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DETERMINANTS OF THE PARAMETERS FOR INNOVATION AND INVESTMENT PROJECTS IMPLEMENTATION

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The article further develops methodological approaches to the analysis of the project form of innovation and investment activities in terms of forming implementation parameters of the innovation and investment project. The demand for contract resources within the innovation and investment project, which is a set of objectively determined rational combinations of price and time parameters of its implementation, is studied in detail. The demand graphical interpretation in the form of a simplified theoretical curve in the coordinates «the price of the contract resource – possible terms of the project implementation» is offered. The logical relationship of the demand model for contract resources in the innovation and investment project with its production function and, accordingly, the influence of the latter on the project time parameters formation have been revealed. In order to study the economic nature of objectively determined factors influence on the processes of forming the demand for contract resources in the innovation-investment project, a graphical-analytical model «contract market – investment project» was created. This model allows to take into account both organizational and technological features of a particular project and action of market mechanisms of the respective contract markets. In particular, the above model reveals the decisive influence of the contract market situation on the price format of the project implementation. The main determinants of the parameters for innovation and investment project implementation are determined, namely: equilibrium specific value added (equilibrium price of contract resources in the relevant contract market), equilibrium volume of contract resources engagement in the relevant contract market, project production function and interest rate (for investment in the project under the best possible alternative investment options). The transmission mechanism of the described determinants influence on the process of forming price and time parameters of the project implementation is revealed. It has been established that these determinants are objective in nature and will exert their influence under any circumstances.

Keywords: production function of the project, determinants, innovation and investment project, demand for contract resources in the project, price and time parameters of the project implementation.

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Introduction and problem statement

Socio-economic development of the modern economy is largely determined by the scale and intensity of innovation and investment activities of enterprises. Economically developed countries are characterized by a high level of innovation and investment activity (70–80% of economic entities invest in innovation) while in Ukraine such activity is still relatively low (up to 20%). One of the important reasons for this situation is the lack of

investment capital, including affordable one. Since the innovation and investment activities of enterprises are carried out mainly in the form of relevant projects, the question of expediency of their implementation is solved on the basis of a comparison of discounted cash flows for the implementation of a particular project and the revenues generated by it. This is a well-developed methodology in financial and investment management [1,2]. Since the cost of capital in Ukraine is high, the discount rate is correspondingly high. For long-term projects (for example, innovative modernization of industrial facilities), a high discount rate will lead to deterioration in NPV and other indicators of project performance. Even more vulnerable in this situation are investments in environmental capital, social development, infrastructure, etc., because only a part of the effect obtained from the implementation of many such projects generates cash flow. That is, such crypto currency projects are characterized by latent (in terms of financial materialization) public utility, and their efficiency is relatively low even at low interest rates. This, in particular, complicates (and sometimes makes impossible) the decision on expediency of their implementation.

However, some cautions about the reliability of NPV and other indicators suggest necessity for more scrupulous approach to their definition. After all, for the calculation of income cash flow forecast data (that are probabilistic in character) are usually used. They reflect future developments that will be affected by many variables. The data for calculating cash flow of expenses, which will also be carried out in the future (planned investments), are also probabilistic, although the methodology developed within the project management allows minimizing this shortcoming in the process of work execution [3,4]. But this is not the only reason. The amount of cash flow costs of a long-term innovation and investment project depends to some extent on the method and duration of a project implementation. The study of objective factors that determine the formation of the main parameters of innovation and investment projects implementation allows us to better understand this relationship and the way it affects the cost of the project, NPV and innovation and investment activity of enterprises in general, which stipulates the relevance of this topic.

Analysis and research of publications

Problems of innovation and investment activity occupies an important place in the development of economics and covers a huge scientific achievements, from the classicists of economic thought of different times and to leading economists of today – M. Tugan-Baranovsky, M. Kondratiev, J. Schumpeter, S. Kuznets , G. Mensh, A. Kleiknecht, J. van Dane, R. Foster, J. K. Galbraith, D. Bell, F. von Hayek, P. Drucker, M. Porter, P. Romer, F. Agion, P. Howit, C. Jones, A. Toffler and others. In Ukraine, this issue is also extremely relevant; its various aspects are considered in the works of O. Volkov, A. Galchinsky, V. Geyts, M. Denisenko, S. Ilyashenko, L. Mikhailova, P. Pererva, A. Peresad, M. Pogorelov, G. Semenov, A. Semenov, V. Seminozhenko, A. Tkachenko, V. Tkachenko, R. Tian, V. Fedorenko, L. Fedulova, B. Kholod, S. Chimshit, Y. Shipulina and many other scientists. In particular, innovation and investment activities are studied in the context of innovation prospects at the micro and macro level [5], problems of innovation development [6,7], issues of organization and management of innovation and investment activities [8,9,10], formation and development of innovation potential industries and enterprises [11], etc. It should be noted that specifically the project form of innovation and investment activities was studied mainly in the organizational and managerial context within the scientific field of project management [3,4,12]. Instead, the aspect of economic analysis of the project form of innovation and investment activities, especially at the theoretical and methodological level, remains little-investigated.

The purpose of the article

The purpose of the current work is further developing methodology of microeconomic analysis of the project form of innovation and investment activities (hereinafter – project activities) in terms of studying the process of forming the parameters of innovation and investment projects implementation.

Presenting main material

The initial data for this study are the following author's developments.

1. Project-oriented production is considered as a specific form of social production that uses two integrated economic resources:

– contract resource – a set of material (raw materials, energy, equipment, etc.) and human (labor, organizational, creative, entrepreneurial) resources belonging to the contractor (executor). An integrating factor for contract resource is the ability to create new value by performing contract work in the relevant professional field;

– time resource – financial resources and time allocated for the project implementation, which belong to its owner.

With this in mind, the production function of the project was developed. Given that the total amount (stock) of contract resources for the implementation of a particular project is a conditionally constant value, the production function of the project shows that the flow or density of the contract resource (contract resource costs) per time unit depends on the term selected from all possible project implementation (time resource costs) under

a certain organizational and technological scheme of work. The production function isoquant (graphic model) of project-oriented production is similar to the isoquant of traditional production, but in the coordinates «the cost of contract resources per time unit – the time resource cost» [13, p. 769].

2. The cost metrics which is adequate to the project-oriented production and is based on the indicator of economic value of the project as a set of compounded costs for its implementation as well as on the indicator of specific value added as the price of the contract resource has been developed. In view of the fact that the cost of the material component of the contract resource is a conditionally constant value, the subject of bargaining when hiring the latter by the project owner is the cost of its executive component, i.e. the added value created by the contractor (set of labor costs, overhead costs and normal profit as costs of the executive component of the contract resource). Accordingly, the specific value added is the value added per unit of the executive component of the contract resource. Its value in some way, through the interest rate (for investment in the project in case of an alternative method of investment) depends on the chosen term of the project implementation, but ultimately in the form of basic parameters is fixed by the contract agreement. The set of indicators of specific value added under concluded contracts forms the equilibrium price of contract resources in the relevant market [14, p. 76-78].

3. A model of contract resources demand within a certain project is developed, which characterizes the limit of rational behavior of the project owner as to hiring a contract resource at a certain price for each possible period of its implementation, i.e. the parameters of project implementation. Graphically, the model looks like a curve, or rather a theoretical curve (taking into account the fact that it was built on the basis of mathematical formalization of economic processes) in the coordinates «the price of the contract resource Q – possible time-frame of the project implementation t» (Fig. 1). The points on the curve and below it determine the possible combinations of parameters for this project implementation of. The points above the curve determine impossible or unlikely combinations of these parameters [15, p. 1082].

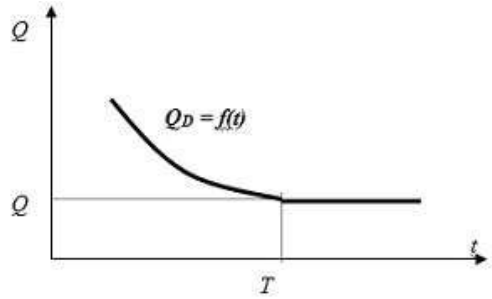

Fig. 1. General view of theoretical demand curve for the contract resource in the project

To further study the process of forming the parameters for innovation and investment projects implementation we'll use the very model of demand for contract resources within the project.

Simultaneously, it should be noted that due to mathematization of objective factors action, which is in a certain way detached from reality, the nature of the economic behavior of the subjects is somewhat dogmatized. Practical experience in mathematical modeling of economic processes and phenomena shows that to study the really complex nonlinear dependences of the real interaction of economic entities the method of reducing the above dependences to linear ones works well. Therefore, to characterize and study the demand for contract resources in the project, it is advisable to use a simplified view of theoretical demand curve Q_D (Fig. 2).

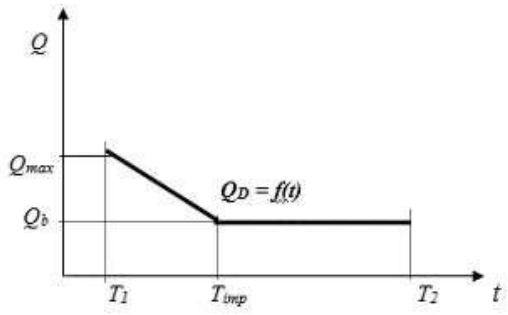

Fig. 2. Simplified view of theoretical curve of demand for contract resources in the project

This curve (hereinafter – the demand curve in the project) reproduces more realistically the behavior of the project owner in the search for the most acceptable alternatives to combine resources for projects due to neglecting (within reasonable limits) mathematical correctness in favor of management logic and economic thinking.

In addition to the above definition for the theoretical demand curve, taking into account the foregoing for its simplification, we can note that the demand curve in the project is a set of points, each of which is adapted to the practice of work extremely rational (given certain external to this project circumstances, scope and nature of work on the project itself) combination of basic parameters of the project implementation.

As can be seen from the graph, this curve is broken one consisting of two segments: sloping and horizontal. It is limited by the project implementation period from T_1 to T_2, as well as by the price – from Q_b (base price of the contract resource typical for the horizontal segment of the curve) to the maximum price Q_{max}, which reflects the cost of contract

resources in case of their mobilization to fulfill the work in the minimum possible term. The breaking point of this curve is determined by some possible time of project implementation T_{imp}. This term is considered to be limiting in the sense that the cost of mobilizing contract resources to perform project work in period less than T_{imp} exceeds the permissible deviations for the contractor from the average market price of contract resources, i.e. the performance of work at the base price Q_b will be unprofitable for the contractor or at least of low profit. Therefore, the project owner is forced to raise the price on the segment from T_{imp} to T_1 (sloping curve) to ensure the involvement of the contractor and project implementation. The slope of the sloping segment can be taken in accordance with previous studies carried out by the author (slope of the curve is proportional to the interest rate) [13, p. 772]. In formalized form we have:

$$Q_D = \begin{cases} Q_b\left[1 + a\left(T_{imp} - t\right)\right], \; T_1 \le t \le T_{imp}, \\ Q_b, \; T_{imp} \le t \le T_2, \end{cases} \qquad (1)$$

where Q_D, Q_b – the demand price and the base price of the contract resource, respectively; t, T_1, T_{imp}, T_2 – possible project implementation periods and their characteristic values, respectively; a – parameter determined by the interest rate r. Provided that the influence of subjective factors is minimized a=r.

Thus, the demand curve for contract resources in the project Q_D characterizes the dependence of the cost of work done on the period of its implementation. This curve is an objective fact, which determines the choice of the project owner the parameters of its implementation. Subjective factors are of applied character and their influence forms (on the basis of the Q_D curve) narrower limits for choosing the parameters of the project implementation – the pricing policy of the project owner, which in a formalized form is the development or degeneration of the demand curve for contract resources in the project.

To fully determine Q_D, it is necessary to set all the constants included in (1). The boundaries, T_1, T_2 are easy to determine using the closest to the origin «volumes of contract resources R – possible terms of project implementation t» isoquant (curve of local technically effective organizational and technological schemes of implementation) of the project (Fig. 3).

Therefore, the Q_D curve characterizes the effective demand for contract resources within the choice of project implementation dates from T_1 to T_2. T_1 is the minimum possible project implementation period, i.e. any $T<T_1$ is impossible from the point of view of works technology on this project (it is impossible to realize this project faster than during T_1 at the existing level of technology and organization of works). T_2 is the maximum term of the project, given the possibility of replacing the time resource with a contract one. That is, any $T>T_2$ though is possible, but is a priori irrational from the point of view of the work performance organization on the given project and does not provide continuity of the project realization process.

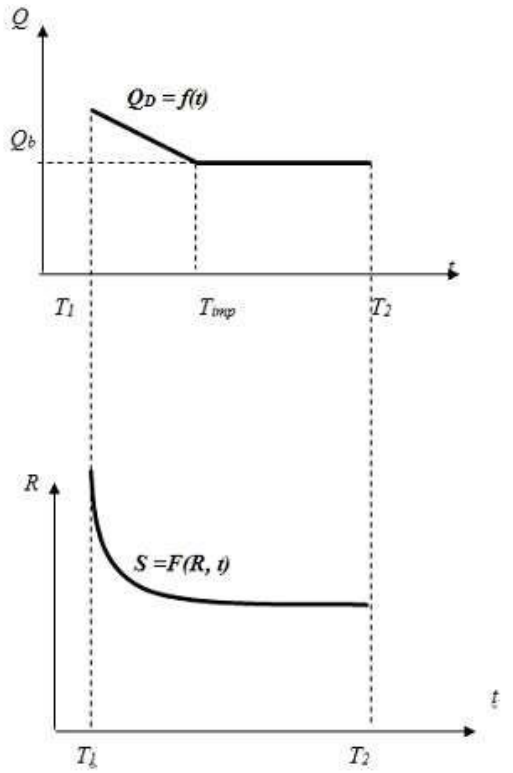

Fig. 3. Defining the limits of effective demand for contract resources in the project

The slope of the sloping segment of the demand curve for the contract resource in the project is objectively determined by the interest rate. Is it possible to change the slope of this segment under the influence of other factors? Of course it is, though these other factors are said to be of subjective origin. It remains to determine the level of the base price of the contract resource Q_b and the marginal term of the project implementation T_{imp} based on the possibility of attracting contract resources at the price of Q_b.

Regarding the marginal term for project implementation, it should be noted that in addition to the economic content mentioned above, it is also limited from the organizational and technological point of view. As a rule, the project implementation period is shorter than marginal term, in addition to the impossibility or difficulty of attracting contract resources at the base price; it also means a forced

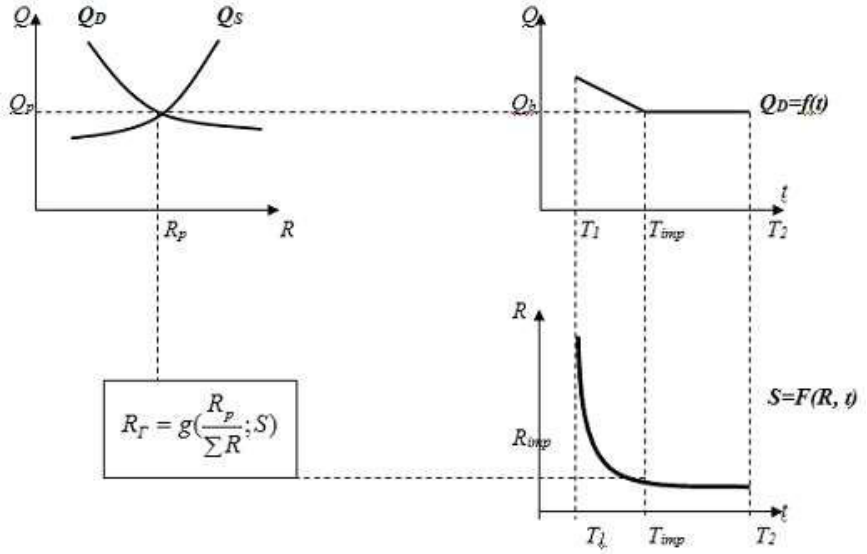

Fig. 4. Model «contract market – investment project»

mode of work. In fact, this circumstance is a significant reason for increasing the contract work cost, and hence, the price of contract resources, which occurs on the sloping section of the Q_D curve.

Now consider the impact of the situation at relevant contract market on the formation of demand for contract resources in the project (Fig. 4).

Figure 4 shows the model of the contract market in the coordinates «the price of contract resources (specific value added) Q – the volume of hiring (sale) contract resources R» and the model of demand in the investment project as well as the relationship between them. This graphical analysis of the interaction between the investment project and the contract market, in which contract resources are hired to implement this project, will be called the model «contract market – investment project» (CM–IP). As we see, the parameters that determine the equilibrium state of the contract market, significantly affect the formation of demand in the project, in other words, they are its determinants. Moreover, the equilibrium specific value added Q_p directly determines the basic specific value added in the project Q_b, i.e. the basic demand price that the project owner agrees to pay for the contract resource hiring, if the project implementation period is not less than T_{imp}: $Q_b=Q_p$ at $T\geq T_{imp}$.

In turn, the equilibrium amount of contract resources affects indirectly the maximum duration of the project T_{imp} through the value of the maximum number of contract resources R_{imp}, which can be attracted at the base price Q_b. At the same time, the value of R_{imp} depends on the isoquant of local technically effective organizational and technological schemes of a particular project. By necessary stock of contract resources for the project implementation it determines its rational flow, which is adjusted depending on the nature of competition in the contract market (indirectly represented by the degree of this market potential use at the moment):

$$R_{imp}=g(R_p/\Sigma R;\ S), \quad (2)$$

where $R_p/\Sigma R$ is the share of using the contract market potential; S is the quantified object of the project (or the amount of contract work on the project).

Therefore, the transmission mechanism for the influence of market determinants on the formation of demand for contract resources in the project is as follows:

$$Q_p \rightarrow Q_b; \quad (3)$$

$$R_p \rightarrow R_{imp} \rightarrow T_{imp}. \quad (4)$$

In addition, this mechanism includes the impact of resource characteristics and production function of the project:

$$S \rightarrow R_{imp} \rightarrow T_{imp}. \quad (5)$$

This interpretation may provoke serious theoretical remarks, as it is a question of the fact that the factors that are traditionally associated with the formation of the supply of contract resources take part in the formation of the demand for contract resources in the project. This conflict is due to the dual economic nature of the project. As already mentioned, the project is such a form of production organization which combines economic relations, typical of the market, and production hierarchy, typical of the firm. The subjects of the project, on the one hand, are independent from the economic and legal point of view; on the other hand, in the

process of project implementation they are in the conditions of operational subordination and of rather strict coordination of production activities. Therefore, the choice of organizational and technological format of the project implementation process is an option for the use of resources, primarily the contract resource, and hence the determinantal demand for the contract resource.

What happens to demand in a project when demand or supply (or both the first and second at the same time) change in the contract market under the influence of, for example, non-price determinants? It is obvious that market fluctuations in the contract market result in significant changes in the position of broken demand curve in the project. In this article, using the model of CM−IP, we consider only the extreme cases of market determinants influence on the formation of demand for contract resources in the project.

1. $T_{imp} \rightarrow T_1$. In this case, the sloping segment of the broken demand curve in the project degenerates into a point, and the curve as a whole consists only of a horizontal segment. This situation can occur, for example, in times of crisis, when the degree of using the market contract potential is low, and the level of competition in the market is high. Such conditions allow the project owner to hire contract resources at the base price regardless of the project timeline.

2. $T_{imp}=T_2$. In this case, the horizontal segment of the broken demand curve in the project degenerates into a point, and the curve as a whole consists only of a sloping segment. This situation can occur, for example, during periods of economic recovery and boom, when the degree of using the market contract potential is high, there is a shortage of contract resources, and the level of competition for contracts is insignificant or is absent at all. In such conditions, the project owner is forced to raise the price of demand for contract resources above the base one depending on the implementation period.

Conclusions

1. Demand for contract resources within the innovation and investment project which just characterizes the parameters of its implementation, is formed as the willingness of the project owner to replace its own time resource with contract resources depending on the price conditions of the project implementation.

2. The decisive influence on forming the parameters of the innovation and investment project implementation is produced by the following determinants:

a) equilibrium unit value added (equilibrium price of contract resources in the market), which directly determines the base price of demand for contract resources in the project, and hence the position of the horizontal segment of the demand curve in the project;

b) the equilibrium volume of contract resources hiring, which has an indirect effect on determining the deadline for project implementation, provided the use of contract resources at the base price, and hence the position of the sloping segment of the demand curve in the project (breakpoints);

c) the production function of the project which affects determining the deadline for its implementation;

d) the interest rate (on investment in the project with the best possible investment options), which determines the slope of the demand curve sloping segment in the project, and thus affects the willingness of the project owner to replace his own time resource with contract resources.

3. All mentioned above determinants are objective in nature and will exert their influence in any circumstances. However, subjective factors may in some way correct or even partially neutralize this effect. Such subjectivization will result in the formation of the pricing policy of the project owner, but the basis for it in any case will be an objective fact − the demand curve for contract resources in the project.

4. In the course of further researches of formation processes of parameters for innovation and investment projects implementation it is expedient to consider influence of offering contract resource in the project.

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ДЕТЕРМІНАНТИ ПАРАМЕТРІВ РЕАЛІЗАЦІЇ ІННОВАЦІЙНО-ІНВЕСТИЦІЙНИХ ПРОЕКТІВ

Конащук В.Л., Олешкевич І.П.

У статті отримали подальший розвиток методологічні підходи до аналізу проєктної форми інноваційно-інвестиційної діяльності в частині формування параметрів реалізації інноваційно-інвестиційного проєкту. Детально досліджено попит на підрядні ресурси в межах інноваційно-інвестиційного проєкту, що являє собою сукупність об'єктивно обумовлених раціональних комбінацій цінових і часових параметрів його реалізації. Запропоновано його графічну інтерпретацію у вигляді спрощеної теоретичної кривої в координатах «ціна підрядного ресурсу – можливі терміни реалізації проєкту». Виявлено логічний взаємозв'язок моделі попиту на підрядні ресурси в інноваційно-інвестиційному проєкті з його виробничою функцією та, відповідно, вплив останньої на формування часових параметрів реалізації проєкту. З метою дослідження економічної природи впливу об'єктивно зумовлених чинників на процеси формування попиту на підрядні ресурси в інноваційно-інвестиційному проєкті створено графічно-аналітичну модель «підрядний ринок – інвестиційний проєкт». Дана модель дозволяє врахувати як організаційно-технологічні особливості реалізації конкретного проекту, так і дію ринкових механізмів відповідних підрядних ринків. Зокрема, вона виявляє вирішальний вплив кон'юнктури підрядних ринків на ціновий формат реалізації проєкту. Визначено основні детермінанти параметрів реалізації інноваційно-інвестиційного проєкту: рівноважну питому додану вартість (рівноважну ціну підрядних ресурсів на відповідному підрядному ринку), рівноважний обсяг найму підрядних ресурсів на відповідному підрядному ринку, виробничу функцію проєкту та процентну ставку (на інвестиції в проєкт з найкращого з можливих альтернативних варіантів інвестування). Розкрито трансмісійний механізм їх упливу на процес формування цінових і часових параметрів реалізації проєкту. Встановлено, що ці детермінанти мають об'єктивний характер і спрямовуватимуть свій вплив за будь-яких обставин.

Ключові слова: виробнича функція проєкту, детермінанти, інноваційно-інвестиційний проєкт, попит на підрядні ресурси в проєкті, цінові та часові параметри реалізації проєкту.

ДЕТЕРМИНАНТЫ ПАРАМЕТРОВ РЕАЛИЗАЦИИ ИННОВАЦИОННО-ИНВЕСТИЦИОННЫХ ПРОЕКТОВ

Конащук В.Л., Олешкевич И.П.

В статье получили дальнейшее развитие методологические подходы к анализу проектной формы инновационно-инвестиционной деятельности в части формирования параметров реализации инновационно-инвестиционного проекта. Детально исследован спрос на подрядные ресурсы в пределах инновационно-инвестиционного проекта, представляющий из себя совокупность объективно обусловленных рациональных комбинаций ценовых и временных параметров его реализации. Предложена его графическая интерпретация в виде упрощенной теоретической кривой в координатах «цена подрядного ресурса – возможные сроки реализации проекта». Выявлена логическая взаимосвязь модели спроса на подрядные ресурсы в инновационно-инвестиционном проекте с его производственной функцией и, соответственно, влияние последней на формирование временных параметров реализации проекта. С целью исследования экономической природы влияния объективно обусловленных факторов на процессы формирования спроса на подрядные ресурсы в инновационно-инвестиционном проекте создана графически-аналитическая модель «подрядный рынок – инвестиционный проект». Данная модель позволяет учитывать как организационно-технологические особенности реализации конкретного проекта, так и действие рыночных механизмов соответствующих подрядных рынков. В частности, она выявляет решающее влияние конъюнктуры подрядных рынков на ценовой формат реализации проекта. Определены основные детерминанты параметров реализации инновационно-инвестиционного проекта: равновесная удельная добавленная стоимость (равновесная цена подрядных ресурсов на соответствующем подрядном рынке), равновесный объем найма подрядных ресурсов на соответствующем подрядном рынке, производственная функция проекта и процентная ставка (на инвестиции в проект при наилучшем из возможных альтернативных вариантах инвестирования). Раскрыт трансмисионный механизм их влияния на процесс формирования ценовых и временных параметров реализации проекта. Установлено, что эти детерминанты имеют объективный характер и будут производить свое влияние при любых обстоятельствах.

Ключевые слова: производственная функция проекта, детерминанты, инновационно-инвестиционный проект, спрос на подрядные ресурсы в проекте, ценовые и временные параметры реализации проекта.

DETERMINANTS OF THE PARAMETERS FOR INNOVATION AND INVESTMENT PROJECTS IMPLEMENTATION

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The article further develops methodological approaches to the analysis of the project form of innovation and investment activities in terms of forming implementation parameters of the innovation and investment project. The demand for contract resources within the innovation and investment project, which is a set of objectively determined rational combinations of price and time parameters of its implementation, is studied in detail. The demand graphical interpretation in the form of a simplified theoretical curve in the coordinates «the price of the contract resource – possible terms of the project implementation» is offered. The logical relationship of the demand model for contract resources in the innovation and investment project with its production function and, accordingly, the influence of the latter on the project time parameters formation have been revealed. In order to study the economic nature of objectively determined factors influence on the processes of forming the demand for contract resources in the innovation-investment project, a graphical-analytical model «contract market – investtment project» was created. This model allows to take into account both organizational and technological features of a particular project and action of market mechanisms of the respective contract markets. In particular, the above model reveals the decisive influence of the contract market situation on the price format of the project implementation. The main determinants of the parameters for innovation and investment project implementation are determined, namely: equilibrium specific value added (equilibrium price of contract resources in the relevant contract market), equilibrium volume of contract resources engagement in the relevant contract market, project production function and interest rate (for investment in the project under the best possible alternative investment options). The transmission mechanism of the described determinants influence on the process of forming price and time parameters of the project implementation is revealed. It has been established that these determinants are objective in nature and will exert their influence under any circumstances.

Keywords: production function of the project, determinants, innovation and investment project, demand for contract resources in the project, price and time parameters of the project implementation.

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