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Investments in Contemporary Russian Artwork as an Alternative Form of Investment

Abstract

The purpose of this work is to evaluate the efficiency of investments in the artworks of contemporary Russian painters and to compare the effectiveness of these investments with the effectiveness of investments in stock, bond and real estate markets in Russia and the USA.

For this research, we first conduct a hedonic regression analysis on the data available for the time period 1950-2019. After that, we build a hedonic price index for the canvases of contemporary Russian artists. A selection of 613 transactions was made, involving canvases from 57 contemporary Russian painters.

According to the results of our study, the trend of this index largely reiterates the price behaviour for world contemporary art market. However, the results of this study indicate that investments in contemporary Russian art do not outperform investments in instruments of Russian and American capital and real estate markets. These results were derived by applying the CAPM model, which demonstrated that Russian art as a form of alternative investment is not advisable for the purposes of diversification of investment portfolios. Based on these findings, contemporary Russian art in general can be considered an unattractive instrument for Russian and foreign investors.

The scientific novelty of this paper resides in a comparison among those on similar topics. Unlike our study, few of the academic papers published over the last several decades have presented any quantitative analysis with regard to art's investment performance, and an even smaller amount of research has been devoted to the analysis of Russian art markets.

Key words: works of contemporary Russian painters, alternative investments, profitability, portfolio diversification, securities, real estate

JEL classification: G39, G11, G12, Z11

Introduction

The history of the art market dates back many centuries. Artwork has been sold in auctions, bought from art-dealers in private galleries, and ordered directly from artists. However, the idea of art as a form of alternative investment only became popular after the Second World War, and became especially favoured after series of crises on financial markets in the second part of the twentieth century [1]. The increasing interest in the role of works of art as investment assets can be attributed to two main causes.

The first cause was the general trend towards expansion of potential areas of investment. During the postwar period, investors actively sought out alternative investment possibilities that pushed beyond the already-existing classes of investment assets. Traditionally, such target areas belonged primarily to those classes of securities and real estate which produced consistent profit and displayed stability. Artwork would prove to be a relatively new class of assets, of quite a significant scale. A growth in the degree of wealth of modern fund holders resulted in a substantial increase in the prices of works of art, and this steady increase in their prices transformed these previously non-monetary objects into a particular type of capital. This dynamic prompted concomitant growth in the private fortunes of the owners.

The second cause was the trend towards development of defenses against market risks. On the financial markets, there is a tendency towards price growth volatility for financial assets. The reason for this volatility stems from the non-material economic nature of certain assets, or from the absence of such anchoring factors as material costs, dependence on "material" technologies, and man-hours. The growth of volatility makes it necessary to search for assets with a substantially low correlation with more traditional financial instruments. Such assets have a crucial significance for contemporary portfolio building, as evinced by almost every existing collective investment scheme. The material nature of art assets, (as opposed to the intangibility of securities investments), and the relative rarity of valuable artworks when compared with real estate assets, promoted the eventual use of art as an instrument for risk diversification. The novelty of valuable artwork may also promote the value of an investment portfolio by a significant degree in case of price drops in the financial markets during periods of economic recession.

For these reasons, the market for works of art gained recognition in the financial world in the late decades of the twentieth century as an independent economic category, with its own means of organisation, means of doing business, and pricing models.

Taking into account the fact that different art movements have their own determinants of offers and demands, it is possible to assume that this tendency also applies to art markets in individual countries. The Russian market for art objects significantly differs from the more widely-examined American and European markets. On the one hand, Russian capital holders considerably accede to the elite of the developed countries as far as their degree of total wealth is concerned. On the other hand, the revenue levels of the majority of the Russian population does not permit this majority to allocate a considerable amount of money for the acquisition of valuable art objects.

There is a limited amount of scientific research containing detailed econometric analyses of the Russian art market, including calculations of profitability attained as a result of investment in the works of contemporary Russian painters only. Only some researchers have utilised the available empirical data, and the majority of the transactions analysed in these data are deals involving well-known canvases with a known history of resale.

Methods of evaluation of profitability for investments in works of art, and research into the Russian art market

Analytical methods for measuring the profitability of investment in artwork were thoroughly examined in the article by B. S. Frey, R. Eichenberger [2]. There are two primary methods of evaluation: repeated sales regression (RSR) and hedonic regression. Most of the indices available at the moment are derived from the results of these regressions.

The repeated sales method has been widely used by researchers, including in one of the first analyses of the art market, by W. J. Baumol [3]. This method was also applied in the work of S. L. Glekov [4], where it was concluded that maximum profitability could be obtained with the works of contemporary painters, and the use of artworks for risk diversification could increase the effectiveness of investment portfolios. However, according to B. S. Frey, R. Eichenberger [2] not all art objects have a particularly long history of sales and resales, and obtaining reliable results through this method can be difficult. Additionally, the use of the method of repeated sales cannot be used for the analysis of profitability for those objects of contemporary art that were not present yet on the aftermarket, or for which the number of deals was relatively small (O. Chanel, L. Gerard-Varet, V. Ginsburgh, [5]).

The second method, becoming more popular among those analysing the art market, is the method of hedonic regression. This regression takes into account the particular characteristics of each art object, and thus leads to more reliable evaluations. This method was first suggested by L. Court [6]. A detailed analysis of the model of hedonic regression and the application of its features to the art market was presented in the work of O. Chanel, L. Gerard-Varet, V. Ginsburgh, [5]. G. Gandela, A. Scoru [7] noted that the method of hedonic regression is preferable to the method of repeated sales, as the prices for paintings could be explained by distinct factors, which vary for every individual art object, and, further, that for

the evaluation of artwork its repeated sales price is not necessary. The method of hedonic regression is usually used when evaluating local markets (J. Nahm [8] – South Korea, H. Higgs and J. Fordter [9] – Australia, G. Candela and A. Scoru [7] – Italy). It was the use of the method of hedonic regression that helped H. Higgs and J. Fordter [9] and J. Nahm [8] to identify the influence of the size of the canvas on the price of the art object in countries where they applied the survey – a phenomenon that has no significant influence in other countries.

Transaction costs play a huge part in the functioning of the art market [7]. Insurance, security and transportation costs are examples of costs in this category. Unfortunately, the magnitude of these costs can vary greatly within one auction house. Even more importantly, there is no public information on the amount of transaction costs for a particular piece of art. Thus, it is almost impossible to take into account the value of such costs when constructing the indexes of art markets. Besides transaction costs, there are also indirect costs associated with investing in art markets. These costs can include lack of liquidity in the art market, risks associated with the authenticity of the art object, the inability to take the art object out of the country, and the possibility of theft of the art object [4].

Nevertheless, transaction costs associated with art markets may significantly reduce returns on art investments [10]. Therefore, in this study we attempt to quantify these transaction costs based on publicly available estimates incorporated in existing academic literature. As shown by G. Urbi, V. Gwendoline and E. Villalobos [11], transaction costs in art markets are one of the highest among all asset classes. According to R. J. Campbell [10], these costs can amount to 30% of sale price. Similar estimates were provided by B. S. Frey, R. Eichenberger [2], who found that auction fees may range between 10% and 30%. Alternatively, O. Ashenfelter and K. Graddy [12] found that transaction costs may range from 20% to 28%. As no research is available with respect to transaction costs on Russian art markets, in accordance with previously established scientific evidence we assume that on average, seller's commission, insurance, storage, and other types of costs amount to 30% of the sale price in this study. A higher point estimate is also justified by a low level of transparency in the Russian art markets as a lack of information availability leads to severe market inefficiencies and, subsequently, higher transaction costs [13].

Currently, there are only a few surveys focusing on an analysis of the Russian art market, and fewer still that apply an empirical analysis of the data from Russian auctions, or of the results of the sales of artwork from Russian painters outside the domestic market. A. N. Sukharev [14] uses data from Russian auctions to define the operative art market dynamics. In particular, the author specifically denotes the index 'ARTIMX-RUS', which represents the price index of Russian art. This index is calculated separately for paintings and graphic arts and for the art from the most popular painters. According to the results of A. N. Sukharev's analysis, he concludes that from 2001 to 2013 the real value of artwork significantly increased (23% for world art and 123% for Russian art). One of the most interesting conclusions of this article is that in 2013 the price index for Russian art was 2 times bigger than the price index for art in general. On foot of this fact, A. N. Sukharev draws the conclusion that Russian art is an attractive instrument for investments. The price index of contemporary art used by the author takes into account the prices of art from all (not only Russian) contemporary painters. He indicates that the price index for the canvases of impressionists and modernists is behind the general trend of the art prices, but this relationship is not thoroughly explained.

A comparison of art objects, including Russian ones, with traditional financial assets is made in the work of A. V. Mikhlin [15]. As A. N. Sukharev [14], A. V. Mikhlin analyses in detail different indexes of the ARTIMX group and compares the movement of the ARTIMX index with the index of the Moscow bourse from 2001 to 2012. A. V. Mikhlin came to the conclusion that the crisis in the Russian art market began after the fall of the Russian stock market in 2009, with a time lag of 6-12 months. Additionally, his work illustrated the connection between the art market index and the price changes of precious metals. In general, the art market has a weak correlation with the market for precious metals. The strongest correlation was found between the art market and the gold market. The main conclusion of A. V. Mikhlin is that art objects can be included in financial portfolios to increase diversification. Nevertheless, the profitability potential of art is still lower than the profitability of traditional financial instruments. When comparing the index of the art market with the index of the Moscow bourse, the author used the common price index for art objects. However, in line with conclusions drawn from the works of foreign researchers, local peculiarities in the art market could significantly influence the level of profitability. Additionally, as was noted in the work of A. N. Sukharev [14] the price index of artworks from Russian painters was a little bit higher than the general price index for art.

Schurina S. V. [16] presented not only a comparative study of the main Russian auction houses, but also a detailed description of the actual situation in the Russian art market. First, she outlined that the Russian market is not as developed in comparison to countries such as the US, the UK and France, but is relatively stable. She also found an increase of interest in investment in art around 2014, mainly connected with the changes in the Russian economic environment during that period. Additionally, the author focuses on the increasing interest of Russian banks in establishing their own collections. Schurina S. V. supposes that in doing so, the banks provide an example to private investors, thus demonstrating that art can be also considered as a legitimate and reasonable object for investments.

Fundamentals of the Russian art market

'ARTinvestment.RU' is a database which contains information on more than 190 000 deals with the artwork of about 10 000 painters in Russia [17]. According to the most recent information from this resource, the Russian art market shrunk by 25% in 2018, whilst the global art market grew 10% [18]. As V. Bordanov, - one of the leading authors of the portal – has said, this decrease in demand for the art objects of Russian painters can be explained by Russia's domestic economic situation. V. Bogdanov also noted high transaction expenses for Russian art objects. According to his opinion, many foreign buyers refuse to buy objects of Russian art because of the enormous amount of formal documentation processes involved, although the export of Russian art objects is permitted by the government.

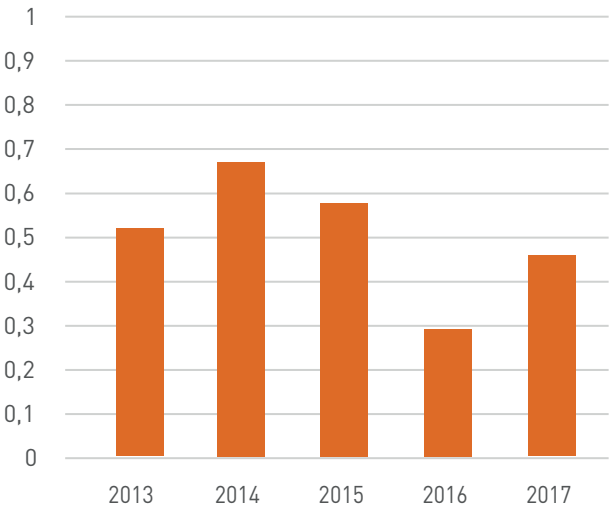
These suppositions are confirmed by the annual report of Artprice.com [19] - an international resource in the domain of evaluation of art market. According to the data of this report, all the most important art market proxies grew in 2018 – the first time since 2008. For the period mentioned, every proxy grew by approximately 18%, and the world auction turnover grew by 19% to 1.9 billion USD. The volume of transactions also grew by 17%, and the number of lots sold was about 67 000. The market index of contemporary art increased by 18.5%. The sole indicator that showed no change for the period studied was the percentage of non-sold art objects, which was 39%. In general, the data of the report illustrates a steady and accelerated growth of sales in contemporary art auctions.

Notwithstanding the above-mentioned decline in the Russian art market in 2018, there were several important deals involving the canvases of contemporary Russian painters. The most expensive canvases were sold in auctions abroad [20]. Of the ten most expensive canvases, more than half (6 paintings) were sold in the auction 'Vladey'. The price of the most expensive painting ("Portrait of group with watermelon", 1963, by Oleg Tselkov) was 170 688 Euro without commission. As for the volume of the market itself, the Russian analytical agency 'InArt', which deals with contemporary art, suggested that in 2018 the volume of the Russian contemporary art market was about 22.4 mln Euro.

Consequently, the share of the Russian contemporary art market in terms of the world art market was only 1.35% in 2018. Nevertheless, from 2017 to 2018 that market share grew by 20.45% (or 0.8 mln Euro) [21]. If this trend were to continue, it would be possible to hope for the further growth in the share of sales for Russian painters in the world market.

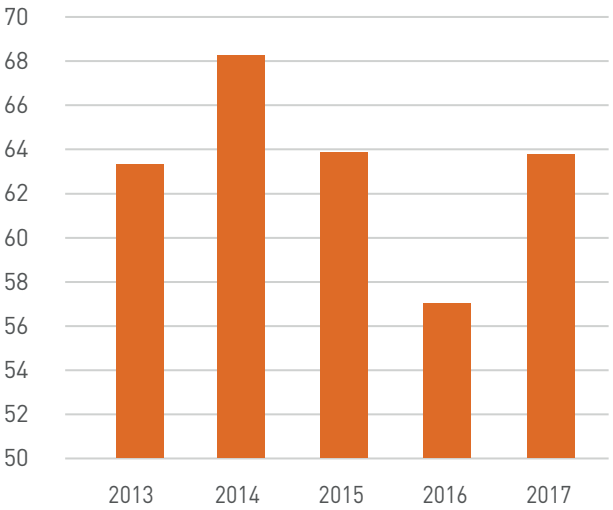
Some data about the Russian art market was mentioned in the analytical report "Art Market 2018" issued from Swiss bank UBS and Art Basel [22]. According to this report, there are only 2 Russian collectors in the "Top 200 Collectors". Most of the largest collectors reside in the US. Taking into account that the global share of dollar multimillionaires in Russia in 2017 was 3% (more than in all European countries excluding Gemany at 4%), but in Europe there are more art collectors from the list "Top 200 Collectors", it is possible to surmise that Russian investors prefer not to invest their money in art objects, at least in large amounts.

Figure 1. Sales volume of Russian art objects in billions USD



Source: artinvestment.ru [13].

Figure 2. Sales volume of art objects on world markets in billions USD



Source: Art Market Report [18].

The share of contemporary art in the total volume of artwork sales considerably differs between the Russian and the global markets. For example, in Russia the share of the contemporary art market is 4.95% of the total volume, while this percentage is 12% for the global market [18]. We may assume that Russian contemporary art is a less popular type of investment than the paintings of old masters, which have traditionally been of more interest in Russian and foreign auctions.

The data for total volume of sales in Russian and foreign art markets for 2013-2017 is presented in Figures 1 and 2. We can see from these figures that changing trends in the volume of sales of art objects on global markets are similar to

the changes in sales volume for Russian art objects. There were no significant deviations in the period examined, and so therefore, it is possible to assume that in general there are no important differences between the volume changes in global and Russian markets. Hence, this analytical perspective should not be included among those variables connected with the particularities of Russian art market.

Formation and analysis of price indexes for Russian contemporary art

For the purposes of this research, a manual selection of 613 transactions was made, involving canvases from 57 contemporary Russian painters. This selection was made on the basis of the rating of the professional consulting agency 'InART' [23]. The main descriptive statistics of the selection variables is shown in Table 1.

As Table 1 shows, the earliest year of canvas creation in the selection was 1952, and the latest was 2018. However, the time lapse between the earliest and the latest year of canvas sale in the selection is considerably smaller, as the first sale was in 2006 and the last one it 2019. In the selection there are also artworks which were created and sold during the same year. The maximum time lapse between the creation and sale of the canvas in this selection was 66 years. The average time lapse between the creation and sale of the canvas was 15 years. The mean surface of the canvas is 9448 cm^2, the lowest figure is 60.84 cm^2, and the highest is 109 200 cm^2. The mean value of canvases sold was 14 602 USD. The canvas with the lowest price was sold for 46 USD ("Construction of hydraulic power station on Irtysh" by Arkady Petrov), and the highest sale price was 96 583 USD ("Infinite beach" by Natalya Nesterova).

The creation of a new index is motivated by the following reasons. Most existing art indices base their calculations on top-100 paintings for a given period of time. Therefore, their sample is biased towards more expensive art objects and, in part, more popular artists. In our research, we take the perspective of a small/medium individual investor who can freely choose between paintings with the price range presented in Table 1. Besides this, in many indices contemporary and modern art are united into one category. This is partially motivated by the fact that there are not that many potential buyers for each category separately.

Table 1. Main descriptive statistics of continuous variables of selection

Variable	(1) N	(2) Mean value	(3) Standard deviation	(4) Min	(5) Max
Year of creation	613	1998	14.30	1952	2018
Year of sale	613	2013	3.752	2006	2019
Width of the canvas (cm)	613	80.75	51.56	7.800	287.5
Height of the canvas (cm)	613	86.59	59.69	6	448.5
Area of canvas (cm^2)	613	9448	11635	60.84	109200
Sale price (USD)	613	14602	18784	46	96583
Adjusted sale price (USD)	613	10221	13149	32	67608
Number of years since the year of creation	613	15.37	13.70	0	66

In our calculations, we take these factors into account and deliberately seek to overcome these issues.

The hedonic regression method was applied to gauge the price index of contemporary Russian art. As previously mentioned, the unfavorability of the use of the repeated sales regression method is explained by the particularities of the existing data. The methods applied to the analysis of investment projects with unconventional cash flows were also not applicable, due to non-recurring nature of cash flows related to art investments [24]. Only 3.92% of the artworks in the selection were sold on auctions more than once. The basic functional form of index is calculated as follows:

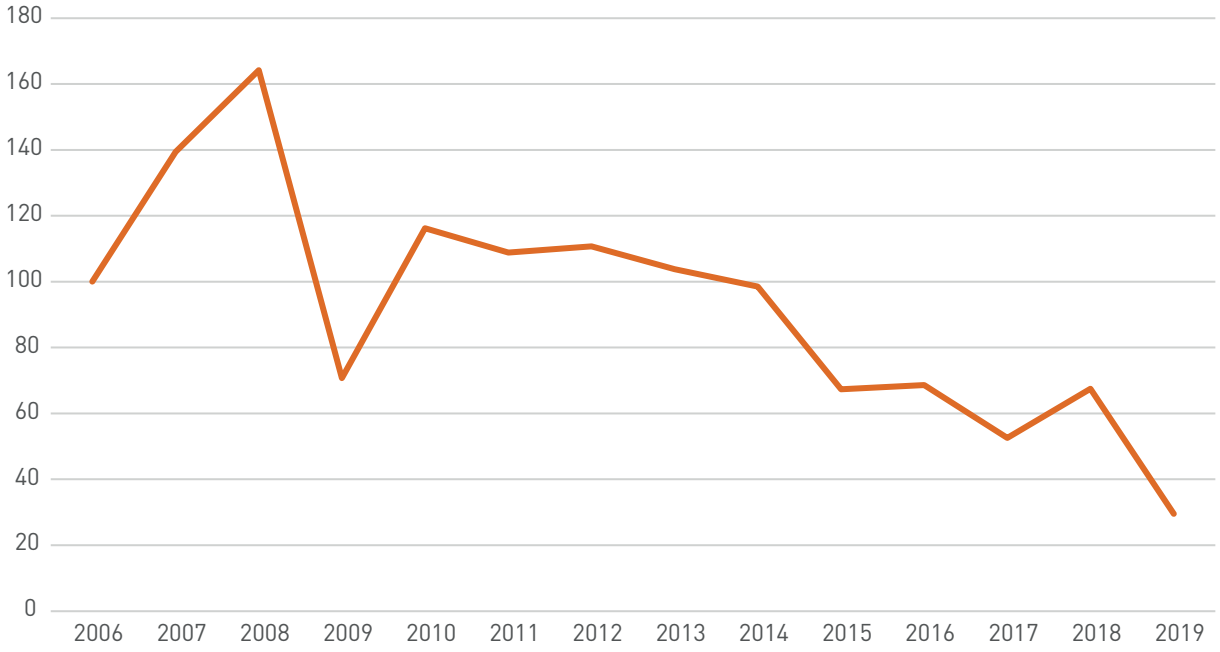
$$lnP_{it} = \sum_{k=1}^{n} a_k x_{ki} + \sum_{\tau=0}^{t} \sum_{j=1}^{m} \theta_{jt} w_{ijt} + c(t) + \varepsilon_{it} \quad (1)$$

The natural logarithm of the sale price of the art object "I" at the time "t" is used as the dependent variable. The variable "x" includes the timely constant characteristic of the object, the variable "w" is the characteristic over time. In this study, these variables can be attributed to the provenance of the canvas, and citations in certain catalogues and special interest magazines. The variable "c(t)" reflects the timely effect of every year of sale and is necessary for designing an index of the contemporary Russian art market.

On the first stage of analysis, specific models were tested – the linear model, the semi-logarithmic model and the double logarithm model. In the first model, the price variable is used as the dependent variable. In the second model the logarithm of this variable is used. In the double logarithm model, not only the dependent variable, but

also some continuous variables have logarithmic form. The explanatory power of the linear model was less than 50%, and thus was excluded from further analysis. To define the most preferable functional form, the Pregibon link test was applied. According to these results, the double logarithm model was selected. Then, the F-test was applied to define the common significance of non-significant variables. Based on the results, the model equation was adjusted. The results of additional tests confirmed the statistical adequacy of the derived estimates.
Next, the price index of contemporary art was calculated by way of raising the exponent to the power of the coefficient with categorical variables of the year of sale. The movement of the index is shown in Fig. 3. As can be seen, the movement of the calculated index is in compliance with the movement shown in previous research. For example, R. Kraeussl, R. Logher [25] identified the sustainable growth of the index up to 2008. That examination conforms to the results we achieved. In general, the movement of the Russian contemporary art index conforms the movement of the index published on the analytical portal 'ArtPrice' for the world market of contemporary art [19]. Both markets showed an increase up to 2008 and a decline in the market after that year. In the years that followed 2008, the break was smoother, with a small growth in 2018. One can suppose that the same set of factors influence the Russian and the world markets of contemporary art.

Figure 3. Movements of the Russian contemporary art index



Comparison of the profitability of investment in canvases of contemporary Russian painters versus real estate and financial instruments

Most researchers develop a benchmarking analysis based around the profitability of the art market and financial instruments. However, as mentioned earlier, according the opinion of B. S. Frey and R. Eichenberger [2], the results of investment in the art market should be compared with the results of investment in real estate. The authors explain this by outlining the similarity of the characteristics (heterogeneity of the items and irregularity of transactions) and by their belonging to an alternative class of investment. In our study, a comparative analysis is presented which is based on traditional financial assets, and the indexes of the real estate market in Russia and the USA.

The comparison between Russian and American art markets is motivated by the following reasons. First of all, there is no data available for a separate and reliable index of European or Asian contemporary art markets (or an index of contemporary art market for one individual country). Secondly, the US art market is one of the most developed, largest and integrated art markets in the world. This implies that data is available for a lengthy time period. Finally, the goal of this research is to assess the performance of the Russian contemporary art market relative to the performance of other alternative and traditional investment asset classes, and only after that to check if the established relations hold in another country.

To estimate returns on real estate markets, we adopt the same approach as in the work of G. Candela, A. Scorcu [7]. We use a real estate market proxy for the Russian market based on the data of the Federal State Statistics Service [26]. This data includes the mean price of $1m^2$ of the total area of typical apartments on the housing market (apartments of medium quality). The market proxy for high-end real estate in the Central Federal District was

calculated separately. Just like art markets, real estate markets are characterised by significant transaction costs [27]. In Russia, they can reach as much as 25% of the property's sale price [28]. A broader range provided by Global Property Guide indicates that in Russia, transaction costs are approximately 22.71% - 27.50% [29]. In our estimates, we incorporate mean transaction costs to avoid overestimation of returns on real estate market. Also, for the purposes of comparative analysis, the Case-Shiller index (an index of the real estate market in USA) and the S&P 500 were used, and also the indexes of corporate bonds in the USA with a circulation period of 1-3 years and 10-15 years (ICE BofAML US Corp 1-3yr and ICE BofAML US Corp 10-15 yr), as well as treasury bonds with a circulation period of three months. Descriptive statistics for these investment instruments are shown in Table 2.

Table 2. Comparative characteristics of investment instruments in 2006-2019

	Contemporary Russian Art	RTS Index	S&P500 Index	US Corporate bonds 1-3yr	US Corp bonds 10-15yr	Case-Shiller home price index	US Gov bonds 3-month	Russian Real Estate Market (Total)	Russian Real Estate Market (Luxury)
Average return	-3.08%	3.03%	6.91%	3.2%	6.37%	1.43%	1.16%	8.52%	15.06%
Median	-5.62%	1.58%	10.12%	2.85%	5.84%	2.91%	0.23%	3.47%	14.89%
Maximum	64.08%	48.69%	19.21%	9.43%	21.65%	9.60%	4.73%	39.22%	56.13%
Minimum	-56.85%	-37.68%	-21.95%	0.87%	-1.37%	-9.45%	0.03%	-7.20%	-40.02%
Standard Deviation	33.75%	21.51%	12.73%	2.20%	5.77%	5.97%	1.60%	14.56%	23.05%
Coefficient of skewness	0.17	0.27	-1.27	1.71	1.26	-0.57	1.35	1.23	-0.52
Coefficient of kurtosis	2.68	3.08	3.59	5.65	4.64	2.17	3.49	3.26	3.81
Sharpe ratio	-0.13	0.09	0.45	0.93	0.90	0.05	-	0.51	0.60
Treynor ratio	-0.042	0.031	-	1.050	0.302	0.008	-	-0.382	0.463

These results illustrate that investments in Russian contemporary art showed the lowest profitability among all the instruments analysed. The results in Table 2 for this class of assets do not correlate with the results of previous research, which focused on Russian art. For example, in the work of R. Kraeussl, R. Logher [25] a profitability figure of 12.57% of the Russian art market was indicated for the years 1986-2008. Nevertheless, it is worth noting that investments in contemporary art should not be directly compared with investments in art in general as they are more risky. This is because for most transactions there are no figures for repeated sales, e.g. due to special characteristics, or the possessor's realisation that it is more difficult to make an evaluation of the art object, etc. Our comparative analysis of the investments in contemporary Russian art with those in Russian real estate demonstrates that these two classes of assets cannot be accurately compared. Apart from this, the mean profitability of investment in art is less than the profitability of the RTS index and the profitability of high-end real estate, though investments in the canvases of contemporary Russian painters show an abnormal maximum profitability among all investment instruments analysed.

The calculation of the Sharpe ratio demonstrates that the best ratio of risk to profitability is associated with those investments in corporate bonds of US companies with different circulation periods, and in Russian high-end real estate. It is worth noting that investments in contemporary Russian art turned out to be the sole instrument with a negative Sharpe ratio. From a formal point of view, this indicates the necessity of excluding this instrument from investment portfolios. Meanwhile, very low values in the RTS index should be considered as a caution against investments in Russian shares.

Evaluation of the CAPM model for diversification of investment portfolios by investment in contemporary Russian artwork

According to the opinions of S. L. Glekov [4] and U. Gray [30] investments in art can be used to diversify investment portfolios. To check this hypothesis, we calculate the values of the CAPM model (Capital Asset Pricing Model). This calculation allows us to identify the metric value of market risk for every asset and the relation between the profitability of financial instruments and mid-market profitability. For the purpose of ascertaining the maximum suitability of this or that instrument in terms of diversifying investment portfolios, its coefficient should be below zero (i.e. having a negative correlation

between the asset and the stock market). The CAPM model reflects a situation where the rate of return of short-term US Government loans (with a circulation period of 3 months) is used as the risk-free asset [31]. The American S&P 500 index was chosen as the market portfolio. Calculation of the market risk premium and further regression analysis is shown in the results, as presented in Table 3 below.

To establish a situation where investments in art are an obviously beneficial instrument for diversification, a negative value for the coefficient is required. This value is inherent only to the Russian real estate market and federal loan bonds with a circulation period of 6 months. Therefore, the canvases of Russian contemporary painters should not be used for portfolio diversification. Using this coefficient, we can calculate the Treynor ratio, and with it we can make the conclusion about the reward-to-volatility ratio. The Treynor ratio for the asset "i" is calculated with the following formula:

$$Treynor\ Ratio = \frac{\overline{R_i} - \overline{R_f}}{\beta_i} \qquad (2)$$

The results of the above calculation are shown in Table 2. The highest result associated with the Treynor ratio belongs to US Corporate bonds with a circulation period of 1-3 years. Much lower values for the Treynor ratio were calculated for the index of high-end real estate of the Central Federal District and the corporate bonds of US companies with a circulation period of 10-12 years. According to the results of the analysis, the Treynor ratio was negative for two instruments: the price index of contemporary Russian art and the index of Russian real estate. The profitability for the real estate index was higher than that for risk-free return, though the index was negative. This instrument is effective, because the risk is low (negative coefficient β), and the return of the instrument was higher than that of the risk-free rate. By contrast, the negative value of the Treynor ratio for the Russian contemporary art market indicates the inefficiency of investment, since the risk-free return is higher than the profitability of the asset with positive coefficient β.

Since not only foreign, but also Russian investors buy the canvases of Russian contemporary art, the CAPM model was applied to calculate values pertaining to Russian investors. The RTS index was chosen as the market portfolio and federal loan bonds (with a period of circulation of 6 months) was chosen as the risk-free asset. The results of this calculation are seen in Table 4.

Table 3. Results of the evaluation of model CAPM for the chosen investment instruments for 2006-2019

	Contemporary Russian Art	RTS Index	Russian Real Estate Market (Luxury)	US Corp bonds 1-3yr	US Corp bonds 10-15yr	Case-Shiller home price index	Russian Real Estate Market (Total)	OFZ 6 months
Constant	-0.1005	-0.0156	0.1218	0.0193	0.0422	-0.0163	0.0847	0.2184
B	1.0102	0.5972	0.3002	0.0194	0.1723	0.3292	-0.1927	-1.815
R^2	0.1490	0.1403	0.029	0.0088	0.1111	0.4817	0.0346	0.3513
F-statistic	2.10	1.96	0.36	0.11	1.50	11.15	0.43	6.50
Constant significance	Not significant	Not significant	Not significant	Significant at 5% and 10% level of significance	Significant at 5% and 10% level of significance	Not significant	Significant at 10% level of significance	Significant at 5% and 10% level of significance

Table 4. Results of the estimation of the CAPM model for Russian investors

	Constant	B	R^2	F-statistic	Constant significance
Contemporary Russian art	-0.0594	1.0177	0.7616	38.33	Not significant

According to the results of these calculations, the index is significant to any reasonable level of significance. The values of this index can be compared with the values in Table 3. The presented index is positive, and therefore the canvases of contemporary Russian painters should not be recommended for diversification of the portfolios of Russian investors.

Finally, we can calculate the correlation ratio for the above-mentioned investment instruments (Table 5).

The price index of contemporary Russian art has a positive correlation with all considered instruments of the stock market (excluding federal loan bonds) and the index of Russian real estate. These type of investments have a negative correlation with the Case-Shiller index and the index of Russian high end real estate. So, the investments in Russian contemporary art should not be widely used for the risk diversification of investment portfolios.

Table 5. Correla tion of investment instrument for the period 2006-2019

	Contemporary Russian Art	RTS Index	S&P500 Index	US Corporate bonds 1-3yr	US Corp bonds 10-15yr	Case-Shiller home price index	Russian Real Estate Market (Luxury)	Russian Real Estate Market (Total)	US Gov bonds 3-month	OFZ 6 months
Contemporary Russian Art	1									
RTS Index	0.5075	1								
S&P500 Index	0.4005	0.4374	1							
US Corporate bonds 1-3yr	0.4958	0.2674	0.0366	1						
US Corp bonds 10-15yr	0.3200	-0.0275	0.2987	0.7355	1					
Case-Shiller home price index	-0.0383	0.1882	0.6889	-0.5139	-0.2336	1				
Russian Real Estate Market (Luxury)	-0.0145	0.1566	0.1983	-0.1773	-0.3010	0.6049	1			
Russian Real Estate Market (Total)	0.2908	0.5997	-0.0790	0.1612	-0.2975	-0.0199	0.4993	1		
US Gov bonds 3-month	0.1588	0.6991	-0.0114	0.0469	-0.4338	-0.0650	0.3040	0.8291	1	
OFZ 6 months	-0.3564	-0.3914	-0.5979	-0.3509	-0.4849	-0.3330	0.0820	0.2123	0.0252	1

Conclusion

According to the estimates for the period studied herein, including the crisis of 2008 and the period subsequent to the anti-Russian sanctions of 2014, we have to draw the conclusion that the canvases of contemporary Russian painters present relatively unattractive investment opportunities in terms of profitability or stability from the perspective of portfolio diversification.

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The Receipt of Grants as a Key Determinant of Venture Investment Size in Russia-based IT Startups

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Abstract

Since 2006, Russian policymakers have taken various measures to stimulate the venture capital market. Government venture capital funds have been created, with, for example, the Russian Venture Company being capitalised to the amount of 15 billion rubles. Consequentially, since 2011, state-owned companies have been investing in private venture funds. These measures have led to increased levels of fundraising for startups. The main mechanism of such financing is grant support for young companies. As of 2018, the ratio of grant money provided to the total amount of funds raised in Russia is one of the highest among developed and developing countries (the USA, by comparison, is more than 2.5 times lower). The venture market landscape is such that when deciding whether to invest in a company, investors inevitably turn their attention to the details of previous rounds of company financing. In that context, the purpose of this work is to analyze the effect of grants received on the volume of subsequent financing a company attracts.

To analyze the effect of receiving a grant, the determinant approach was used. Based on a sample of 184 Russian IT startups, two OLS models were built to show the effect of grant size on follow-on investment rounds. Various sets of determinants were considered that explain the volume of investments attracted by startups for both Russian and international markets. In addition, an excursus was conducted to study the effectiveness of government venture funds, which are the main grantors in the Russian venture market.

Our results indicate that investing in startups which have received a grant increases the likelihood of an exit for the investor in the next investment round. Based on the results of previous studies, we show that the size of a received money grant has a positive effect on the amount of funding attracted in both follow-on rounds. For comparison, a number of previous studies of the Russian venture capital market showed that the investment size of the current round was influenced only by the previous instance of fundraising.

The scientific novelty of this article concerns our evidence that the amount of funding attracted by startups is explained by such a specific indicator as grant support. Our results testify to the attractiveness for investors of Russian IT startups that received grant support. These conclusions have clear practical value for those who invest in Russian startups, the startups themselves, and investors in Russia in general.

Key words: venture capital, start-up accelerator, determinants, microeconomic factors, macroeconomic factors, investment activity, rounds of investments, grants

JEL classification: G32, M13, L25

One of the priority areas for the development of the financial market in Russia is the improvement of the investment environment, including for investments in innovative companies in the early stages – that is, startups. The government has paid great attention to this issue. A large number of start-up accelerators and incubators have been created, and grants are available for potentially significant projects and productive teams.

Introduction

For the first time after a multi-year recession, a consistent increase in the volume and number of transactions and the expansion of the active investor community can be observed. Despite various geopolitical and internal difficulties, start-ups and funds from Russia continue to make deals. This positive trend is mentioned in various commercial research and market surveys. For example, in the report from "MoneyTreeTM: Venture Market Navigator" (PwC & RVC, 2018) for 2017 and the first half of 2018, it was noted that after negative events associated with unfavourable macroeconomic and political factors, a process of stabilization takes place. Evidence of that can be clearly seen from the fact the total volume of the venture capital ecosystem amounted to 410 million US dollars, as was the case in 2016. Nevertheless, the dynamics of various segments of the venture market at the end of 2017 was multidirectional. While an increase in the total volume of venture capital investments from 165 million US dollars to 244 million US dollars (an increase of 48%) occurred, it coincided with a fall in the volume of transactions for investors leaving venture projects, from 120 million dollars to 80 million dollars (a drop of 33%). This may indicate the presence of an active investment phase for many players in the Russian venture capital market. However, it is worth noting that, according to the methodology used in the MoneyTreeTM study, cash grants are not taken into account when assessing the volume of the market of venture transactions, since they are a non-market tool to support innovation.

Nevertheless, various grant systems for young and promising start-ups play an important role in the venture capital industry. As a rule, grantors are structures with the participation of the government and large international corporations. The most active grantors on the Russian market are the Foundation for Assistance to the Development of Small Forms of Enterprises in the Scientific and Technical Sphere (the Innovation Promotion Foundation or the Bortnik Fund) and the Skolkovo Foundation. According to the results of the study "MoneyTreeTM" for 2017, the number of grants issued amounted to 4,558 for a total sum of $ 88.5 million. Compared to 2016, the total amount of grants decreased by 27%, and the number of grants issued fell by 2%. Moreover, from the previous reports cited at (PwC & RVC, 2017) and (PwC & RVC, 2016) it is clear that both the number of grants awarded and their total investment are decreasing from year to year.

Grants are a crucial element for the sustainable development of the venture capital market and the innovation ecosystem as a whole. Nevertheless, participation in a grant competition requires a certain amount of preparation from the team, and may divert its attention from the original objectives of their project. Therefore, it is interesting to analyze how successful the projects are that have received such grants in the past. Furthermore, it is hoped that this research will contribute to a deeper understanding of how receiving a grant affects the further financing of projects.

Literature review

Identifying the determinants of venture capital investment attraction using mathematical and statistical tools is a relatively new and little-studied direction. One reason is that it is not a simple task to select, analyze, and systematize such numerical factors that can potentially influence the value of venture capital investments. In their study (Jeng & Wells, 2000) shows that the diversity of investment mechanisms, sources of capital, and approaches to asset management in investment companies limit the ability to compare venture capital markets among different countries. As a result, attracting venture capital investments from round to round in different countries, as a rule, depends on different market mechanisms. That feature significantly limits the possibility of finding some universal determinants which explain the volume of investments and the market as a whole. In addition, it is also worth noting that, with the exception of the United States, the relevant data are only available from the eighties to the nineties of the twentieth century. For Russia, such period is shorter, and starts only from the beginning of the twenty-first century.

Despite all the mentioned difficulties, it is possible to highlight the factors that have already been studied in the scientific literature and which show a certain statistical significance. These factors include relevant interest rates, the volume of attracted investments in previous rounds, initial public offering (IPO), the "authority" of a venture investor, returns on invested capital in private and public companies, taxation, regulation of pension funds and their activity on venture capital market, stock market capitalization, and labour market elasticity.

Among the factors listed, articles (Black & Gilson, 1999) and (Gompers & Lerner, 1998) highlight a significant relationship between the number of IPOs and the amount of venture capital attracted in developed markets. This established relationship has a clear business case. Thus, the sale of shares of a portfolio company on the open market through a public offering is one of the mechanisms for venture funds to exit from investments. The large number of new IPO transactions indicates the presence of additional returns on the sale of company shares on the open market, which in turn will attract new investments in venture capital projects (Berlin, 1998). On the other hand, large opportunities for raising capital in the public

market also increase the demand for venture capital investments from start-up projects (Jeng & Wells, 2000). Despite the clear positive effect of the growing number of IPOs for the US venture capital market, for the European market, the increase in the number of IPOs has a negative effect on attracted volumes of venture financing (Marti & Balboa, 2001). The authors explain this by the fact that for the considered period of time in Europe, large companies initiated an IPO when they had already passed the stage of venture financing. Accordingly, for European venture capital investors, this is not an indicator of the high demand for their portfolio assets.

A similar factor is the size of the mergers and acquisitions (M & A) market. In particular, (Elisabete, Cesaltina, & Mohamed, 2013) showed that for 23 European countries for the period from 1998 to 2003, the size of the M & A market and the ratio of the company's market value to its balance sheet value (P / B ratio) for the high-tech sector both have significant positive effects on the venture capital activity. The authors explain this by a high level of information asymmetry, which, in turn, is extremely attractive for venture investors, allowing them to exit from their investments in a highly liquid market with an excess premium.

The negative impact of raising the income tax rate was found in the work cited at (Poterba, 1989). The author showed that the increase in the rate of tax on the growth of invested capital significantly reduces the commitment of partners of venture funds, which in turn makes managers more carefully select objects for investment. Such a relationship between the rate of income tax and the amount of attracting new venture capital investments was found not only in countries with developed venture capital financing, but also in China (Aylward, 1998).

Another variable that can significantly affect the volume of venture capital investments is the level of pension funds in the economy, provided that they are allowed to invest in venture capital. Since significant amounts of money are managed by pension funds, their participation significantly affects the supply of venture capital (see (Gompers & Lerner, 1998) and (Jeng & Wells, 2000)). This variable is most important for countries such as the United States. In most European countries, pension funds do not manage such large sums of money and / or do not have the opportunity to invest in private (non-market) companies.

Global macroeconomic indicators such as GDP growth (Gompers & Lerner, 1998) have a positive effect on the volume of attracted investments from venture capital firms. The growth of the economy as a whole contributes to increasing the level of commitment on the part of investors of venture funds themselves (Jeng & Wells, 2000). The growth of the capitalization of the country's stock market also has a positive effect on the volume of funds raised from venture funds. The work cited at (Bonini & Alkan, 2006) showed this for 16 countries from 1995 to 2002. At the same time, it is worth noting that the degree of influence of this determinant varies and depends on the country. (Aylward, 1998) showed that this positive relationship is fair and significant in the case of developing countries. For example, in the countries of Western Europe there was a surge in capital inflows to venture funds from 1988 to 2000 (Schertler & Andrea, 2003), when the prospects for economic development in the region improved. However, this relationship loses its statistical significance from 1995 to 2000 for the Eastern European market, as shown in (Marti & Balboa, 2001).

Another effect of a fundamental economic indicator, such as the elasticity of the labor market, has also been established for developed markets. The research referenced at (Jeng & Wells, 2000) argue that the less resilient the labor market, the more difficult it will be for a person to find a job after an unsuccessful attempt to create his company. This reduces the potential of the entrepreneur, which ultimately reduces investment activity in the venture capital market. Paper (Black & Gilson, 1999) found a negative correlation between the volume of venture investment and legal restrictions on the dismissal of employees. In Germany for example, there is a state protection of workers against layoffs, which imposes additional costs on young companies, and also reduces their potential in the face of venture capital investors. What can be said about the UK and the United States, where labor markets are much more flexible. However, a later study ((Schertler & Andrea, 2003)) on data from 14 countries in Western Europe for the period from 1988 to 2000 shows an inverse correlation. One possible reason for such a result may be an increase in the unemployment rate over the considered period (Elisabete, Cesaltina, & Mohamed, 2013).

The above determinants of venture capital investment are rather global, since they have an impact on the entire economy. Of course, with the growth of the total volume of venture capital investments in the economy, each startup has more chances to attract additional funding. However, if we consider the question of attracting funding from the perspective of each specific project separately, we should consider the determinants directly related to the projects themselves. These determinants include: the amount of financing attracted by the project in the last round, the presence of an experienced investor among investors of the previous round, and the presence of an earlier grant received by the project.

A good example of a fundamental study of the local venture capital market is a series of research papers by Russian researchers. The work in question (Semenov & Gosteva, 2014) represents one of the first attempts to analyze the market impact of various indicators on the volume of attracted investments in the second and subsequent rounds. They showed a strong positive correlation of investments in the second round with the size of investments in the first round. The potential reason for the positive impact of the size of the investments of the first round, according to the authors, is that companies that have already attracted a significant amount of funds are more interesting for new investors. Similar results were obtained (Marti & Balboa, 2001) on a sample of 16 European countries from 1987 to 1999. On the other hand, it is possible that the presence of an "experienced" investor in the previous round,

regardless of the company's results, makes the company more attractive to investors (Semenov & Sokolova, 2015). "Experienced investor" in this context refers to institutional and private investors who have experience in exiting their investments. In addition, experienced investors have a number of connections in this sector and can themselves attract new investors to the project.

The research cycle of the Russian IT market of a start-up company is also studied in (Rodionov, Semenov, & Seleznev, 2018). The total data sample includes 55 venture capital deals from 2010 to 2016 in industries such as e-commerce, tourism, finance, and education. The authors of that research paper refuted the impact on the volume of attracted investments of such internal indicators of companies as the number of project founders, the year of investments, and the project industry.

When studying the issue related to the impact of grants on the further financing of the project, it is worth mentioning the institution of state venture funds and their role in the economy. The governments of many countries around the world have created government venture capital funds (GVC) to promote the development of the private venture capital industry and help young innovative companies. Empirical evidence is ambiguous (Colombo, Cumming, & Vismara, 2016). The impact of GVC investors on portfolio companies requires further analysis of the role of such factors as: the stage of development of a portfolio company, the level of human capital, and the business model. The GVC phenomenon is another promising area of research for the venture capital industry. The effect is positively influenced by projects from GVC funds and is more pronounced when GVC is combined with private investors (Grilli & Murtinu, 2014) and (Grilli & Murtinu, 2014b). GVC programs can act as funds of funds, reducing their risks, and increasing coverage. However, there is no systematic comparison of the effects of GVC direct investment and private venture capital investments.

Data and sample construction

To analyze the impact of the grants received by IT startups on their future performance, a sample of 184 companies was collected, containing the following information about each of them:

- Grant amount received.
- Amount of financing at the seed stage.
- Amount of financing in the first round.
- Amount of funding in subsequent rounds.
- Grantmakers.

The market sector in which the startup operates.

Data sampling was downloaded from the Rusbase portal (Table 1). For the study selected companies from different sectors of the economy were chosen which satisfied the following conditions:

- Grant availability.
- Subsequent investments.

Table 1. Data example

Sector	Company	Grant, $	Grantmakers	Round A, $	Round B, $
Messengers	Budist	25 000	Vkontakte	1 000 000	1 000 000
Security	Technovisor	5 450	Microsoft; IIDF	78 000	240 000
Food	Elementaree	7 000	Web Ready	300 000	500 000
Service	YouDo	25 000	Start Fellows	1 000 000	6 200 000
Software	Parallels	5 000 000	Skolkovo	1 000 000	5 000 000

The main grantors are large and established IT companies, start-up accelerators (mostly with state participation), and the state structures themselves (Diagrams 1 and 2).

Diagram 1. The segmentation of data by economic sectors

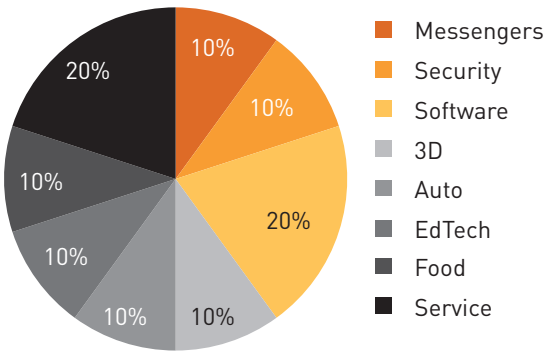
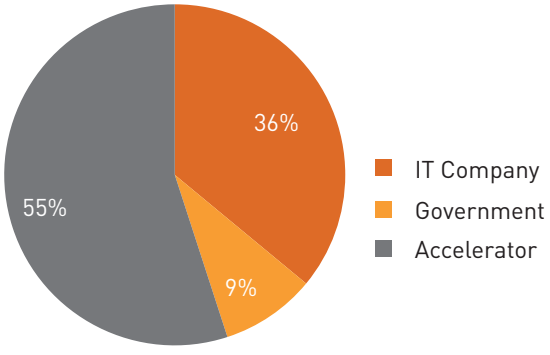


Diagram 2. The main grantors



Variables description

To investigate the impact of the grants received on investment in subsequent rounds, two OLS models were built.

Hypothesis 1: The Round A investment size positively depends on the seed investment and grant investment amounts.

Model 1. In Model 1, the volume of investments received by the company in the first round was considered as a dependent variable. The dependent variables were the volume of investments received at the seed stage and the size of the grant received.

As a result, model 1 has the following specifications:

Round_A = Intercept + b1*Grant + b2* Seed + u, where

- Round_A – natural logarithm of investment in the round A;
- Seed – natural logarithm of seed investment;
- Grant – natural logarithm of the amount of investment received as a grant.

Model 1. Results

	log (*Fundraising*)
Seed	0.333*** (0.094)
Grant	0.022** (0.098)
Constant	4.065*** (0.542)
Source: author's calculations.	*** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	d *f*	SS	MS	F	*Significance* F
Regression	2	33.72	16.86	8.08	0.00067
Residual	74	154.32	2.08		
Total	76	188.04			

	Coefficients	Standard Error	t Stat	P-value
Intercept	4.065	0.542	7.49	0.00001
Grant	0.022	0.098	-2.33	0.02231
Seed	0.333	0.094	3.55	0.00068

According to the F-test results both the model and the coefficients are statistically significant under the 5% significance level.

	Statistic	Critical values
Durbin–Watson	1.84	(1.57; 1.68)
Breusch–Godfrey	0.62	1.99

According to the Durbin–Watson and Breusch–Godfrey tests there is no statistical evidence at the 5% significance level that the error terms are autocorrelated.

	Significance F	Critical values
White	0.29	0.05

According to the White test homoscedasticity is rejected under the 5% significance level.

Hypothesis 2: The Later Round investment size positively depends on the seed investment, Round A, and grant investment amounts.

Model 2. In the second model, the volume of investments obtained in the second round was already a dependent variable. The volume of investments received in the first round and the seed stage, as well as the size of the grant received, were considered as dependent variables.

As a result, model 2 has the following specifications:

Round_B = Intercept + b1*Grant + b2* Seed + b3* Round_A + u, where

- Round_B – natural logarithm of investment in round B, C, and so on;
- Round_A – natural logarithm of investment in the round A;
- Seed – natural logarithm of seed investment;
- Grant – natural logarithm of the amount of investment received as a grant.

Model 2. Results

log (*Fundraising*)	
Seed	0.227 (0.178)
Grant	0.381** (0.167)
Round_A	0.339** (0.167)
Constant	1.978 (2.137)
Source: author's calculations.	*** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	d *f*	SS	MS	F	*Significance* F
Regression	3	51.58	17.19	6.28	0.00266
Residual	24	65.68	2.73		
Total	27	117.27			

	Coefficients	Standard Error	t Stat	P-value
Intercept	1.978	2.137	1.43	0.16453
Seed	0.227	0.178	1.27	0.23173
Grant	0.381	0.167	3.52	0.01737
Round_A	0.339	0.167	2.17	0.02660

According to the F-test results both the model and the coefficients are statistically significant under the 5% significance level, except for the seed investment size.

According to the Durbin–Watson and Breusch–Godfrey tests there is no statistical evidence at the 5% significance level that the error terms are autocorrelated.

	Significance F	Critical values
White	5.5789E-192	0.05

According to the White test homoscedasticity is rejected under the 5% significance level.

Results

Testing model 1 showed that the hypothesis about the impact of the grant received by the company to attract further investment in the first round is not rejected at the 5% significance level. This result confirms the earlier conclusions that the current investment round size is affected by the volumes of previous fundraising. Accordingly, the grant received can be considered as a regular investment round.

Testing model 2 showed that the hypothesis about the impact of the grant received by the company on the attraction of investments in the second round is also not rejected at the 5% level of significance. Compared with the regular investment round, those with prior grant support "win" when it comes to Round B and follow-on rounds. From which we can conclude that the impact of the grant on the volume of attracted financing is more durable. It turns out that investors generally evaluate the startup positively, regardless of whether it received a grant in the previous investment round or a few rounds ago.

In addition, testing hypotheses about the impact of seed investments on investments of the first and second rounds showed that the size of seed investments is significant only for the first round, and not significant for the second round at a 5% significance level.

All tested models are significant and have significant estimates without any sign of homoscedasticity, multicollinearity and autocorrelation of error terms. It also should be mentioned that there is no way to check the model's stability over time on different subsamples because the original sample is rather small.

Conclusion

The growth of state support for small businesses through the allocation of grants through start-up accelerators has fueled interest from companies for such incubators. The procedure for selecting projects for investing in such a start-up accelerator resembles a competition, during which teams work on their projects under the strict guidance of mentors and regularly present the results of the increase in the value of their project.

This work was aimed at testing hypotheses about the effectiveness of financing start-ups by allocating cash grants, and a review of the scientific literature has shown that the venture market can be analysed for this purpose, with the help of econometric models. Moreover, such studies help to identify less-obvious relationships as to the determinants of investment volumes. In particular, this work uses some of the conclusions obtained in previous empirical studies of the Russian venture capital market. Based on the reviewed papers, two models were constructed, investigating the impact of the grants received and the size of seed investments in attracting investments in subsequent rounds.

One of the main findings of the study is the confirmation of the hypothesis that the grant received has a positive effect on the amount of investment in the first and second rounds. This may be explained by the fact that investors consider startup accelerators as a kind of school for a team of entrepreneurs. However, the fact of receiving a cash grant loses its influence on the size of investments attracted in the second and subsequent rounds at a significance level of 1%. This may indicate that during the second and subsequent rounds, potential investors are more interested in "fresh" operating results, and to a lesser extent, the results obtained at the start of the project.

The second less obvious conclusion of the study relates to the significance of the size of seed investments for the first round and the absence of this significance for the second round. The explanation for this may be that, as a rule, seed investments are aimed at creating a minimum viable product and testing the demand for it. Therefore, the size of seed investments signals to investors of the subsequent round about a high degree of trust in the team and the prospects of their ideas. The second round of investment, as a rule, is aimed at a significant expansion in the main market for the product, or access to international markets. Therefore, investors are guided by the results of the team in scaling their product, rather than its original version.

Also, in this paper, the result of previous empirical work on the Russian venture capital market was confirmed, which showed that the volume of investments in the current round is significantly affected by the volume of investments attracted in the previous round.

Based on the conclusions described above, it is possible to hypothesize that when i the determinants of investment volumes in Russian start-up projects, it is worth considering only identifying those determinants that relate to the time period in which the previous round of investments occurred. This hypothesis is worth exploring further. We expect that this study will be useful both for investors investing in Russian startups and for startups themselves. The first will be more confident to enter the companies that received grants, and the latter will be more interested in participating in startup accelerators, which ultimately will have a positive impact on the industry as a whole.

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Factors Influencing the Professional Conduct of Auditors in the Dialogue on Going Concerns: A Study of the Banking Sector

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Factors Influencing the Professional Conduct of Auditors in the Dialogue on Going Concerns: A Study of the Banking Sector

Abstract

This article is dedicated to exploring the dialogue between shareholders, management, partners, government and auditors regarding the status of banking sector entities as 'going concerns'. The purpose of this article is to develop and validate an approach to the study of factors influencing auditors' opinion on going concerns.

The authors identify factors which affect auditors' professional conduct in establishment of an opinion on an entity as a going concern. Articles were retrieved from the Scopus and Web of Science databases and analysed for relevant factors, and a number of research hypotheses are formulated, among which the modification of legislative regulations on banking and auditing activity is identified as a key factor. The state of auditing activity and the banking sector during 2009-2019 is evaluated. Additionally, in order to identify periods during which a significant influence of a selected factor is expected, a novel analytical method was devised based on the nature of modifications of legislative regulation of banking and auditing activity and the period of such modification.

The following factors are significant influences on auditors' decisions on the going concern status of credit organisations: evolution of auditing standards, implementation of external audit quality control, development of banking regulation and supervision, and interaction of auditors with financial institutions and regulators. Evidence was also discovered of conclusions recorded against entities inconsistent with the real conditions of individual banks.

The authors have established a basis for an integrated study of the influence of factors on the professional conduct of auditors in providing opinions on the going concern status of audited entities, and have proposed further research prospects as related to establishing and measuring the relationship between audit report types based on bank statements and factors describing the results of their activities.

Key words: auditing, financial statements, professional conduct, going concern, credit organisations, government regulation

JEL classification: M42, M48, G21, G28, G38

Introduction

An auditor's opinion on an audited entity's going concern may result in various social and economic consequences for its stakeholders. This is precisely why such opinions should be formed by means of a dialogue between auditors and the actual and prospective users of the auditor's evaluation. The context of such dialogue should be established according to auditing standards and the key emphases should be established through the professional conduct of a particular auditor. This way of placing emphasis broadens the potential scope of impact of an auditor's decisions, but also requires a more prolonged involvement of the auditor as a participant in the dialogue.

The point of departure of this research was the widely-held view of audit service users that imperfection in legislative and regulatory acts (including instability of the legislation related to auditing activities) and the inconsistency of certain regulations have an adverse effect on the perception and development of the audit concept. This research is based on an acknowledgement of the specific nature of going concerns as a subject of evaluation. The opinion on a going concern rests on an auditor's professional judgment and requires an individual approach to professional skepticism due to a significant impact of the uncertainty factor.

At first glance, it seems that if auditors comply with certain industry standards, independence rules, and a code of ethics, the audit of a going concern should not yield negative results. However, one should take into consideration the complexity and multidimensionality of the factors which influence not only the ability of an auditee to do business as a going concern, but the auditor's actual appraisal of the business. Such factors comprise external conditions and events which demand recognition of the auditors potential influence on the going concern. This involves factors related to changes in applicable regulations on a nationwide or industry-wide scale, changes in the market, and other similar factors. One should pay particular attention to those factors which influence or can influence reasonable assurance and professional skepticism when audit evidence related to a going concern is collected and analysed.

The foregoing articulates the logic and tasks set for this paper in order to achieve our research objective. First, we conducted a statistical analysis of the Russian practice of issuing auditors' opinions which question a company's ability to continue as a going concern, and define the circumstances which identify the relevance of certain measurement variables for the banking sector.

Second, we analysed foreign publications indexed in the scientific systems Scopus and Web of Science. Publications were chosen on the basis of subject review results according to the category of "going concern". So, we determined the repertoire of methods applied by foreign researchers and identified the factors which influence the evaluation of going concerns, including the factors which have or may have a significant impact on auditors' professional conduct.

Third, we formulated and tested the approach to study of influence of dynamics of regulation of banking and auditing activity on auditors' professional conduct when evaluating going concerns. We determined that the following factors had the most influence on such auditor evaluations within the analysed period: the evolution of auditing standards; the conceptualisation and implementation of external control of audit quality; the development of banking regulation and supervision; the level of interaction of auditors with financial institutions and supervisory authorities. In order to define the periods within which a significant influence of the identified factor is assumed, the authors analysed the relationship according to the following logic – the nature of modification of legislative regulation of banking and auditing activity, and the period of such modifications.

Relevance of Factors which Influence the Assessment of Banking Sector Entities as Going Concerns: National Level

In order to substantiate the relevance of the studied issues and in order to define the appropriate trends, we conducted an analysis of practice of issuing auditor's opinions which question the customer's ability to continue as a going concern for 2011–2018 (Figure 1).

We can see from Figure 1 that within the analysed period, there is an overall increase in the share of auditor's opinions which question the customer's ability to continue as a going concern and indicates a significant uncertainty in the customer's activity (2011 – 2.6%, 2018 – 4.9%). Therefore, in spite of a reduction in the number of audit organisations' customers for whom accounting statements have been audited, there is a forecast predicting a significant growth in the number of auditor opinions questioning the customer's ability to continue as a going concern and indicating significant uncertainty in the customer's activity. We refer to a forecast because official statistics offer no information on the number of issued auditor's opinions with a negative opinion or a qualification related to questioning the ability to continue as a going concern (1,2).

The practice of issuing auditor's opinions which question the customer's ability to continue as a going concern was analysed, taking into consideration the results of external control of the quality of auditors and audit organisations for a comparable period (Figure 2).

Figure 1. Dynamics of auditors' opinions which question the auditee's ability to continue as a going concern for 2011–2018 [1]

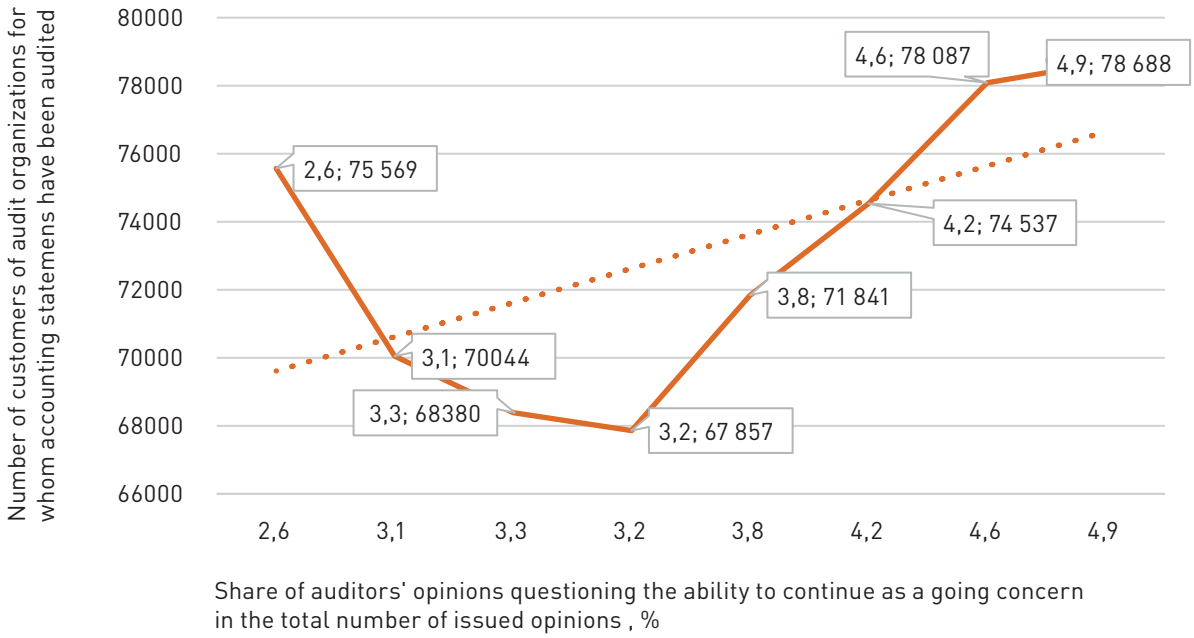
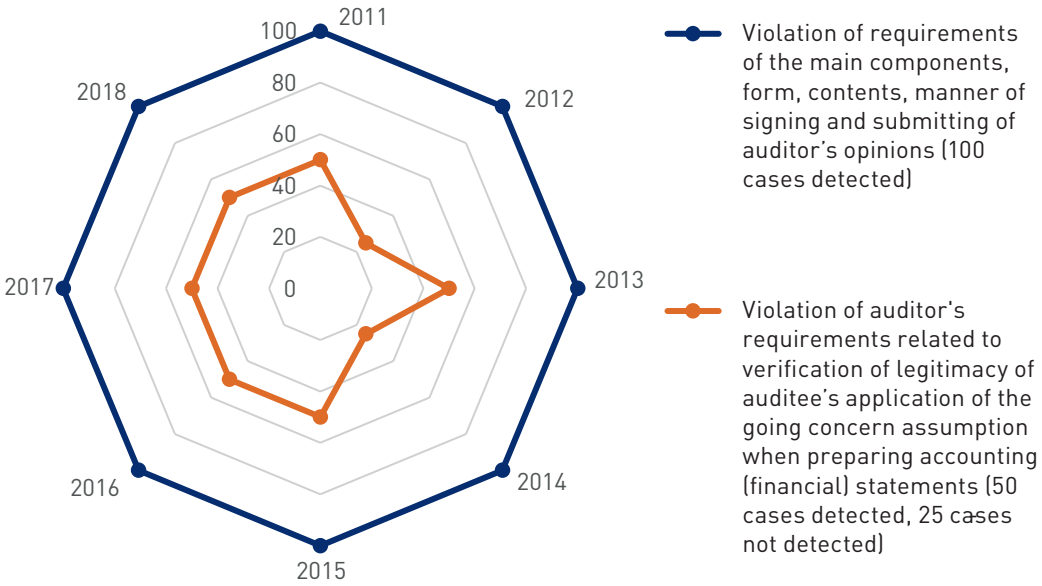


Figure 2. Individual results of external control of the quality of auditors and audit organisations for 2009–2010 [2]



It should be noted that there is no information regarding the results of external control of audit quality and auditor's opinions calling into question the customer's ability to continue as a going concern for the period of 2009–2010. Figure 2 shows that throughout the analysed period, violation of requirements to the main components, form, contents, manner of signing and submitting auditor's opinions are designated as typical violations. As for assessment of going concern only, in 2012 and 2014 violation of requirements to auditor's actions related to verification of legitimacy of auditee's applying the going concern assumption when preparing accounting (financial) statements are not considered typical.

Thus, we can suggest that external quality control found out the following:

Violation of auditor's requirements related to verification of the legitimacy of auditee's applying the going concern assumption in cases where the auditor registered a doubtful opinion as regards the business as a going concern;

Violation of auditor's requirements related to verification of the legitimacy of auditee's applying the going concern assumption in cases where the auditor did not state his/her doubts in the registered opinion as regards the business as a going concern.

In the authors' opinion, both cases may be a consequence of violations not just of auditing standards, but also of professional conduct rules which require independence, impartiality, and professional skepticism. Therefore, it is necessary to study the internal and external factors which influence auditors' decisions.

We propose that the influence of determining factors on auditors' professional conduct should be studied in respect of a certain type of auditee. This auditee type should be determined according to the type of economic activity engaged in, the compulsory or voluntary nature of audit applied, and the types of users of the auditor's opinion. In our research, we determined that credit organisations should represent such a category of auditees. The reasons for choosing the banking sector and credit organisations are explained below.

The banking sector has one of the highest levels of regulation and supervision both nationally and internationally. In order to maintain stability, special mechanisms of sustainable development support of the banking sector are applied along with requirements to comply with a range of compulsory regulations, information disclosure, and other instruments. The significance of these mechanisms increases particularly during financial crises, and the consequences for the financial sector's stable functioning have traditionally had a pronounced and measurable effect on its operations.

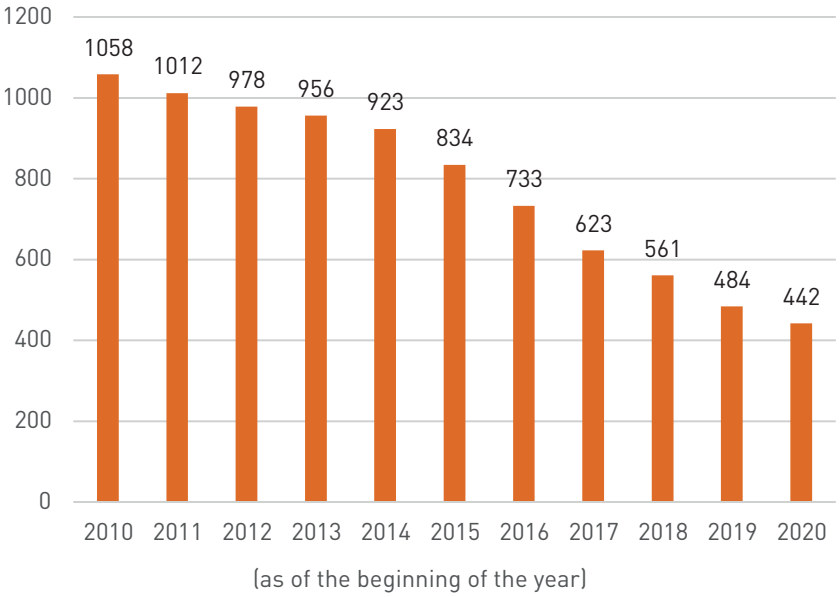
In the analysed period (2009–2019) both internationally recognised approaches and the national system of industry-specific regulation were transformed (e.g. the guidelines and standards of the Basel Committee - FATF - were revised). Additionally, regulator supervisory practices, anti-money laundering practices, and applied mechanisms of credit organisations' financial rehabilitation evolved. We presume that a change of the above factors could exert material influence on auditors' professional conduct from the perspective of evaluating going concerns.

Taking into consideration the highly strict requirements around information disclosure in the banking sector (including the publishing of mandatory regulations and the making available of detailed statistical information) we assume that our research will enable us to focus on the factors characteristic of this sector by means of defining bank-specific variables, and to collect the necessary empirical materials in order to verify the hypotheses suggested in this research.

The paper by N.V. Gorelaya and K. Yu. Kuznetsova [3] outlines the results of the research of creating and managing bank liquidity. It studied the influence of intrabank and macroeconomic factors on the liquidity buffer made by banks using bank statistics at a micro-level. It was noted inter alia that banks showing high liquidity indicators are more prone to go bankrupt. The banking sector is also supervised by reputable ratings agencies and this may expand the list of factors that may be taken into account in the model in future.

As a banking sector regulator, the Bank of Russia pursues a policy of "purging" unscrupulous and financially uncertain credit organisations. As such, the number of operating credit organisations has been diminishing steadily over the past decade: at the beginning of 2020 their number was 58% less than at the beginning of 2010 (Figure 3).

Figure 3. Dynamics of the number of operating credit organisations according to the Bank of Russia in 2010–2020 [4]



In recent years the Bank of Russia has paid special attention to the increased reliability and stability of the financial sector. At the same time, there is a scholarly dispute as to where researchers – banking sector representatives - express their opinions, showing their view on the basis of the attained reliability and stability. So, the research by S.V. Stepanova and V.L. Karakchieva [5] shows that the existing credit risk evaluation method (based on regulatory documents of the Bank of Russia) results in excessive loan loss provisions accumulated by Russian banks. These loss provisions are inconsistent with actual loan losses and, thus, have a detrimental effect on the financial performance of credit organisations. This results in unjustified credit refusals which, in their turn, impede the economic growth of both credit institutions and their corporate customers. Thus, a mega regulator (e.g. the Bank of Russia) enters into the dialogue on going concerns between auditors and credit organisations. The bank, in such an instance, acts as a 'user' of auditor's opinions, which questions a company's ability to continue as a going concern. In accordance with applicable standards, it is the auditor's responsibility to analyse compliance by the auditee with the going concern principle, and to express in the auditor's opinion his/her point of view as regards any serious doubts relating to this principle. That is to say an auditor evaluation may warn the users of financial statements (and first of all, the mega regulator) of the potential and possible causes of the examined credit organisations' bankruptcy.

Bankruptcies of certain credit organisations with expressly positive auditor's opinions (which caused a massive public outcry) confirm the necessity to change the model of bank auditing regulation against the background of its relations with a supervisory authority. This inter alia predetermines the relevance of study of the factors which have resulted in the issuance of such opinions. According to the estimates of the deputy governor of the Bank of Russia Vasily Posdyshev, out of 82 banks declared bankrupt in 2013–2015, 69 had positive auditor opinions [6; 7].

Meanwhile, an analysis of Russian scientific literature allows one to draw the conclusion that audit methodological foundations are highly developed, including the normative and proprietary methods of audit evaluation of going concerns [8–12]. However, the majority of papers are focused on methods of evaluation of event and conditions groups (e.g. financial, operational, etc.) and do not take into consideration the dynamic and uncertain character of the external environment which influences an auditor's professional conduct.

Thus, the relevance of going concern evaluation for audit theory and practice, the efficiency of national policy in banking regulation, and an understanding of the degree of development of these issues in international practice (due to the sophistication of audit institutions) each serve to predetermine the necessity of analysing foreign publications.

Analysis of the Factors Influencing Auditors' Professional Conduct on the Basis of Foreign Research

We analysed certain foreign research publications catalogued in the scientific systems Scopus and Web of Science. For our analysis we chose publications selected by using the object field "going concern" within the period of 2016–2020. The analysis criteria applied to these publications were tailored for our research, including research methods and methodological platforms, and factors which influence the going concern evaluation (e.g. auditor's professional conduct). The results of our review have been systematised on the basis of these criteria in Table 1. It is important to note that we did not attempt to analyse a great number of publications, because we sought to define factors selected as a result of applying a specific methodological template to the representative sample.

Auditing standards dictate that auditors are responsible for the evaluation of uncertainty regarding an auditee's going concern [13]. Some research studies establish that an auditor's opinion may be used to assess a going concern because it contains information on any significant uncertainty related to events which may warn the users of possible causes of bankruptcy. As such, uncertainty evaluation is assessed as a complex and multiple-factor aspect of auditing activity [14]. The paper referenced at [15] systematises a range of research studies on this topic and explains the applied methodology, sample, the variables used and its key results. Among other things, its authors conclude that information disclosure in an auditor's opinion may explain approximately 80% of the causes of business failures.

Other research analyses a two-stage process of issuing an opinion on going concerns which, alongside a professional evaluation of the applicability of the going concern assumption also comprise the stage of taking a decision on the expediency of issuing a going concern opinion. In particular, paper [16] tests the restraining influence of management, family, and institutions, on the relation between auditor's characteristics and issuing an opinion. Its authors emphasise that the pressure exerted by management, family and corporate owners influences the process of making such an opinion. That is, auditors may exhibit an adaptive professional conduct under the influence of external factors. We have not found any research aimed at systematising such factors. So, we generated the following research hypothesis. Appraisal of an auditee's going concern is a complex aspect of audit evaluation which to a is exposed to the influence of the idiosyncratic professional conduct of auditors. Under present-day conditions the influence of external factors which determine the adaptive character of an auditors' professional conduct is on the increase.

The review we conducted in this study allowed us to define some frameworks and factors which influence extent auditors' professional conduct. We identified therein

global frameworks, which include dynamics of macroeconomic conditions, national (country-related) frameworks including regulation models and codes of business conduct, the influence of religion etc., industry frameworks (boundaries) including the extent (level) of regulation in the industry and its nature. According to our reckoning, the influence of public opinion on auditors' professional conduct requires a separate study. Additionally, a distinct focus on sustainable development initiatives which have transformed social and economic systems has also apparently affected the auditor profession.

Many researchers and political commentators have stated that one of the reasons for the global financial crisis of 2008 was a poor-quality audit function, including erroneous evaluations of audited companies as going concerns. The research results cited at [17], describing changes in auditors' conduct in the USA during the global financial crisis, indicate that the number of errors related to the issue of an auditor's opinion which questions the ability of economically viable customers to continue as a going concern is less during a crisis, but is the same before and after the crisis. At the same time, the number of errors related to opinions on customers which went bankrupt andwhere the opinions do not question the business's ability to continue as a going concern, does not differ during the crisis, while post- and prior to the crisis are at similar levels.

On the basis of empirical data, the author proves that auditors' accuracy and conservatism (skepticism) increase during the crisis but return to the pre-crisis level subsequently.

In the pre-crisis and post-crisis period the 'Big Four' auditors are more skeptical. Consequently, the probability of a wrong classification of events in relation to going concerns is lower than by the auditors from smaller audit companies. As such, during the crisis the auditors employed by companies other than the Big Four grow more skeptical, and are less prone to issue auditor's opinions without the qualification questioning the ability to continue as a going concern to the companies which go bankrupt later.

Thus, we may make the conclusion that during the crisis auditors are maximally vigilant as regards going concerns, while in stable times they are more inclined to take mitigating factors into consideration.

Study of national, gender, and religious differences are also included in research papers by modern scientists. So, T.C. Omer et al. [18] show that auditors of companies with offices in highly religious American states are prone to exhibit more professional skepticism than auditors from offices located in less religious states. Consequently, their views on going concerns are more likely to be based on objective criteria and critical evaluation of mitigating factors. These results are typical for both the Big Four and smaller audit companies.

Hence, certain auditors' personal qualities such as religiousness may influence auditors' professional conduct, and encourage the individual auditor to risk less when taking decisions and to observe consistently ethical standards.

The research paper referenced at [19] studies the influence of auditors' gender differences on taking a decision on going concerns regarding companies in financial difficulties. The authors conclude that the above differences exist. Women auditors are less likely to issue an opinion questioning the ability to continue as a going concern of a financially troubled customer. This assumes that women auditors compromise the audit quality, including the going concern evaluation. The authors emphasise that these results may differ from similar research conducted using data from other jurisdictions (countries) but they also draw attention to the fact that one way or another gender differences manifest themselves and influence an auditor's professional conduct.

Within the scope of the research cited at [20] the role of external auditors in supervision over the banking sector is considered, including change of audit practices and audit quality amid financial crises, and taking into consideration the changes in the global industry-specific legal and regulatory framework (such as Basel Committee documents on banking supervision). It studies the dependence of auditors' involvement in supervision procedures in terms of a series of institutional and country-specific factors on the basis of a constructed index of auditors' participation in banking supervision. It was established that the role of the central bank strengthened in terms of supervision over the financial sector in countries which have survived a financial crisis. It was also noted that in the post-crisis period in the countries which had granted great powers to the central bank the probability of auditors' involvement in banking supervision procedures was greater and regulation of supervision over audit in the banking sector increased. However, the issue related to influence of the trend of strengthening the audit supervision regulation in the banking sector, including against the background of auditors' professional conduct when taking decisions on issue of going concern opinions, has been studied incompletely.

Some research studied changes in the professional conduct of bank auditors' in the course of macroeconomic crises, including changes related to an increase of uncertainty in accounting evaluation during periods of perturbations in the economy. In particular, the research paper cited at [21] tested the relation between uncertainty of assets' evaluation at fair value, discretionary loan loss provision, and the role of auditors in containment of possible manipulation with accounting evaluations during a recessionary period. It was found that auditors are inclined to be more conservative during a financial crisis in comparison to the post-crisis period. Therein it was observed that the financial crisis significantly influences the auditors' professional conduct irrespective of their size and industry specialisation.

A model of determinants of going concern opinions for the banking sector is developed and tested in paper [22]. The research is based on industry-specific sources in order to define risk factors characteristic of banks. It was noted in this research that regulatory sanctions are a

significant factor defining views on going concerns along with capitalisation level, credit portfolio quality, and other factors determining the character and conditions of an auditee's operations. A multivariate analysis of the determinants of auditors' views on going concern in the banking sector was conducted in paper [23], using a sample from nine Asian countries. This paper studies, inter alia, the influence of statutory requirements to accounting and information disclosure in the banking sector, and requirements to external audit on the probability of obtaining an auditor's opinion against the background of going concern evaluation.

In the research dedicated to transformation of the audit institution under the paradigm of sustainable development, the following is identified:

- a new approach to understanding of audit as an essential prerequisite for the "green economy";
- expansion of auditing procedures due to insufficient verification of exclusively financial information in order to ensure the sustainable development of public companies;
- necessity to harmonise auditing standards and ethical standards in the circumstances of increasing complexity of international systems of labour differentiation, in particular the globalisation of process flows and supply chains [24–27].

As such, the banking sector of today displays commitment to the principles of the green economy, in particular the building of information systems to slow down greenhouse gas emissions occurring due to the colossal scale of use of electronic appliances and equipment. In paper [25] audit is considered to be an essential prerequisite for high quality study of critical factors of success of the "green" information system.

The emergence of new verification fields requires new competencies from auditors. The paper by E. Dobre, G.O. Stanila and L. Brad [26] proves that financial statements make a single-ended estimate as a source of operating performance indicators of a company, thus precluding investors and authorities from getting a comprehensive estimate of the company's prospects.

The research cited at [27] shows that financial indicators fail to provide an entire explanation of corporate performance, and over the long term a positive correlation was detected between indicators of social and environment-related activity and positive stock exchange results.

The global trend towards sustainable development requires to harmonise auditing and ethical standards because the companies involved in global chains are under pressure from customers, non-governmental organisations, and governments of various countries as regards social responsibility (including responsibility for externalities). M. Boström et al. [24] justified the need to go beyond the narrow bounds of countries and organisations.

Thus, a study of the mechanism of influence of external factors on actions, responsibility and competence of auditors related to going concern evaluation allowed us to generate our hypothesis. The most significant factors defining the adaptability of auditors' professional conduct are as follows: macroeconomic environment at the global and national level; dynamics of regulation of auditees' activities in terms of their industry sector, and transformation of the audit institution under the paradigm of sustainable development.

Thus, the results of the review dictate the need for a new dynamic approach to the study of auditors' professional conduct, which unlike traditional approaches defines external factors (as related to the auditee, statements, and auditor) as variables determining the quality of auditor's conclusions on the issue of the business as a going concern.

The Influence of Banking and Auditing Regulation Dynamics on Auditors' Professional Conduct in terms of Going Concern Evaluations

At the first stage of our research we systematised the statistical information characterising the banking sector and certain aspects of auditing activity related to the audit of credit organisations. The source of information was data published on the official website of the Ministry of Finance of the Russian Federation and annual reports of the Bank of Russia [4; 28; 29].

We constructed a model of dependence between the number of auditor's opinions questioning a credit organisation's ability to continue as a going concern and the factors influencing going concerns in general. The basic data for constructing the model of dependence between the number of auditor opinions on credit organisations and the factors influencing such opinions were statistical data describing the dynamics of the banking sector for 10 years from 2009 to 2018, and the activity of audit organisations for the same period (Table 2 and 3) [4; 28; 29]:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \\ + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 \quad , \quad (1)$$

where Y – number of auditor opinions questioning credit organisations' ability to continue as a going concern;

$\beta_0, \ldots, \beta_8$ – estimates of the model parameters obtained using the least squares method on the basis of statistical data;

X_1 – proprietary capital of the banking sector (total), billion rubles;

X_2 – loss provisions, billion rubles;

X_3 –adequacy of capital of the banking sector;

X_4 – operating credit organisations, pc.;

X_5 – companies with the right to accept retail deposits, pc.;

X_6 – total assets (liabilities) of the banking sector, billion rubles;

X_7 – number of auditor's opinions questioning the customer's ability to continue as a going concern and pointing out a significant uncertainty in the customer's activity;

X_8 – number of customers – credit organisations - with audited statements (mandatory audit).

The explicative variables do not comprise the ones linearly dependent on the abovementioned variables.

Consequently, we obtained the following classical multiple regression model:

$$\hat{Y} = -10,3 + 0,00209 \times X_1 + 0,000693 \times X_3 - 0,659 \times X_4 - 0,156 \times X_6 + 0,208 \times X_7 - 0,000170 \times X_8 + 0,00420 \times X_{10} + 0,0207 \times X_{11} \quad (2)$$

The model of dependence of the number of auditor opinions questioning credit organisations' ability to continue as a going concern, and the factors influencing going concerns
(least squares method, robust estimators of standard errors (adjusted for heteroscedasticity)*

	Coefficient	*Standard error*	*t statistics*	*P value*
const	–10.3209	21.7596	–0.4743	0.7180
X_1	0.00208615	0.000690000	3.023	0.2034
X_2	0.000692545	0.00114935	0.6026	0.6548
X_3	–0.658566	0.162871	–4.043	0.1543
X_4	–0.156310	0.0938225	–1.666	0.3442
X_5	0.208185	0.118903	1.751	0.3304
X_6	–0.000170070	6.52293e-05	–2.607	0.2332
X_7	0.00420375	0.00335878	1.252	0.4292
X_8	0.0207215	0.00490539	4.224	0.1480

* Obtained by the authors on the basis of the data from Tables 2 and 3 using the application software package Gretl.

On the basis of the obtained results, taking into consideration P values we can draw the conclusion that neither of the explicative variables is significant. Therefore it is clear (β) coefficients) that there is a positive relation between the number of issued auditor's opinions with the qualification of existing threats to credit organisations' going concern and such factors as: proprietary capital of the banking sector, loss provisions, the number of credit organisations with the right to accept retail deposits, the number of auditor's opinions questioning the customer's ability to continue as a going concern and indicating a significant uncertainty in the customer's activity, and the number of credit organisations with audited statements (mandatory audit).

There is a negative correlation with the following factors: adequacy of capital of the banking sector, operating credit organisations, and total assets (liabilities) of the banking sector.

We cannot assert that the obtained model entirely describes the interrelations verified in the research. Therefore, in order to confirm or reject the suggested hypotheses it is necessary to verify the model which represents the relation between the type of auditor's opinion obtained by a certain bank (questioning or not questioning its ability to continue as a going concern) and the factors describing the banks' performance (capital dimension, reserves, regulations etc.). Probably it is not unreasonable to add to the model some characteristic features of auditing companies which have performed audits of the banks included in the sample, e.g. experience related to credit organisations, or the existence/absence of comments concerning previous audits, etc.

At the second stage we systematised the factors which influence or may influence the auditors' view on credit organisations as a going concern in order to define the research period and select a representative sample.

The factor of change of statutory regulation of banking and auditing activity within the period of 2009–2019 was defined as the key factor. The authors proceed from the position that within the analysed period the following factors influenced decisions taken by auditors as regards credit organisations' going concern.

- evolution of auditing standards;
- conceptualisation and implementation of external control of audit quality;
- development of banking regulation and supervision, including implementation in the legislation and national banking practice of the approaches and standards of the Basel Committee on Banking Supervision (BCBS);

- vigorous efforts in cooperation of Russia with the Financial Action Task Force (FATF).

First, statutory regulation of an auditor's opinion procedure and going concern evaluation is seen to transform in accordance with modifications to the statutory basis for audit. Externally, the situation is fairly obvious, however, a detailed analysis of expected and actual effects of such modifications is necessary to understand coherence of such modifications and to assess continuity. A gradual development, increasing complexity and improvement of standards on auditor opinions is observed in normative legal documents of each stage (Table 4).

Table 4. Stages of standardisation of the issues of auditor opinions and going concern

Documents defining legal foundation of auditing activity regulation	Auditor's opinion standards	Standards regulating audit of going concern
Provisional regulations of auditing activity in the Russian Federation approved by Decree of the President of the Russian Federation of 22.12.1993 No. 2263	**Regulation (standard)** of auditing Making of an Auditor's Opinion as regards Accounting Statements	–
Federal Law of 07.08.2001 No. 119-FZ On Auditing	**Regulation (standard) No. 6** Auditor's opinion on Financial (Accounting) Statements	**Regulation (standard) No.11** Applicability of the assumption of auditee's going concern
Federal Law of 30.12.2008 No. 307-FZ On Auditing	**Federal Auditing Standard (FSAD 1/2010)** Auditor's Opinion on Accounting (Financial) Statements and Formation of Opinion on their Trustworthiness **Federal Auditing Standard (FSAD 2/2010)** Modified Opinion in an Auditor's Opinion **Federal Auditing Standard (FSAD 3/2010)** Additional Information in an Auditor's Opinion	**Regulation (standard) No.11** Applicability of the assumption of auditee's going concern
Federal Law of 30.12.2008 No. 307-FZ On Auditing	**International Standard on Auditing 700** Formation of Opinion and Drawing up of a Report as regards Financial Statements **International Standard on Auditing 701** Informing on the Auditing Key Issues in an Auditor's Opinion **International Standard on Auditing 705** Modified Opinion in an Auditor's Opinion **International Standard on Auditing 706** Sections: Emphasis of Matter and Other Matter in an Auditor's Opinion	**International Standard on Auditing 570** Going concern

It is obvious that the evolution and improvement of standards of auditor opinions resulted in changes of the requirements of auditor's opinion, and has bearing on the going concern aspect.

So, at the first stage the auditor's opinion expressed a view on the trustworthiness of accounting statements, i.e. on the compliance of accounting statements in all material respects, with the legislative instrument regulating accounting and reporting in the Russian Federation. There was no separate standard as to the going concern aspect, but the auditor's opinion standard stated the possibility to indicate, in the auditor's opinion, serious doubts as regards the economic entity's ability to continue operations and fulfill its obligations for at least 12 months following the reporting period. At the third stage there emerged the Federal Standard (FSAD 3/2010) – 'Additional Information in an Auditor's Opinion' which enshrined the opportunity to state the going concern evaluation results in the paragraph which draws the users' attention to certain events. Currently the International Standards on Auditing describe in sufficient detail the manner and ways of indicating the information related to an auditee's going concern.

Second, the quality control concept, comprising the fundamentals of internal and external quality control of audit, was being made up *ad hoc* since the first version of the law 'On Auditing'. However, it acquired integrity after the emergence of the auditing self-regulatory institution. The present authors hereby postulate that a combination of internal and external control instruments does not just assure a high quality of audit services for the users of statements users and audit services, but also encourages development of audit methods and procedures. External control of credit organisations' audit is performed by a self-regulatory organisation or an authorised federal body.

Thus, it is clear that modification of auditing standards and approaches used for internal and external quality control influences auditors' professional conduct because they define the principles of auditing activity, rights and obligations of auditors, and enshrine auditors' responsibility.

Third, since 2009 Russia is a fully-fledged member of the Basel Committee on Banking Supervision (BCBS), participates in development and improvement of banking regulation and supervision standards, preparation of industry-specific guidelines and has obligations of implementation of international standards' requirements into the national regulation system including capital adequacy requirements. Capital adequacy is related directly to assessment of the going concern assumption by an external auditor and is at the same time one of the most important objectives of prudential banking supervision. In the majority of countries, the testing of capital adequacy is a normal component of constant supervision. It is also emphasised in the BCBS guidelines concerning interrelations with external auditors [30].

It should be noted that international approaches to regulation of credit organisations' activity, including the requirements to capital adequacy, which take into consideration the quality of bank's assets and risks related to them provided for in the International Convergence of Capital Measurement and Capital Standards (Basel I, enlarged in 1996) have been implemented in Russian practice since the 1990s. In 2000, amendments entered into force which clarify the calculation of the algorithm of capital adequacy ratio of Russian banks (H1) taking into consideration market risks. In general these complied with Basel I approaches. Once the 2004 Basel II Accord (included in the final document of 2006) was published the Bank of Russia announced that it planned to implement stage by stage Basel II requirements in the Russian banking sector, taking into consideration legislative limitations, capabilities and priorities of the national banking supervisory authority [31].

At the end of 2009, legislative instruments of the Bank of Russia were adopted and entered into force stage-by-stage (2010-2013) [32; 33]. They regulate calculation of the capital adequacy ratio, taking into consideration the operational risk on the basis of the basic indicator and the simplified, standardised approach to credit risk assessment of Basel II. A complete implementation of the second Basel II component (Supervisory Review Process) and requirements to disclosure of information by banks as regards capital and risks (in order to instill market discipline by means of increase of financial statements transparency) was postponed [34].

It is remarkable that if in 2009–2010 the dynamics of the capital adequacy indicator in the banking sector was mainly defined by the government support programme as a part of crisis response measures (in 2010 by redemption of previously-incurred subordinated loans), then a diminishment of this indicator at the end of 2011–2013 was to a great extent due to regulating changes. New requirements for credit organisations' capital adequacy imposed by the regulator, apparently, could influence auditors' professional conduct, as well including confirmation as to going concern status.

Because of the financial crisis of 2008–2009 BCBS came to an agreement on reforms and started revising prior standards. In 2009, specified requirements called Basel II.5 were published, and in 2010-2011 new regulatory approaches stipulated in the reform package Basel III were approved. Initially it was planned to implement them by 2019. In accordance with the internationally agreed schedule, a stage-by-stage implementation of Basel III standards started in Russia. New standards alongside the reform of capital adequacy requirements (including the capital structure and quality, taking into consideration all risks, introducing the notions of conservation buffer and countercyclical buffer, and debt ratio) also contemplate the reform of requirements for liquidity and other elements aimed at strengthening the financial system stability in general. In Russia, implementation of Basel III elements started before Basel II had been implemented completely, i.e. these procedures were actually performed simultaneously.

Since 2014, significantly more conservative approaches to calculation of capital value in accordance with Basel III have entered into force in Russia. Meanwhile, at the end of 2014, in order to arrange conditions for adapting the banking sector to the volatility of currency and financial markets, decisions were taken to establish temporary specifics of prudential standards' calculation which made a multidirectional impact on capital adequacy indicators. [36]. In 2015, the capitalisation increase of a series of banks also supported the capital adequacy indicator through the Deposit Insurance Agency. Additionally, we should note that due to the adoption of Federal Law of 01.12.2014 No. 403-FZ changes were introduced in some provisions of the Federal Law on Banks and Banking Activities, requirements to contents of an auditor's opinion on credit organisation's statements were also clarified (art. 42).

As of 01.01.2016, for the first time the statutory framework of the Russian Federation as a member of BCBS was verified for compliance with the Basel Accords and standards on the basis of RCAP programme (Regulatory Consistency Assessment Programme). During the verification,

the Bank of Russia performed extensive work in changing banking regulation practices taking into consideration comments obtained from experts [37]. In accordance with reports published in March 2016, the Russian banking regulation was declared, complying with corresponding Basel standards including capital adequacy standards [38].

We would like to indicate the results of the Financial Sector Assessment Program (FSAP) in Russia, including the task of assessment of compliance with the Basel core Principles for effective banking supervision which was completed in 2016. As outlined in the published report, the experts observed that in Russia implementation of principle 27 Financial Statements and External Audit is inconsistent with international approaches to a great extent [39]. According to international experts, due to the drawbacks of the legal framework the regulator has a limited opportunity to comply with a range of criteria of this principle. They recommend to broaden the powers in order to grant the supervisory authority the power to reject appointment of an external auditor which is insufficiently independent or fails to meet professional standards, to provide rotation of an external auditor, or appoint a meeting with an audit company in order to discuss issues related to the institution under supervision. An auditor as well as a supervisor should have legal protection when they exchange confidential information (additional criterion 1).

In 2016–2017, an implementation of reforms in the banking sector continued in accordance with internationally recognised approaches. Since 2016, the requirements for calculation of proprietary funds (capital) and risk-weighted assets have been changed. In addition to the requirements related to capital adequacy ratios, the buffers (capital adequacy maintenance, countercyclical, systemic importance ones) - in alignment with which the capability to distribute profits is contingent - are introduced stage by stage, and changes concerning the creation of loan loss provisions entered into force (some derogations were cancelled). In spite of the constraining influence of regulatory adjustments, the capital adequacy indicator in the banking sector increased within this period (in 2017 - exclusive of the banks being restored to a healthy state) [40].

In December 2017 the Basel Committee published documents dedicated to the completion of post-crisis reforms included in the Basel III standards package (Basel III: Finalising post-crisis reforms). The Bank of Russia implements corresponding changes stage by stage in the national regulation within the time period established by BCBS.

We consider that significant changes in the industry-specific legal and regulatory framework, increasing complexity of calculation algorithms for statutory ratios, methods of detecting the risks significant for credit organisations (and their efficiency evaluation), as well as banking supervision practices, are all significant factors which influence auditors' professional conduct when they issue an opinion including the issue of assessment of the going concern assumption.

Fourth, a significant influence on the state of the credit and finance sector and on interaction of auditors with financial institutions and supervisory authorities was exerted by Russia's active involvement in the field of development and implementation of financial anti-money laundering measures and cooperation with FATF. Since the beginning of the 2000s a sustained effort has been exerted in order to create a national system for combating money laundering and the financing of terrorism. In 2002 Russia was taken off the FATF black list. Subsequently it was admitted as a fully-fledged member of FATF and released from the regular monitoring procedure in 2013. According to FATF experts, in general technical conformity and efficiency are characteristic of the national system of anti-money laundering and combating the financing of terrorism (AML/CFT). A reliable legal framework was created, data was used for investigating cases related to money laundering and terrorism, and was collected and is still complemented on a regular basis.

Improvement of the national system of anti-money laundering and combating the terrorism financing (AML/CFT) affected the financial and credit sector as well. As such, since 2013 the Bank of Russia has used elements of the risk-oriented approach in its supervisory activity, and in recent years it has improved the risk-oriented approach in the supervisory field. In 2013 requirements to licensing of financial institutions were tightened. At present it allows to significantly reduce the risk of delinquents' gaining control over financial institutions.

According to the public report of Rosfinmonitoring [41] for 2018 the coverage of financial institutions by the Russian AML/CFT system increased 1.5 times. Currently the national anti-money laundering system's circuit comprises over 160 thousand entities including approximately 53 thousand credit and non-financial entities. A complex of interauthority measures taken in 2018 significantly reduced the number of dubious operations conducted through the banking sector. As such, since the beginning of 2018 the amounts of cash withdrawals, transit operations and cross-border money transfers on doubtful grounds decreased by over 1.5 times. This is due to the active policy of the Bank of Russia for purging the credit and finance sector (Figure 3): over 2018 licenses of 58 banks were recalled. Additionally, in 85% of cases Rosfinmonitoring informed of the detected risks in advance. Together with the Central Bank of the Russian Federation features of ineffective operation of internal control systems and insufficient attention paid to risks were detected. On the basis of Rosfinmonitoring's risk descriptions in 2018 the mega regulator confirmed the risk areas related to dubious operations conducted by over 140 credit organisations.

Auditors also pertain to the national system of combating money laundering and the financing of terrorism. As the system improves, the role of the professional auditing community and auditors' responsibilities become more important. In accordance with Federal Law No. 115-FZ, when auditors render auditing services and have any grounds to assume that the auditee's transactions or

financial operations can be performed in order to launder illegally-generated money or to finance terrorism, they have to notify Rosfinmonitoring about it. In order to fulfill this obligation the auditors have to observe certain methodological recommendations of Rosfinmonitoring, describing the features of operations which may prejudice the auditee and the financial system in general, and information of which should be furnished to Rosfinmonitoring if they are detected.

Thus, the activity of the Russian Federation and FATF aimed at mitigating risks related to money laundering and terrorism financing is a significant factor influencing the stability of the banking sector, including those which audit financial and credit institutions.

An analysis of the key changes of the statutory regulation of the banking and auditing activity allowed to define the periods within which the authors presume a significant influence of such changes on auditors' decisions as regards credit organisations' going concern. Figure 3 shows the results of correlation analysis of succession of auditing standards' generations and enhancing of cooperation between Russia and FATF between 1996–2018. We assume that the significance of influence of these factors on auditors' professional conduct may be observed in the periods of 2008–2010, 2013–2017 and in 2019.

Conclusions

The authors substantiated and tested the approach to study of influence of the factors which determine an auditor's view on banking sector entities as a going concern. The substantiation points for the need to create an approach to study the factors suitable for the Russian banking sector are as follows:

- increase of the share of auditor's opinions questioning the customer's ability to continue as a going concern, and indicating a significant uncertainty in the customer's operations in the total amount of issued opinions;
- designating during the whole analysed period the violation of requirements to the main components, form, contents, manner of signing, and submitting an auditor's opinion as typical violations;
- A high level of regulation and supervision of the banking sector entities' activity (both at an international and national level) as well as the need to agree upon regulation and supervision boundaries.

The authors' proposals push the boundaries significantly and shift the focus of research in the field of theory and methodology around going concern audit. First of all, this entails raising the issue of the necessity to identify factors which influence the quality of an auditor's conclusions and his/her professional conduct, and to identify the factors characteristic of the banking sector.

On the basis of analysis of foreign researchers' publications found in the Scopus and Web of Science databases, the authors defined the factors and methods applied by foreign researchers to evaluate the influence of certain factors. The authors identified the dynamics of regulation of banking and auditing activity as a key factor for the Russian banking sector. The authors defined that the following factors influenced the auditors' decisions on credit organisations as a going concern within the analysed period: evolution of auditing standards; conceptualisation and implementation of external control of audit quality; development of banking regulation and supervision; and interaction of auditors with financial institutions and supervisory authorities. As a result, the authors determined the periods within which a significant influence of an identified factor is assumed. These periods were defined by a consistent analysis of the relationship of the nature of modifications in regulation taking into consideration the period of such modifications.

We therefore assert that a baseline has been established for a comprehensive study of influence of the factors on auditors' professional conduct when a view on the going concern status of banking sector entities is formed. Further research perspectives have also been identified. In the first instance, it is necessary to study the relation between the type of an auditor's opinion as regards banking statements and the factors which describe the banks' performance, as well as the characteristic features of audit organisations by means of applying the methdological template represented by our analytical approach. In order to study limitations it is important to assess the applicability of the elaborated solutions to the research of influence of the characteristic factors of insurance companies, joint-stock companies, and other socially significant entities.

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Figure 4. External factors which influence auditor's decisions as regards credit organisations' going concern within the period of 1996–2018

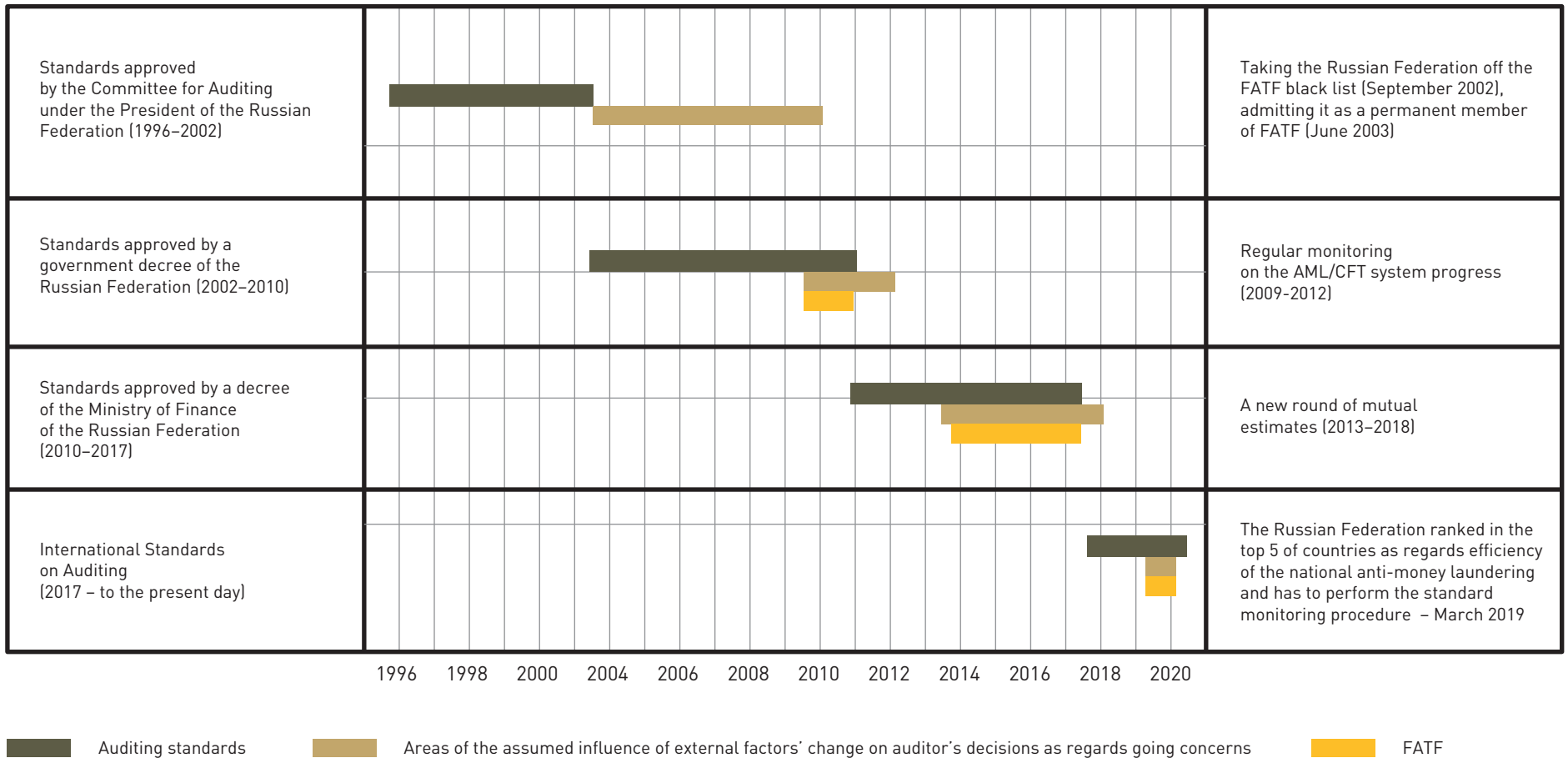

Table 1. Analysis of research of auditing companies as going concerns

Author/year/title	Sample	Methodology	Variables	Key conclusions
N. Muñoz-Izquierdoa,, M.J. Segovia-Vargasb, M. Camacho-Miñanob, D. Pascual-Ezamab – Explaining the causes of business failure using audit report disclosures (2019)	404 bankrupt companies and 404 successful companies in 2004–2014	Multivariate test (logistic model)	Type and contents of an auditor's opinion as regards external and internal factors of going concern (disclosure by financial indicators, management's plans, Events After the Balance Sheet Date, regulation within the industry etc.)	Auditor's opinions to a great extent explain causes of business failure
L.A. Myers, J.E. Shipman, Q.T. Swanquist, R.L. Whited (2018) – Measuring the market response to going concern modifications: the importance of disclosure timing	897 companies which have got an auditor's opinion for the first time with a modification as regards going concern (653 – with a disclosed income statement, 244 – without such statement) (March 2003 – May 2014)	Multivariate test (logistic model)	Disclosure of information on income, financial indicators (EBIT, assets), estimate and expectations of management, period of an auditor's opinion's "falling behind" – influence of indicators on stock exchange prices (i.e. market response)	The majority of auditors' opinions are published simultaneously with income statements. In case of issue of an auditor's opinion questioning the ability to continue as a going concern for the first time there emerges in the income statement a significant negative financial cumulative excess return
M.N. Hisham Osman, Z.M. Daud, A.R.A. Latiff, Z. M. Sori (2018) – The impact of management, family, and institution on the auditor`s going concern opinion issuance decision	644 Malaysian public companies which are financially troubled, contribute significantly to the national economic advancement (2006–2012)	Multivariate test (logistic model)	Auditor's specialisation, period during which the auditor occupies his/her position, auditor's services cost; influence of management apparatus, marital status and higher education institution; size of the audit company, customer, bankruptcy probability, existence of previous auditor's opinions commenting on going concern, default on debts, industry sector etc.	No interrelation was found between auditor's/audit organisation's characteristics and issue of an auditor's opinion commenting on going concern. Influence of a powerful management apparatus and family on the auditor's decision as regards the type of the auditor's opinion was detected.

Author/year/title	Sample	Methodology	Variables	Key conclusions
J. Bedard, C. Brousseau, A. Vanstraelen (2018) – Investor reaction to auditor`s going concern emphasis of matter: evidence from a natural experiment	9,457 companies with statements in SEDAR (System for Electronic Document Analysis and Retrieval) using the Compustat database (2005–2014)	Multivariate test (logistic model)	Extent of uncertainty in disclosures as regards going concern; external and internal factors: bankruptcy probability, company size, financial indicators (leverage, equity, money flows, prior year losses etc.), market return and volatility (and other market factors), audit quality (Big Four factor)	It was discovered that when auditors opine doubts as regards the ability to continue as a going concern there is an additional negative excess return and lower sales volumes in case of insufficiently detailed disclosures of doubts as regards the ability to continue as a going concern in financial statements. Disclosure of information on doubts as regards the ability to continue as a going concern in the additional paragraph of the auditor's opinion is of additional importance to investors.
S. Kanyarat (2018) – Auditors' going concern reporting accuracy during and after the global financial crisis	883 USA companies which have got for the first time an auditor's opinion questioning their ability to continue as a going concern and 537 bankrupt companies in the Compustat database (2005–2010)	Multivariate test (logistic model)	Bankrupt / not bankrupt company, bankruptcy probability estimated on the basis of the Zmijewski model, solvency, sales, whether the audit company pertains to the Big Four, presence in the auditor's opinion of an express doubt in the ability to continue as a going concern, period from the date of the auditor's opinion till declaring the company bankrupt etc.	The number of errors related to issue to economically viable customers of an auditor's opinion which questions their ability to continue as a going concern is less during a crisis but is the same before and after the crisis. The number of errors related to issue of auditor's opinions to customers which went bankrupt later, which do not question their ability to continue as a going concern does not differ during the crisis and after it from the period prior to the crisis. Auditors' accuracy and conservatism (skepticism) increase during the crisis but return to the before-the-crisis level after it.

Author/year/title	Sample	Methodology	Variables	Key conclusions
T.C. Omer, N.Y. Sharp, D. Wang (2018) – The Impact of Religion on the Going Concern Reporting Decisions of Local Audit Offices	3,623 USA companies which ability to continue as a going concern was not questioned by auditors 3,498 companies which auditor's opinion states that they do not observe the going concern principle	Multivariate test (logistic model)	Presence in the auditor's opinion of an express doubt in the ability to continue as a going concern, auditor's religiousness, customer's religiousness, share of population with higher education, customer's involvement in political parties, population endowment in the state, customer's total assets, share of the auditing industry in the national market, period of auditor's working with the same customer and other variables (totally over 35)	The obtained results show that audit companies with offices located in highly religious American states are more prone to express their view on going concern exhibiting more skepticism in evaluation of mitigating factors. These results are typical for both the Big Four and smaller audit companies.
S. Hossain, L. Chapple, G.S. Monroe (2018) – Does auditor gender affect issuing going-concern decisions for financially distressed clients?	7,361 Australian companies (2003–2011)	Logistic model	Presence in the auditor's opinion of an express doubt in the ability to continue as a going concern, auditor's gender, bankruptcy probability estimated on the basis of the Zmijewski model, customer's asset value, number of years during which the company was on the list of the Australian Stock Exchange, return on assets, customer's industry affiliation, whether the auditor pertains to the Big Four etc.	According to the results Australian women auditors are less likely to issue an auditor's opinion questioning the ability to continue as a going concern of a financially troubled customer. This assumes that women auditors compromise the audit quality. The authors emphasise that these results may differ from similar research studies conducted using the data from other jurisdictions (countries).

Author/year/title	Sample	Methodology	Variables	Key conclusions
D. Masciandaro, O. PeiaI, D. Romelli – (2020) – Banking supervision and external auditors: Theory and empirics	115 countries in the period of 2007 to 2012 included in the World Bank's Banking Regulation Review	Ordered logit model	Expected benefit from engaging external auditors (supervisory powers of the Central Bank, supervisory practice), audit quality (regulation quality, measures taken against banks and auditors, Big Four), expenses for engaging auditors in supervision (degree of development of the credit market and information asymmetry)	One of the main factors defining the reform of auditors' participation in supervision is strengthening of the role of the Central Bank in supervising the financial sector. A higher audit quality supported by a tighter control is related to more active auditors' involvement in supervision over the banking sector. Systemic banking crises enhance the likelihood of involving external auditors, but it happens only in the countries where the role of the Central Bank grows.
F. Chen, K. Lam, W. Smieliauskas, M. Ye – (2016) – Auditor Conservatism and Banks' Measurement Uncertainty during the Financial Crisis	1,026 observations of USA public banks for 2008–2011	Multivariate test (logistic model)	Uncertainty of assets evaluation at fair value, frequency of type II errors, whether the auditor pertains to the Big Four, auditor's specialisation, period between issue of the auditor's opinion and financial year end, auditor's remuneration	Auditors are inclined to be more conservative during a financial crisis in comparison to the post-crisis period. Bank auditors are less prone to make errors as regards the banks with a higher risk and uncertainty of assets evaluation. The financial crisis significantly influences the auditors' professional conduct irrespective of their size and industry specialisation.

Table 2. Initial information for building a model (statistics of auditing activity) [34]

No.	Indicator	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	Number of customers of **audit organisations** which accounting statements have been audited	92,683	87,096	75,569	70,044	68,380	67,857	71,841	74,537	78,087	78,688
2	Breakdown of customers of audit organisations which accounting statements have been audited by the types of economic activity, share of financial activity (credit organisations, insurance companies and mutual insurance societies, private pension funds)	*5.6	5.6	6.9	2.5	2.5	2.6	2.0	1.7	1.4	1.2
3	Number of customers of **audit organisations** involved in **financial activity**	*5,190	4,877	5,214	1,751	1,710	1,764	1,437	1,267	1,093	944
4	**Breakdown of issued auditor's opinions by types (in %)**										
4.1	with expressed opinion with a qualification	43	40.2	32.7	28.1	24.8	22.6	21.6	22.1	19.8	18.0
4.2	with a negative opinion	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.7	0.8	0.8
4.3	with disclaimer of opinion	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.5	0.5	0.4
5	Auditor's opinions questioning the customer's ability to continue as a going concern and indicating a significant uncertainty in the customer's activity	*2.2	*2.5	2.6	3.1	3.3	3.2	3.8	4.2	4.6	4.9
6	Number of **auditor's** opinions questioning the customer's ability to continue as a going concern and indicating a significant uncertainty in the customer's activity	2,039	2,177	1,965	2,171	2,257	2,171	2,730	3,131	3,592	3,856
7	**Grounds for audit by auditing organisations (in %)**										
7.1	Mandatory audit	*80.3	*81.5	82.7	81.5	83.3	85.3	88.7	90.6	91.3	91.4
7.2	Voluntary audit	*19.7	*18.5	17.3	18.5	16.7	14.7	11.3	9.4	8.7	8.6

No.	Indicator	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
8	Number of customers which statements have been audited (mandatory audit)	*74,424	*70,983		57,086	56,961	57,882	63,723	67,531	71,293	71,921
9	Share in the mandatory audit of credit organisations	1.6	1.6	1.9	1.5	1.5	1.5	1.2	1.0	0.9	0.8
10	Number of customers – credit organisations - which statements have been audited (mandatory audit)	*1,191	*1,136		856	854	868	765	675	642	575
11	Number of auditor's opinions questioning credit organisations' ability to continue as a going concern	26	28	31	27	28	28	29	28	30	28

Comments:

* Due to lack of information in the analytical reports of the Ministry of Finance some indicators for 2009–2010 have been calculated by the authors:

Line 2: according to the level of 2010

Line 3: line 1*line 2.

Line 8: standard deviation of the growth rate of auditor's opinions commenting on going concern from the average growth rate of auditor's opinions with a qualified opinion, with a negative opinion, with disclaimer of opinion. The aim is to reconcile dynamics of the share of the auditor's opinions different from non-modified opinions with dynamics of auditor's opinions commenting on going concern. This standard deviation was 14%. Further the value of 2011 was adjusted, i.e. reduced by 3% (89% is the average growth in 2011 in comparison to 2010 of auditor opinions different from non-modified opinions +14% = 103%). Thus, we obtained the value of 2010 which is 2.5%. Then the value of 2010 was also adjusted, i.e. reduced by 12% (98 + 14 = 112%), so we have 2.2%.

Line 9: line 1* line 8.

Lines 11 and 12: The average growth of the share of mandatory audit within the analysed period is 1.2. 2010 and 2009 are adjusted consistently on the basis of the share of 2011.

Line 13: line 1* line 11.

Line 15: line 13* line 14.

Line 16: line 15* line 8.

Table 3. Initial information for building a model (statistics in the banking sector) [31; 36; 37]

	Indicator	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	Proprietary capital of the banking sector (total), billion rubles	4,621	4,732	5,242	6,113	7,064	7,928	9,009	9,387	9,397	10,269
2	Proprietary capital of the banks being restored to a healthy state, billion rubles	70	105	250	212	203	52	(24)	(106)	(481)	(602)
3	Proprietary capital of the banking sector without taking into consideration the banks being restored to a healthy state (calculation), billion rubles	4,550	4,627	4,992	5,901	6,862	7,876	9,033	9,493	9,878	10,872
4	Loss provisions, billion rubles	899	1,821	1,904	1,988	2,852	4,054	5,406	5,594	6,916	7,539
5	Capital adequacy of the banking sector, %	20.7	18.2	14.8	13.6	13.7	12.6	12.9	12.9	12.0	12.1
6	Capital adequacy of the banking sector without taking into consideration the banks being restored to a healthy state, %	21.2	18.7	14.9	13.6	13.7	12.9	13.7	13.7	13.5	14.4
7	Operating credit organisations, pc.	1,058	1,012	978	956	923	834	733	623	561	484
8	with the right to accept retail deposits, pc.	849	819	797	784	756	690	609	515	468	400
9	Total assets (liabilities) of the banking sector, billion rubles	29,430	33,804.6	41,627.5	49,509.6	57,423.1	77,653	82,999.7	80,063.3	85,191.8	94,083.7
10	Total assets (liabilities) of the banking sector, billion rubles	29,430	33,804.6	41,627.5	49,509.6	57,423.1	77,653	82,999.7	80,063.3	85,191.8	94,083.7
11	Assets of credit organisations for which bankruptcy prevention measures are applied, billion rubles	800.8	814.9	1,852.4	1,943.6	2,105.9	3,831.3	5,248.4	4,380.4	10,374.6	9,953.7
12	Proprietary funds (capital) of credit organisations for which bankruptcy prevention measures are applied, billion rubles	70.3	105.4	249.7	212.4	202.8	52.1	–24.3	–106.1	–480.5	–602.4

Assessment of Influence of External Factors on Financial Stability of Construction Companies

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Assessment of Influence of External Factors on Financial Stability of Construction Companies

Abstract

When Russian construction companies switch to project financing they face a number of problems which have a negative impact on their operations. While a company is able to influence internal factors (such as resources, capital, their utilization efficiency etc.) it is virtually impossible to control external factors (inflation, unemployment, government policy etc.). These factors make a company less stable financially. One of manifestations of financial stability is resistance to external environmental disturbances. External factors influence corporate financial stability, they are mortgage rate, price increase index etc. Defining the extent of influence of external factors will help to mitigate the impact of external environment, alleviate the consequences. This makes the topic of the research relevant and increases the significance of analysis of external factors which influence corporate operations.

In this paper we conducted content analysis of the financial stability definition; evaluated financial stability of 50 construction companies of the Siberian Federal District; selected statistical information by constituent entities of the Siberian Federal District which influences construction companies' operations; assessed influence of the selected factors on financial stability of construction companies applying the binary choice model (logit model). The research showed that mortgage rate, consumer price index and nominal average salary influence construction companies of the Siberian Federal District. If influence of these factors is taken into consideration when planning and managing construction companies' resources they will be able to resist the impact of external environment and improve their financial stability.

Key words: financial stability, logit model, regression analysis, mortgage rate, average salary, consumer price index, construction companies of the Siberian Federal District

JEL classification: G30, C81, M21

Introduction

When Russian construction companies switch to project financing they face a number of problems which have a negative impact on their operations. This happens because when a co-investment agreement is concluded a commercial bank acts as an intermediary, it holds the co-investors' funds and finances construction of a residential building from loan funds, thus increasing the construction project value and resulting in credit risks. While a company is able to influence internal factors (such as resources, capital, their utilization efficiency etc.) it is virtually impossible to control external factors (inflation, unemployment, government policy etc.). These factors make a company less stable financially.

Financial stability is a controversial notion. Studying this definition it should be noted that Russian scientists interpret it in a narrow and wide sense. In the narrow sense financial stability is maintenance of the target capital structure [1] which manifests itself in liquidity and solvency [2], [3]. In the wide sense financial stability constitutes ensuring of attainment of financial goals accompanied by response to disturbance of external and internal environment [4]. Foreign researchers adhere to the wide-sense interpretation [5], [6]. A great number of definitions offered by various authors makes it difficult to interpret this notion explicitly enough. It is necessary to provide an exact definition to financial stability when studying it. So a rather complete definition was offered by [4]: in the financial stability management a large set of tooling is used which comprises practices of correlation and regression analysis, strategic management etc.; a greater number of factors is defined which influence financial stability (including the external environment factors). This makes it possible to identify rational management solutions.

One of manifestations of financial stability is resistance to external environmental disturbances. External factors influence corporate financial stability, they are mortgage rate, price increase index etc. So we determine the research objective which consists in defining of influence of external factors on corporate financial stability. In this paper we conduct content analysis of financial stability definition and evaluate influence of factors on financial stability of certain industries in various countries. We consider application of the binary choice model (logit model) when assessing influence of external factors on financial stability of construction companies.

We discuss in this paper extension of the financial stability notion, review the construction industry, assess influence of external factors on financial stability of construction companies of the Siberian Federal District.

Approaches to Interpretation of the Financial Stability Definition

In contemporary literature financial stability is considered not just as a line of financial analysis but also as a separate scope of research because in a turbulent environment a company should ensure a sustainable growth of the business value when managing financial stability. Therein the system of financial stability management is considered as the most important component of the complex mechanism of maintaining the corporate financial soundness [4]. So, financial stability management means balancing resources (assets and liabilities) in such a way which provides capital expansion and improvement of corporate good standing.

In order to manage financial stability it is necessary to understand its essence. For all the variety of concept definitions it is difficult to choose the definition which describes completely the essence of financial stability. Russian scientists offer concept definitions of financial stability in a narrow and wide sense. Financial stability in the narrow sense implies corporate internal resources, that is capital, which, in our opinion, is unacceptable in the current economy. In the wide sense financial stability means a stable corporate operation which takes into consideration the state of internal resources and external environment.

V.V.Kovalev thinks that financial stability is the company's capability to maintain the target structure of funding sources over the long term [1]. The author of this definition limits financial stability to capital structure failing to take into account the fact that maintaining the target capital structure may result in deterioration in performance, loss of profit, hence, capital. It follows that there is no point in considering financial stability only from the point of view of the funding sources' structure.

Corporate financial stability rests on the optimum ratio of resources to their sources taking into consideration capital structure, degree of corporate liquidity and solvency. This is confirmed in papers by M.V. Mel'nik [2], G.V. Savitskaya [3], E.Yu. Fayantzeva [7]. This approach to interpretation of financial stability describes it to a greater extent. In other words capital structure is considered as a display of financial stability interrelated with solvency and liquidity. Consequently, a company may be financially stable if it provides the optimal capital structure and settles liabilities in due time.

Vladimirova T.A. and Sokolova T.V. [4] presume that financial stability of a company may be understood as its capability to achieve its financial goals responding promptly to change of internal and external environment, thus, mitigating their disturbing influence. This definition expresses the essence of financial stability most broadly. It is due to the fact that financial stability manifests itself in the balance between resources' and capital's utilization efficiency, resistance to external and internal environment disturbances etc.

Western concepts of financial stability are also based on resistance to external and internal environment factors of a company but the cornerstone of financial stability management is evaluation of its qualitative indicators. G.J. Schinasi [5] notes that financial stability evaluation may not be confined just to qualitative indicators. J. Pera [6]

emphasizes that a stable company is a company continuing as a going concern which is able to resist internal and external disturbances showing no signs of loss of liquidity or solvency in the immediate future. It manifests itself as the company's operation in the circumstances of dynamic and stable balance with its internal environment. Western scientists describe financial stability in a fairly complete manner taking into consideration maintaining the balance in the corporate operations mentioned above.

Thus, the definitions considered above take into account the company internal state, its solvency, resource and capital management, external environment in which it operates, resistance to external factors but at the same time the considered definitions of financial stability fail to take into account efficient management of corporate resources which over the long term manifests itself in corporate profit and capital growth, hence, in enhancement of financial stability. In this context the author of this research gives his own definition of financial stability as the company's capability to resist internal and external threats, achieve its financial goals, maintain liquidity and solvency, ensure the optimal capital structure and performance efficiency in the circumstances of a turbulent environment [8]. This definition differs from interpretations of other researchers in that capital structure and performance efficiency are considered as factors of maintenance of financial stability of the company operating in a turbulent environment.

So, to sum up the above review of literature we can make several conclusions. First, the concept definition of financial stability is still controversial, but as the economic science develops it expands turning into a complex notion which describes a well-balanced corporate resources' and capital's utilization and a stable resistance to changes of external and internal environment. Second, expansion of the financial stability definition causes development of the tooling for its management and taking into consideration industry characteristics while conducting analytical procedures.

Analysis of the Factors Which Influence Financial Stability in Economic Literature

In the study of economic literature it should be noted that traditional analysis and management tools are not indicative of industry characteristics of company operations. However, when corporate management takes managerial decisions they pay great attention exactly to industry-related and external factors because they influence the company operations to a greater extent. Papers by Russian and foreign scientists show results of evaluation of industry-related factors' influence on operations of companies from various industry sectors. However, this influence is more confined to evaluation of internal factors and their impact on capital structure [9; 10] or the corporate operating profitability [11; 12].

M.A. Khalikov and M.A. Nikiforova proved that the degree of financial leverage has no response whatsoever to change of the debt to equity ratio, however, it is flexible in terms of the working capital profitability parameter. On this basis we can assert that for a diversified company in the circumstances of a highly variable market environment the problems of cost-effectiveness and financial stability enhancement are interrelated [9].

S.A. Mazeed, P. Sai Rani, R. Raveendranath, P. Divya, T. Sudharani [10] note that IT companies with a small capital and low operating expenses are highly-profitable, while IT companies with an average income may generate a moderate return at low costs of debt, so that their profitability will be greater. However, the share of debt in the capital structure plays an essential role and its increase results in profitability decline. In point of fact, the research proves antagonicity of the essence of financial stability and profitability. From the point of view of the capital structure a company independent from external financing cannot be profitable because use of equity capital for corporate operations does not promote its development.

Q. Huang, R. Kim [13] in their research studied the side effect of competition with import in the processing and sales industry on capital structure. The authors found out that a significant decrease of import rates in the consuming industry makes suppliers to choose a more conservative financial policy. Companies reduce the leverage when relations between the customer and supplier are more important for them. Summing up, Q. Huang, R. Kim noted that companies adjust their leverage mainly by issuing a greater number of shares. This research confirms that financial risks are reduced in relations with reliable and highly-reputable contractors.

B. Granville, R. Matousek and E. Sokolov [14] considered influence of uncertainty of economic policy on the factors of the capital structure. So they proved that large companies are less subjected to influence of economic uncertainty on the capital structure and to growth of financial risks due to their greater stability. In their opinion, government intervention in the Russian banking system results in the fact that companies which are strategically valuable for the government have privileges in debt financing unlike other Russian companies which makes them less resistant to financial risks.

Thi Thanh Thuy Vu, Thi Tu Oanh Le and Thi Huyen Trang Nguyen [11] in their paper analyzed the construction industry of Vietnam. The research proved existence of a strong positive relation between the share of fixed assets in the asset profile with return on assets and return on equity as well as that of the degree of financial leverage and return on equity. The degree of financial leverage and share of the long-term capital in the total amount of funding sources also have a negative impact on return on assets, i.e. in an economic recession with a low rate of the market development a high debt ratio may adversely affect profitability of total assets. This research reveals a contradiction in achieving financial stability and efficiency

(performance) of the company operations. However, it has another consistent pattern: when financial risk reduces the return on assets grows. Consequently, by choosing the optimal capital structure and pursuing a moderate financial policy a company enhances the resource utilization efficiency.

The author of this paper made the same conclusion in early works [2] when assessing influence of financial stability indicators on return on assets using Russian construction companies as an example. This research also revealed a positive influence of the equity-assets ratio and financial stability on return on assets. In other words, when independence from external funding sources increases the resource utilization efficiency grows.

Finally, I would like to note that often industry characteristics manifest themselves in variability of external environment. So, it is important to take into consideration influence of external factors such as inflation, consumer purchasing power, loan interest rates etc. on company operations.

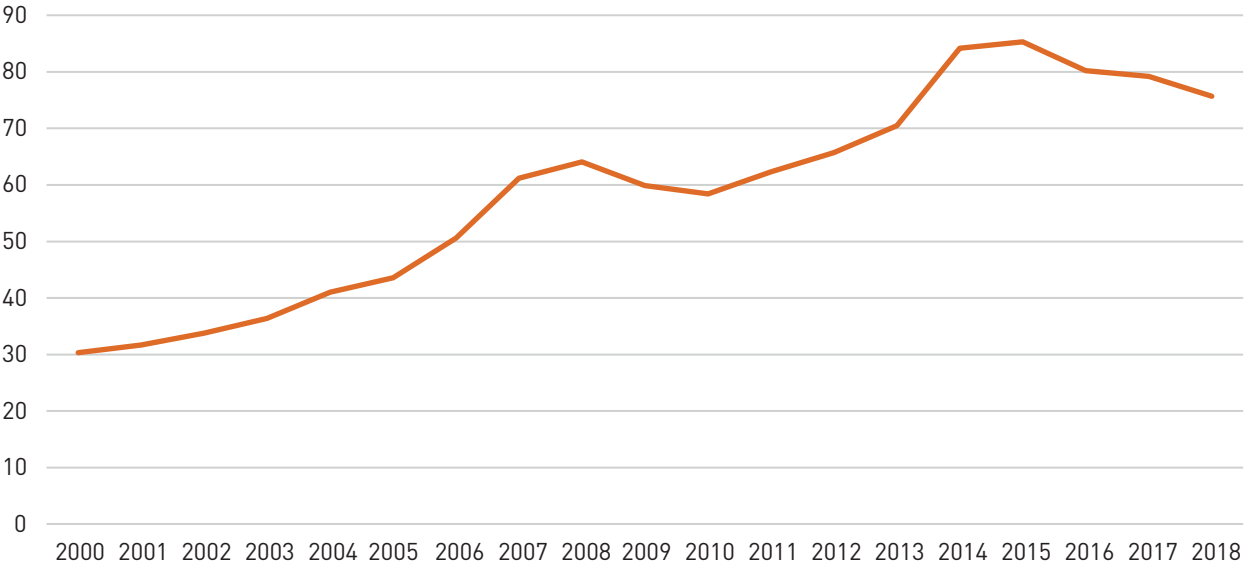
Review of the Russian Construction Industry

We chose the Russian construction industry as the observation object because it is characterized by a high turbulence, reforms in the housing financing. In this section we will consider the current status of the industry and influence of the introduced reform of transfer to project financing (implementation of escrow account) on the industry operation.

Construction is one of the most important types of Russian business activity. Nevertheless, there is a decrease in construction volume. It is caused by change of legislation, a serious tax burden and debt load, a high cost of construction supplies etc.

Since 2000 residential construction has been developing. Up to and including 2015 housing construction was growing (increment for this period amounted to approximately 50%), however, since 2015 and till the present day construction volumes have been decreasing (Figure 1).

Figure 1. Amount of commissioning of residential buildings in the Russian Federation in 2000–2018, million sq. m.



Source: www.gks.ru.

In accordance with Federal Law of 30.12.2004 No. 214-FZ (as amended on 27.06.2019) On Co-funding the Construction of Apartment Buildings and Other Real Estate Property and on Introducing Changes in Certain Legislative Acts of the Russian Federation since July 1, 2018 changes were introduced in the system of the construction industry financing which, in the opinion of the government of the Russian Federation and the Ministry of Construction, ensure protection of co-investors. On July 1, 2018 a prohibition on acceptance of co-investors' funds by construction companies entered into force. A new tool was introduced to attract the population's funds, that is an escrow account. The escrow account is opened with a commercial bank and is intended to freeze the co-investors' funds for the period of construction. After the construction company fulfills its obligations to the co-investors the money from the escrow account is transferred to the executor. Therein the construction is financed by commercial banks by means of project loans. This tool, on the one hand, helps to protect co-investors, on the other hand, - will elevate financial risks of construction companies.

Transfer from the target financing to project financing, on the one hand, will help to protect co-investors because the funds accrued on the escrow account may be transferred to the executor if two conditions are fulfilled: the building is commissioned and the right of ownership to at least one apartment is registered. This may have an adverse effect on construction companies because the construction permit will be issued only in case there is at list 10% of own funds in the total project cost of the apartment. Therein additional costs for the escrow account maintaining, increase of the volume and value of the debt capital will

cause raise in the apartments' value in the primary market including the value at the stage of construction.

In the experts' opinion, a complete transfer of the construction industry to project financing will take approximately two or three years because the industry we study is a slow-response one, the projects take a long time to fulfill, besides, the companies which have obtained permits for construction before introducing new requirements operate on the basis of old regulations [15]. Among other things, the national project Residential Property and Urban Environment which provides for increase of the residential property commissioning, lowering of the mortgage rate and financial support of construction companies will help to mitigate the transfer to project financing

Thus, the society will experience influence of implementation of such tools as an escrow account in the construction industry operation in several years. Yet today we can assert that implementation of this measure will entail reduction in the number of construction companies, rise in prices in the primary market but at the same time solution of the problem of defrauded co-investors will enhance investors' confidence in construction companies.

Experiment Description

As noted above due to raising mainly debt financing the main factors which influence a construction company operations are external factors.

On the basis of official sources of the Federal State Statistics Service (https://rosstat.gov.ru/, https://www.fedstat.ru/) the factors which have impact on construction companies related to consumer purchasing power were identified because a high consumer purchasing power in particular causes increase in the volume of residential construction and improvement of its quality. Such factors are consumer price inflation, amount of investment in fixed capital per capita, gross regional product, mortgage rate, unemployment rate, net migration rate, average nominal salary, business confidence index etc.

At the first stage of the experiment a random sample of construction companies was performed. They were selected from construction companies of the Siberian Federal District of the Russian Federation. The sample comprises five construction companies from each constituent entity of the Siberian Federal District of the Russian Federation. Totally 50 companies were observed (Appendix 1).

At the second stage of the experiment financial stability of the construction companies from the sample was evaluated. We analyzed the dynamics of the capital structure factors such as equity-assets ratio, financial stability, financial leverage; liquidity and solvency indicators: current, absolute, quick liquidity ratios, total solvency ratio; return on equity and return on assets indicators. As a result of the analysis 18 companies are considered to be financially stable and 32 companies show signs of financial imbalance (Appendix 1). The main criteria for a company to get into the group of financially stable ones is compliance of the studied indicators with their recommended values.

At the third stage of the experiment we selected external factors which influence financial stability of construction companies of the Siberian Federal District of the Russian Federation (Table 1).

Table 1. Core statistical indicators for the Siberian Federal District in 2018

Constituent entities of the Siberian Federal District	Consumer price index, %	Amount of investments into the fixed capital, thousand RUB	Gross regional product, thousand RUB	Mortgage rate, %	Unemployment rate, %	Net migration rate (outflow)	Average nominal salary, RUB	Index of business confidence in construction
Republic of Altai	102.6	56,657	231,464.2	9.69	11	–15.7	17,246.48	–48
Altai Territory	104.36	44,409	234,885.9	9.56	5.8	–31.65	16,075.73	–27
Irkutsk Region	105.37	95,676	580,152.8	9.55	6.6	–24.61	27,491.49	–20
Kemerovo Region	104.7	59,768	462,495.1	9.,54	5.5	–31.34	29,209.17	–20

Constituent entities of the Siberian Federal District	Consumer price index, %	Amount of investments into the fixed capital, thousand RUB	Gross regional product, thousand RUB	Mortgage rate, %	Unemployment rate, %	Net migration rate (outflow)	Average nominal salary, RUB	Index of business confidence in construction
Krasnoyarsk Territory	104.51	92,001	792,980.5	9.57	4.5	–0.97	40,813.26	–8
Novosibirsk Region	103.68	64,826	448,658.8	9.59	6.1	28.77	27,320.95	–23
Omsk Region	104.13	59,648	349,165.7	9.55	6.5	–61.99	40,565.04	–16
Tomsk Region	104.3	54,472	597,512.2	9.5	5.5	–6.15	24,022.61	–55
Republic of Tyva	103.87	12,553	231,464.2	9.54	12.4	–30.33	18,906.28	–20
Republic of Khakassia	105.47	45,217	438,326	9.54	6	–16.69	37,617.08	–7

A low variability of the consumer price index should be noted. In all constituent entities prices grow by 3-5%. The mortgage rate in the constituent entities is almost the same, it is 9.5% in the whole district. The values of other indicators are notable for a high variability which is explained by existence of richer and less rich constituent entities in the Siberian Federal District. The value of the index of business confidence in construction in all constituent entities is negative which proves the complexity, uncertainty in operation of construction companies in the Siberian Federal District.

The fourth stage of the experiment consisted in choosing the method of study of external factors influence on financial stability of construction companies. We used the binary choice model on the basis of logit analysis (logit model). We singled out this method because the logit model allows to assess influence of factors on the dependent variable with two outcomes.

Logit Model

A lot of indicators characterizing financial stability with reference to which the conclusion of a stable or unstable financial position of construction companies was made determine the choice of the logit model.

For the binary variable the model is written as:

$$y_i^* = \beta_0 + \sum_{j=1}^{k} \beta_i x_{ij} + u_i, \quad (1)$$

where y_i^* – hidden (latent) variable,

$$y_i^* = \begin{cases} 1, y_i^* > 0, \\ 0, y_i^* < 0. \end{cases} \quad (2)$$

This is a probability model. In its turn the logit model is as follows:

$$y_i^* = \ln \frac{P_i}{1-P_i} = \beta_0 + \sum_{j=1}^{k} \beta_i x_{ij} + u_i, \quad (3)$$

where y_i^* – logit;

P_i – probability of the dependent variable Y_t calculated on the basis of a logistic distribution:

$$\frac{P_i}{1-P_i} = e_t^{y^*} = e^{\beta_0 + \sum_{j=1}^{k} \beta_i x_{ij} + u_i}, \quad (4)$$

$$\hat{P}_i = \frac{1}{1+e^{-y_t^*}} = \frac{1}{1+e^{-(\beta_0 + \sum_{j=1}^{k} \beta_i x_{ij} + u_i)}}. \quad (5)$$

Thus, applying the logit model we will determine with a better accuracy influence of external factors on financial stability of construction companies.

Results and Discussion

Reviving the question of whether external factors influence financial stability of companies we would like to emphasize that the answer is obviously positive.

Table 2 shows a quantitative evaluation of external factors which influence financial stability of construction companies in the Siberian Federal District.

The data obtained after the logit analysis does not provide a basis for definite conclusions because due to a great number of factors included in the model their influence was "diluted". However, even now we can say that the greatest influence is exerted by the mortgage rate and consumer price index while the average nominal salary is the most significant factor. The numerous factors included in the model allow to exclude excessive variables. The study of excessive variables in the model gives the following results (Table 3).

Table 2. Influence of factors on financial stability of construction companies on the basis of logit model

	Ratio	Standard error	Z	P value
Const	–42.2347	760.330	–0.05555	0.9557
Consumer price index	0.405558	1.20692	0.3360	0.7369
Amount of investment in fixed capital per capita	2.98469e-05	3.42374e-05	0.8718	0.3833
Gross regional product	–1.41199e-07	1.16236e-06	–0.1215	0.9033
Mortgage rate	0.249076	67.5452	0.003688	0.9971
Unemployment rate	0.0270021	0.267144	0.1011	0.9195
Net migration rate	–0.0191763	0.0323661	–0.5925	0.5535
Average nominal salary	–0.000156994	7.06775e-05	–2.221	0.0263**
Business confidence index	0.0346476	0.108693	0.3188	0.7499

Table 3. Influence of factors on financial stability of construction companies on the basis of logit model without taking into consideration excessive variables

	Ratio	Standard error	Z	P value
Const	–582.948	379.200	–1.537	
Consumer price index	1.27117	0.746052	1.704	0.1242
Mortgage rate	47.3193	32.9403	1.437	0.0884*
Net migration rate	–0.0345858	0.0217027	–1.594	0.1509
Business confidence index	–0.0394829	0.0502944	–0.7850	0.1110
Average nominal salary	–0.000126946	5.88048e-05	–2.159	0.0309**

Average dependent variable	0.360000	Standard deviation of the dependent variable	0.484873
McFadden R-squared	0.110983	Corrected R-squared	-0.072666
Log. likelihood	–29.04499	Akaike's criterion	70.08998
Schwarz criterion	81.56212	Hannan-Quinn criterion	74.45864

Number of 'correctly predicted cases' = 35 (70.0%)

f(beta'x) for the average variable of independent variables = 0.485.

Likelihood ratio criterion: chi-square (5) = 7.25184 [0.2026].

		Predicted	
		0	1
Observed	0	31	1
	1	14	4

Exclusion of excessive variables allows to make the conclusion that the strongest influence on financial stability of construction companies is exerted by the mortgage rate and consumer price growth index. It should be noted that rise in prices and increase of the mortgage rate will cause growth of financial stability. So increase in the price growth index by 1% will result in improvement of financial stability of construction companies by 1.27 points while increase of the mortgage rate by 1% will enhance financial stability of construction companies by 47.3 points. Besides growth of the migration rate and business confidence index will have a negative impact on financial stability of construction companies and will decrease it by 0.3 and 0.4 points relatively. Under otherwise equal conditions growth of the average nominal salary will adversely affect financial stability of construction companies and will reduce it by 0.0001 notwithstanding that salary growth is a factor improving the welfare of the community. In spite of such insignificant influence of the average nominal salary on financial stability of construction companies influence of this factor is the most significant one.

The test for errors of the first and second kind revealed that 70% of cases has been predicted correctly. This allows to take into consideration influence of the analyzed factors on financial stability of construction companies.

Thus, the likelihood of achieving financial stability under the influence of external factors will take the following form:

$$\hat{P}_i = \frac{1}{1+e^{-y_t^*}} = \\ = \frac{1}{1+e^{582{,}95-1{,}27\beta_1-47{,}32\beta_2+0{,}03\beta_3+0{,}04\beta_4+0{,}001\beta_5+u_i}}. \quad (6)$$

The experiment results may be interpreted in two ways. For example, a positive influence of the mortgage rate on financial stability of construction companies consists in the following: when demand for mortgage services is preserved financial stability actually improves but growth of the mortgage rate increases the financial load on the community and pushes down demand. Consequently, a fast growth of the mortgage rate may have a negative influence on income of construction companies and undermine financial stability.

In the dispute on the experiment outcome we would like to note that in order to support the construction industry on May 1, 2020 President of the Russian Federation offered to launch a special mortgage benefits programme with the rate of 6.5% aimed at assisting in purchase of the comfort-class residential property. The rate exceeding the abovementioned one will be subsidized from the Federal Treasury of the Russian Federation [16]. This measure will help to support the buyers and mortgage market but it will have a strong negative impact on financial stability of construction companies. This happens because co-investors' funds are not construction companies' income or proprietary funds, they are rather used as target financing. After transfer to the project financing the co-investors' funds will be available to a construction company only after commissioning of a residential building. Thus, the reform of the construction industry financing will have a negative impact on companies' operations because expansion of demand to mortgage loans will prompt construction companies to use banks' loan assets. The cost of such assets is much higher than the value of investment money used according to a traditional pattern of a co-investment agreement.

Generally we would like to note that taking into consideration influence of external factors on financial stability facilitates optimal resource management. If an external factor changes construction companies may adjust the financial strategy and manage resources in such a way which minimizes their influence on the company operations.

Conclusion

Financial stability is one of the main factors of corporate development. A stable financial position helps a company to survive troubled times increasing its income and capital and over the long term is a guarantee of a commercial company's efficient operation.

The conducted research revealed that the concept definition of financial stability is a complex notion describing a well-balanced utilization of corporate resources and capital and a firm resistance to changes of the external and internal environment. Expansion of the concept definition of corporate financial stability facilitates development of the tools for its management and taking into consideration industry characteristics when analytical procedures are carried out.

Resistance to external environment disturbances and revealing the influence of external factors is of most importance in the financial stability management. The research determined that construction companies of the Siberian Federal District are under the influence of the mortgage rate and consumer price index while the most significant influence on financial stability is exerted by the nominal average salary. If these factors are taken into consideration for construction companies' resource planning and management the companies will be able to resist more firmly influence of the external environment and to enhance financial stability.

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Appendix 1

Evaluation of the ratios of financial stability and return on assets of construction companies in the Siberian Federal District of the Russian Federation for 2017–2018

Short name	2017, debt to equity ratio, %	2018, debt to equity ratio, %	2017, net debt to capital ratio, %	2018, net debt to capital ratio, %	2017, equity ratio, %	2018, equity ratio, %	2017, return on assets (ROA), %	2018, return on assets (ROA), %
ACTIVSTROYINVEST LLC	1,262.89	2,273.01	9.98	7.46	7.34	4.21	0.34	–4.59
ZHILREMMONTAZH LLC	242.28	175.94	–1.90	–0.72	29.22	36.24	–24.23	18.40
CONSTRUCTION COMPANY VOSTOK LLC	1,136.31	837.54	0.42	0.56	8.09	10,67	1.42	–1.45
SIBERIAN CONSTRUCTION COMPANY ETALONPROM	960.28	–186.24	34.93	–0.99	9.43	–115.95	8.44	–63.43
CITYSTROY LLC	10.84	0.70	–2.00	–0.17	90.22	99.31	10.91	5.14
SIBTRANSSTROY LLC	16.83	13.61	–0.61	–0.01	85.59	88.02	10.03	0.54
TGSK INVEST LLC	–16,196.78	–14,986.35	–84.16	–290.27	–0.62	–0.6	–0.02	–0.18
JSC CONSULTINGSTROYINVEST	2,327.34	1,277.34	1,357.75	237.13	4.12	7.26	3.39	2.64
RSK LLC	4,011.59	4,011.59	0.00		2.43	2.43	–1.53	
SSP LLC	–5,438.10	–34,471.70	557.36	–13,481.13	–1.87	–0.29	0.94	–0.13
STROYMODUL LLC	57.37	55.32	–6.41	-6.14	63.55	64.38	35.41	32.24
ALIANS-SYSTEMY LLC	323.81	500.00	1.90	152.63	23.60	16.67	–2.62	–6.44
ISS LLC	2,584.28	1,182.14	87.25	237.75	3.73	7.80	1.30	1.73
NORMA-LUX LLC	466.38	–156.30	–310.83	6.20	17.66	–177.62	7.4	–105.18
CONSTRUCTION COMPANY OMSK-TRACE LLC	1,341.72	1,805.33	493.08	451.23	6.94	5.25	0.57	0.19
YUZHSTROY-GRUPP LLC YUS-GRUPP LLC	694.53	428.51	–85.81	–63.65	12.59	18.92	8.67	12.60
SIBPROMGAZ LLC	699.22	508.49	–25.34	–56.33	12.51	16.43	9.59	6.63
STROITELNAYA COMPANIYA RAI LLC	69.55	36.29	15.63	11.30	58.98	73.37	71.18	71.08
SIBIRSPETSMONTAZH LLC	4.51	1.97	–16.77	–47.82	95.68	98.07	1.20	10.56
KKhM-KUZNETSK LLC	862.20	790.74	–1.82	0.86	10.39	11.23	0.19	0.21
YULAN LLC	3,979.07	1,817.65	0.00	–243.70	2.45	5.21	0.90	1.14
RSK EUROPA LLC	87.36	136.97	–16.63	10.96	53.37	42.20	28.80	11.42
TVORETS LLC	176.63	187.07	39.30	35.25	36.15	34.83	0.56	0.11
AGRIK-KS LLC	52.02	26.21	–7.50	–2.38	65.78	79.24	25.78	3.63
PSM LLC	–672.77	–1,185.50	2.80	–3.88	–17.46	–9.21	–8.12	9.30
CAPITAL CONSTRUCTION MANAGEMENT ZHILSTROY LLC	–10,002.04	–76,625.81	–1,784.08	–11,299.30	–1.01	–0.13	–2.80	0.78

Short name	2017, debt to equity ratio, %	2018, debt to equity ratio, %	2017, net debt to capital ratio, %	2018, net debt to capital ratio, %	2017, equity ratio, %	2018, equity ratio, %	2017, return on assets (ROA), %	2018, return on assets (ROA), %
KHAKASGRAZHDANSTROY LLC	517.70	417.03	208.37	187.03	17.05	19.34	2.31	3.07
REGIONSTROY LLC	275.89	–527.69	–31.18	–80.43	26.60	–23.38	19.26	10.02
SKADI LLC	128.72	118.03	76.24	–0.21	76.30	83.73	–0.61	0.40
MUNICIPAL UNITARY ENTERPRISE ATB	528.05	249.77	–1.43	–87.73	15.92	28.59	46.52	13.56
TAVAL LLC	2,377.33	410.83	–11.92	–409.23	4.04	19.58	0.64	10.30
CONSTRUCTION COMPANY GO-ROD LLC	112.65	32.14	–3.95	–48.49	47.03	75.68	7.98	36.68
CONSTRUCTION COMPANY SIB-PROMSTROY LLC	1,197,024.24	–4,667.49	139,331.82	–760.57	0.01	–2.19	0.01	–2.46
MASTER LLC	1.65	6.30	–39.46	–27.35	98.37	94.07	5.32	72.87
SIBSTROYREGION LLC	1.58	820.17	–93.22	–91.60	98.45	10.87	–8.13	–51.10
SSK LLC	19.37	0.99	–23.95	–0.63	83.77	99.02	21.99	–8.63
PRODUCTION COMPANY AVANTE LLC	4,786.57	–18,646.15	3,534.68	–13,895.13	2.05	–0.54	–3.05	–2.59
PRODUCTION COMPANY PROM-STROY LLC	94.31	190.79	53.61	141.84	51.47	34.39	8.47	1.88
SIB-SERVICE LLC	259.98	361.66	–20.04	20.21	27.78	21.66	7.50	0.37
STROYENERGOMONTAZH LLC	4,269.89	3,829.81	–2,092.30	1,324.11	2.29	2.54	3.51	0.77
SPETSSTROYINVEST LLC	5.96	3.41	–89.20	–13.94	94.37	96.70	27.06	3.56
SIBSPETSSTROY LLC	–424.28	50.49	–237.74	–12.53	–30.84	66.50	–78.72	95.31
TECHNOSIBBAIKAL	432.83	121,046.15	23.12	–13,138.46	18.77	0.08	2.45	–32.34
CHKHOLSAN LLC	29.82	135.74	–82.85	16.94	77.03	42.42	26.01	–14.53
SKIF LLC	147.60	63.41	–1.42	–24.,98	40.39	61.20	0.60	1.13
SIBINVESTSTROY	–241.50	–175.08	0.00		–70.67	–133.20	–22.64	–14.32
YUNOST LLC	127.18	82.02	–130.69	–51.70	44.02	54.94	45.48	12.67
OLCHEY LLC	629.55	330.65	23.02	–254.80	13.71	23.22	14.12	10.47
SUUGU LLC	45.97	40.41	–5.28	–6.40	68.51	71.22	–3.97	–1.62
ULU LLC	227.84	187.89	203.75	176.68	30.50	34.74	–136.66	5.44

Review of Methods and Tools for Intellectual Property Analysis of Public Sector Entities[1]

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Review of Methods and Tools for Intellectual Property Analysis of Public Sector Entities

Abstract

The low efficiency of intellectual property (IP) in the public sector in our current economic environment is largely due to the insufficient development of the prevailing accounting and analytical system. Analytical methods, and the information basis of their application, are the core of this system. The formation of an accounting and analytical system consistent with the development priorities of public sector entities requires special research.

This article provides a review of the methods and tools of analysis used by Russian and foreign scientists in the field of IP. Our research sample comprises 52 foreign and 39 Russian sources. Through a detailed textual analysis process, we systematise the existing methods used in the analyses of certain aspects of intellectual activity, and assess the information disclosure therein. Our evaluation is targeted towards identifying prospects for harmonising Russian and international approaches, and provide the groundwork for the improvement of accounting and analytical support for IP management in the public sector.

Our results reveal possibilities for expanding the system of IP analysis methods for solving problems in the field of the IP economics and management on the basis of patent analytics. We also collate and classify patent analytics methods, and identify existing methodological problems at the macro- and microeconomic levels. Analytical methods are grouped in accordance with three stages of the reciprocal model of IP accounting and analysis in the public sector, developed within the framework of a novel theoretical and methodological approach.

In conclusion, we illustrate the potential for applying the methods of nonlinear dynamics and the dynamic theory of innovation (re: patent information) to determine the trajectories of public sector entity development concerning levels of information disclosure. We also identify areas for follow up research revealed through our analysis.

Keywords: intellectual property, intangible assets, public sector, patent analytics, information disclosure

JEL classification: O34, O32, H83, M41, G32

Introduction

Issues around intellectual property (IP) analysis and the efficiency of such analysis have grown in relevance in recent years. This is especially the case in the public sector, where global development trends are related to the strengthening of the role of public sector entities in the area of science and innovation. As such, active distribution of scientific knowledge throughout society, and in particular to industrial entities, assumes an ever-greater level of importance in the assessment of of public sector entity performance. However, theoretical and methodological research and methodological guides dedicated to IP analysis are currently not sophisticated enough (можно оставить так) and offer no opportunity to develop reasoned recommendations for improving efficiency or choice of the best ways to commercialise IP. This situation has been described in a number of research papers published over recent years.

We analyse various publications on IP management, patent analytic investigations, and the disclosure of knowledge capital and intangible assets, in aggregate comprising 900 scientific articles. Our results indicate that investigations in these areas focused mainly on patenting, including patentability evaluation and choice of legal protection types [1]. Scientists pay special attention to patenting and licensing of university research results performed by Technology Transfer Offices (TTOs) founded in American universities after the passing of the Bayh-Dole Act of 1980 [2]. University-industry research cooperation, efficient collaboration of public and commercial entities [3], measurement of the innovation potential of research and development centers in the public and commercial sector [4], and the development of effective technology transfer models each represent multifaceted and significant areas of relevance.

It should be noted that the majority of scientific papers relevant to this area are focused on solving certain research issues rather than systematising methods and tools. Special studies on analysis of applied methods were dedicated only to patent analytics [6; 7], while the system of economic methods applied to solve problems of effective commercialisation in IP management has been rather neglected in earlier research.

We contend that databases represent a resource of primary importance for solving economic and management problems, and applying corresponding analytical methods. In this regard, our study is especially focused on the disclosure of information on IP and intangible assets, and assessment methods of public sector entities' transparency. The published scientific papers we reviewed lack such research in terms of public sector focus. Thus, F. Castilla-Polo and D. Gallardo-Vázquez, who performed a critical review of publications on the disclosure of intangible assets information, pointed out that the majority of research papers evaluated large public companies, while the number of small business and public sector entities analysed was insufficient [8]. F. Castilla-Polo and C. Ruiz-Rodriguez, who published 74 academic papers applying content analysis methodology to study disclosure established that in 61% of research papers public companies' data was used [9]. In the paper by B. Cuozzo, J. Dumay, M. Palmaccio and R. Lombardi - which analysed 246 scientific papers on intellectual capital disclosure - just 5% of papers were related to the study of the public sector [10].

It should be noted that public universities occupy a special position among public sector entities, which is borne out in the existing research. The problems of the analysis and assessment of efficiency of public universities' IP utilisation are characterised by a number of distinctive features which are of importance for our research, which will be detailed below.

When we summarised the research results from recent years we failed to find a significant number of survey papers published by Russian authors on this theme. Additionally, there are very few Russian scientists' papers cited in the survey research of foreign authors. Against this background, we propose that in our research Russian publications should be studied separately in order to find out possible similarities and differences in approaches and methods of IP analysis. We also propose to define the prospects of integration and harmonisation of research methodologies.

Considering the background of the development of unified theoretical and methodological justifications of accounting and analytical support of IP management in the public sphere, we assume that IP analysis tools should be improved. This motivation provides for the creation of a database to be used for taking reasoned management decisions. So, one of the objectives of this paper is the adjustment of the methods that are systematised in the survey research (in accordance with the stages of the reciprocal model of IP accounting and analysis in the public sector, which we outline). The model comprises procedures of identification and commercialisation of IP, and is described in detail in papers [11; 12]).

This paper consists of the following sections. The section titled 'Research Methodology' outlines research issues and describes the core principles of preparing the studied research selection for analysis. In the section 'Research Results' we answer the raised scientific issues. 'Results Discussion' deals with the prospects of using the results of the present research for the purposes of IP management in the public sector. This is justified on the basis of a new methodological approach, developed by the author and presented herein. To close, 'Summary and Conclusions' are articulated in the final section of the paper.

Research Methodology

We defined the research questions (RQs) stated below on the basis of up-to-date trends of development of the analysed topic, the displacement of vectors related to the topic and to applied research methods, and with a consideration of the lack of papers on analysis of public sector entities' operations.

RQ1. Which methods are used in IP analysis of public sector entities, and are there any differences in the methods applied by foreign and Russian scientists?

RQ2. What are the main objectives and analytical methods of disclosure of IP and intangible assets by public sector entities?

We searched for scientific papers in the Web of Science and Google Scholar databases using all available sources. We used the following query fields: 'Title', 'Abstract', and the 'Key Words' used were "intellectual property" and "intangible assets". The search results were limited by the 'AND' filter and the terms "public sector", "universities", "educational institutions" in order to select the researches related to the public sector. The terms "patent analytics" and "disclosure" were applied in order to select certain segments of the sampling.

In order to analyse the Russian segment using the same terms, we made a sampling of the most relevant academic papers, monographs, and educational publications by Russian scientists taken from the Elibrary database, the electronic library system Znanium, the electronic catalogues of the Russian State Library and the State Public Scientific Technological Library of the Siberian Branch of the Russian Academy of Sciences.

The search did not comprise the term "goodwill" related in its meaning to our topic, which covers the issues of intangible assets and IP management. This is because it mainly pertains to the commercial sector, while in our research the primary focus is on the public sector entities.

Analysing the abstracts and key conclusions of the papers included in the sampling, we selected 10 review papers where the research was not focused on regional issues or certain sciences (e.g. medicine, physics etc.) and which were of maximum relevantce the scientific issues raised. Moreover, we chose papers written in the past five years since 2016, as survey researches of recent years comprise the most relevant publications up to the present day. We selected themed published papers, which analysed IP from a variety of perspectives, on the basis of the content of abstracts and key research results. The most often quoted papers were preferred.

Research Results

Current Status of Research on Public Sector Entities' IP, based on existing Reviews

The papers on innovation management, management of IP activity results and intellectual capital account for the widest range of issues. Analysis of academic papers conducted by M. Holgersson and S. van Santen, which comprised 12 review papers and over 400 articles dedicated to certain management areas, revealed that this topic in general has been on the rise since the 2000s, showing a substantial increase in the number of published papers. In this author's opinion, a significant revelation is the fact that most of the research is related to patent rights items (in particular, inventions) and that substantially smaller attention is paid to other IP items and issues of alignment of patent and business strategy in general in the field of strategic management [1]. As such, we pay particular attention to the special issue of the International Journal of Industrial Organization (2003), titled "The Economics of Intellectual Property at Universities" which deals mainly with the issues of policy-making and some economic and IP management issues. Topics covered include licensing and university-industry collaboration, which are within the competence of TTOs.

M. Holgersson and L. Aaboen, who conducted a survey of 108 literature sources with respect to performance of TTOs founded in universities to commercialise development results established that as a rule, existing research represented a simplistic approach to management of IP results. The predominant approach is based upon recommendations concerning the choice of legal protection of items, the description of the protected contents of engineering solutions, and the determination of a patent holder. Within this approach, which we name the "appropriation model", the key performance indicators are the quantity of patents, licenses, and spin-offs a university has. In the authors' opinion, in a more efficient "utilisation model", it is necessary to emphasise how TTOs facilitate access to universities' protected research results, how awareness of concerned parties of the universities' research activity is facilitated, how the provision of continuity of the innovation process is managed, and how partnering with the business community is managed [2].

C. Mascarenhas, J.J. Ferreira, and C. Marques also write of the importance of partnering with private companies, which should be arranged by TTOs. Their bibliometric analysis of 294 papers (which consider innovation strategies based on cooperation of universities with businesses) showed that companies are taking an increased interest in scientific cooperation with universities. The thematic clusters of the published papers which the authors have selected are associated with various focuses of such cooperation [3].

Apart from the problems solved by TTOs, P. Maresova, R. Stemberkova and O. Fadeyi considered existing technology transfer models applied in various countries and selected 22 relevant sources after performing a systematic literature review [5]. The authors established that generally accepted or 'most efficient' standard models do not exist. The models become more complicated as the commercialisation process complexifies, and institutional and other conditions of innovation process implementation change. At the same time, issues of IP management remain the central issues in various technology transfer models.

The research by I. Buonomo, P. Benevene, B. Barbieri and M. Cortini comprises a review of nine published papers on a rather narrow topic related to the influence of intangible assets on the performance of non-commercial organisations. In spite of the controversial approach applied by the authors when they consider various intel-

lectual capital components (including human, relational and structural capital) as intangible assets, the discussion opened up by the authors concerning the parameters characterising the performance of non-commercial organisations is noteworthy. In that study, the relation between intangible assets and performance manifests itself in the fact that the use of intangible assets allows non-commercial organisations to carry out the core activities in the circumstances of government financing decrease and to withstand competition for additional funding sources with other non-commercial organisations [13].

Along with a performance assessment, the most important line of research is the measurement of innovation potential. Within this strand of research M. Yaghoubi, E. Teymourzadeh, M. Bahadori and F. Ghardashi made an extensive systematic review comprising 200 published papers which enabled them to develop a conceptual model of such measurements [4].

M. Holgersson and L. Aaboen emphasise that in the digitalisation environment, the importance of manufacturing secrets, copyright, and design inventions increases. Such items are often a "digital addition" to technology protected as inventions [2]. Information technology penetrates patent analytics more and more. A survey research by L. Aristodemou and F. Tietze comprising 57 papers on this topic revealed an increasing number of cases of applying artificial intelligence, machine learning methods and deep learning technology when arrays of patent information were processed. Besides this, the authors defined four key fields of application of patent-analytical studies. They are: knowledge management (including classification and patent quality evaluation), technology management (revealing technology trends and forecast of development of certain technology areas), IP economic value (including the issues of high-tech companies' performance, patent value estimation and defining the amount of loss inflicted by patent infringements, as well as macroeconomic forecast issues), data management (including mainly patent digitising, provisioning of patent information databases and improvement of searching algorithms) [6].

Thus, the survey papers of recent years cover a wide range of published research which considers management in innovations, technology transfer including the role of universities in the processes of intellectual activity results' commercialisation, scientific potential evaluation and research output. The authors solve particular research problems in the above fields. However, in order to make a complete picture of the system of methods applied in IP analysis for solving various problems, it is necessary to conduct a separate survey research, the main purpose of which is systematising the methods applied by the authors instead of selecting topics for research. In its turn, methods systematisation will allow to reveal the problems related to the building of the database necessary for use of corresponding analytical tools, and this requires further study of disclosure issues. Additionally, in the existing research, public sector entities (except for universities) have been referred to too little. We assume that analysis problems and methods in the public sector require a separate research due to the specific character of their operations. In this regard, universal methods and those which are most applicable to analysis of the public sector entities' operations should be distinguished, as well as the limitations related to applying certain methods developed for the private sector, to the public sector.

Analysis Methods of IP in the Public Sector Used by Foreign and Russian Scientists

The objectives of our research did not comprise an exhaustive segmentation of the topic in order to select the research topics. However, we distinguished the fields within which the authors define the research problems, which include:

- researchers' human personality and behavioural characteristics, which influence patenting, including the discussion of what is of higher preference and priority for scientists, i.e. patenting, or publishing of scientific findings;
- IP management and strategy development;
- academic and technological cooperation and collaboration between public sector and commercial sector entities;
- intellectual activity regulation and institutional environment.

In the majority of published papers the selected topics overlap and certain issues prevail. Thus, Y.H. Wu, E.W. Welch and W-L. Huang distinguished institutional and personal factors related to human personality characteristics of researchers which influence the prospects of licensing IP items of USA universities [14]. N. Halilem, N. Amara, J. Olmos-Peñuela and M. Mohiuddin studied the influence of three political aspects in the field of IP (attachment of exclusive rights, disclosure duty and profit distribution principles) on the entrepreneurial behaviour of scientists from Canadian universities [15].

S. Öcalan-Özel and J. Pénin defined the advantages and drawbacks of the two key strategies of universities: patenting of research and development results, or their publications paying special attention to the universities' attempts to maximise the social effects of their activity instead of profits [16]. Opposing patenting as a tool used in the "closed partnership" model to publishing of scientific findings which promotes the "open science" model, J. Chataway, S. Parks, and E. Smith note that negative consequences of patenting manifest themselves when it is conducted too early in research stages. Mainly implementing the comparative method, they emphasise that at present there are no researches which use quantitative data and methods to justify the preference for patenting over publishing of research and developments results [17].

The widest range of issues was considered in the research on IP management where the issues of management strategies development were of primary importance. So, J. de Beer, I.P. McCarthy, A. Soliman and E. Treen offered an

approach which implies choosing one of the four strategies of IP crowdsourcing: passive, possessive, persuasive or prudent, taking into consideration two key factors: intention to gain exclusive rights to IP, and risks related to infringement of third-party rights when using the IP obtained as a result of crowdsourcing deals. A combination of the factors which may manifest themselves at a low or high level in certain situations analysed by the authors determines the choice of a strategy [18]. Those public sector entities which, as a rule, try to appropriate exclusive rights and pay insufficient attention to the verification of infringement of third parties' rights as a result of transactions made by such entities, are characterised more by the possessive strategy. For the purpose of commercialisation, a subsequent transfer of IP to startups is possible. According to N. van Stijn, F.J. van Rijnsoever and M. van Veelen, it is least preferable for the universities engaged mainly in fundamental research, and most preferable for engineering and technical universities [19].

When implementing innovative activity strategies it is important to evaluate the managerial staff's efficiency. S. Veltri and P. Puntillo analysed management practices using the case study and interview methods, and established that effectiveness of human capital management is a more significant parameter of managers' efficiency evaluation in comparison to other components of intellectual capital including IP management [20].

A central issue of several research studies is the cooperation of public sector and commercial sector entities aimed at enhancement of efficiency of scientific research and provision of technology transfer. According to the results of interviewing the managerial staff from 737 Spanish and European innovative companies conducted by M. Fernández-Esquinas, H. Pinto, M.P. Yruela and T.S. Pereira use of IP turned out to be the most rare cooperation mechanism, along with joint-ventures foundations. Staff training is most widely spread and joint research and collaborations for the purpose of use of specially made equipment are a little less widespread [21]. M. Bikard, K. Vakili, F. Teodoridis established (on the basis of the data on the study personnel's published papers and patents) that the team members collaborating with companies publish their papers more actively than academic team members. They outline feedback concerning patenting [22]. Possible reason for that include that companies often take a hard line when it comes to conferring to them exclusive rights to IP items created as a result of joint projects with universities. However, O. Gretsch, F. Tietze and A. Kock found out that the milder the way in which the issues of sharing the rights and coming to an agreement on other contractual terms between the collaboration participants are settled, the more efficient their joint activity is [23].

A number of authors place attention on the issues of intellectual activity regulation on the level of individual economic entities, as well as on the institutional level. In these cases mainly qualitative methods are applied for analysis, including comparative analysis. Thus, D.J. Jefferson, M. Maida, A. Farkas, M. Alandete-Saez and A.B. Bennett conducted a comparative analysis to define similarities and differences in the programs in the field of IP management, technology transfer and entrepreneurship used by five top American research institutes, paying special attention to disclosure of information on inventions, IP, legal protection and licensing strategies, and the policy of settlement of concerned parties' conflict of interests in the innovation sector which is extensively studied by USA universities - and to a lesser extent, by Latin America universities [24].

C. Kalantaridis, M. Küttim, M. Govind and C. Sousa carried out the comparative analysis of institutional conditions which influence spread of knowledge and technology transfer in Great Britain, Portugal, Estonia and India and considered eight cases in four top universities of the above countries. The scientists made an important conclusion that concentration of development results protected as IP and founding of communities for certain knowledge branches on the basis of universities facilitates global commercialisation to a greater extent than the provision of formal (including legislative) conditions and may form an alternative to institutionalisation of the innovative sector [25]. At the same time D.M. Weckowska, J. Molas-Gallart, P. Tang et al. came to the contrary conclusion that national legislation may stimulate development of IP management practices in corresponding countries and regions and this, in turn, has a positive effect on patenting in universities [26].

Over recent years, scientists more often criticise the established statistical approach to assessment of research effectiveness based upon such key measures as the number of published papers, the number of submitted patent applications, and the number of granted patents. Such parameters make it impossible to assess the actual contribution of this activity to the community welfare and also to evaluate the effects for individual economic entities. The paper by T. Mets, A. Kelli, A. Mets and T. Tiimann is dedicated to the development of a new system of qualitative and quantitative strategic indicators which facilitates scientific cooperation and the encouragement of commercialisation of university development results. The indicators system offered by the authors is customised for public, commercial sector entities and the government (region) in general [27].

G. Fernandes, E.B. Pinto, M. Araújo, P. Magalhães and R.J. Machado offered a method of quantitative evaluation of effectiveness of the research conducted by universities and business partners within joint projects or programs and practical recommendations for its use. On the basis of analysis of the project life cycle, the authors developed a system of backward-looking and forward looking, quantitative and qualitative indicators which comprise *inter alia* patent and publishing performance indicators [28]. I. Stefan and L. Bengtsson also analysed implementation of innovation processes at various stages but did it from the point of view of effects from collaborations with different groups of partners. The authors established that cooperation with universities at early stages allows to increase

the novelty of developments and this is confirmed by the predominance of research in university-business cooperation [29].

M. Grazzi, C. Piccardo, C. Vergari evaluated the relation between innovation activity indicators (patents and trademarks) and financial operational performance indicators (income and profit) by building algorithmic relations with a probability estimate. The authors made the conclusion that it was a positive relation and studied the effects of patent use in comparison to trademarks. This information may be used to develop strategies [30]. Meanwhile, the method applied by the authors was not new. It was considered for the study of similar relations by T.J. Lybbert and N.J. Zolas [31].

Thus, in the analysis of management practices, institutional conditions of innovative activity and behavioural aspects of invention activities, nonquantitative analysis methods were mainly used. Foreign authors apply quantitative methods in their research studies related to effectiveness assessments of patent and licensing activity, research activity in general or collaborations in the field of research and development (Appendix 1).

When analysing Russian scientists' published papers it should be noted that top priority is given to the development of the most general theoretical and methodological provisions (A.D. Sheremet, M.V. Mel'nik, M.I. Bakanov, R.S. Saifulin, G.V. Savitskaya et al.) [32-34]. On this basis they are followed mainly by economic and financial analysis methods related to evaluation of the structure, dynamics of financial and economic indicators including yield on capital investment, profit and profitability level, intangible assets liquidity etc. and the influence of certain factors on their change (N.V. Zhuravleva, K.I. Kremer, E.M. L'vovich, Yu.V. Prokop'eva, I.P. Mistyukova et al.) [35-41]. The ratio method gained a widespread use. It was used as a tool of innovation, marketing, investment analysis of IP (N.N. Ilysheva, S.I. Krylov, O.V. Mikhailov) [42-44], managerial analysis of intellectual assets (S.A. Kuzubov) [45], and financial analysis of intangible assets utilisation (N.M. Balakireva) [46]. For risk assessment and management of the innovation business the authors offer to apply the options method (R.P. Bulyga) [47], the reflexive analysis method and expert analysis (V.B. Gusev, N.A. Isaeva) [48-50] but in general econometric, mathematical and probability analysis methods are used in the Russian scientists' papers to a substantially smaller degree (Appendix 2). The approach of "translating theory into practice" predominant with Russian scientists differs significantly from the foreign approach where methods are developed and modified on the basis of certain research problems.

In comprehensive interdisciplinary research, economic analysis methods may be efficiently combined with patent analytics methods, which help to study academic and technological development fields on the basis of patent information. M. Holgersson and S. van Santen emphasise that patent analytics as a tool of technological foresight, assessment of technology development level, patent portfolio construction, defining competitors, search for partners in certain fields, and patent infringement risk assessment, has been widely used in academic papers since the early 1990s. The second important category of patent information analysis is patentability assessment, and choice of the types of items' legal protection taking into consideration specifics of the national legislation, industry characteristics and other factors. It is important to note that the authors attributed the researches aimed at strategy development, improvement of mechanisms of IP legal safeguard and protection and other issues to the macro level, while the research studies focused on IP efficiency management were defined at the level of individual economic entities [1]. This approach is in general consistent with the understanding of the Russian scientists (Appendix 3).

The main methods of preparing industry-specific and express patent landscape reports have been developed by the World Intellectual Property Organization. Specialists of the Federal Institute for Industrial Property (FIIP) analysed the methods of patent landscape development applied by WIPO, patent offices of Great Britain, Australia, Switzerland, etc., as well as foreign business companies rendering services of patent landscapes development. They prepared instructional guidelines for patent landscape designing when performing scientific research, titled NIR 9-EP-2014 (НИР 9-ЭП-2014), "Study of Methods for Preparing Patent Landscape Reports as a Tool of Management Decision Making in the Field of Research and Development".

The industry-specific patent landscape is the most complex patent analytical investigation targeted at identifying that technology which is most important for solving the problems of development within an industry. It also seeks to identify the development of patenting strategies and introduction of goods made by the leading industry sector companies in the market, on the basis of an in-depth technical analysis with a multilevel expert interpretation [51]. An express landscape is designed on the basis of an in-depth analysis of the engineering solutions (patterns), most typical of a certain technological development stage, and detection of "anomalies" indicative of a change in the development thrust. This allows one to define the top global development centers, the owners of the most valuable technology, and to forecast the rate of introduction of new technology in the markets. The specific features of express patent landscapes as a type of patent analytical investigation and their difference from industry-specific patent landscapes are described by specialists of the Project Office of FIIP [52]. In that context, A.S. Nikolaev [53]. A. Oplachko determined the key issues of patent landscapes use in companies' management activity. They include a lack of skilled professionals, low integration of patent analytical, management activity, and business processes [54]. A. Abood and D. Feltenberger showed the possibilities of applying the machine learning method for patent landscapes design [55] while J.A. Smith, Z. Arshad, A. Trippe et al. analysed the quality and structure of patent landscape reports in order to elaborate recommendations for their improvement [56].

Patentability assessment is one of traditional and most frequent types of research comprising patent and non-patent data published before submitting an application for patenting of the studied engineering solution. The purpose of such study is to define the possibility and degree of legal protection of an engineering solution within the jurisdictions of the countries chosen for patenting. Russian applicants are recommended to use 'GOST R 15.011-96 System of Products Development' and 'Launching into Manufacture. Patent Investigations' in order to verify patentability and patent purity [57]. In other jurisdictions patentability is assessed in accordance with the national legislation.

Examination for patent purity implies defining the product critical components and search for the patents valid in the certain fields which may be potentially infringed. It is of particular importance when a new product is introduced in the market. The general patent purity research methodology is described most consistently in the papers by V.V. Shvedova who also considers specific features of the patent purity investigation at various stages of research and development [58]. E.P. Skornyakov and M.E. Gorbunova also consider the interrelation between the main types of patent researches and product development stages [59].

The patent technology scouting which contemplates an in-depth study of the core companies, technology, products and services in the priority technological field may imply a combination of patent analytics with other methods taking into consideration the raised research problems. Thus, F. Pasimeni, A. Fiorini and A. Georgakaki used patent information to analyse innovative activity. Then, on the basis of mathematical analysis methods they defined the relation between patent information and R&D expenses of corresponding companies and determined the leaders in financing of research and development [60]. The possibilities and prospects of determining academic and technological priorities on the basis of patent information (also for Russian scientific and educational organisations) are shown, inter alia, in the papers by O.P. Neretin [61].

At the microlevel, a technology audit is carried out. On the basis of its results organisation's needs and capabilities are defined concerning product positioning and defining target markets, revealing technology fields of special priority, those which require establishing of technology readiness levels, and defining the innovation sources and means of technology transfer for development of partnership relations in the technology field. V.V. Kerimov advocates the innovative audit theory based on 'Due Diligence' technology which implies exerting operational, financial, tax, legal, potential Due Diligence and Due Diligence influence [62]. V.A. Antonets, N.V. Nechaeva, K.A. Khomkin, V.V. Shvedova also developed a proprietary methodology of technology evaluation [63]. M. Grimaldi, L. Cricelli and F. Rogo offered a technology audit methodology applied to the patent portfolio analysis when technology assessment is performed against the background of the general business strategy and when it allows to choose the patents which comply and do not comply with it for more efficient use of the compliant patents and taking decisions as regards further support and use expediency of non-compliant patents [64].

On the basis of patent data and analysis-of-variance method S.Y. Kim and H.J. Lee established that further patent activity increases and the patent quality improves if an economic entity purchases a significant patent in the technology field. They also found out that universities purchase a lot of patents from non-commercial organisations, research institutes, and other patent co-holders which seemingly contradicts the idea of scientific knowledge and technology transfer from universities. In the authors' opinion, the final objectives and consequences of such purchase require a separate study [65].

Apart from that the results of patent analytical investigations may be used to evaluate the significance of technology and finding patents of high commercial value. One of the most widely used approaches to assessment of invention importance which implies use of the coefficient method has been applied in the papers by V.G. Gmoshinskii and G.N. Fliorent since 1966 [66] and later – in the papers by N.V. Bezsonov [67]. However a substantial drawback of this approach was its failure to contemplate use of 'market criteria of importance' appraisal. Instead, it took into account mainly the parameters characterising the technological essence of an invention. E.P. Skornyakov and M.E. Gorbunova modified the coefficient method taking into consideration evaluation of the invention influence on technological sophistication of the products which presumably or actually will be manufactured using the invention as well as the expenses related to manufacture [59; 68]. Meanwhile, as a rule, in order to assess the patent's importance and value, foreign authors use market indicators, such as offering price and closing price when making transactions on the exchange [69]. Other indicators include future profit [70] and characteristic features of the patents, including forward and/or backward citations, number of quotes in non-patent sources, number of claims, structure of triadic patent families, patenting geography etc. [64; 71; 72].

On the basis of a desk study, a questionnaire survey and a discussion with experts, L. Aristodemou, F. Tietze, N. Athanassopoulou and T. Minshall systematised the existing patent analytics methods and designed a roadmap of their development. They identified artificial intelligence, machine learning, neurolinguistic programming, and some other technologies as the key ones to the development of patent analytics. New visualisation techniques, automated translation technology and methods of patent and economic data interrelated analysis are determined as related technology [7].

At the moment, Russian research studies insufficiently exploit the patent analytics opportunities for solving research problems. Now, patent analytics in Russia develop mainly as a part of consulting focused on the applied aspects and opportunities of various professional data search and visualisation systems. However, it seems that academic interest to analysis of patent information in Russia as well as all over the globe will rise in the following years.

Objectives and Analysis Methods of Transparency of Public Sector Entities

The term "disclosure" is construed in the researches dedicated to IP in two ways. In the first case disclosure of the invention contents (technical essence) is discussed which may create threats related to the impossibility of items' legal protection in the future and a decrease of their commercial value [73]. However, some scientists are on opposite side of the issue. So, T. Peters, J. Thiel and C.L. Tucci, after analysing cases of various companies, showed that a "strategic disclosure", understood as an intentional disclosure of information on a new engineering solution which impedes patenting of the same solution or the one similar in content by other applicants may create competitive advantages and provide economic benefits [74].

The second side of the research is related to the analysis of disclosure of information not related to the essence of engineering solutions, but used to justify management decisions and develop strategies in the IP field, including indicators of scientific and technological activities, financial-economic and other indicators which characterise innovation processes and their results. Public sector entities submit these indicators in annual reports, separate intellectual capital reports, accounting (financial) reports, scientific reports, sustainable development reports and in other forms. F. Castilla-Polo and C. Ruiz-Rodriguez established that the majority of authors in 77% of cases use the annual report as the main source of information in the disclosure analysis [9]. However B. Cuozzo, J. Dumay, M. Palmaccio and R. Lombardi offer to differentiate the notion of "disclosure" and "reports" and for research purposes consider "disclosure" in the widest sense, not to be limited to statutory reports or even to voluntary reports including, for example, the integrated reporting concept. Nowadays information is often disclosed digitally and, in the authors' opinion, any "digital source" should be considered as an information base for disclosure analysis [10].

The widest range of disclosure analysis methods was used in the paper by I.M. Welpe, J. Wollersheim, S. Ringelhan and M. Osterloh. Thus, the correlation analysis allowed the authors to define redundant parameters in the Intellectual Capital Report made by universities of Austria which are not informationally useful for concerned parties. These parameters are excluded from further analysis because they may compromise the quality of its results. The factorial analysis is used by the same scientists in order to reveal hidden variable factors responsible for existence of linear statistical correlations between the observed variables. On the basis of the absence of such factors, they made the conclusion that the models obtained as a result of the regression analysis are reliable. The authors also applied the frontier analysis to evaluate performance efficiency of the decision-making units in Austrian universities. As such, the results of this analysis were expressed in percentages, where 100% meant an entirely effective unit. The authors applied the fuzzy logic methods which are characterised by high flexibility, and enabled them to analyse financial, non-financial, quantitative and qualitative indicators to construct an expert system where the knowledge database contains facts (statistical information in a certain field) and information analysis rules laid down by experts. The model of such an expert system is represented by a decision tree, the branches of which describe parameters of structural, human and relational capital. It allows to assess the most probable changes of each capital type [75].

Content analysis is, perhaps, the most common method of disclosure analysis. It is conducted by various authors on the basis of the search terms system. The number of terms mentioned in the reports is, as a rule, evaluated by a specially designed software. At the same time B. Kamath notes that quantitative (volumetric) parameters of disclosed information make it impossible to characterise unambiguously the disclosure level because it is also necessary to take into account the quality of disclosed information. However, he thinks that it is possible to assume that the amount and quality change simultaneously [76]. A number of authors in order to assess the disclosure level and the disclosed information quality in addition to content analysis offer to apply qualitative methods, including interviews, case studies, and some other methods. Another significant limitation of content analysis use is the current terminological ambiguity related to the meaning and correlation of the notions "intellectual capital", "intellectual property", "intangible assets", "intellectual assets" and other related terms which should be eliminated by theoretical researches. In the practice of content analysis, modification of search queries by adding and excluding various terms causes substantially varying results, thus, decreases the reliability of research and calls into question the key conclusions [9; 10]).

P. Catalfo and I. Wulf combined content analysis tools with a semantic analysis to study disclosure of IP and intangible assets information in the 'management comments' to the reports prepared in accordance with IFRS and in the evaluation of its sufficiency to satisfy the concerned parties' informational needs [77]. F. Castilla-Polo and C. Ruiz-Rodriguez point out that often content analysis results form the information base for application of statistical methods in assessment of the assets and business value, efficiency and effectiveness analysis etc. [9].

Considering various aspects of disclosure, scientists first analyse the mandatorily disclosed information and indicate that other information is not disclosed due to absence of corresponding requirements or because it is incomplete, incommensurable and, consequently, not suitable for application in all researches. Also the researches which analyse whether the actually disclosed information complies with the requirements established by accounting and reporting standards are widespread [78; 79]. Their authors, in most cases, apply the index method. The model of construction of the disclosure index implies indicating in the numerator the actual volume of the disclosed information measured in points, the number of search terms used in content analysis etc., and in the denominator – the maximum possible volume of information. Besides, the

authors often use indexes for further regression analysis aimed at revealing the disclosure determinants. Thus, B. Kamath uses the disclosure index as a dependent variable in the multiple regression model [76] while S. Fontana, D. Coluccia and S. Solimene use the value added intellectual coefficient (VAIC) as a factor in the model applied for assessment of the general disclosure level [80].

M. Kachouri and A. Jarboui showed use of the disclosure index in establishing the relation between corporate reporting and corporate management efficiency [81]. At the same time A. Maaloul, W. Ben Amar and D. Zeghal applied the correlation-regression analysis and established that the intangible assets disclosure level has a positive effect on forecasting profitability evaluations created by experts [82].

However the disclosure index may be applied to analyse public sector entities' transparency, not just using the information subject to mandatory disclosure, but also the voluntarily disclosed information. In this regard, the three-level model of IP and patent strategy disclosure is of great importance. It contemplates selection of the information to the extent which is minimally required, and mandatory for disclosure by all economic entities (the first level), recommended information disclosed taking into consideration the correlation of expenses and results related to its preparation (the second level) and additional information (the third level), which may be disclosed or not disclosed in the corporate reporting on a variable basis [83]. Here, the author relies upon the true and fair disclosure concept and the materiality concept, and four effective communication principles in corporate reporting stated in the report of the Financial Reporting Council of Great Britain (named "Louder than Words") [84]:

- focus on the information which is of the most interest for users;
- transparency and honesty;
- clearness and comprehensibility;
- interestingness and attractiveness of information for users.

Among the indicators offered by the author, he describes an expanded amount of information on the corporate patent portfolio and characteristic features of some patents, license agreements, uncertainty risks related to patenting and IP management (which exercise a significant influence on assessment of the item's fair value where it was noticed that many companies may overestimate or underestimate it). The author also emphasises that voluntary disclosure of additional information characterises dynamics of corporate strategic development. Along with this, on the basis of the regression analysis F. Schiemann, K. Richter, T. Günther established the presence of negative relations between the intangible assets information disclosed in accounting (financial) reports and the knowledge capital data disclosed voluntarily. This attests to the fact that such information may be redundant for the concerned parties' decision making [85].

Thus, use of various methods in the disclosure analysis is intended to improve the information quality and select relevant data for further analysis conducted for management purposes as well as to estimate the general level of transparency of public sector entities (Appendix 4).

F. Castilla-Polo and D. Gallardo-Vázquez combined the key goals of disclosure into two groups [8]:

- goals related to accounting (a substantial influence of intangible assets on estimation of the company value, their importance for taking management decisions in the financial field, including the ones related to resource distribution); we would like to add statutory requirements to them;

- goals not related to accounting (anticipated rise in incomes, business value, strengthening of reputation and willingness to satisfy the concerned parties' informational needs on the basis of voluntarily assumed obligations of disclosure).

The authors consider that the factors impeding disclosure are the risk of possible competitiveness loss, lack of necessary expertise, and conservatism. However they think that these are indirect influence factors. Therewith, the direct and most significant influence is exerted by the factors related to the problems of identification, measurement and assessment of IP and intangible assets as well as absence of sufficient theoretical and methodological grounds for disclosure. This is the most serious lacuna in modern researches. Along with that, the authors assume that it is impossible to develop such grounds inductively, on the basis of existing practices. A more profound theoretical research is necessary.

When there are no basic grounds for making decisions on disclosure, virtually the only criterion is the balance between benefit and cost. However, such an approach brings us back to the discussion of effectiveness measurement. Another consequence is the fact that even in the case of taking a decision on disclosure development of the further "disclosure strategy" which defines the content, amount of disclosed data, form of disclosure and other aspects becomes very difficult.

Apart from that, consistency of methodology of disclosure and IP management is of crucial significance. It will allow to improve the information usefulness for taking management decisions. Differentiation and defining these aspects in detail for various economic entities' groups including small business entities, business leaders, non-commercial organisations and public sector entities, are also a necessary precondition for improvement of the information quality and usefulness for various users' groups. The majority of authors define them as a promising vector of research development in the field of disclosure analysis. We presume that only after these important theoretical and methodological objectives are achieved will a justified comparative assessment of the extent of public sector entities' transparency be possible.

Table 1. Analysis fields and methods recommended for use at various stages of the reciprocal model

Stages of the reciprocal model	Analysis field	Recommended analysis methods
Stage 3	Analysis of the amount, dynamics, state, structure and utilisation efficiency of intangible assets	Horizontal analysis, vertical analysis, ratio analysis, factorial analysis, balance method, comparison method etc.
Stage 4	Choice of fields and risk evaluation of the innovation activity, choice of commercialisation ways of IP	Options method, discounting, correlation-regression analysis, simulation modeling, patent analytics tools etc.
Stage 6	Assessment of IP utilisation efficiency against the background of strategic tasks and defining further development pathways	Economic-and-mathematical and econometric methods, stochastic analysis methods, probabilistic method, reflexive analysis, nonlinear dynamics methods etc.

Results Discussion

We tried to solve the above theoretical and methodological problems, and in doing so set forth the principles, conceptual foundations of accounting and analytical support of IP management and develop a reciprocal model of accounting and analysis of IP in the public sector comprising identification and commercialisation of items [11; 12].

The offered model consists of three stages where analytical tools are used:

- stage 3, the final stage of identification;
- stage 4 and 6, respectively, the first and final stage of commercialisation.

So, while performing identification (stage 3) the amount, dynamics, state, structure and use of items is analysed as components of the corporate asset complex identified as a part of intangible assets. At the same time, for performing commercialisation, analysis methods are applied first in order to choose the innovative activity fields and ways of IP commercialisation (stage 4) and, second, in order to assess efficiency of IP utilisation against the background of fulfillment of the strategic tasks of the public sector entities (stage 6).

In this case, the analytical methods considered within our survey research may be systematised in accordance with the stages of the offered reciprocal model of IP accounting and analysis in the public sector (Table 1).

The majority of the methods applicable at the stage 3 to analyse the structure, dynamics, state, flow of intangible assets as well as the extent and efficiency of their use, which are measured on the basis of indicators of turnaround, return and cost-effectiveness of intangible assets as a part of the corporate asset complex was considered primarily by Russian scientists. Analysis methods and tools used at the stage 4 to choose the most promising fields of research and development, innovative activity, and ways of its results' commercialisation, as well as the methods applied at the sixth stage in order to evaluate efficiency of IP utilisation against the background of fulfillment of strategic tasks (and defining further development pathways of a public sector entity) are used mainly in the published papers of foreign scientists and some papers by Russian scientists. In general they require further development. Patent analytics tools have a high potential for solving the tasks at the stage 4.

At the stage 6 one chooses further development pathways in innovations and forecasts a public sector entity's operations under risk and uncertainty. In our opinion, economic-and-mathematical and probabilistic methods may be used to solve these problems. We also offer to expand these methods by applying nonlinear dynamics methods, in particular, the channels and jokers method described by G.G. Malinetskii and A.B. Potapov in the analysis of public sector entities transparency [86]. Prerequisites of this method application consist in the fact that it has proved its efficiency in economic research, in particular, in risk assessment and management [87], macroeconomic processes modeling [88] and modeling of insurance companies' operations [89]. However special attention should be paid to the papers by A.A. Minaev and G.A. Minaev, the founders of the dynamic theory of innovation, who showed the potential of nonlinear dynamics methods in a study of dynamic patent systems [90; 91].

Alongside that, there has been no research dedicated to application of nonlinear dynamics methods in order to determine the development pathways of public sector entities conducted on the basis of analysis of information capacity and information quality established in accounting and disclosed in the reports. This defines the novelty and originality of the offered approach.

The research hypothesis generated from the perspective of the application of nonlinear dynamics methods states that public sector entities' transparency level, and the characteristic features of disclosed information may be used to identify the state of entities as dynamic systems and to define the pathways of their further development. For a theoretical demonstration of the hypothesis, we use the space-time coordinate system (Figure 1) which represents projections of the dynamic economic system (channels G1-G3) and its movements caused by probability laws (jokers J1-J3).

Figure 1. Behaviour of the dynamic economic system in the space-time coordinate system

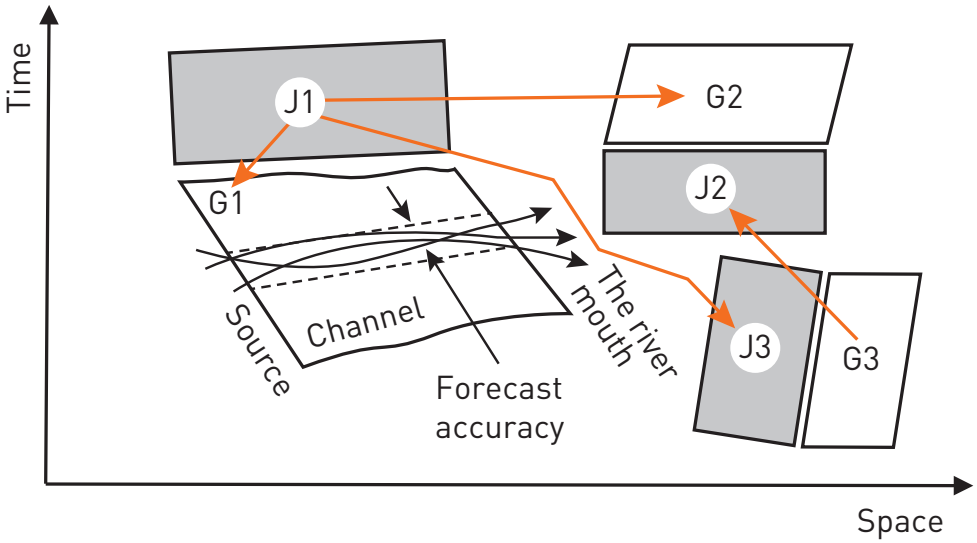

Figure 1 shows that at any given time, a public sector entity, as a dynamic economic system, is at some point of the space-time continuum lying within a certain channel. Therewith the following consistent patterns are observed. When an entity is at the channel source its behaviour and development forecasts are to a great extent determined by statistical laws, and functional dependencies between the activity indicators, mainly financial ones. Under such circumstances the activity may be forecasted on the basis of financial analysis and planning methods, while the level and characteristic features of disclosed information are the minimum required for applying such methods, mainly limited to accounting (financial) reports which comply with legislative requirements to its preparing and submitting.

The entities which disclose a wider range of indicators are searching for the trajectory which ensures sustainable development between the channel source and mouth. Analysis of such indicators (financial and non-financial ones which are disclosed in various forms of accounting and other reports) is conducted using a wide range of methods of factorial analysis, correlation-regression analysis, simulation modeling etc., and allows the concerned parties to take decisions which adjust the entities' movements between various trajectories within a channel. In this case, the level and characteristic features of disclosed information comply not just with the legislation but also with the informational needs of concerned parties.

Finally, the entities which disclose the largest amount of information approach the channel mouth. It is confirmed by an increase in the amount of disclosed "information noise", i.e. the information which is redundant for the justification of decisions by the concerned parties and for forecasting of sustainable development within the channel. Analysis of such redundant information shows contradictory results which just partially meet the criteria specified within the channel. In our opinion, this redundancy occurs where the manifestation of "bifurcation" may be found. It is indicative of the transfer of quantitative changes into qualitative ones as the dynamic system develops.

Thus, measuring of the level and characteristic features of disclosed information allows to identify the approach of the system initially functioning in channel G1 projection to the joker area (J1), where such laws are in effect which may possibly transfer the system to another channel area (for example, G2 or bring it back to channel G1 as illustrated in Figure 1) as well as another joker area (J3). In this case, the stochastic motion will continue till the moment when the system approaches the source of a new channel.

It should also be noted that the application of the channels and jokers method in the IP analysis offers opportunities to establish interrelations between microeconomic factors and macroeconomic conditions of conducting innovative activity. It is of special importance for ensuring sustainable development of public sector entities and achievement of public management objectives in science and innovations.

Summary and Conclusions

In this paper we conducted a survey research comprising 10 previously-published survey papers, 42 special issue materials by foreign authors, and 39 Russian sources dedicated to various management issues as well as accounting issues and IP and intangible assets disclosure issues in order to generalise and systematise the methods applied by the authors. It was established that in the management practices analysis as well as analysis of organisational, behavioural and institutional aspects of intellectual activity, qualitative methods were mainly applied. Interview, questionnaire survey, and case study methods are the most widely used ones. Foreign authors use quantitative methods (mainly regression and correlation analysis) in their research studies, which implies evaluation of innovation activity efficiency and its influence on financial and economic indicators of the public sector entities' operations.

Russian scientists tend to mainly consider economic and financial analysis methods related to assessment of the structure and dynamics of various financial and economic indicators. Factorial and ratio analysis methods were widely used. Some authors offer to apply the options method, reflexive analysis method and expert analysis but in general econometric, mathematical and probability analysis methods are applied substantially less often in Russian scientists' papers. At the same time the Russian scientists' deductive approach contemplating, first of all, development of the most general theoretical and methodological provisions differs significantly from the approach of foreign authors, where methods are developed or modified on the basis of certain research problems. This is the most substantial difference between the Russian and foreign analytical approaches. This crucial difference manifests itself not just in the research logic and results but also in the way they are represented. In the international practice, the most typical way of presenting the results is a scientific paper, while Russian scientists publish the most important research results, including the contents of the developed methods in research monographs and educational editions.

In recent years, increasingly greater attention is paid to the tools of modern patent analytics which have a high potential for solving the problems of defining the key partners and competitors, priority research topics and markets. The corresponding tools are well-developed, and are used by foreign authors. However, broad perspectives are related to the use of the patent analytic tools in combination with economic analysis methods for solving the problems of monetary estimates of IP items, efficiency evaluation of the public sector entities' innovative activity, and other management problems which need an interrelated analysis of patent and economic data. The key technologies which predetermine development of patent analytics were also defined. They comprise artificial intelligence, machine learning, neurolinguistic programming and some related technologies including new visualisation techniques and automated translation technology. Up-to-date Russian research mainly reveals the results of statistical analysis of the patent and license activity while patent analytics in Russia just starts evolving mainly as a part of consulting.

Improvement of the tools of IP analysis in the public sector is closely connected with the opportunities to expand the analysis information base. In this regard generalisation of the disclosure analysis methods was a separate research issue. It was established that content analysis of reports submitted in various formats (statutory financial accounts, voluntary reports on intellectual capital, sustainable development etc.) was most widely used. Also the authors extensively use disclosure indexes, often constructed on the basis of content analysis results. Meanwhile insufficient development of theoretical and methodological grounds for disclosure substantially restricts application of this method, as well as development and use of new tools. First of all it manifests itself as terminological ambiguity of the notions "intellectual property", "intellectual capital", "intangible assets" and some others.

At present the choice of a term often depends on the author's preferences and has no necessary justification. On the one hand, it occludes comprehension of the logic of existing research papers where the same term is used in different senses. On the other hand, within thematic studies and application of the content analysis method this presents problems with choice of key words. We have not used the term "intellectual capital" in this paper as a search query for bibliographic databases because it was established that it has a very wide context of use which comprises, in particular, a wide range of human resource management and reputation management issues which are beyond the topic of our research. The scope of this research was limited to analysis of intellectual activity results protected as IP, and recognised in intangible assets of public sector entities.

It was also established that an increase in the amount and quality of disclosed information is hindered by absence of sufficient theoretical and methodological grounds for disclosure which define the contents, amount of disclosed information, disclosure form and a series of other aspects. This requires further research in this field. Apart from that, consistency of methodology of disclosure and IP management is of crucial significance. It will allow to improve the information usefulness, and benefit those taking management decisions.

We developed and presented a new theoretical and methodological approach to fill in the identified lacunas. The approach comprises the reciprocal model of IP accounting and analysis in the public sector. It systematises the considered analytical methods in accordance with the stages of the offered model. It is also shown that at the final stage, in order to determine the further development pathways of public sector entities, the model provides an opportunity to use nonlinear dynamics and the dynamic theory of innovation methods (patent information).

Finally, further research into various categories of economic entities (in particular public sector entities) are of crucial significance. The majority of authors write about the dearth of such researches. In our review we pay the main attention to universities because in existing research universities are often independent subjects of research. At the same time, the authors of published papers paid substantially less attention to the activities of scientific institutions, state-owned enterprises and corporations, as well as other public sector entities. The absence of a sufficient number of researches focusing on the public sector prevented us from solving to the fullest extent the research problem related to assessment of applicability in the public sector of various analytical methods widely used in the commercial sector. This means that it is necessary to continue to promote further research in this area.

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Appendix 1

Intellectual Property Analysis Methods in Papers by Foreign Authors

Authors	Analysis problems	Analysis approaches and methods	
		Qualitative	Quantitative
J. de Beer, I.P. McCarthy, A. Soliman, E. Treen	Choice of IP crowdsourcing strategy	Case study	-
M. Fernández-Esquinas, H. Pinto, M.P. Yruela, T.S. Pereira	Research and classification of the ways of interaction between commercial companies and universities	Interviewing, data grouping and processing	-
D.J. Jefferson, M. Maida, A. Farkas, M. Alandete-Saez, A.B. Bennett	Comparison of programs for IP management, technology transfer and entrepreneurial activities encouragement of the top American research institutes and universities	Comparative analysis	-
C. Kalantaridis, M. Küttim, M. Govind, C. Sousa	Comparison of institutional conditions which influence technology transfer	Comparative analysis	-
D.M. Weckowska, J. Molas-Gallart, P. Tang, D. Twigg, E. Castro-Martínez, I. Kijenska Dabrowska, D. Libaers	Assessment of influence of different countries' legislation and successful practices on patent and licensing activity of universities	Case study, expert evaluations	Patent analysis
J. Chataway, S. Parks, E. Smith	Contraposition of patenting institutions and scientific results publication in the "closed partnership" and "open science" model	Comparative analysis	-
M. Bikard, K. Vakili, F. Teodoridis	Assessment of efficiency of scientific work of the teams engaged in similar developments and comprising only academic staff with the teams based on collaboration with business	Comparative analysis	Bibliometric, patent, regression analysis
O. Gretsch, F. Tietze, A. Kock	Evaluation of influence of the conditions which define attaching the IP rights and other standard contractual terms on effectiveness of university-business collaboration	Questionnaire survey	Regression analysis, correlation analysis
N. van Stijn, F.J. van Rijnsoever, M. van Veelen	Development of the concept of cooperation between universities and startups, analysis of advantages of using startups for technology transfer	Interviewing, qualitative data systematic analysis (INVIVO)	-

Authors	Analysis problems	Analysis approaches and methods	
		Qualitative	Quantitative
Y. Wu, E.W. Welch, W-L Huang	Study of influence of institutional factors and scientists' human personality characteristics on universities' licensing activity and prospects of commercialisation of patented developments	Questionnaire survey	Descriptive analysis, regression analysis
N. Halilem, N. Amara, J. Olmos-Penuela, M. Mohiuddin	Study of influence of the universities' IP policy (including the issues of choosing legal regimes and distribution of profits from items use) on scientists' invention activity and entrepreneurial behaviour	Questionnaire survey	Regression analysis
S. Öcalan Özel, J. Pénin	Comparative analysis of strategies of licensing of universities' IP	Case study	-
	Justification of the choice of patenting or publishing of scientific results followed by choosing a licensing strategy (exclusive license, non-exclusive license etc.)	-	Game theory methods
T. Mets, A. Kelli, A. Mets, T. Tiimann	Development and approbation of the activity indicators system related to creation and use of IP for assessment of its performance	Interviewing, comparative analysis	Bibliometric, patent analysis
G. Fernandes, E.B. Pinto, M. Araújo, P. Magalhães, R.J. Machado	Development of a method and indicators system for quantitative measurement of performance of joint research projects and programs implemented by universities and business	Case study	Bibliometric analysis
M. Grazzi, C. Piccardo, C. Vergari	Study of the relation between indicators of the amount of intellectual activity and financial indicators which characterise organisations' performance. Study of complementarity and substitutability of patents and trademarks for justification of IP management strategies	-	Econometric (including regression analysis) parameter analysis methods, probabilistic methods
I. Stefan, L. Bengtsson	Study of influence of the extent of readiness to enter into collaborations with various partners' groups on efficiency of the innovation process at different stages	Questionnaire survey	Patent, regression, correlation analysis
S. Veltri, P. Puntillo	Study of use of the indicators which characterise various components of universities' knowledge capital as criteria for evaluation of effectiveness of the managerial staff activity	Case study, interviewing	-
F. Pasimeni, A. Fiorini, A. Georgakaki	Assessment of the amount of innovation activity and R&D expenses for development of strategies in the priority technological fields	-	Patent analysis, mathematical analysis methods
L. Aristodemou, F. Tietze, N. Athanassopoulou, T. Minshall	Study of promising areas of patent analytics development. Development of a technology roadmap in order to facilitate cooperation and coordinated actions in the patent analytics experts' community	Desk study, questionnaire survey, expert methods	-

Authors	Analysis problems	Analysis approaches and methods	
		Qualitative	Quantitative
S.Y. Kim, H.J. Lee	Revealing the factors which define the sources of IP (development and patenting of own engineering solutions or purchase of exclusive rights) and evaluation of influence of patent purchasing deals on further patent activity (on the basis of patents quantity and quality)	-	Patent analysis
A. Abood, D. Feltenberger	Development of a new method for patent landscape design aimed at simplification of the technique of patent information processing and creation of analytic representations	Expert methods	Machine learning
J.A. Smith, Z. Arshad, A. Trippe, G.S. Collins, D.A. Brindley, A.J. Carr	Content analysis and development of recommendations concerning the structure of a patent landscape report	Delphi method	-
C. Odasso, G. Scellato, E. Ughetto	Analysis of influence of patent characteristic features on their market value and revealing the factors which have positive effect (number of quotes, claims of a patent etc.) on the price	-	Econometric analysis methods (including probit regression)
S-H. Chang, C-Y. Fan	Analysis of influence of patent characteristic features (number of backward citations), scope of legal protection, patenting geography) on dynamics of patents value change	-	Time series analysis, modeling
K. Jutimongkonkul	Analysis of practice of applying the income, cost and market-based approach by IP evaluation experts and modeling of the patent evaluation procedure	Interviewing (of experts)	-
L. Tahmooresnejad, C. Beaudry	Study of interdependence between the patent value assessment and characteristic features of a triadic patent family	-	Binomial regression models
M. Grimaldi, L. Cricelli, F. Rogo	Development of a technology audit methodology in order to manage the patent portfolio and develop an IP management strategy on the basis of its reconciliation with the general business strategy of an economic entity	Case study, questionnaire survey, interviewing	Coefficient method

Appendix 2

Areas and Methods of Intangible Assets Analysis in the Russian Scientists' Papers

Authors	Analysis areas	Analysis methods
Bakanov M.I., Sheremet A.D., Saifulin R. S., Mel'nik M.V.	General methodological foundation	Complex economic analysis (role of noncurrent assets analysis in the complex economic analysis system, complex analysis methods)
	Analysis of the amount, dynamics, state and structure of intangible assets	Horizontal analysis which implies calculation of absolute and relative deviations from the permanent and changing base as well as average deviations; vertical analysis in order to assess the structure of intangible assets on the basis of sources, types, usable life expectancy, degree of legal protection, prestige value, liquidity and risk of investing in immaterial goods, disposal locations and extent of utilisation for manufacture and sales
	Analysis of intangible assets utilisation efficiency	Ratio analysis (intangible assets earning power, turn-round, cost-effectiveness); discounting (calculation of economic benefit from use of licenses and know-how); factorial analysis
Savitskaya G.V.	Analysis of intangible assets amount, dynamics, structure	Horizontal analysis, vertical analysis, comparison method
	Analysis of intangible assets utilisation efficiency	Ratio analysis (intangible assets earning power, cost-effectiveness, yield on capital investment), factorial analysis of change income per one rouble of the capital invested in intangible assets
Bulyga R.P.	Analysis of information and intellectual resources, technology and products as well as the client capital of business	Relative indicators analysis (coefficients, indexes including the index of the corporate intellectual potential recognition, novelties turnaround, trademark popularity index)
	Assessment and management of risks of a business based on intellectual capital	Options method (real options, intangible options)
Zhuravleva N.V., Kremer K.I., L'vovich E.M.	Analysis of intangible assets dynamics	Horizontal analysis, absolute values, comparison method, ratio analysis
	Analysis of intangible assets dynamics, structure and evaluation of its change	Vertical analysis, comparison method
	Analysis of yield on capital investment of intangible assets	Relative indicators analysis (coefficients), comparison method, factorial analysis, balance method
	Analysis of intangible assets cost-effectiveness	Relative indicators analysis (coefficients), comparison method, factorial analysis, balance method

Authors	Analysis areas	Analysis methods
Zhuravleva N.V., Kremer K.I., L'vovich E.M.	Analysis of intangible assets liquidity and degree of risk of investing in intangible assets	Building of predicative models, forward financial statements, dynamic analysis models, vertical analysis, discounting, ratio analysis
	Analysis of influence of intangible assets utilisation efficiency on the corporate financial standing	Relative indicators analysis (coefficients), factorial analysis
Endovitskii D.A., Isaenko A.N., Lubkov V.A., Zhuravleva N.V., Korobeinikova L.S. Kretov A.A., Kupryushina O.M., Panina I.V., Rakhmatulina R.R., Silaeva Yu.A.	Analysis of company's needs in intangible assets	Functional analysis, econometric and mathematical methods, stochastic analysis methods
	Assessment of the value (fair) of intangible assets	Relative indicators analysis, ratio analysis, comparison method
	Analysis of composition, structure and flow of intangible assets	Vertical analysis, comparison method, horizontal analysis, absolute values analysis, ratio analysis
	Analysis of legal protection of intangible assets	Vertical analysis, discounting, econometric and mathematical methods, comparison method (with preceding period, with a plan, with industry average indicators)
	Predictive analysis of intangible assets supply and demand	Correlation-regression, predictive, functional analysis, econometric and mathematical methods
	Analysis of intangible assets turnaround and cost-effectiveness	Relative indicators analysis (coefficients), comparison method, factorial analysis, balance method
	Analysis of return on investments in intangible assets and risks related to them	Predicative models construction, drawing up of forward financial statements; dynamic analysis model construction; vertical analysis; discounting; ratio analysis
	Analysis of expenses for maintenance of intangible assets in working order	Forward financial statements, dynamic analysis models, vertical analysis, discounting, ratio analysis, simmple and compound interest method
	Revealing of the stochastic dependence between the amount of intangible assets and various factors which influence the result indicator	Correlation-regression analysis (model of dependence of the intangible assets amount on various values of the financial ratios series)
	Analysis of evident and not evident income from intangible assets utilisation	Relative indicators analysis (coefficients), comparison method, factorial analysis, balance method, calculation of the intangible asset actual efficiency
	Analysis of influence of presence and utilisation efficiency of intangible assets on the company financial standing and its market value	Relative indicators analysis (coefficients), comparison method, factorial analysis, econometric and mathematical methods, simulation modeling, calculation of absolute and average values

Authors	Analysis areas	Analysis methods
Ilysheva N.N., Krylov S.I., Mikhailov O.V.	Integrated managerial analysis of the entity innovative activity	Ratio analysis (analytical indicators of innovation, competitive, marketing, investment analysis, in total 24 ratios); non-formalised (logical) methods (Delphi method, scenario method, psychological methods, morphological methods, comparison methods, construction of analysis schedules); elementary methods of microeconomic analysis (factorial analysis methods, differential analysis, logarithmic analysis, integral analysis); conventional methods of economic statistics (average values method, grouping method, time series processing methods, index method); mathematical and statistical methods (correlation analysis, regression analysis, variance analysis, cluster analysis, time-space population processing methods); decision-making theory methods (case study and forecasting methods, simulation modeling, decision tree derivation method, linear programming, sensitivity analysis); financial computing methods (discounting and increment, cashflow analysis)
	Analysis of reputation (goodwill)	Calculation method of profitability rate of the goodwill created by the company
	Analysis of IP as a factor of earning power regulation	Factorial analysis, correlation and regression analysis
Prokop'eva Yu.V.	Complex analysis of intangible assets utilisation (analysis of the structure, state, flow, investment analysis, integrated assessment of intangible assets utilisation efficiency)	Ratio analysis, factorial analysis (factor model of labour productivity on the basis of return on intangible assets and labour intellectual level, factor model of profit from the amount and rate of return on intangible assets)
Gusev V.B., Guseva N.E., Isaeva N.A.	Analysis of risks, uncertainty, solutions and models of intangible assets management	Reflexive analysis method, expert analysis
	Analysis of influence of intangible assets on synergistic effect of the company operations	Method of synergistic effect evaluation using the equilibrium growth indicator, optimisation methods
Mistyukova I.P., Ryabchenko T.N. and Furmanova N.V.	Analysis of the amount and dynamics of intangible assets	Horizontal analysis, absolute and relative indicators, ratio method
	Analysis of intangible assets structure	Vertical analysis (on the basis of sources, reasons for disposal etc.)
	Analysis of return on and capacity of intangible assets	Ratio method, factorial analysis (of return on intangible assets)
	Analysis of profitability (cost-effectiveness) of intangible assets utilisation	Ratio method, factorial analysis (of individual profitability of each IP item)

Authors	Analysis areas	Analysis methods
Krivitskaya K.V.	Analysis of structure and dynamics of license and franchising agreements	Horizontal analysis of contracts in monetary terms, vertical analysis of concluded contracts according to areas of making the assets available for use, types of the assets made available for use, validity terms of the contracts, ratio analysis (indicators of the rate of concluding contracts of making intangible assets available for use)
	Analysis of income and expenditure from making industrial intangible assets available for use	Discounting (of royalty, punitive damages, service payments and the total income of the rightsholder organisation defined as the sum of income earned as a result of making the assets available for use and the income earned additionally from use in the organisation's own operations)
	Analysis of financial results of making industrial intangible assets available for use	Analysis of absolute indicators of financial results from making industry intangible assets available for use depending on the type of organisation (rightsholder and usufructuary) and the type of use (making available for use, getting for use, utilisation in one's activities and making available for use by third parties); ratio analysis (of cost-effectiveness), revealing reserves for income growth of the rightsholder organisation and licensee organisation
Plaskova N.S., Polyanskaya T.A., Prodanova N.A.	Assessment of effectiveness of the company innovation activity	Qualitative methods, factorial analysis, investment design, assessment of growth reserves of innovation activity expansion
Kuzubov S.A.	Assessment of the synergistic economic effect from patent exploitation	Mathematical apparatus of the game theory, in particular, finding situations of Stackelberg equilibrium in the analysis of a three-dimensional restrictive model of patent protection and defining: – the economic benefit of the patent height which defines the minimum number of new elements which the invention improvement should contain; – the economic benefit of the patent width which defines the maximum permissible number of elements of a patented subject which may be imitated; – the synergistic economic effect of the patent height and width.
	Managerial analysis of intellectual assets	System of relative analytical indicators and indexes of efficiency evaluation of corporate intellectual assets offered for use within the model of nodal structure of intellectual assets management accounting
Balakireva N.M.	Financial analysis of intangible assets utilisation	Comparison method (current data - to similar data of the previous period, current data – to budget and forecast data, current indicators – to their regulatory values, current indicators – to industry average indicators, financial ratios – to non-financial indicators); ratio method; balance method (preparing a comparative analytical balance sheet)

Appendix 3

Objectives and Tools of Patent Analytics at the Macro- and Microlevel

Analysis level	Analysis problems	Patent analytics tools	Sources/authors
Macro	Study and forecasting of scientific and technical development (of an industry, region, country), revealing the top global development centers, owners of the most valuable technology, forecasting of introduction of new technology in the markets	Preparing industry-specific and express patent landscape reports	Guidelines for Preparing Patent Landscape Reports (WIPO) A. Abood, D. Feltenberger, 2018 J.A. Smith, Z. Arshad, A. Trippe, G.S. Collins, D.A. Brindley, A.J. Carr, 2018
	Assessment of the probability of obtaining a protection document for an intellectual product in one or more countries	Patentability assessment	GOST R 15.011-96 L. Aristodemou, F. Tietze, N. Athanassopoulou, T. Minshall, 2017
	Assessment of the probability of use of a technological item in any country in compliance with the exclusive rights in force in its territory to the IP items which belong to third parties	Examination for patent purity	V.V. Shvedova, 2015 L. Aristodemou, F. Tietze, N. Athanassopoulou, T. Minshall, 2017
	Study and cataloguing of modern technology, products and leading companies followed by analysis of the patents protecting the selected products and technology	Patent technology scouting	F. Pasimeni, A. Fiorini, Georgakaki, 2019 S.Y. Kim, H.J. Lee, 2019
Micro	Evaluation of importance/quality of patents, finding engineering solutions which have commercial potential	Technology assessment or technology audit	V.A. Antonets, N.V. Nechaeva, K.A. Khomkin, V.V. Shvedova, 2009 V.V. Kerimov, 2014 M. Grimaldi, L. Cricelli, F. Rogo, 2018 S.Y. Kim, H.J. Lee, 2019
	Monetary estimate of IP items for the purpose of accounting and management	Ratio method taking into consideration patent research results	E.P. Skornyakov, N.M. Tsekhmistrenko, M.E. Gorbunova, 2008 E.P. Skornyakov, M.E. Gorbunova, 2011
		Analysis of influence of patent characteristic features on their monetary estimate	C. Odasso, G. Scellato, E. Ughetto, 2015 S-H. Chang, C-Y. Fan, 2017 L. Tahmooresnejad, C. Beaudry, 2019

Appendix 4

Methods of Transparency Analysis of Public Sector Entities

Authors	Analysis problems	Analysis methods
I.M. Welpe, J. Wollersheim, S. Ringelhan, M. Osterloh	Revealing redundant parameters showing a strong correlation with other variables in order to exclude them	Correlation analysis
	Establishing a mathematical relation between reporting indicators	Regression analysis
	Revealing of hidden variable factors determining presence of linear statistical correlations between the observed variables	Factorial analysis
	Defining the "efficient frontier", estimation of efficiency of the analysed item, its individual structural units, their grading according to efficiency level and forecasting of inefficiency states	Non-parametric and parametric methods of the frontier analysis
	Defining the most probable scenarios of prospective changes of the analysed item, drawing up recommendations for management decision making	Expert system on the basis of fuzzy logic
B. Kamath	Evaluation of the amount of information disclosed in the statutory and voluntary reporting	Content analysis
	Assessment of the relative disclosure level	Disclosure index
	Revealing disclosure determinants	Regression analysis
J. Denoncourt	Systematising of the information disclosed in reports which is mainly of descriptive character according to three levels: essential, desirable and optional	Three-level model of IP and patent strategy disclosure
T. Peters, J. Thiel, C.L. Tucci	Evaluation of the possibility of improvement and use of competitive advantages by means of disclosing information on inventions for efficient strategies development	Case study
P. André, D. Dionysiou, I. Tsalavoutas	Analysis of compliance of the information actually disclosed in reporting with the International Financial Reporting Standards as regards accounting of intangible assets and analysis of interrelation of the disclosure extent and the company market value	Index method, regression analysis
A. Devalle, F. Rizzato, D. Busso	Analysis of compliance of the information actually disclosed in reporting with the International Financial Reporting Standards as regards accounting of intangible assets and analysis of influence of various factors (size, business legal structure, industry sector etc.) on the extent of disclosure	Index method, regression analysis

Authors	Analysis problems	Analysis methods
J.S. Gans, F.E. Murray, S. Stern	Comparative analysis of four strategies of engineering solutions disclosure: secrecy, patenting, scientific paper, combination of patenting and publishing a paper. Development of a theoretical model for the strategy choice justification.	Modeling
A. Maaloul, W.B. Amar, D. Zeghal	Analysis of influence of the extent of intangible assets disclosure (including elements of human, intellectual and relational capital) on analysts' forecasts of the company profitability	Correlation and multivariate regression analysis
F. Schiemann, K. Richter, T. Gunther	Study of the relation between the intangible assets information disclosed in the accounting (financial) reports and voluntarily disclosed information on intellectual capital	Regression analysis
P. Catalfo, I. Wulf	Study of the structure and contents of the Management Comments to the reports prepared in accordance with IFRS in Germany and Italy in order to assess the possibility of satisfying needs of concerned parties in the information which has been disclosed insufficiently in the reports using the data stated in the Management Comments	Semantic analysis, content analysis
S. Fontana, D. Coluccia	Study of influence of various factors on the disclosure level, herewith the value added intellectual coefficient (VAIC) and monetary estimate of intangible assets are considered as the factors	Stakeholder approach, index method, regression analysis, statistical modelling

Corporate Cash Flow Transformation and Payment Space Digitalisation in the Eurasian Economic Union

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Corporate Cash Flow Transformation and Payment Space Digitalisation in the Eurasian Economic Union

Abstract

Modern digital systems in the EEU do not meet the requirements for official methods of transferring funds, and are not appropriate for use in the field of corporate finance. As such, we propose the development of a modified digital system combining the principles and capabilities of traditional and innovative systems based on distributed registry technology. This should promote integration of national payment systems into the financial sphere under conditions of sanction burden, and low trust in the virtual world.

First, we outline the features of corporate cash flows through digital financial assets transfer in a national digital system, and cross-border settlements within a common digital payment space. Next, we describe the possible roles of corporate structures and individuals in payment systems within an EEU common digital payment space. We combine methods of formal logic, historical and comparative analysis, modeling, and graphical interpretation. The study of the digital financial space was carried out on a selection of materials from the Russian Federation, Armenia, Belarus, Kazakhstan, and the Kyrgyz Republic.

Our results illustrate the practical value of a new digital system in reducing the influence of intermediaries, and of integrating systems with different types of information into a common database. In addition, we indicate how the prevailing international digital transfer system will accelerate, simplify and reduce the cost of cash flow procedures for organisations. By leveling the need for an international digital unit, such a system will play an intermediary role. We identify the necessary conversion operations to achieve this.

The scientific novelty of this study resides in the fact that there is no current analogue for the project proposed herein. As such, we present a large scale and straightforward roadmap for an ambitious and adaptive response to digital development opportunities, social evolution, and financial obstacles.

Keywords: cash flow, corporate finance, distributed register; digital system; digital settlements; digital financial assets

JEL classification: G30, O16, O33

Introduction

Nowadays, society is highly dependent on information financial systems. Their regular failures result in losses of funds, reputational damage, instability in financial flows, decline of trust to organisations and national payment systems, and interstate conflicts. Existing closed settlement and payment systems are based on the principle of centralisation and concentrating "power in the hands of a single person" which impedes the reliability, transparency, and independence of operations as well as countering the dollar spread in circumstances of a global recession, financial crisis, or a generally tight geopolitical and economic environment [1–5]. The available information systems are overloaded by the increasing amounts of data to be processed. As a result, significant financial expenditures are necessary to modify these systems, otherwise they fail to ensure a proper quality of rendered services. At the same time, their autonomous functioning complicates and lengthens the relevant cross-functional interaction procedures. Corporate entities increasingly need to develop automation of financial procedures and transform their corporate interactions, which in the long run facilitates reduction of time, labour, financial costs, intermediation of economic entities, the number of repetitive (double) operations, and the paper and electronic workflows. The solution which addresses the requirements imposed by the fourth industrial revolution regarding storage, processing, and transfer of information consists in innovative distributed registry technology (e.g. blockchain), which entered the financial field at lightning speed and is still gaining popularity [6–13]. In previously published papers dedicated to issues of common digital space creation, the authors identified comparative characteristics of the traditional and innovative approaches to arranging settlement and payment systems. These were accompanied by descriptions of operational principles and advantages and disadvantages of each of them[1], a stipulation that it is reasonable to integrate innovative technology into the settlement and payment space (which consists of a positive technological, economic and social effect[2]), and compared versions of the common digital space model, justifying the most reasonable choice[3]. Apparently, it is exactly the capability of digital settlements to satisfy the corporations' needs in the automation of financial procedures which made them popular against the background of no lawful status and legal and regulatory framework. Digital systems did not find legal use either in the national payment system or in the international payment space [14–16]. Different attitudes to the digital financial system of the Eurasian Economic Union members slows down the process of establishment of the common digital space. In this context, it is reasonable to create a common digital settlement and payment system, and to establish an EAEU Interstate Bank (EAEU IB) which will initiate and drive preparation and unification of information exchange formats, creating a new structural architecture and arranging of an extensive implementation of innovative technology at the international and national level.

Model of the EAEU Common Digital Payment Space

Currently, the majority of central banks of the countries which jointly account for 75% of the global population and 90% of economic industry acknowledged the potential of digital settlements which are gaining popularity [17]. The Bank of Russia is no exception. It made a public announcement of the consultation paper "A Digital Ruble" [18], which was the first stage of digitalisation of the settlement and payment field. This document defines controversial issues related to the integration of digital assets into the payment system. The author's position on these issues is outlined in this paper.

Payment space digitalisation requires a unification of different functionalities in order to achieve a transparent 'interdepartmental' interaction and respond to current global challenges. Therefore it is important to note that the digital system modifications we propose are aimed at providing an opportunity for use by corporations and organisations which cash flows are mainly serviced by cashless transfers. In particular, these systems which clearly indicate the roles of legal entities and stages of cash transfer require the attention of corporations and organisations. While credit organisations and government authorities are still considering and investigating the possibility of implementing digital systems, organisations already use them for mutual settlements' procedures, adjusting the technology innovation to requirements of the Russian legislation (S7 Airlines is a specific example).

The development and implementation of the model of the common digital payment space involves the following stages:

- formation of the legislative framework for digital financial assets turnover, which unambiguously determines the concept of their integration and further development;

[1] *Apergis N., Kunitsyna N., Dyudikova E.* The Role of Electronic Money in the Payment System: Evidence from Middle-Income Economies // International Journal of Emerging Trends in Engineering Research. 2020. Vol. 8. No 1. Pp. 67–78.

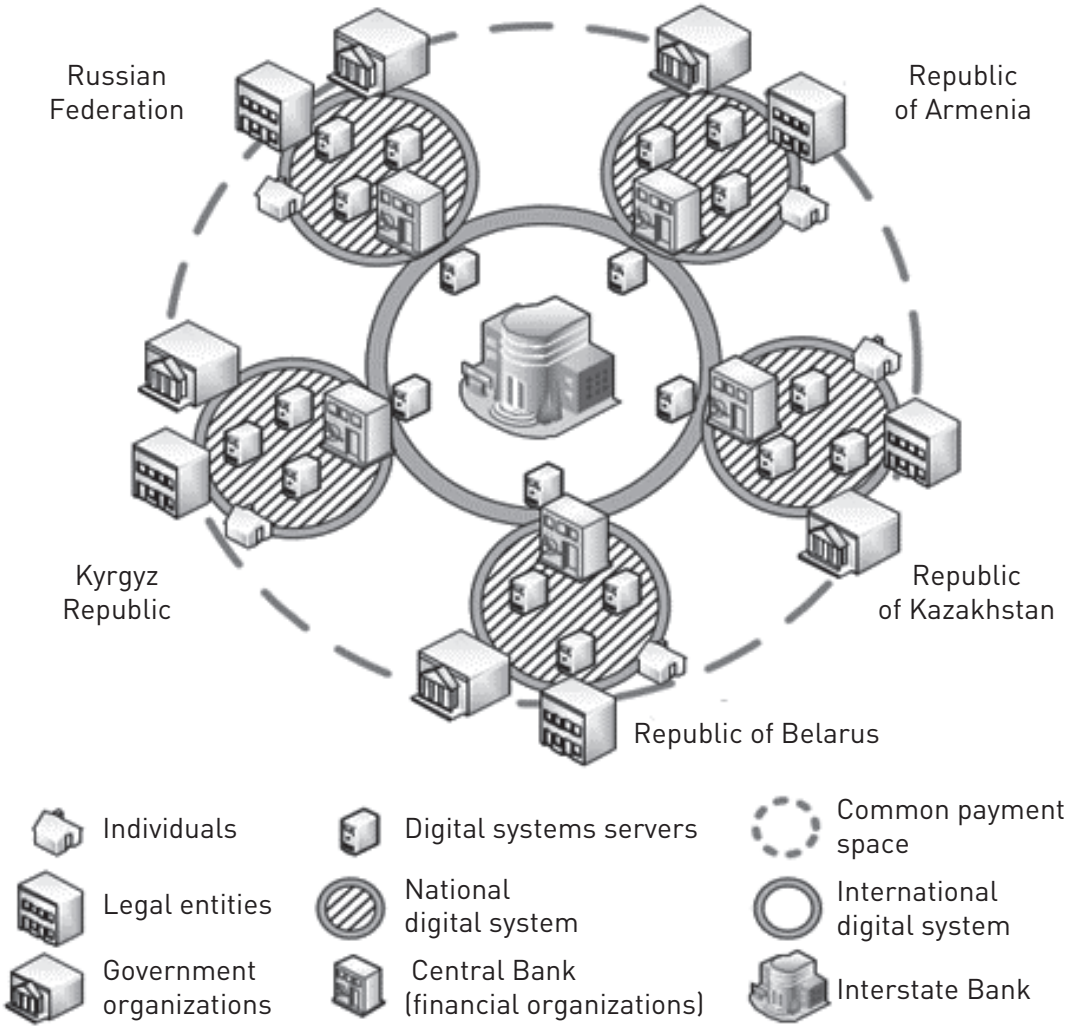
[2] *Kunitsyna N., Dyudikova E.* Prospects of Implementation of Cryptocurrency in the Russian National Payment System // Current Problems of Operation of the Regional Financial Mechanism: Materials of All-Russian Research-to-Practice Conference. Makhachkala: Dagestan State University, 2016. pp. 215–221; *Dyudikova E.* Risks as an Integral Part of Applying Centralized and Decentralized Approaches to Arrangement of Electronic Money Systems // Contemporary Trends in Economics and Management: New Insight: Collection of papers of the XLII International Research-to-Practice Conference. Novosibirsk: publishing house Center of Scientific Cooperation Development, 2016.

[3] *Dyudikova E.* Implementation of Cryptocurrency into the Russian National Payment System // Economics and Management: Problems, Solutions. 2016. No. 9. Vol. 1 (57). Pp. 185–190; *Dyudikova E.* Models of Digital Technology Integration into the International Payment Space // St. Petersburg State Polytechnical University Journal. Economics. 2020. Vol. 13. No. 3. Pp. 187–200.

- defining requirements to a legitimate digital settlement and payment system;
- defining the approach to creating a common digital payment space;
- choosing the model of the national digital settlement and payment system;
- calculation of financial and economic indicators of the national digital settlement and payment system;
- development of organisational and methodological recommendations for interaction between subjects of the national digital settlement and payment system;
- establishment of the national digital settlement and payment system in accordance with the chosen model and its integration into the payment space;
- transformation of the national digital settlement and payment system into a common comprehensive multifunction digital platform;
- calculation of financial and economic indicators of the digital system of international interaction;
- development of organisational and methodic recommendations for interaction of subjects of the digital system of international interaction;
- establishment of the digital system of international interaction in accordance with the chosen approach and model with its further integration into the payment space.

In constructing the model of the common digital payment space of the EAEU, we presume that each member state will establish a common national digital settlement and payment system. The interaction between the countries when making settlements should be performed through the common digital payment space. The EAEU IB will be its operator, which will devise rules for international settlements, and become the supervision and control authority for cross-border settlements (Figure 1).

Figure 1. Structural diagram of the common digital payment space in the EAEU



According to the presented model, the national digital systems and the international digital system are autonomous and interact on the basis of the sidechain technology within the common digital space [19]. National digital systems operate in accordance with the relevant national legislation, and are available for their departmental corporations and organisations in the operations monitoring mode. The model serves to automate the taxation and settlements functions. In its turn, the EAEU Interstate Bank can monitor all financial operations in the international digital system.

Making a distinction between the role of users (corporate entities and individuals) and national and international settlement systems, we defined their functionality and identified cash flow directions. Various proposed modifications of interactions between settlement participants are characterised in the model below. We would like to emphasise that the presented components are considered not as a part of the digital system in the context of its architecture, but from the perspective of modification of operating cryptocurrency systems which allow to eliminate their drawbacks to make them legitimately applicable.

User Roles in the National Digital System

Depending on the user's role in the digital system, users are divided into individuals and legal entities. Various functions and capabilities will be available for them. Individuals performing settlement and payment operations in the system personally, on behalf of third parties, or as an organisation's representative, may be the ultimate users of digital systems. Each of them registers an account in the digital system which allows to go through an identification and authorisation process using a public and private key to enter the personal account. A user with an account can transfer funds through the system, request information on other users, get access to private and public information about other users in the system, and sign smart contracts (SC). Each account is mandatorily inextricably connected with the object (an individual), and if necessary, has additional connections with other objects (e.g. individuals, third parties, corporations, organisations, and government authorities).

The personal account of an individual user contains his/her private data, information on all issued documents, an electronic wallet, and states the resident/non-resident status. This information is placed and stored in the private data register. If necessary, additional entries may be entered in it. Information may be used by means of interdepartmental interactions in order to automate taxation procedures, the granting of social payments, etc. Individuals may make a transfer of digital financial assets (DFAs) between users of the national digital system. As such, the digital system may limit the amount of a transaction, or number and frequency of transfers within a certain period.

Users' accounts are unique and belong to specific individuals. Depending on the roles available to the user, operations may be performed by an individual on his/her behalf or on behalf of a legal entity. Access to management and performance of functions on behalf of an organisation is granted through the role of an officer of such organisation when the organisation is established, or when such person is appointed to his/her position. All information on a legal entity is placed and stored in the legal entities register and is available for interdepartmental interaction.

Financial organisations are granted additional functions such as the routing of financial information between users, rendering financial services, and the recharging and lessening of the balance of users' e-wallets by means of cash lodgments and transfer of funds performed with use of other settlement and payment systems. It should be emphasised that apart from the Bank of Russia, financial organisations cannot issue DFAs in the national digital system. The Bank of Russia is authorised to make the rules of settlement operations.

It is supposed that information in the national digital system is entered by government administrators while they perform their operations. Thus, for example, original registration and information update for individuals is carried out by civil registry offices and the migration service, for legal entities this is done by the tax authorities etc. Functions of the authorised government establishments also comprises monitoring of international funds transfers. As such, supervisory authorities are able to control all incoming and outgoing DFA flows in the national digital system in order to comply with anti-money laundering legislation.

User Roles in the International Digital System

Unlike the national digital system, where accounts are registered for each user, in the international system accounts may be registered only by the EAEU IB and financial organisations' employees authorised to deal with international operations. In this case, mandatory inextricable connections are established with the object (an individual user) and objects (organisations). In the international digital system only utility functions are available for them (e.g. identification and authorisation using a public and private key; adding and changing the rules and terms of DFA settlements; request of information from the national digital system in order to register accounts). The account of an individual user in the international digital system contains only his/her private data, placed and stored in the private data register.

Information on financial organisations which are cross-border settlement participants is entered in the legal entities register of the international digital system. The international digital system provides for the routing of financial information between users in the international space. It also provides for the exchange of public

information between national digital systems on request of financial organisations regarding the correctness and legitimacy oftransaction possibility. The EAEU IB would exclusively perform the function of differentiating access and registration rights' of the end users in the international system.

Digital System Infrastructure Components

We presume that the following objects of the digital platform and its subsystems will be the digital system infrastructure components, inform the digital platform's operation, and arrange the functions necessary for its users: access to the right verification servers, validators, and registration of storage servers. Access to the right verification servers will provide for confirming the possibility of performing operations before they are added to the block on the basis of the rules of access (connection) to the distributed registers of the digital system. Validators will generate transaction blocks and send them to the distributed register after verifying the performed operations for absence of semantic errors and compliance with the terms of transfers (availability of a necessary DFA amount, unblocked status of the account, etc.). Finally, registration of storage servers is intended to add operation entries to the distributed register's structure, such as:

- private data register, intended to store different types of individuals' private information;
- legal entities register, providing storage information on legal entities stated in the Unified State Register of Legal Entities / Unified State Register of Individual Entrepreneurs;
- access rights register, comprising access permissions to the distributed registers' data. The control mechanism of access to the user's personal account provides an opportunity to restore access to the digital system in case of loss of access to the account and to entrust to a third party a complete or partial control on behalf of an individual. Such mechanism confirms the legitimacy of certain operations with data: if entries concerning furnishing of such information have not been cancelled, such an operation is deemed legitimate;
- payment register, which stores information on DFA flows: charging and withdrawal of funds, transmitting between the digital system users (the register comprises smart contracts);
- a register of the data not included in other registers.

The list of registers in the international and national digital systems is similar but limited by the available set of information. Private data comprises information on employees of financial organisations dealing with international operations, and processed corporate data comprises information on financial organisations involved in international operations.

In each EAEU member country the government is responsible for the digital system design and creation expenses. The central bank maintains its operation. At the international level, the capital financial expenditures for implementation of the system are distributed among countries, while the EAEU IB covers operational costs. We propose for the EAEU IB to own 100% of computation capacity (servers). However, in order to ensure the system's territorial independence the servers should be located in EAEU countries pro rata with the estimated amount of operations performed in the international space multiplied by two.

User Logging in the Digital System

The primary account in the national digital system will be the entry made by the central bank of the country, in the international system – that of the EAEU IB. The central bank will establish a department for support of the digital platform whose functions will comprise the registration of accounts (and thus control of access to accounts) of financial and governmental organisations of the country, as well as their first administrators responsible for the registering and the state of accounts of their organisations. Then, on the basis of available data, governmental organisations enter the information into the legal entities and individual registers. Accounts of users of the national digital system, which also provides access to the e-wallet, are registered by financial organisations if there is validated information in the individuals and legal entities registers. If such information is unavailable, requests are sent to corresponding governmental organisations.

It is necessary to establish a department of the EAEU IB for support of the digital platform in the international digital system. Its functions will comprise aggregation of accounts of financial organisations involved in international settlements and the relevant access control.

User Rights and Personal Account Access Control in the Digital System

Depending on their role, users may be assigned different rights. The same user may perform several roles simultaneously (for example, as an individual and an employee). According to the user's role, the system of personal account access control allows for determination of the possibility of certain operations with data and objects of the digital system (Figure 2). When a user is assigned rights, information on the administrator assigning it is indicated. Rights cannot be eliminated from the digital system permanently and tracelessly. In case of change in the rights 'portfolio', a new right is assigned. In order to provide an opportunity to use this function, the objects in the digital system are connected with other objects (for example with a user) via his/her rights portfolio. An account is an object of the digital system, therefore the application of rights

establishes relations between the object of an "account" and a "user". In case of a locking of the "account" object, rights will emerge which deny access to the previously connected "user" object. In this instance the "user" object and all objects connected with it remain intact, and access to them may be granted through a new account.

We assume that rules of use of the distributed register of access rights should comprise the following:

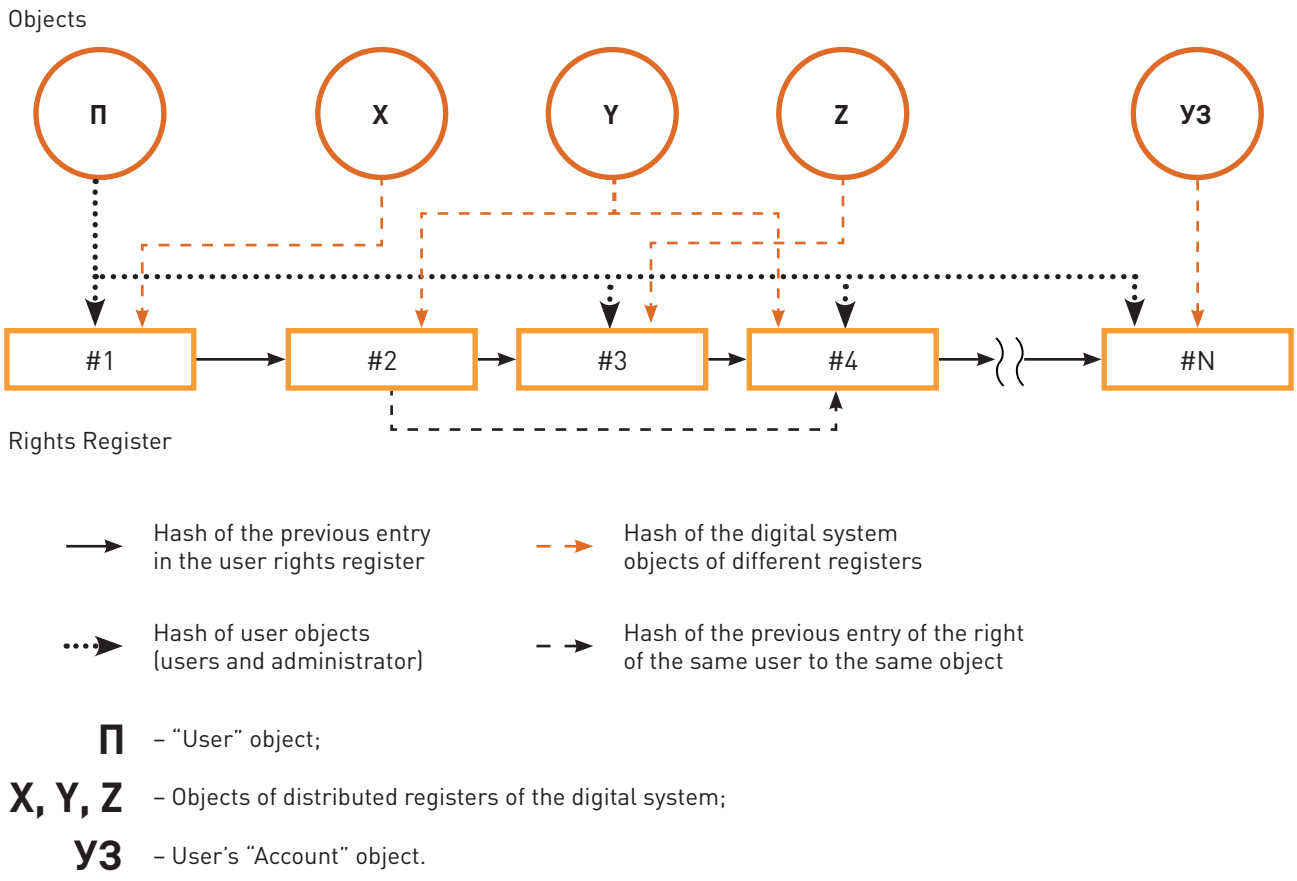
- all rights and their changes are entered into the common register and are added in the order of arrival;
- the right of the same object and user entered into the register later than the previous one prevails;
- all user rights in the system are registered as separate entries indicating a certain right or limitation (prohibition);
- each entry regarding a change of the access right contains a hash (record) of the previous entry of the distributed register, a hash of the previous entry on the right of this user, a hash of the user, and a hash of the administrator which has assigned this right.

Issue and Introduction of Digital Financial Assets

It is supposed that at the national level the issue of DFAs is the responsibility of central banks. DFAs are handed over to financial organisations entitled to operate in this field by transfer from the central bank's e-wallet to the financial organisation's e-wallet. The central bank may perform a continuous online control in the national digital system. Besides this, we would like to note that in this model, national DFAs have the status of a legitimate payment instrument and are identical all through their country, thus complementing the cashless money operations.

DFAs are not issued within the international digital system. DFAs introduced into the international digital system by means of the sidechain technology are indicated in e-wallets of financial organisations. In the international system, DFAs are an accounting unit of national digital financial assets. The EAEU IB has an opportunity to perform continuous online control in the international settlement and payment system.

Figure 2. Personal account access control system[4]



[4] The administrator has the function of creating and changing user accounts, as well as assigning rights to them.

Interaction of the Digital System with Cash and Cashless Money Turnover

There are two ways of introducing money into the national digital system at the ratio of 1:1. One is replenishing e-wallet with cash through a system representative, and the other is a cashless transfer from a bank account in the electronic settlement and payment system to the e-wallet in the digital system.

Money may be withdrawn from the national digital system at the ratio 1:1 only by a transfer from the e-wallet in the digital system to a bank account in the electronic settlement and payment system. After this, encashment is available.

Introduction and withdrawal of traditional payment instruments may be performed only within national digital systems through financial organisations.

In the international digital system, the e-wallet balance may be increased or decreased exclusively by financial organisations participating in international settlements by the use of the sidechain technology. In the international system, financial assets are not kept in the e-wallet. In this case, the e-wallet is intended to register current cross-border transfers because it emerges from the national digital system. In the international segment, the operations are performed automatically.

The exchange rates of national DFAs exchanged for DFAs of the system member states are furnished to the EAEU IB automatically by each central bank of the EAEU at the intervals defined by the charter of the EAEU IB. The EAEU IB consolidates the furnished information and places it into the oracle (an infrastructure algorithm which transfers information from external environment to the digital system [20]) of exchange rates for further use in the digital system. This simplifies the procedure of cross-border settlements due to the automation of direct conversion of national currencies within the international digital system.

In each DFA transfer transaction, its type and description is indicated. The conducted transaction is processed on the basis of this information. Certain requirements may be imposed on transfers in digital systems, for example: maintaining records of the amount of transferred DFA sums, maintaining records of the number of conducted transactions, automatic calculation and transfer of tax payments (at the international level tax payments are not taken into consideration because they are registered and entered in the national digital systems), etc.

Smart Contracts

The innovative technology of digital systems provides an opportunity to enter into smart contracts. These allow for the automation of settlement operations and fulfillment of contracts, including those concluded with legal entities and governmental organisations [21]. In order to transfer DFAs on the basis of a smart contract it is necessary to indicate the terms and type of the deal, transfer description, amount of tax burden etc.

A smart contract is an object with a unique address in the distributed register, and unique input and output parameters. The contract processing description differs from a traditional agreement (as a rule, concluded in hard copy) by the fact that it is entered in the distributed register and has a certain algorithm of automated processing of its terms. It contains a hash of the previous entry in the distributed register and hashes of its parties. The following two basic requirements should be imposed on smart contracts: first, a strict typing of their parameters and results, and second, a strict format of the contract's description. When a smart contract is fulfilled its parameters are processed automatically, its value is distributed between the parties, and transactions are entered in the distributed register of the digital system. It is advisable to add details of which mechanism has been tested to the system contract forms for frequently performed operations. The result should be explicitly guaranteed. In order to mitigate the risks of development of new smart contracts, sandboxes[5] are necessary for modelling and assessment of contracts results.

Apart from the sandbox mechanism, a smart contract designer may be used for making new contracts. It draws them up using standard components which makes them less flexible but allows to analyse the interaction between the standard components included in it.

Transfer of Digital Financial Assets in the National Digital System

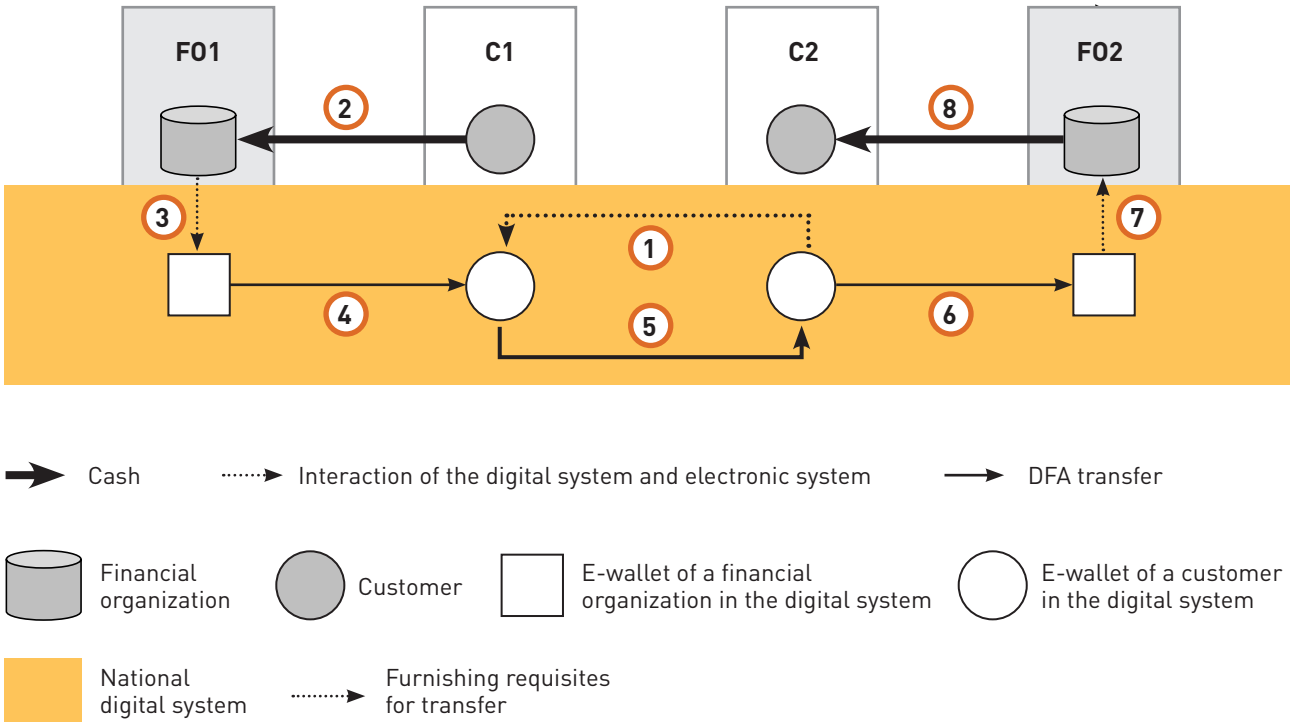
A transmitter and recipient of funds take part in transferring DFAs in the national digital system as well as financial organisations servicing them, where a DFA transmitter and recipient have bank accounts. Figure 3 shows the diagram of funds transfer from Customer 1 (C1) to Customer 2 (C2).

Cross-Border Transfer of DFAs on the basis of a Smart Contract in the International Digital System

In order to make cross-border transfers, e-wallets of the national and international digital system are used. Therefore the EAEU IB takes an indirect part in settlement operations, maintaining the operation of the digital system, establishing rules of its use, providing access to exchange rates in the system, performing control and regulation, and undertaking anti-money laundering and anti-terrorist financing procedures (Figure 4).

[5] Sandbox is an isolated information environment where a smart contract may get access to described data for reading. However, information and transactions stored in it are not transferred to the actual environment of the digital system.

Figure 3. Scheme for replenishing e-wallets, transferring DFAs, and receiving cash from the e-wallet in the national digital system



I. E-wallet replenishment with cash:

1. Customer 2 (C2) informs Customer 1 (C1) of the e-wallet number.

2. Customer 1 (C1) receives cash from Financial Organisation 1 (FO1) in order to replenish its e-wallet in the digital system.

3. Increase of the e-wallet balance of Financial Organisation 1 (FO1) in the digital system in order to replenish the e-wallet of Customer 1 (C1).

4. Transfer of DFA from the e-wallet of Financial Organisation 1 (FO1) to the e-wallet of Customer 1 (C1) in the digital system.

II. Transfer of DFA in the national system from the e-wallet of Customer 1 (C1)to the e-wallet of Customer 2 (C2):

5. Customer 1 (C1) transfers on its own DFA from its e-wallet to the e-wallet of Customer 2 (C2) in the digital system.

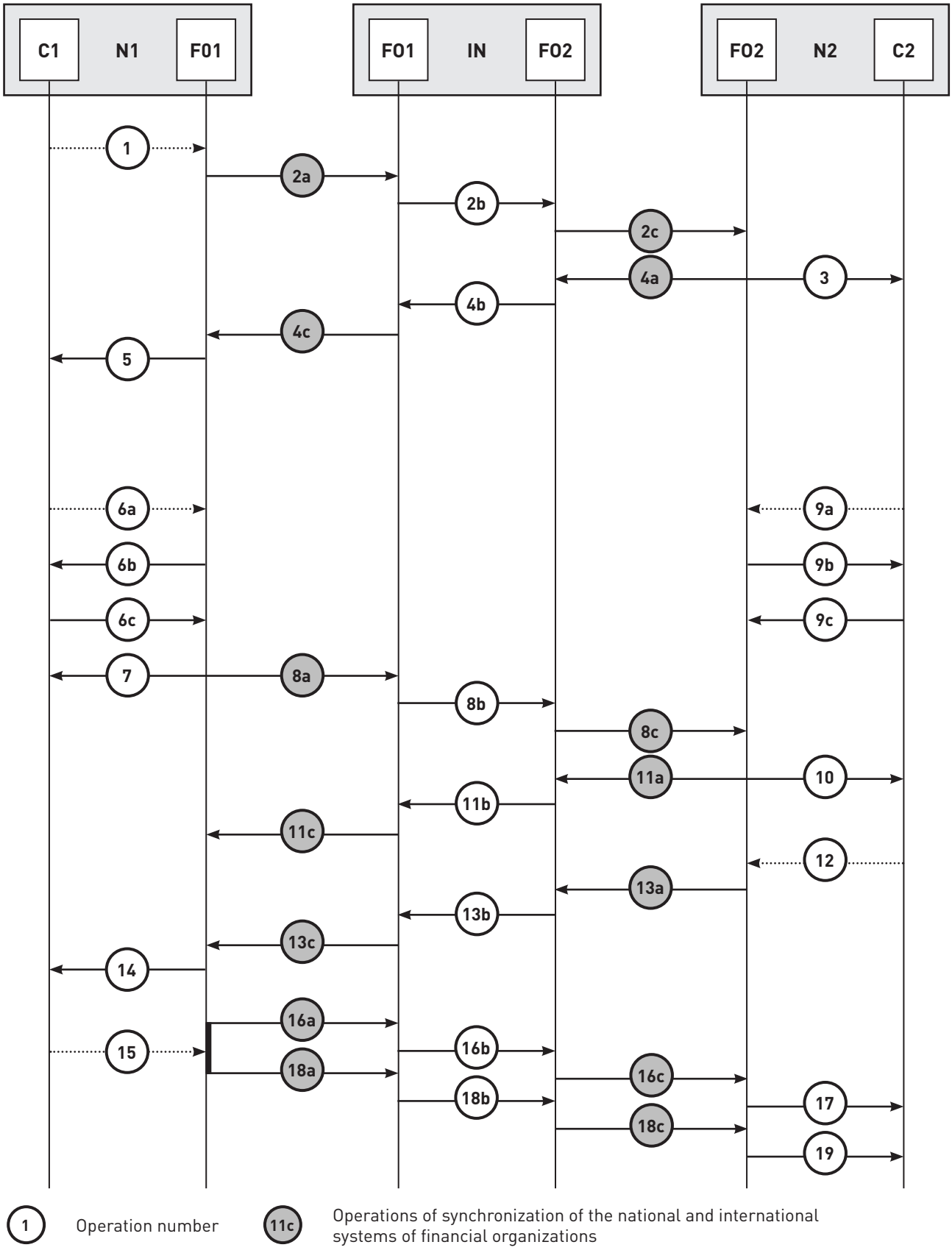
III. Customer 2 (C2) receives cash from its e-wallet:

6. Customer 2 (C2) transfers DFA from its e-wallet to the e-wallet of Financial Organisation 2 (FO2)

7. Financial Organisation 2 (FO2) replenishes the bank account of Customer 2 (C2).

8. Customer 2 (C2) receives cash from its bank account.

Figure 4. Scheme for cross-border transfer of DFAs with smart contracts in the international digital system



I. Conclusion and fulfillment of a smart contract

1. Customer 1 (C1) creates a smart contract (SC) in the national distributed register assigning unique requisites and sends it to the Financial Organisation (FO1) which services it for sending to Customer 2 (C2).

2. FO1 requests confirmation of correctness of C2's requisites with whom SC has been concluded and sends the address and requisites of SC to the servicing financial organisation (FO2):

2a. transmission of the request through the sidechain technology from the personal account of FO1 in the national digital system to its personal account in the national digital system;

2b. transmission of the request in the international digital system from FO1 to FO2;

2c. transmission of the request through the sidechain technology from the personal account of FO2 in the international digital system to its personal account in the international digital system.

3. FO2 transmits the address and unique requisites of SC in the national digital system.

4. FO2 confirms correctness of requisites of C2:

4a. transmission of the confirmation through the sidechain technology from the personal account of FO2 in the national digital system to its personal account in the international digital system;

4b. transmission of the confirmation in the international digital system from FO2 to FO1 servicing C1 with whom SC is concluded;

4c. transmission of the confirmation through the sidechain technology from the personal account of FO1 in the international digital system to its personal account in the national digital system.

5. FO1 transmits to C1 in the international digital system a confirmation of correctness of requisites of C2.

6. C1 signs the created SC:

6a. C1 requests signing of the created SC in its national digital system;

6b. DFA adequacy in the e-wallet of C1 for freezing the SC value is verified in the national system;

6c. availability of funds in the e-wallet of C1 is confirmed and SC is signed automatically.

7. In the national digital system the SC value is frozen in the e-wallet of C1.

8. FO1 transmits information on freezing the SC value to FO2:

8a. transmission of information through the sidechain technology from the personal account of FO1 in the national digital system to its personal account in the international digital system;

8b. transmission of information in the international digital system from FO1 to FO2;

8c. transmission of information through the sidechain technology from the personal account of FO2 in the international digital system to its personal account in the national digital system.

9. C2 signs the SC created by C1 on the basis of the requisites transmitted to it:

9a. C2 requests signing of the created SC in its national digital system;

9b. DFA adequacy in the e-wallet of C2 is verified in the national system for freezing the SC collateral value;

9c. availability of funds in the e-wallet of C2 is confirmed and SC is signed automatically.

10. The SC collateral value is frozen in the e-wallet of C2 in the national digital system.

11. FO2 transmits information on freezing the SC collateral value to FO1:

11a. transmission of information through the sidechain technology from the personal account of FO2 in the national digital system to its personal account in the international digital system;

11b. transmission of information in the international digital system from FO2 to FO1;

11c. transmission of information through the sidechain technology from the personal account of FO1 in the international digital system to its personal account in the national digital system.

12. Entry of information in the national digital system by C2 on fulfillment of the SC terms for its transmitting to C1.

13. FO2 transmits to FO1 information on fulfillment of SC terms by C2:

13a. transmission of information through the sidechain technology from the personal account of FO2 in the national digital system to its personal account in the international digital system;

13b. transmission of information in the international digital system from FO2 to FO1;

13c. transmission of information through the sidechain technology from the personal account of FO1 in the international digital system to its personal account in the national digital system.

14. FO1 transmits to C1 information on SC fulfillment by C2 in the national digital system.

15. C1 confirms acceptance of the results of SC fulfillment by C2, then the SC value is transferred automatically to the electronic account of FO1 for transfer to C2.

16. Acceptance by C1 of the results of SC fulfillment initiates release of the SC collateral value of C2:

16a. transmission of a communication on release of the SC collateral through the sidechain technology from the personal account of FO1 in the national digital system to its personal account in the international digital system;

16b. transmission of a communication on release of the SC collateral in the international digital system from FO1 to FO2;

16c. transmission of a communication on release of the SC collateral through the sidechain technology from the personal account of FO2 in the international digital system to its personal account in the national digital system.

17. Return of SC collateral to the e-wallet of C2.

II. DFA cross-border transfer

18. DFA transfer as a payment under SC from C1 to C2 whose e-wallets are registered in different national digital systems:

18a. after receipt of the SC value at the electronic account of FO1 as a result of step 15 the SC value is transferred automatically from the e-wallet of FO1 in the national digital system to its e-wallet in the international system;

18b. the SC value is transferred automatically in the international digital system from the e-wallet of FO1 to the e-wallet of FO2 and is converted at the exchange rate established in the system by EAEU IB (when SC is created one of its compulsory terms is to indicate the applied DFA exchange rate at the time of the cross-border transfer);

18c. transfer of the SC value from the e-wallet of FO2 in the international digital system to its e-wallet in the national digital system;

19. Crediting of the received SC value to the e-wallet of C2.

The e-wallet in the international system is replenished from the e-wallet in the national system of the corresponding country by means of the sidechain technology at a ratio of 1:1. When DFA are transferred between the e-wallets of financial organisations of different countries in the international system directly, the national DFA are automatically converted at the established exchange rate. It is advisable to provide additional analytical instruments and detection measures for anti-money laundering and anti-terrorist financing operations at this stage of the technological process of furnishing information on DFA flows. Additionally, it is necessary to stipulate the possibility of DFA freezing or distrainment and notification about the actions performed with dubious assets of financial organisations, central banks, and financial intelligence units of the countries of both the funds transmitter and the recipient.

Conclusion

Globalisation and integration processes face rigorous challenges, which accounts for the preference of corporate entities and population for innovative technologies. Digital systems are an objective necessity under this current reality. As such, they require prompt actions aimed at modification, legitimation and integration into the existing settlement and payment field in order to satisfy the needs of funds transfer participants. Consequently, this has a significant impact on the competitiveness of organisations, national payment systems, the financial security of countries, the independence of countries in the international context, and the strengthening of cross-border cooperation. In order to provide for financial safety and provide development against the stagnation of the global economy, as well as to cushion the negative consequences of restrictive measures related to the pandemic and a highly-charged political environment across the globe, EAEU member states have to create a common digital payment space. Implementation of the offered model will enhance the quality of financial systems operating on the basis of the principles of independence, reliability, transparency and imputability, accelerate financial turnover, and simplify cash flows and accounting procedure in the corporate sector.

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