V. LIVCHITS, S. LIVCHITS, N.TROFIMOVA

Evaluating Efficiency of Industrial Innovations [1] in Russia

1. Introduction

The target of this article is to regard methods of evaluating efficiency of industrial innovations in Russia and peculiarities connected with transitional character of its economy in particular.

Along with it a term of "industrial innovations", as it is usually assumed in Russia [1-6] will be treated rather widely and will include (as applied to any industries and regions) the following components:

1) creating new products (equipment, machines, materials, consumer goods and others) and their supply to the market;
2) applying new industrial resources or materials in production;
3) using new and more effective technologies in production;
4) improving methods of production organisation and management;
5) new methods of ecological preservation and diminishing harmful anthropogenous influence to environment.

Naturally, some innovations can be of complex character, i.e. be oriented to achieving commercial and social, ecological and economic aims simultaneously.

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[1] In writing this article I.Bocharova, S.Klimenko, T.Titshenko took part.

As a rule, innovations (irrespective of their purposefulness) demand industrial investments, rather significant sometimes. Therefore, the expediency of their realisation should be thoroughly tested - in essence, the question is about evaluating efficiency of corresponding investment projects concerning development and realisation of the considered innovations.

In most cases (and Russia isn't an exclusion) innovations are directed to:

a) Achieving commercial effects through creating a new product or through improving quality and cutting costs and prices of producing the products already existed and known, thus increasing the volume of sales and profits, as a result of gaining the largest part of the market;
b) More effective solving socio-economic problems (improving ecological conditions in the region, achieving a higher level of safety of production and transportation, declining a level of unemployment and some others).

Solving these problems in Russia has got a lot of peculiarities connected with the country specific features and the character of social and economic processes taking place in it.

As it will be shown below, to a high degree they are of non-stationary character and this demands a significant transformation of the methods of evaluating efficiency of innovations that are quite successfully used in the countries with stationary market economy. Most attention will be paid just to these specific features and methods of their reflection and calculating.

2. Specific features of Russia and its economy

First let's consider the country. Russia is the largest (as to the territory) country in the world, capable to satisfy almost fully its demand in nearly all kinds of industrial raw materials at the expense of its huge natural resources. The population of the country is relatively highly educated, possesses high professional skills and distinctive collectivistic mentality that is still influenced by the previous period of time when three generations of people lived without any private property and real market relations. Labour productivity and wages are relatively low, level of unemployment, criminalisation and social tension in the country is high; process of reforming centrally planned economic system into the market one has been going on over 10 years. This process has been especially intensified since 1992 - during a period of radical economic reforms, when price liberalisation and "opening" of the economy from the view point of foreign economic relations, and then "voucher" privatisation was carried out. As a result, the country turned out to be in a serious social and economic crisis.

Its character and depth can be judged by the values of macro indices related to 1991-1998 and covering the most important economic, social and financial indices of the Russia "health". They are given in Table below [7-8].

Even a fleeting glance at this data makes it clear that the way of the economy reformation adopted in Russia has conduced to catastrophic results - in the course of almost a decade economic decline is being observed: GDP, industrial and agricultural production volumes, reduced 2 times, industrial investments – more than 5 times. Real population incomes and wages have been cut in half during this time, consumer prices have increased far more than 10000 times, unemployment has appeared and is going on to grow, more than a quarter of population has 'slipped' below the level of poverty and so on.

Transitional period, certainly, has got not only negative features - among the positive ones there are successes in the country democratisation, liquidation of queues and deficit in goods, emergence of different kinds of property that are usually stressed and it's quite correct. But to the opinion of most Russian economists (as well as many foreign ones, including many Nobel prize-winners [9]) social and economic balance of the reforms in Russia is still negative and construction of a developed market economy in Russia is out of question yet.

Economic stabilisation, including the financial one (though radical reforms will be 10 years old soon), that was being much talked about during the first half of the previous year hasn't come true either. The events of August 1998 (which were conditioned, after all, not only and not so much by the tactical mistakes of S.Kirienko's government of "young reformators", but, first of all, by the policy of internal and external borrowing conducted by the Russian governments in 1992-1997; "life in credit" based on financial pyramids) again revived significant inflation, and badly slowed down investment flows into the Russian economy, including those ones aimed at innovations.

There is no doubt that August default in 1998 resulted in a great increase of foreign exchange rate gave a certain chance to domestic producers, of export products in particular, and in 1999 some economic growth can be observed. It's not clear however whether it is a limited echo of the above mentioned default or the beginning of a real and stable growth of Russian economy (as the RF Ministry of Economy considers, forecasting the GDP growth by 1,5% in 2000 by 5% and even more some time later).

Table 1. Main economic indicators

Indicators	1991	1992	1993	1994	1995	1996	1997	1998
Gross Domestic Product, -trln.rubles(non-denom.)	1,4	19,0	171,5	610,7	1585,0	2200,2	2585,9	2684,5
- % to 1990	95,0	81,2	74,1	64,7	62,1	59,9	60,4	57,5
Industrial products - % to 1990	92	75	65	51	50	48	49	46
Agricultural products - % to 1990	95,5	86,5	82,7	72,7	66,9	63,5	64,3	54
Fixed capital investments - % to 1990	85	51	45	34	31	25	24	21,9
Foreign investments, bln.$		1,6	1,3	1,07	2,8	6,5	9,68	1,51
Accumulated foreign investments, bln.$		1,6	2,9	3,97	6,77	13,27	22,95	24,46
Real incomes of population: - % to 1990	116	60,9	70,9	80	67,9	67,5	69,8	57,1
Number of people with income below minimum cost of living, %		33,5	31,5	22,4	24,8	22	20,8	23,8
Real wages, US dollars		22	57	90,8	103	157	163	180,6
Economically active population, mln.persons		75,7	75,0	74,0	72,9	73,0	72,8	72,1
Number of unemployed, mln.persons(according to ILO methodology)		3,6	4,2	5,5	6,4	7,0	7,8	8,5
Federal budget deficit,		4,8	9,9	9,8	3,1	3,6	3,3	3,2
% of GDP		13,8	9,4	10,4	2,9	3,3	3,2	3,6
Index of consumer prices (inflation) - to the previous year, times	2,6	26,1	9,4	3,1	2,3	1,22	1,1	1,84
- to 1990, times	2,6	67,86	637,9	1977,5	4548	5548,8	6103,7	11231
Share M2 in GDP, %	68,6	33,7	19	16	14	13	14,5	16,9
Share M0 in M2, %	19,8	26,6	40	37	37	34	35	41,5
Official US dollar to ruble ratio	169	414,5	1247	3550	4660	5508	5960	20650
CB rate of refunding, % (for the end of the year)	20	80	210	180	160	48	28	60

Analysing the data given in Table 1 a very important conclusion comes to mind: changes of practically all macroindices are of non-stationary character. Such financial indices as CB rate of refunding, inflation index and others illustrate this fact most obviously. All this is tightly connected with the peculiarities that are mostly typical for the Russian economy and that should and significantly influence in reality the efficiency of concrete innovation investment projects and methods of their evaluation.

Specific feature of this kind related to macroeconomic environment and determining conditions for carrying out innovation activities are the most important. Factors given in Table 2 should be stressed in the first place [6].

Table 2. Characteristics of macroeconomic instability

Factor	Nature of manifestation
Dynamics of macro-indexes	1.1. Non-stationary, often fluctuating character 1.2. Considerable fall of production, sharp reduction of predicting investments 1.3. Correlations noticeably distinguished from that of the stationary economy of macro-indexes
Fiscal system	2.1. Irrational structure of state expenditures, considerable volume of expenses on debt payment 2.2. Complicated, non-stable tax system. 2.3. High level of non-payment and surrogates of the “money” being in use
Risks	3.1. Complicated structure of risk 3.2. High and variable risks of all types: political, economic, criminal and others 3.3. Low quality of risk forecast
Markets	4.1. Not formed, in particular stock market 4.2. Significant differences between “fair cost” of stocks, real estate, etc. and their market cost
Inflation	5.1. Sufficiently high 5.2. Variable in time 5.3. Non-uniformed by different resources and products 5.4. Differs great by national and foreign currency
Monetary system	6.1. Practically multi -currency (rouble, dollar, surrogates) 6.2. Unstable 6.3. Sharply reduces ratio of M2 to GDP 6.4. Unstability of interest of the Central and commercial banks 6.5. High level of cost of capital 6.6. Varying rate of money falling cost (rates of discount)

3. Efficiency evaluation

Peculiarities of the Russian economy reflected in Table 2 are rather significant and they should be taken into account both in methods directly and in procedures of evaluating innovations efficiency.

Let's consider what these changes are to be proceeding from the generally accepted principles of evaluating innovations efficiency. A system of these principles (methodological, methodic and operationalistic) is described in a number of papers [10-13], therefore, let's dwell (without reiteration) only on some of them, with which the changes under discussion are tightly connected, and so methods and procedures of realising those principles, undoubtedly, require some corrections (though, generally speaking, those principles seem to be invariant in relation to different kinds of the systems considered, in particular to stationary and non-stationary economies of Western countries and Russia).

3.1. The base for evaluating efficiency is adequate to the considered innovation project model of "Cash flow", i.e. is considered at every step of the project life-cycle succession of cash inflows and outflows corresponding to receipts under the project (goods realisation and so on) and payments (different expenses and charges and so on). In standard project analysis procedures (f.e. adopted in the World Bank [14-16]), related to the countries with stationary economy and poor inflation, the whole design-basis time interval is usually divided up into equal (most often to a year time) steps and inflows and outflows are calculated in constant current prices. In terms of non-stationary Russian economy due to high, variable in time and dissimilar for different resources inflation (as well as to some other reasons) it is, as a rule, ineffective and it's necessary:

a) to take into account prices changes in time and to carry out testing project of financial realisability in future variable in time, i.e. in project nominal prices, and to carry out efficiency of direct evaluation in future variable but deflated (excluding total inflation) prices. At the same time calculations in constant current prices in terms of Russian economy most often will result in unfounded raising of the project efficiency compared to the real state of things, though in separate cases a reverse picture can take place.

b) in terms of the Russian non-stationary economy it's often inexpediently to assume different duration of steps to be identical and equal to a year - when inflation is of a higher level it's better to assume the duration of a step as a shorter value (i.e. not a year but half year, quarter and so on).

c) in terms of stationary economy distribution of cash flows within the limits of a step isn't usually taken into account (only inflows and outflows balance is), and at each step it is related to its end or to its beginning.

d) in terms of non-stationary economy in a number of cases real distribution of cash flows should be inserted into calculations; distribution not only between the steps, but within each or some of them.

3.2. A principle of economic inequality of separate in time (though, probably, equal in nominal value) cash flows is, naturally, justified both for stationary and non-stationary economies. However, in terms of the last one, under determining the integral value of "Cash flow", i.e. summarising flows with respect to the steps, a preliminary adjustment of these steps to a comparable form requires the insertion of far a larger number of corrections.

Indeed, if we designate a flow at step m expressed in nominal, i.e. forecasted prices as $\varphi(m)$ then in comparable conditions corresponding to the base without any risks it will be equal to

$$\overline{\varphi}(m)=\varphi(m)\cdot k_1(m)\ldots k_4(m) \tag{1}$$

and integral estimate for the whole design-basis time interval-to

$$\sum_m \overline{\varphi}(t_m,\tau)=\sum_m \varphi(m)\cdot k_1(m)\cdot k_2(m)\cdot k_3(m)\cdot k_4(m) \tag{2}$$

where: $k_1(m)$ - coefficient taking into account rate of inflation at moment t corresponding to the end of step m ;

$k_2(m)$ - coefficient taking into account risk influence at step m;

$k_3(m)$ - coefficient taking into account lowering value of money without risks and inflation at the end of step m in relation to base τ;

$k_4(m)$ - coefficient taking into account distribution of cash flows at step m;

As a matter of fact, the above suggestions of adjustment of a future flow $\varphi(m)$ to its comparable, analogue and multiplicative form of this adjustment were based on the following assumptions (axioms):

a) whichever "cash flow" is under consideration (i.e. dynamics of future nominal values of cash flows in time, distribution of money inflows and outflows by steps and within them), characteristics of external surrounding and internal project parameters and so on (i.e. total inflation value and its structure at every step, size of systematic and non-systematic risks and others) monetary valuation corresponding to this "cash flow" always takes place and can be determined and it makes possible to get an adequate integral knowledge of the considered project efficiency (or its variant), to compare it impartially by value with the others, including those ones that significantly differ from it by size and structure of the cash flow on the whole and by steps, risk level and so on;

b) during the process of adjusting the "cash flow" under consideration to its comparable analogue various convenient for analysis and evaluation, equivalent "cash flows" can be received. Thus multiplication by coefficient $k_1(m)$ eliminates inflation (deflates the flow), multiplication by $k_2(m)$ gives risk free equivalent, multiplication by $k_3(m)$ brings to the flow the value of separate components which is represented on a scale of moment of time (τ) assumed to be the base one; and finally, multiplication by $k_4(m)$ changes the structure of the received flow for the conventionally-typical one, when all the inflows and outflows are "tied" to its certain part, for example, (as it will be assumed further) to its end.

Naturally, under theoretical analysis (further this assumption will be adopted, if it is no provisos) a time interval between two sequential elements of the flow, i.e. cash inflows and outflows can be considered as a step, and then a problem of accounting money distribution within a step is taken off the agenda. This question, however, isn't a principal one - in conformity with [17] it's possible to determine and insert into the calculation values of coefficients $k_4(m)$.

c) with reference to a wide spectrum of the conditions under consideration there are theoretically grounded and successfully approved in practice or, at least, easily realised methods of determining all the above mentioned coefficients when their using is required.

Let's note essential "details" connected with these coefficients - first, they are directly connected with concrete steps, and second, in terms of non-stationary economy parameters that determine these coefficients can change by steps.

3.3. In terms of stationary economy there exists an effective stock market which enables an investor to reach higher profitability (to be more exact, a higher expected value of profitability) along with a higher level of investment risks (including those of innovation character). Therefore in these terms it's quite reasonable to estimate risk value as dispersion (or standard deviation) of an occasional profitability value, its volatility. Naturally, along with it in a case of risk availability possible deviations of occasional profitability from its average value in different directions are supposed. According to this premise a lot of known Western models of risk accounting are based on G. Markovits-D.Tobin model of securities portfolio optimisation, and model CAPM (Capital Asset

Pricing Model) of determining the required profitability (discount rate) in terms of risk availability and others [18-19].

An effective market availability makes it possible to consider that an investor can behave quite rationally and that the expense of the assets diversification excludes unsystematic risk, forming optimal portfolio, hedging risk by a lot of methods (including options) [18-23].

There is quite a different situation in the Russian non-stationary economy. A developed stock market practically hasn't been formed yet, and due to the events of the 17-th of August even its weak spouts were brutally crushed. Therefore it's rather senseless to speak of any positive connection between the expected profitability and a level of the market risk, as well as of a possibility to exclude unsystematic risk while analysing investments efficiency. So the well-known very effective models of the investors behaviour (such models as CAPM, β -model) have got rather limited range of using in Russia. Moreover, a concept of "risk" itself and methods of its evaluation should transform significantly. It seems that in Russia under a term "risk" it's reasonable to mean a deviation from the base "cash flow" only in a negative direction. Therefore, volatility as a measure of risk, naturally, isn't a proper instrument. A more adequate one is a direct accounting influence of risk to efficiency, i.e. relative decrease of cash inflows positive value in terms of risk and positive cash flow balance at the corresponding step (and vice versa, increase of cash outflows values and negative balance). It should be certainly taken into account, along with it, that the inflows - outflows values can be correlated and this connection should be taken into consideration, too. In a case of stationary economy it corresponds to inserting into discount a correction for systematic risk - this follows from model CAPM and other available recommendations [18-19].

3.4. While evaluating efficiency in terms of stationary economy, a Net Present Value (NPV) maintained by the project is used as the main criterion. It's calculated according to:

$$NPV = -K + \sum_{m=1}^{m=M} \varphi(m)(1+E)^{-m} \tag{3}$$

where: K — initial investments corresponding to step-zero (m=0, …, M);

φ (m) - cash flow at moment t at step m (as it has been already mentioned, it's usually the end of step m);

E — rate of discount assumed to be constant in time;

The sum $\sum_{m=1}^{m=M} \varphi(m)(1+E)^{-m}$ is, accordingly, just a Present Value - PV.

Along with NPV and PV another construction is also used - Future Value (FV) and Net Future Value (NFV), that are determined as follows:

$$FV = \sum_{m=1}^{m=M} \varphi(m)(1+E)^{M-m}$$

$$NPV = -K + \sum_{m=1}^{m=M} \varphi(m)(1+E)^{M-m} \tag{4}$$

If $NPV \geq 0$, then the project is effective (irrespective of risk level which should be taken into account in discount rate); if $NPV < 0$ – it isn't effective. Naturally, in this case calculations are being carried out in deflated prices and

$$(1+E) = (1+E_{rf}) \cdot (1+r) \tag{5}$$

where: E_{rf} - market profitability without risk and inflation

r — correction for risk

If there are several alternative projects, a project where $NPV = max$ is considered to be optimal.

Naturally, a value of lost profit is determined by that alternative project where it is maximum. Alternativeness of other projects can be caused both by the fact that in this concrete project some material resources the other projects need are used (i.e. a building or a territory), and the fact that financial capital K is used, without which other projects can't be realised. If the lost profit from using some material resources determined by alternative resources in this or that way can be directly inserted into ($\varphi(m)$) values, then capital alternativeness is usually taken into account in a different way - capital profitability of alternative projects is assumed namely as discount rate, with the same risk as that of the considered period;

- along with NPV as an instrument of evaluating, some other indices are used, such as Internal Rate of Return (IRR), Profitability Index, Pay-back period (PP). The essence of IRR, i.e., is that IRR represents discount rate for which NPV= 0 (naturally, on condition that this equation has got the only positive root), i.e.

$$- K + \sum_{m=1}^{m=M} \varphi(m)(1 + IRR)^{-m} = 0 \qquad (6)$$

There is one mistake that often takes place (though it is described in all the fundamental textbooks [16,18-19]) which is the following: in case of alternative projects availability of the most effective one is chosen according to criterion

$\max\limits_j IRR^j$, $\max\limits_j PI^j$ or $\min\limits_j PP^j$, while a correct condition of choice is

$$\max_j NPV^j \qquad (7)$$

where j - index of project j under consideration.

Much less often the instructions about using NFV in projects evaluation can be found.

It's easy to notice that when $NPV > 0$ then $NFV > 0$ too, and the efficiency of a separate project can be successfully evaluated both by Net Present Value and Net Future Value. However, choosing the best alternative project by the criterion of max NFV is rightful only if all the alternative projects are of the same risk level. If it's not so (i.e. in one project there is no risk at all and the other has got a risk of high level) then it's possible to come to some paradoxes: against all common sense, from two projects with flows equal by steps the project with a higher risk level could turn out to be more effective than the other risk free, as it would have a greater NFV value conditioned by a higher discount rate level.

The directions given in literature how to determine profitability of alternative projects as well as of projects on the whole are even less clear. Quite often maximum profitability of alternative projects, assumed as discount rate in the project, i.e. as its alternative cost of capital, is determined as the maximum Internal Rate of Return of the alternative projects.

It seems that in general case it's not correct and capital profitableness in any project (let's write f^j for it) is determined according to the formula: Future Value (FV^j) is equal to the value of initial investments adjusted by the desired profitableness to the end of the design-basis time interval, i.e.

$$K^j\left(1 + f^j\right)^M = FV^j \qquad (8)$$

from $$f^j = \sqrt[M]{\frac{FV^j}{K^j}} - 1 \qquad (9)$$

and accordingly, discount rate for this project j^0 is:

$$E^{j^0} = \max_{j \neq j^0} f^j(K) = \sqrt[M]{\frac{FV^j\left(K^j\right)}{K^j}} - 1 \tag{10}$$

where $FV^j\left(K^j\right)$ - the lost profit of an alternative project (on scale of time M), that is connected with using in this project investments of K size)

3.5. Under evaluating efficiency in terms of non-stationary economy and absence of developed stock market in Russia the situation is becoming significantly complicated.

a) It's senseless to speak about availability of sufficiently objective connection between the risk level and desired profitableness and, besides, risk itself is determined and evaluated differently than in terms of stationary economy (see p. ...), so the question becomes actual of how and at what rate monetary balance received at m-step will be refinanced (assuming, it's positive). In reality there are a lot of possibilities for refinancing to place this balance on deposit with this or that risk level, to invest it in other risky projects or packets of securities and so on.

Therefore under evaluating efficiency of the project this scenario of using its funds should be singled out[2].

b) on calculating integral efficiency indices (NPV, NFV and others) the key parameters (and discount rate, first of all) don't remain constant but change in time, hence, by steps. Along with it rates of refinancing project funds also change according to scenarios under consideration;

c) size of the future project value according to j-scenario of refinancing will be correspondingly equal to:

$$FV^j = \sum_{m=1}^{m=M} \prod_{s=m+1}^{s=M} \left(1 + d_s^j\right) \tag{11}$$

Values NPV^j and NFV^j are determined by the following formulas:

$$NPV^j = -K^j + \frac{\sum_{m=1}^{m=M} \varphi(m) \prod_{s=m+1}^{s=M} \left(1 + d_s^j\right)}{(1+E)^M}$$

where d_s^j - rate of refinancing according to j scenario

$$NFV^j = -K^j (1+E)^M + \sum_{m=1}^{m=M} \varphi(m) \prod_{s=m+1}^{s=M} \left(1 + d_s^m\right)$$

Let's remark that discount rate is calculated on the basis of:

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[2] This suggestion is made by P.Vilensky.

$$K\left(1+E\right)^T = \max_{j \neq j^0} FV^j \quad or \quad E = \sqrt[T]{\frac{\max_j\left(FV^j\right)}{K}} - 1 \tag{12}$$

where the right part of the equation represents the maximum by alternatives profit lost in connection with using in this project capital K.

d) thus, in non-stationary case a role of future value under evaluating project efficiency becomes stronger. Therefore, in essence, the question is about changing the criterion - instead of Net Present Value maximisation it's suggested to maximise Net Future Value. An important "detail" should be marked here. Russian economy is the one of high risk level. Therefore on determining Future Value and Net Future Value it's necessary:

- to play through all the possible scenarios, evaluating them by risk-free rates of refinancing and basing on the received figures to determine the expected FV and NFV values; or

- to determine efficiency according to the base component, a corresponding coefficient will be taken into account - one and the same for calculating NPV, PV, FV and NFV.

For a standard project (first - investments, and then positive balances by steps) this risk coefficient is always (i.e. at each step) less than unity in terms of non- stationary economy.

The calculations carried out show that the above mentioned issues often correct the result rather significantly.

e) in terms of Russian non-stationary economy inflation of not only national but also foreign exchange takes place. As a result, rate of exchange changes in time significantly and it causes methodical complications under evaluating projects with multiple exchange rates.

It is shown in [6] that in case of simple converting in the current plan one currency into another, as it is often done, a project effective under evaluating in one currency could turn out to be ineffective under its evaluating in another currency.

4. Intellectual property - application of real options theory

Industrial innovations are tightly connected with intellectual property which can be both a component of production or innovation costs and a direct result of implementing innovations.

According to the Russian legislation intellectual property is interpreted as the rights of the owners for the results of intellectual activity that are of social value irrespective of the objects they are embodied in. Intellectual property includes three kinds of rights:

1. Rights on industrial property - trade marks, patents, licences, drawings and so on.
2. Rights on information that represent commercial and professional secrecy - secret methods and technologies, "know-how", formulas, results of research, experimental and construction works (unprotected by patents), technical documentation, systems of production organisation and so on.
3. Objects of copyright and overlapping right - works of art and science, topologies of microcircuits, computer data base and so on.

Principles and methods based on adjusted cash flow value help to evaluate efficiency of investment projects related to developing and realising industrial innovations from the viewpoint of the passive use of the assets, i.e. not taking into account the value of managing the project that emerges under considering intellectual property as a real option. According to the theory of options evaluating [18-23], the rights on the objects of intellectual property lain in the foundation of investment projects can perform as real options hedging risks of the project realisation.

Proceeding from this, it's possible to single out several strategies of hedging the project risks under considering intellectual assets from the viewpoint of real options: a strategy aimed at investments realisation (or to their prolonging), a strategy aimed at the project renunciation and a strategy aimed at choosing the time of investments. In every case the right on intellectual property can provide either the right on option "put", i.e. the right to sell the assets, or the right on option "call", i.e. the right to buy it. Depending on the project terms and possibilities of the assets realisation (technical and legal), in concrete periods an option can perform as the European type, i.e. it can't be realized till the moment T, or the American type with possibility to be realized at any moment $t \in (0;T)$.

Let's suggest intellectual assets being available (patent, licence, new technology and others), that give the right to produce some product and the value of this right $C(t)$ is unknown; the volume of necessary investments (price of implementation) - X, and current cost of the project cash flows - S are the given values. It's forecasted that under favourable combination of circumstances, i.e. under increase of demand for a product or its price the volume of cash flow in time T will grow h times, so the adjusted project cost will be - hS. Under unfavourable combination of circumstances - that is under decrease of demand or the price of product the project cost will decline *k* times and the adjusted project cost will be equal to *kS*.

Basing on the classic theory of evaluation project efficiency, it's necessary to calculate the forecasted value of *NPV* and in case $NPV \geq 0$ to begin realising project and in case $NPV<0$ - to turn the project down. This is a passive strategy of managing the projects. If investment project is based on intellectual assets, it can be managed actively, evaluating additional profits of its realisation. Even with negative *NPV* the investment project realisation potentially can be extremely profitable from the viewpoint of holding or expanding the market and also serve as a base for further introducing the next project with positive *NPV*. On the other hand, even with the positive *NPV* of the project it could turn out to be more profitable to postpone project realisation for some time in view of the expected improvement of realisation conditions and the project external surroundings - perspectives of the industry's development, demand for products, price dynamics, etc.

Intellectual assets in these cases perform as real option and evaluating its cost enables to take into account the profit of possessing the assets which increases the adjusted cost of the project aimed at producing some product or expanding the market of this product by the value of the profit from intellectual assets possessing, i.e. by the cost value of active managing the project.

To evaluate cost of the options that became prevalent financial instruments in 1973 (when the Chicago Board Options Exchange was founded) a number of models are used. The most popular and widespread of them are: a model by Black and Scholes, proposed in 1973 and a binomial model proposed in 1979 by J.Cox, S.Ross and M.Rubinstein.

Black and Scholes model is very popular in practice due to its simplicity, It has got a few assumptions, the main of which are:

1) efficient market;
2) no transaction costs and taxes;
3) model assets can be infinitely divisible;
4) σ - standard deviation of assets cost – is a well-known value and is unchangeable in time;
5) risk-free interest rate is known and constant.

Black and Scholes model enables to calculate the price of option under assumption the changes of realisation conditions are taking place continuously, a number of time periods before the date of realising the project ("call"-option) or the date of selling the assets ("put"-option) is growing infinitely and their duration is utterly short. Then a formula of evaluating the European - "call" - option is:

$$C(t) = S \times F(z) - e^{rt} \times X \times F(z - \sigma\sqrt{t}) \quad (13)$$

where $C(t)$ - current price of "call" option for production development with volume of investment equal to X;

r - risk-free interest rate;

t - time to maturity

$$z = \frac{ln(S/X) + (r + \sigma^2/2)t}{\sigma\sqrt{t}};$$

$F(z)$ - function of standard normal distribution.

If a firm possessing intellectual assets decides to start making investments and gets down to work at the project then "call"-option is realised. If the project's postponement is more attractive due to a high uncertainly of the future flows or if the conditions of the project realisation are expected to be improved (then NPV could be positive), a firm has at its disposal "call"-option that can't be realised.

If a firm realises project using intellectual assets, in the unfavourable course of events, when to continuation of project realisation is unprofitable, the assets can be sold. In this case the right to sell intellectual assets is considered as "put"-option, the price of which is determined proceeding from the theorem concerning parity of values of "put" and "call" options.

$$C(t) + \frac{X}{(1+r)^t} = P(t) + S \quad (14)$$

where: $P(t)$ - current value of the European "put"-options on sale.

Black and Scholes formula is extremely popular and simple in calculations, though situations can emerge, mentioned in [18], when its use is inapplicable. Then binomial method of evaluating options value is used.

It's assumed in binomial model that time changes discreetly, moreover, duration of each elementary period is short in respect to its time of maturity: if maturity of the project realisation or the option expiration is equal to a year, then duration of an elementary period is equal to a day, a week or a month.

If the date of starting the project realisation is limited by time or a condition "now or never", then in case $S > X$ (i.e. net present value - $NPV \geq 0$) the project would be adopted; in case $S \leq X$ (i.e. $NPV < 0$), the project would be rejected. If a condition "to postpone" is taking place, i.e. it's possible to realise the project at a favourable moment of time, intellectual assets can be considered as "call"-option with the right of expectation, value of which is determined by binomial formula of the option evaluation:

$$C(t) = \frac{1}{(1+R)^t}\left[\sum_{i=i^*}^{t} \frac{t!}{i!(t-i)!} \times g^i (1-g)^{t-i} \times (Sh^i k^{t-i} - X)\right] \qquad (15)$$

where $g = \dfrac{1+R-k}{h-k}$; $1-g = \dfrac{h-R-1}{h-k}$,

i^* -- minimal integer for which a condition is executed $Sh^i k^{t-i} \geq X$.

R - one-day risk-free rate of interest within the period under consideration;

t - life of the option's contract.

Despite the fact that applying the options theory in practice is connected with some assumptions in equaluating models, using options in real investment projects has its own indisputable advantages. Owing to options strategies active project managing based on the right of taking decisions proceeding from a reaction to the situation development. Real project possessing in its assets an option has got a mechanism of feedback with external surroundings, i.e. under the favourable course of events the firm increases the assets value and under the unfavourable one - decreases its losses. Thus value of its managing is taken into account.

5. Conclusions

The study of methods of evaluating investment projects efficiency in terms of different social systems enables us to make the following preliminary conclusions, important in Russian conditions:

Evaluating one and the same investment project (from technological and cost points of view) in different social systems (stationary and non-stationary) should not be made identically and its results could differ (just up to being the opposite ones).

To evaluate investment projects in Russian transitional economy it's quite important to take into account the following factors of external economic environment that have got non-stationary dynamics:

- inflation rates;
- rate of changing real and nominal deposit and credit interest rates;
- local and external inflation of foreign currency and exchange courses connected with it;
- terms of allotting and repaying credits.

In multi-currency investment projects evaluating efficiency of the projects under realisation in Russia be can affected by a choice of final currency (national or foreign).

A system of principled and major indexes of evaluating investment projects efficiency in stationary and non-stationary terms can be taken as identical (*NPV, IRR, PI, ...*). However, economic structure (i.e.composition of cots and benefits forming project cash inflows and outflows) and mathematical structure of evaluation algorithms (i.e. methods of displaying inflation, time-factor, etc. under calculating NPV, IRR ...) in stationary and non-stationary terms can differ from each other quite significantly.

In many cases applying methods of evaluating efficiency of the projects realised in Russia that are adopted in terms of stationary economies can lead to wrong conclusions. Due to this reason many investment projects quite efficient for realisation in the countries with stationary successful market economy could turn out to be inefficient in present Russian conditions and their short media-term perspective.

Many important methodological problems of evaluating investment project efficiency in terms of transitional economies (including Russian) haven't been solved on the well-grounded basis (it concerns, in particular, risk accounting, multi-currency projects and so on).

A new direction in the process of evaluating project efficiency is applying the theory of options. An important factor of its application is the use of intellectual property in real investment project.

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