows.

The economists who assessed protection against environmental risks emphasized that the risk premium sign for discount rate adjustment relative to a risk-free rate depends on the way of evaluation of the cost of insurance of environmental risk consequences: decrease of the expected benefit or increase of estimated costs [18; 19]. Insurance companies demand a greater premium in order to cover more uncertain cases in future and for this reason they reduce the rate more in order to assess the current value of future more uncertain payments [27].

This review shows that in order to perform different adjustments relative to a risk-free rate, the discount rates for positive and negative cash flows should be different. Recently there appeared publications which proved that nonconventional projects should be evaluated by the Generalized net present value (GNPV) method which by definition applies different rates to discount investments and loans forming such projects [22; 23]. The funds are attracted at the financial rate but invested at the reinvestment rate. The GNPV method by default implies an increase of the financial rate and decrease of the reinvestment rate when performing risk adjustment [2].

Depreciation and Arbitrage When Using Different Rates

J. Miles and D. Choi [6], R. Berry and R. Dyson [8] followed by R. Ariel [7] came up with valid arguments justifying use of the single rate (more specifically, a single method of risk adjustment of a risk-free rate) for discounting of random opposite sign cash flows. Probably, these old arguments are an obstruction to the final solving of the problem of the RADR applied to risky negative cash flows.

J. Miles and D. Choi [6] strongly criticized Beedles' offer to apply the CE method for assessment of random nonconventional projects. Let us quote a translation: "Assume company A has to make an uncertain payment of X US dollars to company B at the end of the current period. If company A uses $\alpha_A > 1$ as the CE factor to assess a negative cash flow the cost of this outflow will be calculated as follows:

$$V_A[X] = \frac{\alpha_A \cdot X}{1 + r_f}, \quad (1)$$

where r_f – a risk-free rate; X – expected cash flow; α_A – CE factor which forms a guaranteed (risk-free) outflow $\alpha_A > 1$".

According to Beedles, company B evaluates such uncertain cash inflow using $\alpha_B < 1$ as the CE factor:

$$V_B[X] = \frac{\alpha_B \cdot X}{1 + r_f}, \quad (2)$$

As long as $\alpha_A > \alpha_B$, company A assesses the payment value higher than company B i.e., $V_A[X] > V_B[X]$.

Then Miles and Choi reason as follows: "In perfect markets this difference in the value results in profit due to arbitrage because the same asset X is evaluated by the market players in a different way. So, a rational investor will offer company A to make payment X to company B at the price of $V_A[X]$. At the same time, he will offer com-

pany B the amount of $V_B[X]$ in exchange to a promised future payment of X. The arbitrage profit of $V_A[X] - V_B[X]$ will make market players compete reducing $V_A[X]$ and increasing $V_B[X]$ till $V_A[X] = V_B[X]$".

On the basis of the condition of equality of present values, to preclude arbitrage they made the conclusion that the rates should be equal, otherwise the law of conservation of value is not complied with. Therefore, in perfect markets evaluation of cash inflows and outflows should be identical.

The error in Miles and Choi's reasoning consists in the fact that they identify the present value of a future payment X from company A to company B with a certain amount which company B pays and company A receives at present. In fact, when a deal is concluded at the beginning of the period the asset value equals some value of Y which in a perfect market is defined irrespective of the players[1]. For this reason, company A evaluates a loan (Y; $-X$) while company B evaluates an investment ($-Y$; X). In order to preclude arbitrage in perfect markets it is necessary to even the present values of an investment and loan for companies B and A and in no way – the present values of individual random cash flows X and $-X$. Assuming that $X > 0$ and $Y > 0$ we will define the present value of a loan for company A by means of the CE method:

$$PV_A = Y - \frac{\alpha_A \cdot X}{1+r_f}. \quad (3)$$

For company B the net present value of an investment equals

$$PV_B = -Y + \frac{\alpha_B \cdot X}{1+r_f}. \quad (4)$$

The condition of arbitrage preclusion in a perfect market $PV_A = PV_B$ will be fulfilled if

$$2Y = \frac{(\alpha_A + \alpha_B) \cdot X}{1+r_f}.$$

If we assume that a random cash flow X has symmetric distribution then $\alpha_A = 1+\alpha$, $\alpha_B = 1-\alpha$, where $0 < \alpha < 1$.

The result is $Y = \frac{X}{1+r_f}$.

Thus, the current payment value equals the present value of the expected future payment calculated at a risk-free rate. Therefore, arbitrage in such a deal is impossible.

Ariel makes a similar error in his reasoning when assessing long and short positions of a risky asset. He also identifies the present value of a future random cash flow to the current value at which the asset is traded. The error is caused by the fact that future flows are evaluated irrespective of the transactions which generate them. First, an investor has to buy an asset and then sell it and vice versa.

Evaluation of Stochastic Investments and Loans

Paper [2] showed that discount rates of positive and negative present values differ in their nature and offered a RADR calculation method for investments and loans numerically. In this paper we will reproduce this method from an analytical point of view.

Symmetric Distribution of Cash Flow Random Values

Assume the first cash flow is precisely known and equals CF_1 while the second cash flow is a random value described by the normal law of distribution with the mean of $\langle CF_2 \rangle$ and a root-mean square error (RMSE) σ.

The theory of probability showed that if some normally distributed random variable x has the mean value of M and a root-mean-square deviation of σ, the probability of its getting into the interval of $x < y$ is predetermined by the probability integral of $F(x)$ [28]

$$P(x < y) = \frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{y} e^{\frac{(x-M)^2}{2\sigma^2}} =$$

$$= \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\frac{y-M}{\sigma}} e^{-\frac{t^2}{2}} = F\left(\frac{y-M}{\sigma}\right). \quad (5)$$

The probability of profit CF_2 is less than *the* CE_i value and equals

$$P(CF_2 < CE_i) = F\left(\frac{CF_i - \langle CF_2 \rangle}{\sigma}\right)$$

Suppose the profit CE_i is a certainty equivalent in case of investments. For the random variable CF_2 with the normal law of distribution the probability of profit is anyway not equal to zero and less than CE_i. If we let this probability be equal to δ, then the certainty equivalent for investment may be determined by the following formula:

$$F\left(\frac{CF_i - \langle CF_2 \rangle}{\sigma}\right) = \delta, \text{ hence } CE_i = \langle CF_2 \rangle + \sigma F^{-1}(\delta)$$

where the inverse function is $F^{-1}(\delta) < 0$.

The present values of cash flows calculated applying the CE and RADR methods should be equal, so we have

$$\frac{CE_i}{1+r_f} = \frac{\langle CF_2 \rangle + \sigma F^{-1}(\delta)}{1+r_f} = \frac{\langle CF_2 \rangle}{1+r_{RADR}} = \frac{\langle CF_2 \rangle}{1+r_f+RP}, \quad (6)$$

where r_f – risk-free rate; RP – risk premium.

[1] Miles and Choi's reasoning may be considered as a mechanism for establishing an equilibrium price of a deal.

$$\frac{\langle CF_2\rangle+\sigma F^{-1}(\delta)}{1+r_f}=\frac{\langle CF_2\rangle}{1+r_f+RP}\Rightarrow(1+r_f)\langle CF_2\rangle-(1+r_f+RP)\left(\langle CF_2\rangle+\sigma F^{-1}(\delta)\right)\Rightarrow$$

$$\Rightarrow(1+r_f)\sigma F^{-1}(\delta)+RP\left(\langle CF_2\rangle+\sigma F^{-1}(\delta)\right)=0\Rightarrow RP=\frac{(1+r_f)\sigma F^{-1}(\delta)}{\langle CF_2\rangle+\sigma F^{-1}(\delta)}. \quad (7)$$

Now let us consider a loan. The second cash flow in case of a loan is also a random variable distributed according to the normal law, but with the mean value of – $<CF_2>$ and a root-mean-square deviation of σ. As in case with investments we predetermine the probability of undesirable outcomes as δ, and define the minimum allowed outflow using the probability integral formula. Suppose this minimum allowed outflow is the certainty equivalent CE_b for the loan:

$$F\left(\frac{CF_b+\langle CF_2\rangle}{\sigma}\right)=\delta\text{, hence } CF_b=\langle CF_2\rangle-\sigma F^{-1}(\delta),$$

$$-\frac{CE_b}{1+r_f}=\frac{-\langle CF_2\rangle+\sigma F^{-1}(\delta)}{1+r_f}=\frac{-\langle CF_2\rangle}{1+p_{RADR}}=\frac{-\langle CF_2\rangle}{1+r_f+RP^*},$$

where RP^* – risk penalty.

$$-\langle CF_2\rangle(1+r_f)=\left(-\langle CF_2\rangle+\sigma F^{-1}(\delta)\right)(1+r_f+RP^*)\Rightarrow$$

$$(1+r_f+RP^*)\sigma F^{-1}(\delta)=\langle CF_2\rangle RP^*\Rightarrow RP^*=$$

$$=\frac{(1+r_f)\sigma F^{-1}(\delta)}{\langle CF_2\rangle-\sigma F^{-1}(\delta)}. \quad (8)$$

The relation of inverse values of risk premium and penalty may be presented as follows

$$\frac{1}{RP}=-\frac{\langle CF_2\rangle+\sigma F^{-1}(\delta)}{(1+r_f)\sigma F^{-1}(\delta)}\text{ and }\frac{1}{RP^*}=\frac{\langle CF_2\rangle-\sigma F^{-1}(\delta)}{(1+r_f)\sigma F^{-1}(\delta)}.$$

The sum of these inverse values is:

$$\frac{1}{RP}+\frac{1}{RP^*}=-\frac{\langle CF_2\rangle+\sigma F^{-1}(\delta)}{(1+r_f)\sigma F^{-1}(\delta)}+$$

$$+\frac{\langle CF_2\rangle-\sigma F^{-1}(\delta)}{(1+r_f)\sigma F^{-1}(\delta)}=\frac{-2\sigma F^{-1}(\delta)}{(1+r_f)\sigma F^{-1}(\delta)}=$$

$$=-\frac{2}{1+r_f}. \quad (9)$$

After several more transformations we obtain:

$$\frac{1}{RP}+\frac{1}{RP^*}=-\frac{2}{1+r_f}\Rightarrow\frac{1}{RP}+\frac{1}{1+r_f}=$$

$$=-\left(\frac{1}{RP^*}+\frac{1}{1+r_f}\right)\Rightarrow\frac{1+r_f+RP}{RP(1+r_f)}=$$

$$=-\frac{1+r_f+RP^*}{RP^*(1+r_f)}\Rightarrow\frac{1+r_f+RP}{RP}=$$

$$=-\frac{1+r_f+RP^*}{RP^*}\Rightarrow\frac{RP}{1+r_f+RP}=$$

$$=-\frac{RP^*}{1+r_f+RP^*} \quad (10)$$

Formula (10) defines the relation between the risk premium and penalty for any symmetric distribution of the random variable. The left-hand side defines the present value of the risk premium calculated at the RADR rate applied to inflows. The right-hand side is the present value of the risk penalty calculated at the RADR rate applied to outflows. Relation (10) is universal. Its economic substance will be explained below.

After simple transformations of equation (10) we have a formula to calculate the risk penalty.

$$RP(1+r_f+RP^*)=-RP^*(1+r_f+RP)\Rightarrow$$

$$RP+RP\cdot r_f+RP\cdot RP^*=-RP^*-RP^*\cdot r_f+RP\cdot RP^*\Rightarrow$$

$$RP^*(1+r_f+2RP)=-RP(1+r_f)\Rightarrow$$

$$RP^*=-\frac{RP}{1+2RP/(1+r_f)}. \quad (11)$$

Consequently, RADR for evaluation of risky outflows will be

$$p_{RADR}=r_f-\frac{RP}{1+2RP/(1+r_f)}. \quad (12)$$

Paper [2] obtained target values of risk premium for risk adjustment of the rates applied respectively to assess investments and loans in case of normal distribution of random cash flows. See these values in Table 1.

Table 1. The risk premium and penalty depending on the level of risk (%)

σ, $	r_f	Premium	Penalty
100	30	16.0	–12.8
200	30	36.5	-23.4

Let us employ formula (11) to calculate the risk penalty depending on risk premium values and the risk-free rate. For a smaller risk level σ = $ 100 we obtain:

$$RP^*=-\frac{16\%}{1+32\%/1.3}=-\frac{16\%}{1.246}=-12.8\%$$

In case of a high-risk level σ = $ 200 we have

$$RP^* = -\frac{36.5\%}{1+73\%/1.3} = -\frac{36.5\%}{1.562} = -23.4\%.$$

As we see, the obtained values of the risk penalty are the same as the values in the table.

Although formula (11) defining the risk penalty was obtained for random flows distributed according to the normal law, it is true for any symmetric distribution.

Indeed, as long as certainty equivalents of the random inflow and outflow are equal, consequently $CE_i = \langle CF_2 \rangle + \sigma F^{-1}(\delta)$ and $CE_b = \langle CF_2 \rangle - \sigma F^{-1}(\delta)$ the CE factor will be as follows

$$\alpha = \frac{\sigma F^{-1}(\delta)}{\langle CF_2 \rangle}.$$

Therefore, for deriving the formula which defines the risk penalty, the value of the CE factor is of no importance while certainty equivalents of inflow and outflow have to be symmetric with respect to the mean value.

$$CE_i = \langle CF_2 \rangle (1+\alpha),\ CE_b = \langle CF_2 \rangle (1-\alpha). \quad (13)$$

Asymmetric Distribution of Cash Flow Random Values

Now, we consider the case when random values distribution of a cash flow is not symmetric. Assume, for example

$$CE_i = a \cdot \langle CF \rangle,\ CE_b = \frac{1}{a}\langle CF \rangle. \quad (14)$$

Then on the basis of the equation of present values of a future inflow calculated by means of the RADR and CE methods we have

$$\frac{CE_i}{1+r_f} = \frac{a \cdot \langle CF_2 \rangle}{1+r_f} = \frac{\langle CF_2 \rangle}{1+r_{RADR}} \Rightarrow a = \frac{1+r_f}{1+r_{RADR}}. \quad (15)$$

Relation (15) was obtained by A.A. Robichek and S.C. Myers as a necessary and sufficient condition of equivalence of the CE and RADR methods applied to evaluate random cash flows [29].

On the basis of the equation of present values of a future outflow calculated by means of the RADR and CE methods, we have:

$$\frac{CE_b}{1+r_f} = \frac{1}{a} \cdot \frac{\langle CF_2 \rangle}{1+r_f} = \frac{\langle CF_2 \rangle}{1+p_{RADR}} \Rightarrow a = \frac{1+p_{RADR}}{1+r_f}. \quad (16)$$

Making (15) and (16) equal and making the change of, $r_{RADR} = r_f + RP$,we have

$$\frac{1+p_{RADR}}{1+r_f} = \frac{1+r_f}{1+r_f+RP} \Rightarrow p_{RADR} = \frac{(1+r_f)^2}{1+r_f+RP} - 1 =$$

$$= \frac{1+2r_f+r_f^2-1-r_f-RP}{1+r_f+RP} \Rightarrow p_{RADR} =$$

$$= \frac{r_f(1+r_f)-RP}{1+r_f+RP} = \frac{r_f(1+r_f+RP)-r_f \cdot RP-RP}{1+r_f+RP} =$$

$$= r_f - \frac{(1+r_f)\cdot RP}{1+r_f+RP} \Rightarrow p_{RADR} = r_f - \frac{RP}{1+RP/(1+r_f)}. \quad (17)$$

$$RP^* = -\frac{RP}{1+RP/(1+r_f)}. \quad (18)$$

Relation (18) defines the risk penalty value for random cash outflows with asymmetric distribution.

Y. Gallagher and J. Zumwalt [10] pointed out that as the rate of p_{RADR} approximates –1 the value of negative cash flows increases infinitely. Is it possible in real life? As the risk level of cash flows increases, the risk premium *RP* grows. But, even if the risk premium increases infinitely, the risk penalty for symmetric distribution is limited to the value of:

$$RP^* = -\lim_{RP\to\infty} \frac{RP}{1+2RP/(1+r_f)} =$$

$$= -\lim_{RP\to\infty} \frac{RP(1+r_f)}{1+r_f+2RP} = -0.5(1+r_f).$$

Formula (12) also implies that if $p_{RADR} = -1$ the r_{RADR} rate will also be –1:

$$p_{RADR} = r_f - \frac{RP}{1+2RP/(1+r_f)} = -1 \Rightarrow r_f + 1 =$$

$$= \frac{RP(1+r_f)}{1+r_f+2RP} \Rightarrow 1+r_f+2RP = RP \Rightarrow r_f +$$

$$+RP = -1 \Rightarrow r_{RADR} = -1.$$

Consequently, the expected return on investment and the expected interest rate are -100%. This means that the investor expects to lose all invested funds and the borrower is not going to repay the debt in future. There is no contradiction in this reasoning and if it is not a fraudulent deal, a rational investor is unlikely to conclude it.

For asymmetric distribution of random flows, as the risk premium grows the risk penalty value tends to $RP^* = -(1+r_f)$ and consequently, $p_{RADR} = r_f + RP^* = -1$. However, it is possible when $RP >> 1+r_f$ i.e., if the premium exceeds 100% by far. On the other hand, if $p_{RADR} = -1$, the risk-free rate r_f equals –1.

Practical Implementation of the RADR Method

Let us suppose that we have to assess a nonconventional project with cash flows from Table 2 [22]. All cash flows, except for the initial one, are random variables with mean values as in Table 2.

Table 2. Evaluating a nonconventional project ($)

Project	CF_0	CF_1	CF_2	CF_3	r_f, %	r_{RADR}, %	p_{RADR}, %	$GNPV$
A	–100	75	150	–100	10	17	3.8	3.3
A'	–100	75	150	–100	10	20	1.5	–1.7

The risk level of the project cash flows is offset by the risk premium which changes in the range of 7–10%. The capital cost for the company which decides to participate in the project is 10%. It is the rate at which the company may attract and lend funds implementing its projects without risk.

If we evaluate the project as an investment, at the r_{RADR} within 17–20% according to the NPV rule the project should be accepted because

$$NPV(17\%) = 11.2 > 0;\ NPV(20\%) = 8.2 > 0\ .$$

However, this conclusion is wrong. The last cash flow of the project is negative and the RADR rate intended for positive cash flows cannot be applied to it. We will use the GNPV method to assess this project. Table 2 states p_{RADR} values calculated by formula (12) for random negative cash flows with symmetric distribution. Let us calculate the GNPV

$$GNPV(17\%, 3.8\%) = 3.3 > 0;$$
$$GNPV(20\%, 1.5\%) = -1.7 < 0\ .$$

As we see, as cash flows become riskier the present value of the project decreases and the project is perceived as more attractive. As long as change of the risk level within the expected range renders the project ineffective (GNPV < 0) it should be rejected.

Conclusion

Recently there were serious debates concerning the approach to risk adjustment of the discount rate in the NPV method when evaluating nonconventional (combined) projects in an uncertain environment. Some scientists presumed that project profit and costs with an equal risk level should be discounted at the same rate according to the risk-return ratio. Others thought that the risk premium for positive and negative cash flows with an equal risk level should be different.

A recently published paper [2] showed that the same approach to risk adjustment of the discount rate applied to random opposite sign cash flows stems from imperfection of the NPV method which use for evaluation of nonconventional projects is not always correct. The NPV method applies the same discount rate (opportunity cost of capital) to assess investments and loans which form a nonconventional project. This rate serves both as the required return for investment with a similar risk level and as cost of capital used for investment funding. However, it is commonly known that the IRR rule has opposite signs when investment and loans are evaluated because IRR itself has different sense for investment and loans. Therefore, the discount rates should be different.

In this paper we have eliminated the root causes of the problem of the RADR applied to random negative cash flows. We have considered the reasoning justifying application of the same risk adjusted discount rate to evaluate random cash flows of opposite signs. In the opinion of the scientists who think that only the RADR should be applied, when different rates are used to assess cash inflows and outflows there arises "arbitrage probability" and "depreciation". These arguments are based on a false conclusion that the present value of a cash flow for purchase or sale of an asset in future equals the price at which the asset is traded now. Therefore, if participants use different rates to assess the asset value it will cause "arbitrage probability" and "depreciation". In fact, the price at which the asset is traded in a perfect market is defined irrespective of the players' expectations. It is also shown that expectations related to evaluation of the asset price in future depend on the operations performed with the asset now (purchase or sale). A deal comprised by two cash flows (long and short sales) instead of just a future cash flow should be evaluated. In order to assess these differently directed deals different rates should be applied, therefore no "arbitrage probability" and "depreciation" takes place.

On the basis of the condition of equality of present values of a short and long sale of the asset the RADR formula was derived to evaluate uncertain negative cash flows. The risk penalty is defined depending on a risk-free rate and risk premium for symmetric and asymmetric distribution of random cash flows.

The offered approach accords the controversial recommendations which one can still find in textbooks concerning risk adjustment of the discount rate applied to assess the value of future random cash flows. It provides a possibility to apply investment evaluation methods under risk and uncertainty to evaluation of risky loan projects and nonconventional projects in accordance with theory.

Our proposed approach may be applied to expand existing asset pricing models in order to evaluate a short position, calculate a fair insurance premium, define an appropriate rate for the assessment of public-private partnership projects' value, and other business applications.

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Organisational Characteristics, Corporate Governance and Corporate Risk Disclosure: An Overview

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Abstract

Certain attributes of corporate governance behaviour have been identified in academic research as major factors correlating with corporate risk disclosure amongst listed companies. This is in spite of the fact, however, that much of the empirical research in the area reveals mixed results.

This study analyses corporate risk disclosure practice involving listed companies and investigates whether such diverse results are attributable to regulation, jurisdiction, operating industry, business environment, or the methodologies employed. We use risk disclosure, corporate governance and organisational characteristics keywords to search the relevant studies on which 46 empirical research papers were sampled, and employ a meta-analysis procedure to evaluate the findings of the previous empirical research.

Our analyses reveal that firm size is the major organisational-specific characteristic affected by moderators, and board size and institutional investors are the major corporate governance variables that affect moderators. On the analysis of the nature of disclosure, financial risk information is higher for companies operating in the banking sector, while operational risk disclosure is higher for non-financial companies. Additionally, the study finds that the data generating procedure, time interval, diversity of sample and size, and the statistical technique employed are among the major factors that influence discrepancies among the prior studies.

Such variables complicate stakeholders' effort to comprehend the main factors that influence companies to unveil their risks profile. We propose that the current data collection process is labour intensive and time consuming, and promote the selection of smaller sample sizes compared to most of the existing research. It may be the case that constraints can be overcome through research that employs an automated procedure for analysis of textual data.

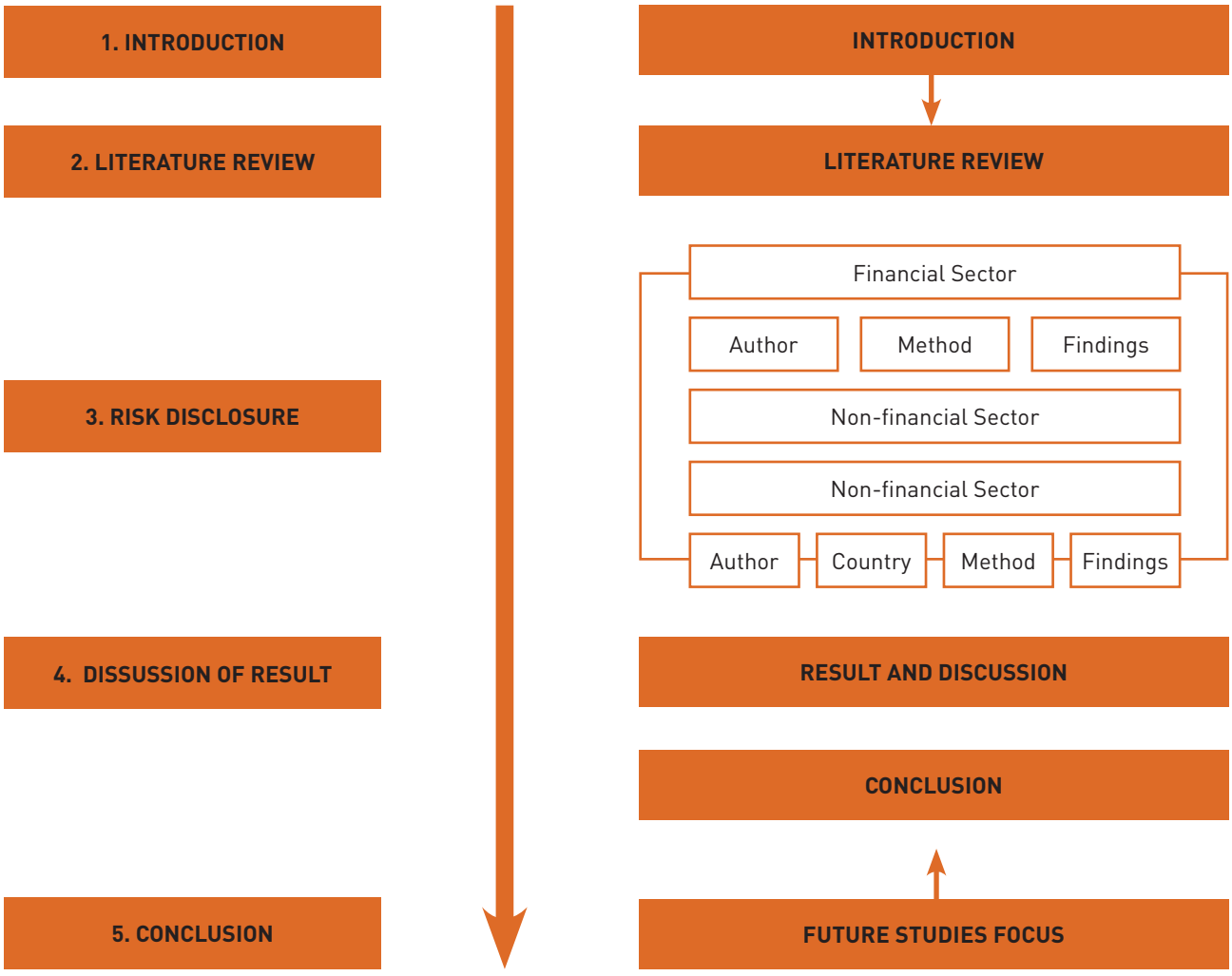
Keywords: risk disclosure, risk management, corporate governance, organisational characteristics, financial sector, non-financial sector, emerging countries

Introduction

Risk disclosure is the process of ascertaining, quantifying, handling, and disseminating organisational prospects and challenges that have the potential to impact present or future firm value to users of corporate reporting. Disclosure of this nature is usually facilitated in the 'risk review' section of annual reports (e.g. management discussion, chairman statement), interim reports, prospectuses, company websites, or other media, provided the users of financial statements can access the information for informed decision-making. A short time ago, and sparked by the financial and economic crisis, corporate risk disclosures considerably puffed-up the interest of regulators, standard setters, analysts and academic communities worldwide [1–3]. In light of the prominent corporate scandals involving companies with extraordinary reputations (e.g. WorldCom and the Enron Cooperation), the restoration of public self-confidence or faith has become one of the main agenda topics among today's business frontrunners [4]. These were the major factors that caused the release of IFRS 7, which requires corporate entities to disclose the risk associated with financial instruments for informed decision-making. These new regulations have been adopted by several companies operating in developed and emerging markets. For example, it is reported that the European Union (EU) requires all listed companies to disclose their risk profile and create more transparency in their annual reports [5].

According to earlier conceptions [6], only occurrences of bad or negative events are considered as 'risk'. However, the contemporary impression of risk embraces occurrences of both positive and negative events as well as uncertainties. According to [7], certain disclosed items have been acknowledged as 'risk disclosures' provided the person who reads the annual report is notified about every business prospect or negative challenge (e.g. danger, hazard, harm, threat and exposure, etc.) previously encountered by the corporation, or may be encountered by the corporation in the future, or proposed techniques to deal with business opportunity and negative challenges. The readers are thus informed through an extensive explanation of risk that comprises positive and negative factors, risks and uncertainties, and ways of managing risk.

The relevance of studying risk disclosure cannot be overemphasised, as company transparency on risk related information is helpful for capital markets to behave optimally [8].



In order to accomplish and preserve a precise stock valuation, self-confident and conversant investors are required. In the absence of sufficient disclosures, a management team has greater information than outside stakeholders, who may not fully appreciate the fundamental risks and returns of an organisation's business [8]. As such, corporate risk disclosure can be vital in minimising investor uncertainty [9] thus decreasing the premium associated with risks that are required from the firm [9].

This study is aimed at analysing the literature on risk reporting. We focus mainly on corporate governance and organisational characteristics that seem to facilitate corporate risk disclosure for firms that are functioning in countries with advanced and emerging economies. As a result of the financial and economic crisis of 2008–2009, corporate governance has become one of the most extensively examined aspects of company activities [10]. Given the high exposure of financial firms to different risks, we firstly examine the relevant literature on the financial sector. The papers on non-financial firms from developed and emerging countries are analysed in section 3, our results are discussed in section 4, and section 5 concludes the study by proposing directions for future research.

Financial Sector and Corporate Risk Disclosure

The research at reference number [7] argues that the finance and accounting fields have recently unfolded one of the most interesting areas of research, relating to 'corporate risk disclosure'. The fact is that several studies have been conducted over the last couple of decades with a focus on risk disclosure, due among other things, to improving corporate transparency. A prior long-time concern of regulatory authorities seemed to concern the management of risk disclosure in their jurisdictions [11], or the voluntarily reporting of same by corporate managers. Despite this, much of the existing research establishes that existing corporate risk disclosure is insufficient, and extensive regulatory improvement is required.

Recently, the amount of research on risk related information disclosures has been increasing in the field of finance and accounting. For instance, various scholars [12–15] have explored diverse jurisdictions and evaluated the degree of risk disclosure practice in the content of companies' annual reports, interim-reports, and prospectuses. The financial sector remains one of the most important sectors in driving global economic activities. This can be evidenced from the 2007/2008 global financial crises. Stakeholders across the globe support the idea of incorporating corporate risk profile after the incidence. The financial sector is one of the most regulated industries, because entities are exposed to different regulations. Hence, most of the previous studies [7] suggested the studying of the financial sector independently. In addition to regulations, several factors have been identified in the literature as major drivers behind corporate risk disclosure in the financial sector. These drivers include liquidity, profitability, company size, leverage, dual listing, industry, and listing status. Corporate entities vary considerably in terms of the levels of asset base, annual profit, turnover, location, governance, financial architecture, and, clearly, several other factors. Consequently, previous studies [e.g. 7; 13; 16–21] found some of these characteristics to be major determinants of risk related information disclosure in the financial industry. The majority of these studies were conducted in both developed and emerging economies.

For example, one the first studies conducted by [22] examines corporate risk reporting practice in the annual reports of Canadian and UK banks. Content analysis and regression methods were used as evaluation methods. It was established that the quantity of risk definition and company size are positively and significantly related with corporate risk disclosure, while profitability and degree of risk in the company was insignificant in explaining risk disclosure behaviour. They also found no significant difference in terms of the level of information disclosed by Canadian and UK banks. The 2007 global financial crisis has drawn several scholars' attention towards evaluating the effect of the crisis on the disclosure patterns of the banks. For example, [23] samples eight (8) German banks and evaluated their risk disclosure pattern. A total of 32 annual reports were taken from 2005–2006. The content analysis and regression result shows that profitability and bank size do not influence risk disclosure behaviour of banks from 2005 to 2006. However, it was interesting to discover the bank size variable driving risk disclosure upward from 2007 to 2008 – perhaps this is the influence of the global financial crisis. Nonetheless, GAS 5-10 might explain risk disclosure levels for the 2005–2006 financial years. Moreover, the result highlighted significant risk reporting improvements in terms of quality and quantity over the study period.

The study at reference [13] evaluates the effect of a firm's governance as well as the demographic behaviour of top governing squads on voluntary corporate risk disclosure in the Saudi banking sector. The investigation employs the content analysis method in measuring the amount of risk information contained in the annual reports of listed bank between the years 2009 to 2013. They discovered that board size, profitability, size, gender, audit committee meeting and outside ownership are the most important factors that influence corporate risk disclosure. Meanwhile, [24] assesses the influence of governance attributes on risk disclosure practice in Jordan. The data was extracted from the 15 listed banks' annual reports over the period of 2008 to 2015. The study divides the disclosure into voluntary and mandatory risk disclosure categories, and utilises content analysis and OLS regression as analytical tools. The findings show that the presence of a non-executive director, and the variables of board size, separation of duties, and audit committee meetings had a statistically positive influence on voluntary risk disclosure, while this was not the case with the managerial ownership attribute. However, audit committee size and independent directors are positively significant in explaining mandatory risk disclosure. Table 1 below shows the summary of the prior empirical studies in the financial sector:

Table 1. Prior Research on Financial Institutions

Scholar(s)	Country	Sample & Method	Findings
[22]	UK & Canada	*Content analysis *Descriptive statistics *Regression *18 banks	*Canadian banks disclosing more risk than UK counterparts. *Most of the disclosures are qualitative and past related information. *Size, volume, risk definition, are positively significant. * Degree of bank's risk and profitability are not significant
[25]	Best 25 world banks	*Content analysis *Disclosure index *Descriptive statistics *25 top world banks *2000–2006 annual reports	*Risk disclosure trends increases overtime. *Institutional approaches to voluntary disclosure seem to overshadow the part played by code of practice (e.g. IFRS, US GAAP) in shaping risk disclosure patterns. *Length of annual reports is linked with supplementary corporate risk disclosures. *Bank size is not significant in explaining market risk disclosure. *Market risk disclosure unveils substantial difference within and across geographical borders
[20]	Portugal	*Content analysis *Disclosure index, *Descriptive statistics *Regression *111 banks *2006 annual reports	*Size, age, listing status, investors' confidence and risk management ability are positively significant. *Mutual credit bank is negatively significant. *Profitability and ownership structure are not significant. *The disclosures are low, mostly qualitative and past information. *Operational risk disclosure dominates capital structure and adequacy disclosure
[16]	Europe	*Content analysis *Descriptive statistics *Regression	*Regulations, vigorous audit committee, concentrated external non-governmental ownership, lesser executive ownership, external board members, and delivery of higher quality risk reporting. *The supervisors' role in the quality of risk disclosure depends on the bank ownership structure
[26]	Greece	*Content analysis *Descriptive statistics *Pearson correlation *15 listed banks in ASE *2008 & 2005 annual reports	*Basel II increases the amount of risk disclosure; nonetheless, some insufficiencies still exist. *Minor numerical and more historical risk related disclosures are publicised. *No quasi-norm is proved between bank risk profile, profitability or firm size and corporate risk disclosure

Scholar(s)	Country	Sample & Method	Findings
[17]	Gulf Corporation Council (GCC) Countries	*Content analysis *Descriptive statistics *Regression *677 listed firms *2007–2011 annual reports	*Marker Risk Disclosures (MRD) are substantially greater for companies with an independent RC. *RC characteristic (size and qualification) is positively related with MRDs. *The effect of an RC on MRDs is higher for firms in a mature lifecycle stage
[13]	Saudi Arabia	*Content analysis *Disclosure index *Descriptive statistics *Regression *12 listed banks *60 observations *2009–2013 annual reports	*External ownership, gender, audit committee meeting, firm size and profitability are positively significant. *Board size is significant negatively. *Internal ownership, non-executive director, independent director, independent audit committee, size of audit committee, education, tenure and diversity are not significant.
[18]	United Arab Emirate	*Disclosure index *Regression *176 observations for the listed banks *2003–2013 annual reports	*The corporate risk disclosure is low. *There are momentous variances in the whole risk disclosure, thus; financial, strategic, and risk management reporting between Islamic banks and conventional banks. *The complete risk disclosure have influence the banks' performance
[19]	Egypt	*Descriptive statistics *Regression *28 banks *2010–2017 annual reports	*Level of total risk disclosure is average. *Independent director, audit committee size, institutional ownership and big four, board size and CEO duality are significant positively. *Bank social responsibility, bad news and leverage are negatively significant. *Bank size, profitability, liquidity and listing status are not statistically significant
[21]	China	*Content analysis *Disclosure index, *Descriptive statistics *Regression *100 financial firms *2013–2015 annual reports	*Firm size, growth (BTM), board size, audit quality is positively significant. *Capital structure, board independence is negatively significant. *State ownership, CEO duality, firm risk and leverage appeared to be insignificant. *The quality of risk disclosure has an effect to the market liquidity. *Banks disclose less risk during 2014 crisis

Studies on Non-financial Firms: Evidence from developed countries

There are vast numbers of studies that are peculiar to the economies of the developed world that identify relevant benefits and drawbacks as well as determinants of corporate risk disclosure. For a review, see studies [7; 23; 27–31]. The study referenced at [28] samples 90 non-financial firms quoted in the Tokyo Stock Exchange and analyses risk disclosure behaviour reported in the annual reports for the year 2003. Based on content and regression analysis, the results indicate that Japanese companies disclosed their risk information voluntarily. Firm size and risk disclosure are significantly connected in a positive way, while profitability and ownership distribution pattern are not significant in explaining corporate risk disclosures. Similarly, the research cited at [7] explores corporate risk reporting practices in the UK. The sample includes the annual reports of 79 companies. The content and regression tools employed show that company size and environmental risk are positively significant in explaining risk disclosure level. Nevertheless, no association appears to exist between corporate risk reporting and five other measures of risk, i.e. beta factor, quiscore, asset cover, book to market value of equity, and gearing ratio. In another study, [27] analyses risk management disclosure behaviour and its determinants in Belgium. The sample comprises non-financial companies quoted on Euronext for the year 2006. The findings show that size and beta are positively significant in determining corporate risk disclosure, while profitability is negatively significant. The beta factor demonstrates that corporate managers of firms with large quantity of systemic risk are very conscious about their risk profile and they are willing to reveal it. In Spain, [29] samples 35 listed companies' annual reports for the year 2009 and evaluates their risk disclosures practice. The tools of analysis used were content analysis and regression. It is discovered that the firm size and the industry of a firm are positively correlated with corporate risk disclosures, while foreign market quotation, profitability, and the pursuit of SOSO reports have no association with corporate risk disclosure. Table 2 summarises a number of the previous studies focusing on advanced economies.

Table 2. Prior Studies on Non-Financial Firms: Evidence from Developed Countries

Scholar(s)	Country	Sample & Method	Findings
[3]	Canada	*Content analysis *Disclosure index *Descriptive statistics *300 TSE listed firms *1999 annual reports	*Large volume of voluntary and mandatory risk management disclosures. *The most regular disclosure is financial risk. * The risk assessment analysis lacks uniformity, clarity, and quantification
[28]	Japan	*Descriptive statistics *Disclosure index *Content analysis statistics *Pearson's correlation *90 listed firms in Tokyo Stock Exchange *2003 annual reports	*Firms are revealing their risk voluntarily. *Firm size is positively correlated with risk disclosure. *Ownership distributing pattern, level of risk, and profitability are insignificant. *Past and descriptive risk outweigh future and quantitative information respectively
[7]	UK	*Descriptive Statistic *Disclosure index *Content analysis *Pearson's correlation *79 FT-SE 100 Index *Year 2000 annual reports	*EcoValue '21 and firm size are positively correlated with financial risk disclosure, non-financial risk disclosure and total risk disclosure. *Asset cover, beta factor, market value of equity, gearing ratio and quiscore are insignificant. *Non-monetary, future and good news dominates monetary, past and bad news risk information respectively. *The presence of general risk management policy statements are too much and therefore reduces the disclosure relevance to users

Scholar(s)	Country	Sample & Method	Findings
[32]	UK	*Content analysis *Descriptive statistics *Regression *420 observation *1991–2003 *Prospectors	*IPO firms disclosed much future information but less information on risk management and internal controls than the listed firms disclosed. *The disclosure has improved over time. *The directors' ownership caused the minimisation of risk disclosure
[33]	UK	*Descriptive statistics *Disclosure index *Content analysis *Regression *52 firms listed in FTSE-100 *1998, 2001 & 2004 annual reports	*Accounting regulation causes the risk disclosure to increase within six-years. *Qualitative, non-time, as well as good news dominate quantitative, past & future and bad news respectively. *Industry and US dual listing improve risk disclosure. *Leverage and company size are insignificant
[27]	Belgium	*Descriptive statistics *Disclosure index *Content analysis *Regression *46 listed firms in Euronext as at 2006	* Large variation in the quantity of risk disclosures. *Operational and financial risk have the highest disclosures. *Size and beta are positively significant. *Profitability is negatively significant. *Audit quality, presence or risk committee or manager, non-executive director and CEO duality are not statistically significant
[34]	Canada	*Descriptive statistics *Disclosure index *Content analysis *Regression *225 companies *year 2002	*Qualitative dominate quantitative disclosure and operational risk disclosure dominate the remaining categories. *Service sector faces the highest exposure to operational risk more than financial, mining and transportation sector. *Size and independent directors are positively significant. *Minority holding impact disclosure negatively. *CEO compensation shows mixed results
[3]	US	*Content analysis *Disclosure index, *Descriptive statistics *Regression *S&P 500 listed manufacturing companies *2006–2009 annual reports	*In each year, operational risk disclosures are substantially dominated by business risk disclosure. *Bad news, risk factors, non-monetary, and future risk disclosure are the most dominant. *Non-monetary risk disclosures was steady all over the financial crisis era. *Board size, firm size, firm risk (BMV ration) and board independent are negatively significant. *Leverage and profitability are positively related with total and business risk disclosures

Scholar(s)	Country	Sample & Method	Findings
[9]	Spain	*Disclosure index *Descriptive statistics *Regression *Firms listed in Madrid Stock Exchange *231 annual reports for the year 2007 to 2009	*Size is not statistically significant. *Leverage and BMV are positively significant. *Financial risk and cost of capital are positively associated, while no evidence is found in relation to non-financial disclosure
35	Spain	*Content analysis *Disclosure index, *Descriptive statistics *Regression *All non-financial firms listed in Madrid Stock Exchange. *2007–2009 annual reports	*Companies reveal little information on risk. *Compulsory risk disclosure and board size are positively associated. *Board size and firm size influence voluntary risk disclosure but negatively. *External directors, managerial ownership, board activity, profitability, leverage and sector are not significant in both compulsory and voluntary disclosure
[36]	UK, Germany and US	*Automated content analysis *Descriptive statistics *Regression *219, 339 and 320 firms from German, UK and US respectively. *2005–2010 *Annual reports: 1000 German, 1,410 UK and 1,270 US	*US publicised the highest mandatory risk disclosure, then Germany, while UK discloses the lowest. *US publicised the lowest voluntary risk disclosure, then Germany while UK discloses the highest *The legal system, systematic risk and cultural values are substantially caused by VRR and MRR variations. *Firm and country characteristics had greater explanatory influence over the observed variations in MRR than over those VRR
[37]	UK and Italy	*Automated content analysis, *Descriptive statistics *Regression * UK and Italy firms *2005–2010 annual reports	*Non-executive directors, firm size and board size boost voluntary risk disclosure in UK. *In UK, dividend and audit quality are negatively related with VRD and MRD respectively. *Growth, profitable and firm risks are negatively associated with MRD. *Mandatory risk disclosure rises provided CEO duality exists. *Liquidity is causes the reduction of both VRD and MRD in Italy. *Firm risk and size have significant impact on MRD in Italy
[2]	Germany	*Descriptive statistics *Disclosure index, *Content analysis *Regression *100 non-listed manufacturing firms	*Non-listed companies disclose lower risk. *Big 4 and presence as well as size of a supervisory board escalate the risk disclosure volume. *Risk disclosure is decreases family firm or subsidiaries have block ownership

Scholar(s)	Country	Sample & Method	Findings
[38]	Italy	*Descriptive statistics *Disclosure index, *Content analysis *Regression *Italian firms *2016 annual reports	*Firm size is statistically significant. *Leverage, industry, independent director and share block holder are not significant

Evidence from Emerging Capital Markets

The contribution of emerging countries towards economic development is highly significant. Nevertheless, the extent of corporate transparency is not substantially relative to developed economies. The study referenced at [39] examines a sample of 6 years non-financial listed firms in India and evaluates the major factors that influence their risk disclosure. They examine the annual reports of 318 firms. The results conclude that large levels of independent directors, gender diversity, and board size quotients improve risk disclosure, although the dual function of CEO constrains maximum disclosure. A smaller amount of profit, less liquidity, and big firms are more likely to divulge better risk disclosure, especially historical disclosures. Furthermore, the study referenced at [40] evaluates the voluntary and mandatory risk disclosure quality among Indonesian firms. They examined 48 annual reports of listed firms for the period 2011 to 2012 as the sample. The results reveal that the major emphasis is still on quantity rather than quality. Firm size and industry competition determine the firm's preference on the maximum risk to disclose. In reference to South Africa, the study referenced at [1] examines the effect of firm governance on risk reporting. The study samples 169 listed firms for the years 2002–2011. It is reported that in instances where fewer persons hold significant ownership, they are reluctant to divulge much risk disclosure. Aside from this, a higher number of persons on the board, non-executive directors, and higher diversity levels on the board are enthusiastic in terms of increasing risk disclosure. Strangely, the presence of a CEO who also serves as chairman of the board has no influence on the amount of risk information to be disclosed. In another study, referenced at [41], the authors analyse the impact of having a member of royalty as a board member, as well as the features of the board on amount of risk information to be disclosed in Saudi Arabia. They evaluate 307 observations over the period of 2008 to 2011. The descriptive statistics result shows a moderate level of corporate risk disclosure practices among the companies. Moreover, board size, royal board member, firm size, independence, and frequency of board meetings each have a significant influence on corporate risk disclosure. Furthermore, the study cited at [42] assesses the quality of risk disclosure and its causes in Egypt. Based on the authors' framework, the disclosure can be qualitative, provided the risks disclosed are relevant, understandable, comparable and verifiable. They sampled 135 listed firms' annual reports for the year 2006–2010. The findings give the impression of being high quality, because the risk data unveiled are pertinent and comprehensible. Nevertheless, the data is incomparable and unverifiable. In addition, leverage and company size play a considerable role in generating qualitative risk confession, whereas audit firm size, profitability, and book-to-market values remain silent in providing any evidence that enriches risk disclosure quality. Table 3 below presents summaries of some of the existing studies focusing on emerging market economies:

Table 3. Prior Researches on Non-Financial Firms: Evidence From Emerging Countries

Author(s)	Country	Method & Sample	Findings
[43]	Kuwait	*Regression *Descriptive statistics *Content analysis *109 listed firms	*Firm size, auditor type, complexity, and liquidity are positively related to CRD. *Leverage and profitability are is insignificant. *Results indicate significant differences among industries
[42]	Egypt	*Content analysis *Descriptive statistics *Regression *135 observation *2006–2010	*Leverage and firm size cause RDQ. *Audit size, B/M ration and profitability insignificant

Author(s)	Country	Method & Sample	Findings
[44]	MENA Countries	*Content analysis *Descriptive statistics *Regression *320 companies *789 0bservations *2007–2009	*Board size and structure enhance risk confession. *CEO duality is insignificant
[45]	South Africa	*Descriptive statistics *Regression * 80 top JSE companies *2011 annual reports	*Presence of chief risk officer and frequency of meeting are significant. *Existence of risk committee, presence of independent director and his experience in the audit committee, audit, firm size, profitability and industry are not significant
[46]	Indonesia	*Content analysis *Descriptive statistics *Regression *118 observations *2013 annual reports	*The degree of risk revelation is still low in public companies. *Financial performance, firm size and audit committee size improve risk disclosure. *Managerial and institutional ownership as well as independent commissioners are statistically insignificant
[47]	Pakistan	*Descriptive statistics *GLS regression *85 observations *2011–2016 annual reports	*Audit committee meetings, firm size, big four and z-score are significant with risk disclosure quality (RDQ). *Dual leadership structure is negative and significant impact on RDQ. *Executive ownership, first shareholders ownership, governmental ownership and institutional ownership has insignificant and negative association with RDQ. *Board size, profitability and independent director has positive and insignificant relation with RDQ
[48]	Indonesia	*Content analysis *Descriptive statistics *Regression *365 listed firms for the year 2015	*Good news overcomes bad news. *Ownership concentration has an inverse influence on risk disclosure. *Risk committees, board size, government ownership, profitability, firm size have a positive effect. *No significant effect is evident from gender diversity, independent director, foreign ownership, and leverage on degree of risk revelation
[49]	Saudi Arabia	*Content analysis, *Descriptive statistics *307 companies	*Risk disclosure is low because non-monetary, historical, current, unspecific time and impartial risk confessions overshadow the monetary, forthcoming, and negative risk confessions. *CRD increases over the period of study

Author(s)	Country	Method & Sample	Findings
[50]	Malaysia	*Content analysis *Descriptive statistics *Regression *300 listed companies *2014 annual reports	*Service sector has the highest disclosure on which operational risk disclosures dominate. *Board membership is positively significant. *CEO duality and tenure of independent director are negatively significant *Independent non-executive director, tenure and firm size and sector are not significant
[51]	Indonesia	*Content analysis *Descriptive statistics *Regression *96 observations *2008–2015 annual reports	*Auditor type, board size, entry obstructions, board size, and industrial profile escalate risk revelation. *Ownership concentration have a negative effect on risk disclosure *Cost leadership and liquidity are insignificant
[52]	Jordan	*Content analysis *Descriptive statistics *Regression *376 observations *2014–2017	*Foreign director and sector are positively significant. *Industrial sector reports more than service sectors. *Leverage and company size are not significant
[53]	Malaysia	*Content analysis *Disclosure index, *Descriptive statistics *Regression *200 companies	*Institutional ownership is positively significant. *Managerial ownership, family ownership, firm size and industry are not significant. * Risk disclosure lessens a firm's profitability
[54]	Saudi Arabia	*Content analysis *Descriptive statistics *Regression *307 companies *2008–2011 annual reports	*Risk disclosure diverges fundamentally among companies and improves over time. *Royal ownership and government ownership are positively significant. *Board size, family and institutional ownership are negatively significant. *Executive and independent directors' ownership, ownership dispersion and leverage are not significant. *Board independence, board meeting frequency, and firm size are also significant positively

RESULTS AND DISCUSSION

Corporate risk disclosure is among the most popular current research topics in finance and accounting. Our study illustrates that current risk disclosure practices involving developed and emerging countries are not sufficient to meet stakeholder demand, although, it is observed this trend is gradually moving in a positive direction. Our review of the existing literature highlighted that financial news, forecasts, and information on negative developments are the major sources of information required by interested parties. Nevertheless, directors often prefer to release non-financial news, old news, and information on positive developments. This practice has reduced the relevance of the information disclosed by firms. The financial sector is more likely to release risk information more than the non-financial sector, although firms operating in the financial sector experience more regulations (CBN, insurance commission etc.) than other sectors.

We have uncovered a lack of uniformity in risk disclosure practices, as many researchers employed different approaches in their study. Moreover, the major problematic issue found is the risk disclosure coding process. Scholars have extensively discussed the difficulty in the coding procedures, its labour-intensive nature, the level

of time consumption, and the element of subjectivity. For example, labour-intensive content analysis is inefficient and causes the selection of smaller sample sizes in most of the prior studies. We hereby postulate that perhaps such constraints could be resolved by research that employs an automated procedure to analyse their textual data.

This study also identifies a greater use of small sample sizes in risk disclosure research. Perhaps this is connected with manual content analysis, which is considered highly stressful. Nevertheless, several scholars [2; 43; 53; 55–56] are still encouraging researchers to consider a wider sample in their respective studies in order to validate or refute earlier findings. Moreover, the study uncovered a greater use of cross sectional data on which single-time year duration data is considered. Nonetheless, [13; 53] contend that the use of single-year data has the limitation of not generalising the findings, and consequently they motivate studies to elongate the time-frame beyond a one year period. Accordingly, this can strengthen research findings and help with the analysis of risk disclosure trends.

Despite the numerous avenues by which firms can release information for informed decision-making, our study found that annual reports constitute the most common document considered by previous studies in sourcing their study data. However, [13; 53; 56] recommend the use of other media, including the internet, press releases, prospectuses, and interim reports, as these could also potential be the vehicles for transmitting significant data relevant to corporate risk disclosure.

Meanwhile, regardless of the suggestion of some scholars [9; 13; 21; 27; 43; 55–57] in favour of comparative studies between two or more countries, our study discovered few research papers that explored more than one country. The comparative study concept is very important as it would clarify our understanding about risk disclosure variance across geographical borders. Diverse regulatory and accounting policies, economic and political systems, cultural, religious and social settings as well as the extent of countries' interactions with international communities would certainly shape the firms' risk disclosure pattern across national boundaries.

CONCLUSION

This study analyses literature focusing on the effect of corporate governance and the organisational characteristics of corporate risk disclosure. It generally appears that risk disclosure practice is not adequately disclosed by firms, as there is no static regulatory framework that can be used as a term of reference. Therefore, researchers are regularly developing or adopting risk disclosure analysis instruments (e.g. checklists) used by earlier studies in order to identify and code risk information. Consequently, the pattern under which firms divulge their risk profile in annual reports is vague. Moreover, despite the lack of risk disclosure regulation in many jurisdictions, various directors are enthusiastic about disclosing less essential risk information (past information, non-monetary information and positive information) rather than most valuable risk information (future information, financial information, and negative information) predominantly to impress stakeholders who aspire to see risk information in corporate reporting. Although risk disclosure practices do not meet the demand of investors and other stakeholders, developed countries and financial firms are fair in terms of risk disclosure relative to emerging countries and non-financial firms, respectively.

Although corporate risk disclosure is amongst the most popular research topics in finance and accounting, nonetheless data generating procedures have influenced many prior studies to focus on cross sectional data and small sample sizes. This practice has created space for future research studies to consider wider sample and panel data especially in emerging countries. Likewise, the listing status of the companies has been identified as one of the foremost aspects that effect corporate risk disclosure. The non-listed firms studied deliver a fascinating direction for future research, as promoted by scholars [2; 21]. Potentially-omitted variables include ownership structure [53], cost of capital [43] and management team characteristics [13], each of which are worthy of being explored in future studies.

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