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An Empirical Study of Unsystematic Risk Factors in the Capital Asset Pricing Model: the Case of Russian Forestry Sector

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A B S T R A C T

Objective: The objective of this paper is to consider the Capital Asset Pricing Model, to determine its most disputable points, to identify concepts defining and supplementing the points of the model. The article ends with an example of calculation of the cost of equity for a company of a forestry sector of Russia.

Research Design & Methods: Two levels of study were used: theoretical and empirical. The theoretical level of research was based on interrogation, measurement, observation, experiment. The experimental part of the study has been performed by calculating models for three options of implementing the investment projects and the assessment of the total impact of reducing non-systematic risks for the Russian forestry sector.

Findings: The practical application of the research is the development of tools to assess the non-systematic risks arising during the project implementation in the forest-based sector of Russia, which enables to assess those risks for logging and sawmill woodworking enterprises.

Implications & Recommendations: The research provides the ability to assess non-systematic risks and determines the viability of risk mitigation for both initiators of investment projects and existing investors.

Contribution & Value Added: The originality of the research is based on the assessment of the effects of non-systematic risks on investment projects in the forestry sector in Russia.

Article type: research paper

Keywords: asset's rate of return; risks and riskiness of investments; market portfolio; unsystematic risk factors; forestry sector

JEL codes: D24

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INTRODUCTION

Russia currently produces only 2.3% of the world's timber and its share of the timber trade is only 2.8%, despite being the country with the fourth largest timber reserves (Forest Products …, 2010; UNECE, 2011).

With an annual increment of 800 million m^3 and an allowable logging volume of about 540 million m^3, the usage of forest capacity is about 20%. This unfavourable trend has an impact on domestic politics: the forest industry accounts for approximately 3.8% of total production and about 4% of all foreign industrial currency revenue. This figure is four times higher in countries with a developed forest industry (Forest Products …, 2013; Production, consumption…, 2010).

The main reason for this situation is the high level of depreciation of equipment, the industry's uncompetitiveness, caused primarily by a lack of investment in modernization, and the underdevelopment of some areas of country's forestry sector. In spite of a pre- and post-crisis world market growth for forest products (which has already begun), which should have stimulated the development of the Russian forestry sector, the situation is rapidly deteriorating.

The choice of an appropriate model for the estimation of the cost of equity in emerging markets is still a very challenging problem. Market inefficiency, limited opportunities for diversification, as well as liquidity issues inspire researches to look for risk characteristics beyond the traditional framework of the classical capital asset pricing model. Various models have been developed over the past several decades proposing new ways of risk assessment. However, the empirical evidence of these models requires careful consideration.

The objective of this paper is to consider the Capital Asset Pricing Model (CAPM), to determine its most disputable points, to identify concepts defining and supplementing the points of the model. It is the presence of non-system (specific) risks inherent in the logging industry which complicate the decision-making process for investing in the most promising projects. This process could be simplified by the Government, if it assumed certain obligations to reduce those risks for the industry, particularly through the implementation of integrated logging and wood-processing projects. At the same time, the cost of risk reduction should equate to the promotion of the Russian forestry sector's and the individual federal districts' development.

Two levels of research were used in the article: theoretical and empirical. The general scientific research methods (i.e. sets of regulatory principles and rules of research activity) that we applied were: surveying, measurement, observation, and use of experiments.

The experimental part of the research was done by calculating the models for three options of investment project implementation (logging, sawmilling and woodworking, and joint production), on the basis of standard materials currently used in the forestry sector, based on research studies with regard to market prices (the date of research: January 2012).

The practical significance of this work is to develop the tools to assess the non-systematic risks when implementing projects in the Russian forestry sector, making it possible to assess the risks to logging enterprises and sawmilling and woodworking

enterprises. This work provides the opportunity to assess non-systematic risks and the need for their reduction by the authorities and initiators of investment projects in the Russian forestry sector.

The methodology of the study includes the following steps:

1. analysis of the state of the Russian forestry sector by means of the SWOT analysis with the overview to evaluating the non-systematic risk,
2. determination of the approach to the non-systematic risk assessment while executing investment projects in the forestry sector (it is the Warren Miller method that binds non-systematic risks with the SWOT analysis),
3. composition formation of the main risks of implementation of investment projects in the Russian forestry sector,
4. survey of experts and representatives of the Russian forestry sector with an assessment of the main risks of investment project implementation in the Russian forestry sector,
5. project evaluation in the current circumstances by taking into account the reduction in the non-systematic risks,
6. determination of the economic cost advantages of reduced non-systematic risks while implementing investment projects in the Russian forestry sector.

In the practical part, the author has developed a set of tools to assess the unsystematic risks arising upon implementation of the projects in the Russian forestry sector, which enabled to perform assessment of these risks for logging, sawmilling and wood conversion enterprises. The conducted work made it possible to assess the unsystematic risks and reasonability of mitigation thereof by state authorities and initiators of the investment projects in the course of their implementation in Russia.

LITERATURE REVIEW

A classic capital asset pricing model (CAPM) is regarded as a theoretic basis of a number of different pricing methods widely applied in the investment practice. The model considers a limiting case based on the following assumptions of a normative approach to investing (Brigham & Gapenski, 1997; Sharpe *et al.*, 1999):

- investors evaluate investment projects by looking at the expected returns and their standard deviations for the right to hold,
- investors are never satiated: when given a choice between two projects, all other things equal, they will choose the one with higher expected return,
- investors are risk averse: when given a choice between two projects, all other things equal, they will choose the one with the lower standard deviation,
- individual assets are infinitely divisible; an investor can buy a fraction of a share, if he or she desires so,
- there is a risk-free interest rate at which an investor may either lend (that is invest) or borrow money, and this risk-free rate is the same for all investors,
- taxes and transaction costs are irrelevant,
- all investors have the same investment period,
- information is freely and instantly available to all investors,

– investors have homogeneous expectations that is they identically assess the expected returns, standard deviations, and covariances of return on investments.

All investors have the same information and equally assess the prospects for the projects, thereby they uniformly analyse the information received. Investment markets are perfect ones, and there are no factors which impede investing. Such approach enables to switch the focus of consideration from the question, how investor should invest his or her money to the question, what will happen to an investment project return, if all investors follow the same pattern. By studying collective behaviour of all investors in the market, one can identify the nature of ultimate equilibrium dependence between risk and return of each investment project.

The relation between the risk and the return of an investment project can be presented in the CAPM in a graphic form (Figure 1). Point *M* represents an investment project, and r_f is a risk-free rate of return. Efficient projects lie on the line crossing the axis of ordinates in the point with coordinates (0, *r*) and passing through *M*, and are formed by alternative combinations of risk and return obtained through the combination of investment project with risk-free borrowings or loans. This CAPM linear effective set is known as a Capital Market Line (CML). The CML expresses the balance relationship between expected return and average squared deviation for efficient investments. All other projects will lie below the CML, though some of them may also be in close proximity to it at the same time.

The slope of the CML is equal to the difference between the expected return of investment project and that of a risk-free security:

$$\left(\overline{r_M} - r_f\right) \tag{1}$$

divided by the difference of their risks:

$$\left(\sigma_M - 0\right), \text{ or } \left(\left(\overline{r_M} - r_f\right) / \sigma_M\right) \tag{2}$$

Therefore, the investment market equilibrium may be characterised by two key values. The first one is a point of crossing of the CML with a vertical axis (i.e. a risk-free rate), which is also referred to as the compensation for waiting. The second value is the CML slope which is referred to as the compensation for a unit of assumed risk. In essence, the investment market enables to trade time and risk at prices determined by demand and supply, and, thus, these two values can be interpreted as prices of time and risk.

At the same time, many researchers conclude that CAPM has several drawbacks. Assumptions of a normal distribution of returns and market efficiency do not apply to emerging market stock price fluctuations. These drawbacks led to various modifications of the model.

A number of empirical studies of the 1970s proved CAPM advantages in forecasting return. The works of Scholes and Fama can be attributed as classic works (Fama & MacBeth, 1973; Scholes & Williams, 1977). However, critique of the model started almost immediately after the first publications.

The works of Richard Roll (1971) focus on problems related to determination of a market portfolio. In practice, the market portfolio is replaced by a maximum diversified portfolio which is not only available to an investor in the market, but is also analysable (in particular, stock index). The problem of dealing with such portfolio lies in the fact that choice thereof can significantly influence the results of calculations (for example, beta value).

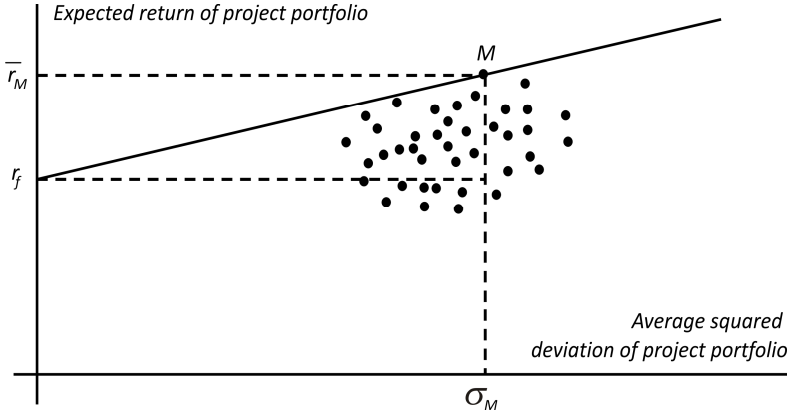

Figure 1. Capital Market Line
Source: (Sharpe *et al*., 1999, p. 245).

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The works of R. Levy (1971), M. Blume (1971) and Scholes & Williams (1977) also draw attention to the beta coefficient which is traditionally evaluated by means of linear regression, based on retrospective data using an ordinary least square method. According to the analysis results, R. Levy concluded that for any share its beta is not stable in time and, therefore, cannot constitute a precise assessment of future risk. However, beta of portfolio consisting even of 10 accidentally chosen shares is quite stable, and, thus, can be considered as an applicable measure of portfolio risk. Thereby, M. Blume's studies (Blume, 1971) showed that with lapse of time the portfolio's

beta approaches one, and company's internal risk nears industry average or market average risk.

An alternative solution of the problem of the CAPM parameters sustainability are evaluations obtained in the derivative market, when expectations as to prices on capital assets are taken as a basis. Such approach realises the Market-Derived Capital Pricing Model.

One more area of criticism concerns time intervals for calculation of the CAPM parameters (an investment horizon problem). Since in most cases the model is used to analyse investments for a term over one year, calculations on the basis of annual evaluations become dependent on environment in the capital market. If the capital market is efficient (future return is not predetermined by past dynamics, share prices are characterised by accidental movement), the investment horizon is irrelevant and calculations based on annual indicators become feasible. If the capital market cannot be considered efficient, the investment term should be taken into account.

The question about significance of only systematic risk factors has also been raised. It was empirically proved that unsystematic variables, such as market capitalisation or price/profit ratio, have impact on the required return.

The studies of the 80-90s of 20th century showed that the CAPM's beta cannot explain industry differences in return, while size and other characteristics of a company are capable to do so.

Korkmaz *et al*. (2010) used a different approach. They developed a model with the embedded Markov process, switching between two different modes depending on the volatility of regression residuals. The model with the embedded Markov process takes into account the market reaction to economic shocks. The evaluation of the performance of the model showed that it has greater explanatory power than the standard CAPM supporting the hypothesis of beta changing over time. Korkmaz *et al*. (2010) concluded that the CAPM underestimates the systematic risk during periods of high volatility and overestimates it during the periods of low volatility.

Another subject to criticism is related to behaviour of investors that rely not on a speculative, but pure risk. Here, investors are ready to invest in assets featuring excess of asset return over an average level. And vice versa, investors negatively perceive assets with negative volatility. Variance is a function of deviation of the average both towards share price rise, and towards decrease. Therefore, based on the variance calculation, a share characterized by variability towards price increase is considered as a risky asset to the same extent as a share price of which fluctuates towards decrease. Empirical studies prove (Miller, 1996) that investor behaviour is motivated by lack of tendency to unilateral negative risk, as contrasted to general risk (or variance).

Expected return variance is quite a disputable measure of risk, at least, for two reasons: variance is a plausible measure of risk only for assets expected return of which has symmetrical distribution; variance can be directly used only when symmetrical distribution is normal.

One more critical area is connected with prerequisites about probabilistic distribution of prices and returns of securities. As the practice shows, simultaneous fulfilment of the requirements on symmetry and normality of distribution of expected share return is not reached. This problem is solved by use of not classic (bilateral)

variance, but semi-variance. Such solution is justified by the following arguments: use of semivariance is justified upon various distributions of share return: both symmetrical and unsymmetrical; semivariance contains information given by two characteristics of the distribution function: variance and skewness coefficient which enables to utilise one-factor model to evaluate the asset expected return.

As many researchers note, a number of specific problems of the CAPM application is intrinsic to the developing capital markets (in particular, Russia). Here it is very difficult to justify the model's parameters (risk-free return, market risk premium, beta coefficient) based on the data of the local capital market, due to the lack of information efficiency and low liquidity of traded assets.

In 1999, two more opposite points of view at the developing markets were considered. Under the first one, the level of integration into the global capital market (or presence of barriers in capital flow) shall determine choice of the model to justify the cost of equity (De Swaan, 2003). An alternative view is presented in the works of Rouwenhorst (1999). The author came to a conclusion that in terms of the factors there is no influence of the difference between the developed and developing markets. The factors explaining return on equity, which appeared to be significant in the developed markets, are also material in the developing ones.

In her study Daryl Collins (2006) tested different measures of risk for 42 developing countries: systematic (beta), general (standard deviation), individual, unilateral (unilateral deviation, unilateral beta and cost of risk) risks, and market size (determined subject to average capitalization of country), skewness and kurtosis indicators. The test was conducted using an econometric approach (as in the majority of similar works) from the perspective of an investor over a 5-year time interval (from January 1996 to June 2001) by weekly returns. Depending on the size of capital market, liquidity and development level, the initial sample of 42 countries was divided into three groups: the first level included countries with big capital market (for example, Brazil, RSA, China), and with small market but it is being economically and informationally developed; the second level comprised smaller developing markets (Russia), the third level included small markets (such as Latvia, Estonia, Kenya, Lithuania, Slovakia and others).

Foong and Goh (2010) tested several risk measures in order to determine the best model for estimating the cost of equity based on the data from Malaysia covering the period of 2000-2007. Foong and Goh (2010) estimated the regressions and then ranked the risk measures according to their explanatory power. They concluded that their results support the implications of Estrada (Estrada, 2007) regarding the advantage of downside risk measures over symmetric ones.

Galagedera and Brooks (2007; Galagedera, 2009) considered data from 27 emerging markets for the period of 1987-1994 and examined the validity of CAPM versions. They developed a new risk measure of co-skewness and named it downside gamma. The authors concluded that downside gamma may be a more appropriate for the explanation of returns than downside beta.

Bali *et al*. (2009) considered the intertemporal aspect of the mean-semi variance behaviour concept. They examined the relationship between expected returns and downside risk, using value at risk (VAR) as a proxy for downside risk. The authors used the data from the US market, i.e. monthly returns of NYSE/AMEX/NASDAQ; NYSE/AMEX;

NYSE; NASDAQ indices for the period of 1962-2005. A positive and significant relationship between expected returns and downside risk was confirmed. Moreover, VAR outperformed variance and conditional variance risk measures. The authors discovered that as long as VAR accounted for stock returns with high explanatory power, the other measures of downside risk also performed well.

According to the received research results, for some markets beta values turned out to be smaller than was expected, which gives false signal about existence of low risk for investors. The conclusion of the work was that it is improper to apply beta (and, consequently, the CAPM) for the entirety of the developing countries. Thereby, D. Collins and M. Abrahamson (2006) argue that there is no unified risk indicator suitable for any developing state.

The CAPM contemplates that the aggregate risk for a particular project can be divided into several elements:

- β-coefficient determining change of price on company's shares, as compared to change of prices on shares of all companies in the market,
- risk of investment in a company of particular size,
- country risk,
- risk of investment in a particular project.

β-coefficient is connected with the market risk; for projects with high β-coefficients value of the market risk higher, but the expected return is also higher. Other risks are non-market and are not related to beta. Growth of these risks does not entail growth of the excepted return and, therefore, investors are not remunerated upon growth of these risks, though they have to bear them in any case (Sharpe *et al.*, 1999).

An important peculiarity is also the fact that all risks, except for the last one, are systematic. These risks arise out of the structure of markets and their dynamics; all agents in the market face the disturbances caused by such risks and uncertainty as a result of them; these disturbances can occur as a consequence of state policy, international economic forces or calamities. These risks are studied by major investment agencies, and information on them is transparent and is always updated.

But there is also a risk of investment in particular business which, in essence, is not systematic. It is not connected with development of markets, in general, and may be determined only on the basis of a professional judgment with identification and evaluation of factors determining feasibility of a particular investment project in strictly given conditions. Thereby, there are several approaches to the assessment of unsystematic risks (Karamehmedovic, 2012; Robert, 2010):

- Black/Green approach,
- Gary Trugman approach,
- Warren Miller approach.

Parnell Black and Robert Green suggested six categories for choice and evaluation of factors determining the unsystematic risk level: competition, financial stability, professionalism in management, return on and stability of investments, national economic effects, and local economic effects (Karamehmedovic, 2012).

Gary Trugman (2012) divided the factors into three main categories. The first category includes risk factors: economic, operational, assessment, market, regulatory,

business, financial, commodity, technological, legal risks. The second category concerns non-financial factors: economic environment, business location, professionalism in management, barriers to market entry, production conditions, competition, and management quality. The third category comprises factors related to a particular company: economic conditions, business location, professionalism in management, barriers to market entry, production conditions, competition, management quality, and aggregate result (Trugman, 2012).

Warren Miller proposed the structure of competitive advantages in conjunction with strategic analysis. Thereby, he suggested arranging the factors into groups within three main categories and connecting them with SWOT analysis. Warren Miller noted that the unsystematic risk analysis should be conducted downwards and start at the wide macroeconomic level and go down to the industry level and then to the level of a particular company (Miller, 2010).

Economic, political, international, demographic, technological and social and cultural factors were referred to the macroeconomic category. The factors determining development of industry, market environment, market competition (M. Porter's model of five forces of competition) were attributed by Warren Miller to the industry category. The level of a particular company included specific factors determining development of a particular business in particular conditions and reflecting conditions of conducting business and level of company management.

More or less, all factors have impact on feasibility of a certain project, and if the project implementation conditions are favourable, influence of these factors is insignificant, and, therefore, the project implementation risks are also low. It is attractive both for investors (mitigation of risk of non-return/partial/untimely return of investments), and for project initiators (opportunity to receive cheaper money for a project). But if the factors affect the project implementation very adversely, it has impact on increase of riskiness of investments and, thus, cost of money.

It is also material that the risk of investment into a particular project is, firstly, non-market one and its increase/decrease does not result in respective increase/decrease of the expected return for investor, and, secondly, shall each time be calculated separately by an expert way upon project implementation (or change of conditions of its implementation). In essence, this risk is only an obstacle increasing cost of money for a project and shall be reduced on account of special programmes supporting business development in particular economic environment. To a great extent, such improvement depends on state and municipal administration bodies, general economic conditions.

MATERIAL AND METHODS

Research Methods

Assessment of the unsystematic risk was conducted based on the methodology of Warren Miller who suggested examining the structure of the factors influencing the investment risks in conjunction with the SWOT analysis (Robert, 2010).

The key factors effecting the risk of investment into the domestic forestry sector were identified on the basis of the performed SWOT analysis. The factors were included in a questionnaire which became the basis for questioning representatives of forest

industry companies engaged in forest exploitation and wood conversion. 42 respondents were questioned, who assessed impact of the factors constraining investment processes in the forest industry of the country by an expert way on a 10-point scale (from 1 to 10). Representatives of logging, sawmilling, wood conversion industry predominantly from the north-west part of Russia participated in the survey. A body of data was prepared on the basis of the survey, which was tested using statistical tools for the possibility to utilise such data in further research.

Research Framework

From that point, we constructed three experimental models of the projects most characteristic of the current developmental phase of the Russian forestry sector, formulating two financial models for each: the first model typified the "status quo," and the second was built in due consideration of the nullification of factors to the absolute minimum. As a result of comparing and contrasting these models, we arrived at a sound estimate of the overall economic effect of the lowering of non-systematic risk under the implementation of various projects in the Russian forestry sector.

Statistical evaluation is conducted for the purposes of identifying the attributes contained in the benchmark data that could be included in further investigations, and encompasses:

- check of the statistical grouping for uniformity,
- study of attribute variation,
- check of the actual distribution of attribute values for proximity to normal.

The survey found the following: the greatest variation across all production operations is characteristic of the indicator: Risk of price increases for raw inputs and materials. The highest level of uncertainty is characteristic of the indicator: Infrastructure risk, with the lowest level of uncertainty characteristic of the indicator: Risk of intensifying competition. The greatest variance for all production enterprises is intrinsic to Risk of rise of prices on raw and other materials. The highest level of uncertainty is inherent in Infrastructure risk, and the lowest level in Increased competition risk. According to the survey results, the main deterrent of the investment activity in the industry is insufficient level of infrastructure development (as a rule, these are roads for logging enterprises and power infrastructure to processing enterprises). At the same time high potential of markets for possibility of modernisation, extension of existing capacities and creation new ones is recognised.

Let us consider a practical example of equity cost modelling for companies of forestry sector. The main reasons of low investment attractiveness of forestry business in Russia lie in three areas: market environment, legal and regulatory framework and resource provision. As a rule, experts state two main problems related to the market environment: lack of confidence in improvement of general economic situation, growth of competition in the forest product market.

The biggest group of questions arises in the area of resource provision; here, it comes to instability of prices on raw and other materials, personnel problems (both highly-skilled management staff, and operators of sophisticated industrial complexes), dependence on key counterparties (first of all, it concerns power, binders for wood conversion, maintenance and repairs of machinery), unavailable credit resources,

problems connected with infrastructure development. Some problems related to infrastructure (for example, connection of industrial sites to power, heating and gas supply systems) are attributed to the sphere of legal and regulatory framework; since forest resources are owned by the state, the problems of improvement of forest legislation receive special attention upon consideration of low investment attractiveness of the Russian forestry sector. And since the forest resources are of natural origin, for many and, foremost, logging companies issues related to occurrence of unforeseen natural and emergency human-caused situations are highly important.

The Russian forestry sector is a complex of logging enterprises (including forestry), sawmilling enterprises, woodworking enterprises (mechanical wood-processing) and timber-processing enterprises (chemical timber-processing). Each group of enterprises produces a homogeneous product. The extent and form of processing these forestry sector products can be classified as follows (Figure 2):

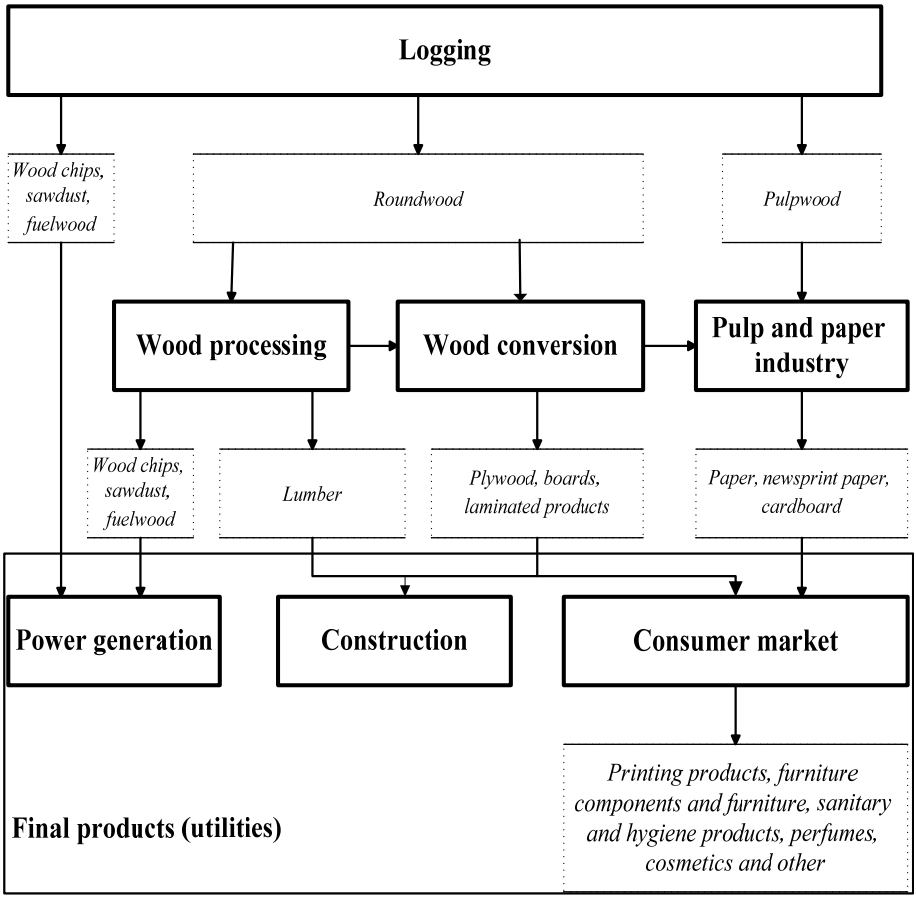

Figure 2. Structure of the Russian forestry sector
Source: own elaboration.

The SWOT analysis of the Russian forestry sector is brought in the section "Results". In terms of the SWOT analysis, the researchers exposed the main factors influencing the investment risks in the Russian forestry sector.

RESULTS AND DISCUSSION

SWOT Analysis

As many experts maintain, in the long term, with a significant increase in investment activity, the Russian forestry sector would be able to provide not only for the domestic market but also the international market. However, we should take into account not only the status of the Russian forest industry in the global market for forest products, but also the opportunities and threats which may arise through this global market. The best way to show the state of the Russian forestry sector is to carry out the SWOT analysis (see Tables 1-4).

Table 1. SWOT analysis of the pulp and paper industry in Russia

STRENGTHS	WEAKNESSES
◦ Large regional markets. ◦ Self-sufficiency of the own raw material base. ◦ Availability of relatively cheap raw materials, fuel and labour. ◦ Qualified staff and management at existing production works. ◦ The ability to develop and introduce new products. ◦ The ability to attract investment.	◦ Absence of national policies, concepts and a mechanism to develop the industry as a whole. ◦ Tendency to over-regulation and establishing prohibitions. ◦ The need for technical retooling, low technical level of production. ◦ Underutilization of capacity of the industry. ◦ Strongly pronounced raw-material orientation for the exports. ◦ The need for extensive investment. ◦ High wear of fixed assets. ◦ Limited range of exported products of the industry because of their poor quality. ◦ Significant capital intensity.
OPPORTUNITIES	**THREATS**
◦ Steady demand in the domestic and world market for the products of the industry as a whole. ◦ Large capacity of a high-quality product market. ◦ Limited number of countries with their own raw material resources. ◦ Extension and modernization of existing facilities. ◦ Increased and improved use of wood. ◦ Consolidation. ◦ Establishment of import substitution production works. ◦ Construction of new integrated enterprises in highly forested regions of the country.	◦ Rise in the cost of fuel, energy and transport. ◦ Increase in remoteness of the raw wood. ◦ Leakage of investment into new industries and macro-regions. ◦ New requirements of environmental authorities and less stringent standards in competitive countries. ◦ Decline in pulp prices.

Source: own elaboration.

The "availability of relatively cheap raw materials" factor is fundamental and it forms the basis for the strengths of the sector at present. However, the threats should have included not only the rise in the cost of fuel and energy, but also, as a consequence, the inevitable future rise in the cost of raw materials. Increase in production costs at a low investment level in the reconstruction and development of new facilities is a major problem for the industry's future development. In the future, this situation will result in

reducing the profitability of export operations, even if exports increase in value terms. From that point, we constructed three experimental models of the projects most characteristic of the current developmental phase of the Russian forestry sector, formulating two financial models for each: the first model typified the "status quo," and the second was built in due consideration of the nullification of factors to the absolute minimum. As a result of comparing and contrasting these models, we arrived at a sound estimate of the overall economic effect of the lowering of non-systematic risk under the implementation of various projects in the Russian forestry sector.

Table 2. SWOT analysis of logging industry in Russia

STRENGTHS	WEAKNESSES
◦ Low fees for forest resources. ◦ Government support in terms of rent reduction and obtaining forest resources. ◦ Availability of large timber resource bases for the organization of large enterprises in a limited area.	◦ Weak structure of the forestry sector, consisting mostly of small producers. ◦ Low level of technological equipment in production facilities. ◦ Seasonality of production. ◦ Low profitability associated with difficulties in selling softwood timber, process feedstock and fuelwood. ◦ The need for greater investment in transport infrastructure. ◦ Lack of investment in plantation enterprises for growing targeted assortments.
OPPORTUNITIES	**THREATS**
◦ Development of technologies for processing wood and logging waste makes it possible to involve higher volumes of raw wood. ◦ Raising environmental consciousness of consumers results in growth of demand for wood products.	◦ Change in customs duties for exporting roundwood. ◦ The ongoing modernization of forestry relations. ◦ Reduction in raw material markets.

Source: own elaboration.

Table 3. SWOT analysis of sawmilling industry in Russia

STRENGTHS	WEAKNESSES
◦ Low costs associated with basic items: roundwood, heat and labour resources. ◦ Experience in processing larch (the main forest resource in Russia). ◦ State support of investment projects, especially in the advanced processing of wood.	◦ Weak structure of the forestry sector, mostly consisting of small producers equipped with outdated machinery. ◦ Poor quality of products. ◦ Low profitability in case of producing rough lumber only. ◦ The need for a significant decoupling stock to ensure the smooth production flow. ◦ The need to build an internal market for forest products (especially when new product is developed).
OPPORTUNITIES	**THREATS**
◦ Growing Asian markets. ◦ Increasing popularity of wood housing with a high market potential. ◦ Government programs for housing development. ◦ Growing furniture markets with a high potential.	◦ Steady increase in transportation rates and fuel and energy rates. ◦ The tendency for replacing lumber and mouldings with products of metal, plastic, ceramic and other materials.

Source: own elaboration.

Table 4. SWOT analysis of woodworking industry in Russia

STRENGTHS	WEAKNESSES
◦ Growing domestic market. ◦ Low costs associated with basic items: roundwood, heat and labour resources. ◦ Abundance of cheap pulpwood – the main raw material for the production of wood boards. ◦ High entry barriers (primarily due to the high investment expenditures).	◦ The high level of wear of the core process equipment. ◦ The need for a significant decoupling stock to ensure the smooth production flow. ◦ Lack of Russian companies producing up-to-date binding materials. ◦ The need to build an internal market for forest products (especially for new products).
OPPORTUNITIES	**THREATS**
◦ With the increasing demand in the domestic market, some boards are not produced (OSB, fibreboard insulation, etc). ◦ Growing Asian markets. ◦ Increasing popularity of wood housing with a high market potential. ◦ Government programs for housing development. ◦ Growing furniture markets with a high potential.	◦ Steady increase in transportations and fuel and energy costs. ◦ Construction and development of modern wood board production facilities in the neighbouring countries (Latvia, Belarus and China).

Source: own elaboration.

The composition of the key risks leading to decrease of the investment attractiveness of the country's forestry sector is presented in Table 5.

Table 5. Composition and description of risks based on questioning results

Statistical indicator	Risk of deterioration of general economic situation	Increased competition risk	Regulatory risk	Risk of emergency situations	Risk of rise of prices on raw and other materials	Risk of management staff	Dependence on key counterparties	Infrastructure risk	Capital availability risk	Deficit of skilled personnel at operational stage
minimum	2	1	2	3	1	1	1	3	4	3
maximum	6	4	7	7	7	6	3	10	8	9
mean	3.52	1.86	4.48	4.40	2.67	3.64	1.36	6.93	5.19	5.43
standard deviation	0.93	0.74	1.30	0.98	1.28	1.47	0.53	2.23	1.07	1.48
coefficient of variation (in %)	26	40	29	22	48	40	39	32	21	27

Source: own study.

The greatest variation across all production operations is characteristic of the indicator: Risk of price increases for raw inputs and materials. The highest level of uncertainty is characteristic of the indicator: Infrastructure risk, with the lowest level of uncertainty characteristic of the indicator: Risk of intensifying competition.

The greatest coefficient of variation for all production enterprises is intrinsic to Risk of rise of prices on raw and other materials. According to the survey results, the main deterrent of the investment activity in the industry is insufficient level of infrastructure development (as a rule, these are roads for logging enterprises and power infrastructure to processing enterprises). At the same time high potential of markets for possibility of modernisation, extension of existing capacities and creation of new ones is recognised.

To further assess the impact of risks and to develop a set of measures to minimize this impact, three most typical forest enterprise models were prepared within the framework of this article to simulate their activities and evaluate their performance.

The summarized indicators of organized production operations are presented in Table 6.

Table 6. Main characteristics of implemented projects

Indicator	Logging and forestry	Milling (mechanical)	Wholesale manufacture
Logging volume, m³ K/year	300	-	300
Milling volume, m³ K/year	-	300	300
Investments, RUB K	450 000	1 800 000	2 150 000
Annual earnings, RUB K	384 000	1 061 000	1 445 000
Annual operating costs, RUB K	234 000	504 000	705 000
EBITDA/Sales (in %)	39	52	51
Financing structure:			
- in-house funds, RUB K	200 000	900 000	1 075 000
- borrowed funds, RUB K	200 000	900 000	1 075 000
Loan cost (in %)	12.5	12.5	12.5

Source: own study.

Findings

In order to determine the rate of return on equity, a capital asset pricing model is applied.

A discounting rate (rate of return) of equity (R_e) is calculated according to the following formula:

$$R_e = r_f + \beta \cdot (r_m - r_f) + s_1 + s_2 + c \quad (3)$$

where:

r_f – is a risk-free rate of return (taken at the rate of coupon of Eurobonds (Russia), 2030),

β – is a coefficient determining change of price on company's shares, as compared to change of prices on shares of all companies in the market (taken under quotations of Stora Enso Oyj (STERV.HE) (Helsinki Stock Exchange)),

$(r_m - r_f)$ – market risk premium,

r_m – average market rates of return in the stock market (RTS index (RTSI) taken),

s_1 – additional rate of return for risk of investment into a particular company (unsystematic risks),

s_2 – additional rate of return for risk of investment into medium-sized company (taken under 2010 Ibbotson SBBI Valuation Yearbook);

c – additional rate of return considering country risk (as of January 2012).

Calculation of the cost of equity is presented in Table 7.

Table 7. Calculation of cost of equity

Indicator	Symbol	Logging and forestry	Wood conversion (mechanical)	Complex production enterprises
Return on risk-free investments (in %)	r_f	7.50	7.50	7.50
Market risk premium (in %)	$r_m - r_f$	10.83	10.83	10.83
Average market rate of return (in %)	r_m	18.33	18.33	18.33
Beta coefficient	β	0.8	0.8	0.8
Additional rate of return for risk of investment into a particular company (in %)	s_1	3.74	3.70	4.23
Additional rate of return for risk of investment into small company (in %)	s_2	3.95	3.95	3.95
Additional rate of return considering country risk (in %)	c	2.25	2.25	2.25
Rate of return on equity (in %)	R_e	26.10	26.06	26.59

Source: own study.

Therefore, the cost of equity is approximately the same for all three projects and is quite high for the projects of this type (over 26%). Attractiveness of these projects for an investor is low. At the same time the cost of equity may be reduced (and attractiveness of the projects increased) in case of reduction of the unsystematic risks occurring upon implementation of the investment projects in the Russian forestry sector.

To assess the effectiveness of each project, financial economic models of its implementation were prepared. In accordance with the terms of implementation, key implementation efficiency indicators were obtained (discounted payback period, NPV, and IRR). As the result, with the reduction of non-systematic implementation risks, the economic effect will be 5.5 to 7.3% of the project cost. The greatest effect has been seen with complex projects, and this is obvious, since there is a reduction of non-systematic risks, not only in the logging, but also in the processing of wood.

By extending the simulated projects for the entire Russian forestry sector, we obtain a sufficiently high benefit (Table 8).

Thus, with state support for the Russian forestry sector, the net effect of non-systematic risk reduction for the logging industry can reach 10.5 billion roubles, for mechanical wood processing enterprises (in this example: sawmilling and woodworking) – 16.7 billion roubles, for complex enterprises for logging and mechanical wood processing (in this example: logging, sawmilling and woodworking) – 22.8 billion roubles. These amounts represent the maximum amount of state support in terms of reducing non-systematic risks in the implementation of projects in the forestry sector for the

production areas specified. Therefore, the state should first reduce the infrastructure risks and the capital availability risk, improve the situation in the field of forestry education, make the forestry legislation more consistent (including the establishment and conduct of a proper forestry policy), as well as mitigate the risks of a rise in prices for services by natural monopolies.

Table 8. Benefits of non-systematic risk reduction for the Russian forestry sector

Indicator	Unit	Logging and forest management	Wood processing (mechanical)	Integrated production facilities
Volume of wood processing at the facilities that require modernization	m^3 K /year	103 800	49 360	43 360
Effect of non-systematic risk reduction per 1 m^3 of logged and processed raw materials	RUB/m^3	101.3	338.2	527.0
Net effect of non-systematic risk reduction	K RUB	10 514 940	16 693 552	22 850 720

Source: own study.

It should be noted that similar risks and opportunities to reduce them are typical for other woodworking production facilities (producers of plywood, wood boards and laminated products), and, importantly, for chemical wood processing facilities (in particular this applies to pulp and paper production works). For these fields of production the effect of reducing the non-systematic risks will be much higher due to the higher capital intensity of these production works and the more serious risks assumed by the investor in the implementation of such projects.

It should be noted, that since the non-systematic risks in one way or another are common to all investment projects of all sectors of the country's economy, reducing these risks (in relation to a particular industry) will have a positive impact on the investment attractiveness of these projects and will strengthen the position of the Russian Federation in the global financial and economic space.

CONCLUSIONS

1. The decision formulation about investing is determined by the correlation of value-project profitability and risks run by the investor while investing in a particular business, in a particular company. These risks are laid the calculation of the discount rate and, as a rule, are reflected in the CAPM model as a part of additional returns for the risk investment in a specific company.
2. The required rate of return is based on the risk assessment of the company's investors, and it is one of the key parameters in estimating its value. Despite the wide application of the required rate of return, the choice of the best method for assessing the cost of equity capital in emerging markets still raises many questions that researchers want to answer. The fact is that developing capital markets are characterized by additional risks that affect the dynamics of the required return on equity.
3. Most researchers have concluded that the CAPM has a number of drawbacks, particularly when used in developing capital markets. This has led to the emergence

of various modifications of the model. There are ways to define the cost on equity that are not based on the CAPM. The researchers got conflicting results while testing models in emerging markets.

4. In an empirical study, the choice of the model of assessing costs of capital is determined by the requirements of accuracy and clarity. The classic design of the model of CAPM gives the prediction based exclusively on market risk premiums and as a specific risk. For more accuracy, it is necessary to use modifications of the classic model of CAPM.
5. The main reasons for low investment attractiveness of the forestry business in Russia lie in three areas: market conditions, regulatory affairs and resourcing. Generally, two major problems – lack of confidence in the improvement of the general economic situation, increased competition in the market for timber products – are linked to the issues related to market conditions.
6. The unsystematic risks are determined by the structure of market and its dynamics, but are intrinsic only to some agents in the market and can be identified on the basis of a professional judgment with identification and assessment of the factors defining these risks in strictly limited conditions. The majority of these risks are characteristic of virtually all enterprises of Russia's forestry sector. At the same time, there is only one difference: between the significance of each risk in specific conditions, as well as for each company and investor.
7. According to the research, the weighted average cost of capital is approximately the same for the most common models of forest enterprises (logging, sawmilling and woodworking, and joint production), and it is high enough for this type of projects. The attractiveness of such projects for investors is low. At the same time, the cost of capital can be reduced whereas the attractiveness of projects can be increased while reducing the non-systematic risks, arising during the implementation of investment projects in the forestry sector of Russia.
8. The net effect of non-systematic risk reduction for the forestry sector was estimated; for the logging industry it was 10.5 billion roubles, for mechanical wood processing enterprises (in this example – sawmilling and wood-working) – 16.7 billion roubles, for complex enterprises for logging and mechanical wood processing (in this example - logging, sawmilling and woodworking) - 22.8 billion roubles. These amounts show the maximum amount of state support in terms of reducing non-systematic risks in the implementation of projects in the forestry sector for the production areas specified.
9. For individual fields of the woodworking industry (e.g. plywood, boards, pulp and paper industries), the effect of reduced unsystematic risk will be much higher due to a higher capital intensity of production data and more serious risks which an investor assumes in such projects.
10. It should be noted that, since all investment projects are characteristic of non-systematic risks in one way or another in all sectors of the economy, the reduction in these risks (applicable to a particular industry) will have a positive impact on the investment attractiveness of these projects and the industry in general. To assess risks and identify mitigation opportunities, this research methodology, developed

by the author, will be useful. Moreover, it can be applied to any sector of the Russian economy.

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