

**EFFECTIVE MECHANISM OF PUBLIC FINANCING
INNOVATION START-UPS: EVIDENCE FROM
UZBEKISTAN**

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Abstract: **Nowadays developing countries are raising the volumes of financial support of the enterprises with high potential for the innovation growth with the aim of improving national innovation system and activation of innovation processes. As the volume of budget transfers increase, the problem of their efficient and targeted use is becoming more urgent. This article is devoted to studying the financial aspects and economic efficiency of start-ups financing via public funds of venture capital instead of grant support of innovation projects in the evidence of the Republic of Uzbekistan. The analysis is based on abstracting techniques with the use of IRR. Moreover, this article suggests advantages of using the venture financing mechanism of start-ups which turn out to be more efficient than through grant support.**

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1. Introduction

In the majority of developed countries one of the most successfully implemented directions of the government policy on promotion and support of innovations are the programs of financing projects through public funds of venture capital. However, Uzbekistan is not experiencing the practice of financing innovative projects via either public or private venture capital funds. Only the “Fund for supporting innovative scientific and technical activities” of the Committee for Coordination Science and Technology Development under the Government of Uzbekistan has been allocating grants to innovative projects since 2003. For example, if in 2003 the Fund granted 722.1 million UZS for 112 projects, in 2013 the volume of grants significantly increased and amounted to 17,568.2 million UZS for 352 projects (UZSTAT information). According to experts’ estimations, the government gets only public externality from these grants as it enables to maintain a current level of R&D, but the commercialization level of these innovations financed through grant in the market is significantly low (BFA Uzbekistan 2015). Thereby, we suppose, as the state budget R&D expenditures are increasing, the crucial issue for the government is providing an effective distribution and the most efficient use of these funds.

In the framework of this problem, a sufficient number of researches have been conducted in the sphere of financial stimulation of innovation start-ups in Uzbekistan. However, some peculiarities of financing via establishing venture funds as a financial support of the government to the innovative developments of initiators, degree of economic efficiency of funds, financial efficiency of funds haven’t been completely investigated. This article is devoted to the research of the problem how the venture capital funds can be used for start-ups financing instead of public grants and we are going to investigate how efficient they can be for the state budget and national economy. The second section represents a Literature review. The third section is devoted to the data origin and methodology of the research. The fourth chapter analyzes profitability of the established public fund of venture capital, its financial efficiency and budget effectiveness. The fifth section offers conclusion, recommendations and suggested directions for further researches.

2. Literature review

Venture capital is considered to be investing in the exchange of the share in the innovative enterprise which is on the initial stage, with the account of the growth of capitalization funded by the enterprise in the future, and getting high profits on the sale of this share after a certain period of time. Venture investments are characterized with high risks and intention to get high

profit. Plummer distinguishes 8 stages of implementing investments by innovative enterprises: 1- seed, 2-start-up, 3-early development, 4-expansion, 5-profitability but cash poor, 6-rapid growth toward liquidity, 7-bridge investment, 8-liquidity or exit capital investment (Plummer 1987). In the opinion of Gladstone and Gladstone, investments are referred to venture capital investments only in the first three stages (Gladstone and Gladstone 2002). Review and considerations about venture investments are studied in details in scientific papers of Wilson (1985), Gorman and Sahlman (1989), Fenn, Liang et. al (1995), Gompers (1999), Lerner (2000).

Public programs of venture investments are considered to be «government programs that make equity or equity like investments in young firms, or encourage other intermediaries to make such investments» (Lerner 2002). OECD treats public programs of venture investments in a more broad sense and these programs should include (1) direct supply of capital, (2) financial incentives for investing in private venture capital funds or small firms, (3) regulations controlling types of venture capital investors (OECD 1997).

Many countries possess public programs of venture investments in start-up projects. Public funds of venture capital have become an important part of developing an innovation branch in the economy (OECD 1997). Practice of financing innovation start-ups by public funds of venture capital are widely used in the USA, Canada, western European countries and some East-Asian countries (Japan, Korea, Singapore, Malaysia and etc.) and Australia. Though these kind of public funds appeared in the markets quite late, nowadays public sources have become available, wide-spread and comprehensive institutions of venture investments market (Hood 2000; and Auerswald 2002; Leleux and Surlemaunt 2003). In 15 European countries which have been studied by Leleux and Surlemaunt, governments place about 6-58% of the total volume of investments with venture capital funds (Leleux and Surlemaunt 2003). In the USA federal government and municipal governments provide 22-30% of cash flows to start-up projects of technologic development (Branscomb and Auerswald 2002).

In spite of general cognizance about a positive role of functioning of public funds of venture capital in the economy, economists differ in the opinions on the issues of financial efficiency for the government and raise the following question: “Should the government invest resources directly in innovation start-ups as venture capital funds or direct this money to support private funds of venture capital?” Such kinds of controversies have been considered in details in

scientific papers of (Lerner 20002; Lerner 1996; Wallsten 1999). However, we should note, that both of them agree that innovative enterprises face a significant funding gap on the initial stages (Moore 1994; Murray and Lott 1995; Sohl 1999; Hall 2002).

If we touch upon the problem of positive arguments of direct financial support of start-ups to be involved in innovations, public funds of venture capital create public benefits with high positive externalities, like R&D, technology, knowledge spillover and etc. (Wang, 2006). The profit maximizing enterprises are intending to invest in R&D, because such investments, in their opinion, cover commercial benefits, which do not mean positive public externalities. Sizeable R&D spillovers have been identified both at the firm and industry levels (Nadiri 1993). Results of empirical analysis show that direct investments of public venture capital funds enhance R&D profitability and enhance private innovation (Levy and Terleckyj 1983; Nadiri 1993; Robson 1993).

Moreover, as Lerner notes public funds of venture capital can partly solve the information asymmetry problem (Lerner 2002) and start-ups will have more chances to get funding from other sources by certifying start-up which creates a «halo effect» and in this way create more conveniences to external investors (Moore and Garnsey 1993; Ruegg and Feller 2003). The reasons are the following:

- Going through a tight competition gives an additional signal to new investors of start-ups in the framework of technological perspective;
- Investments of public funds improve the start-ups' business, management fundamentals and its profitability (Moore and Garnsey 1993);
- Established start-ups are supposed to be perspective and potential in the certain sphere of the economy for the government (Lerner 2002).

From the opposite point of view, the biggest issue of concern is a variety of different distortions occurred as the result of the activities of public venture capital funds. The first distortion was a rent-seeking behavior of interested groups or politicians which use government programs and divert received benefits from the aimed beneficiaries to their own interests. An overall literature review on the issue of the public option is presented in the scientific paper of Buchanan and Tollison (1984). The next distortion is the fact that when officials select a project, they do not allocate funds for the final result of the enterprise which needs these funds, but they

entirely rely on the intuition and probability (Cohen and Noll 1991; Wallsten 2000). In such cases public funds will crowd-out private funds in the market and start-ups will not obtain any kind of additionality. Additionality can occur only when the considered start-up is continuing an existing R&D activity, but will not follow this form without public funds (Moore and Garnsey 1993). Moore and Garnsey have discovered that 100% additionality of government funds on top of private R&D funds are based on a case study of 15 SMART projects (Moore and Garnsey 1993). However, Wallsten has attained the result that SBIR (USA) awards have completely crowded out private R&D funds on the database of 457 projects including rejected ones (Wallsten 1999).

One more argument is that the system of officials cannot operate as well as the market system. There is a possibility that, in the best scenario, public fund of venture capital will select the start-up project proceeding from the following reasons (1) selected start-up has a relatively high potential but it is just a minor part among many enterprises, therefore it turns to be a very moderate aim, (2) support of public funds can raise perspectives and plans of marginal applicants and other side effects, after which new problems can arise instead of the existing ones (Boviard, Hems et. al. 1995; Meza 2002). Ruegg and Feller in their scientific work state other negative arguments such as: minimal government role in economy regulation is supposed to promote a more effective long-term economic growth and technological innovations; officials may insist on the extremely high development of unreliable and economically problematic technologies; an overall public benefit from these projects can be represented as vested interests which, in turn, will lead to such financing which consequences cannot be considered as successful ones (Ruegg and Feller 2003).

Having considered above-stated arguments and conclusions of economists as well as the fact that venture investments market in Uzbekistan is not replete and many start-ups feel an acute shortage of funds we have made a conclusion that a public fund of venture capital will be economically efficient and will provide the public with positive externalities. On the basis of our assumptions our research hypothesis is that (1) this public fund of venture capital will be commercially profitable and (2) the government can get investment and budget benefits via an efficient support of establishing small innovative enterprises.

3. Methodology

With the aim of analyzing profitability of the establishing public fund of venture capital we have developed the model of financial aspect. As we are going to analyze the fund which doesn't exist for the time being, we have used to modeling and analyzing the abstracting techniques. Experimental duration of the establishing fund operation is supposed to be 8 years. The technique of analyzing financial part of the establishing public fund used in our research has been developed on the basis of the scientific works of Weidig (2002), Meyer and Weidig (2003). This model is typical for the evidence of Uzbekistan and in case of other countries it is recommended to take into account tax rates of these very countries. While assessing profitability of the fund's placements in innovative enterprises we used Internal Rate of Return indicator (IRR). In the process of analyzing budget efficiency for the state budget we have taken into account the rates of the following taxes: Value Added Tax (VAT), profit tax, tax on income of innovative enterprises' specialists, different compulsory deductions to the state extrabudgetary funds, for example, to the Pension fund.

Empirical data used in the analysis are fictional and they have been calculated proceeding from average statistic opportunities of these kinds of start-ups. The data is given in billion Uzbek soums (UZS).

4. Analysis of financial aspects

4.1 Analysis of financial efficiency

Initial indicators of the financial model are supposed to be as it follows: the volume of the fund is equal to 40.0 billion UZS; the volume of commitments amounts to 4.0 billion UZS; duration of the fund activity accounts for 8 years; management fee is 3% from the value of fund assets under the management; hurdle rate equals to 7%; carried interest of the managing company on the results of the fund activity is 20%; share of the venture funds in each invested innovation start-up amounts to 50%. Profit can be received only at leaving the enterprise, which means that interim dividends received before leaving, are reinvested in start-ups.

As a rule, each financed start-up develops with different degrees of success. So let's suppose that there are four types of start-ups: unsuccessful, medium-profitable, highly profitable and superprofitable. Peculiarities of start-ups are IRR of the fund investments and the value of the fund share in innovative enterprises at the exit.

Investments are being made in innovative projects of start-ups, out of which exits 5 years after the beginning of investment. After the start of investing process start-ups will be meant as innovative enterprises.

Investing trances are being implemented in 3 following stages:

- I stage (initial) – 300 million UZS;
- II stage (in 1 year after the beginning of investment) – 400 million UZS;
- III stage (in 3 years after the beginning of investment) – 800 million UZS.

To determine the value of the fund assets and management costs it is required to calculate the cost of the share in each innovative enterprise in the period of time during which the fund holds the share. The task presented in Table 1 has been solved by means of linear interpolation with the theories of Riesz-Thorin and Marcinkiewicz (Bernard, 2013) technique.

Table 1. Parameters of invested start-ups

| Type of start-up | IRR | Cost of the fund share in innovative enterprise, billion UZS | | | | | |
|-------------------|-------|--|--------|--------|--------|--------|---------------|
| | | Beginning | 1-year | 2-year | 3-year | 4-year | 5-year (exit) |
| Unsuccessful | -100% | 0.30 | 0.55 | 0.28 | 0.14 | 0.00 | 0.00 |
| Medium profitable | 30% | 0.30 | 0.79 | 1.03 | 2.14 | 2.78 | 3.61 |
| Highly profitable | 60% | 0.30 | 0.94 | 1.69 | 3.85 | 6.92 | 7.82 |
| Superprofitable | 100% | 0.30 | 1.09 | 2.51 | 6.57 | 15.10 | 19.20 |

In addition, using this modeling let's consider 3 possible scenarios of distributing start-ups by IRR, as it was supposed by Kashirin and Semenov (2006): realistic, optimistic and pessimistic. The realistic scenario reflects a typical situation for venture funds. Under this scenario half of start-ups turns out to be unsuccessful or brings a rather low income. The main part of the income is generated due to placements in other innovative projects and one of them can be superprofitable. Optimistic and pessimistic approaches are developed on the basis of the slight change of parameters.

Table 2. Variants of start-ups division by IRR out of 10 start-ups

| Start-up | Optimistic scenario | Realistic scenario | Pessimistic scenario |
|-----------------------------|---------------------|--------------------|----------------------|
| Superprofitable (IRR 100%) | 2 | 1 | 0 |
| Highly profitable (IRR 60%) | 3 | 3 | 4 |

| | | | |
|-----------------------------|---|---|---|
| Medium profitable (IRR 30%) | 3 | 3 | 3 |
| Unsuccessful (IRR -100%) | 2 | 3 | 3 |

The fund is supposed to place its funds in 30 start-ups for 3 years, by 10 start-ups each year. Investing in unsuccessful projects is supposed to be terminated after the second tranche. Termination of this project does not happen because of the absence of the enterprise's cost. Negative cash flows of the last line mean public fund investments.

Table 3. Financial dynamics of the fund under the realistic scenario, billion UZS

| Cash flow article | Year | | | | | | | |
|--|-------|--------|---------|---------|---------|---------|---------|---------|
| | 0 | 1-year | 2- year | 3- year | 4- year | 5- year | 6- year | 7- year |
| Cash flow from the enterprise to the fund / year | | | | | | | | |
| 3 unsuccessful start-ups | -0.90 | -1.20 | | - | | 0.00 | | |
| 3 medium profitable start-ups | -0.90 | -1.20 | | -2.40 | | 10.82 | | |
| 3 highly profitable start-ups | -0.90 | -1.20 | | -2.40 | | 23.45 | | |
| 1 superprofitable start-up | -0.30 | -0.40 | | -0.80 | | 19.20 | | |
| 3 unsuccessful start-ups | | -0.90 | -1.20 | | - | | 0.00 | |
| 3 medium profitable start-ups | | -0.90 | -1.20 | | -2.40 | | 10.82 | |
| 3 highly profitable start-ups | | -0.90 | -1.20 | | -2.40 | | 23.45 | |
| 1 superprofitable start-up | | -0.30 | -0.40 | | -0.80 | | 19.20 | |
| 3 unsuccessful start-ups | | | -0.90 | -1.20 | | - | | 0.00 |
| 3 medium profitable start-ups | | | -0.90 | -1.20 | | -2.40 | | 10.82 |
| 3 highly profitable start-ups | | | -0.90 | -1.20 | | -2.40 | | 23.45 |
| 1 superprofitable start-up | | | -0.30 | -0.40 | | -0.80 | | 19.20 |
| Cash flow of the fund generated from operations with innovative enterprises, (M) | -3.00 | -7.00 | -7.00 | -9.60 | -5.60 | 47.87 | 53.47 | 53.47 |
| Fund assets – cost of fund share in innovative enterprises | 3.00 | 10.93 | 22.42 | 44.34 | 80.60 | 122.59 | 97.67 | 53.47 |
| Management fee | 0.09 | 0.33 | 0.67 | 1.33 | 2.42 | 3.68 | 2.93 | 1.60 |
| Cash flow from the fund to the government (F=M – management fee) | -3.09 | -7.33 | -7.67 | -10.93 | -8.02 | 44.19 | 50.54 | 51.87 |

As the table shows, to assess the fund assets and further payouts of the management fee, the management company doesn't need cost of the fund money assets. Calculations of the costs of the fund assets are given in the following table. While calculating figures, the interpolation

method has been applied. It is necessary to note that due to the «commitments» principle, in the framework of this model cash flows of the fund are not taxable while calculating costs of assets.

Table 4. Cost of the share fund in innovative enterprises under the realistic scenario, billion UZS

| Placement type | Year | | | | | | | |
|--|------|--------|--------|--------|--------|--------|--------|--------|
| | 0 | 1-year | 2-year | 3-year | 4-year | 5-year | 6-year | 7-year |
| 3 unsuccessful start-ups | 0.90 | 1.65 | 0.83 | 0.41 | | | | |
| 3 medium profitable start-ups | 0.90 | 2.37 | 3.08 | 6.41 | 8.33 | 10.82 | | |
| 3 highly profitable start-ups | 0.90 | 2.82 | 5.08 | 11.54 | 20.77 | 23.45 | | |
| 1 superprofitable start-up | 0.30 | 1.09 | 2.51 | 6.57 | 15.10 | 19.20 | | |
| 3 unsuccessful start-ups | | 0.90 | 1.65 | 0.83 | 0.41 | | | |
| 3 medium profitable start-ups | | 0.90 | 2.37 | 3.08 | 6.41 | 8.33 | 10.82 | |
| 3 highly profitable start-ups | | 0.90 | 2.82 | 5.08 | 11.54 | 20.77 | 23.45 | |
| 1 superprofitable start-up | | 0.30 | 1.09 | 2.51 | 6.57 | 15.10 | 19.20 | |
| 3 unsuccessful start-ups | | | 0.90 | 1.65 | 0.83 | 0.41 | | |
| 3 medium profitable start-ups | | | 0.90 | 2.37 | 3.08 | 6.41 | 8.33 | 10.82 |
| 3 highly profitable start-ups | | | 0.90 | 2.82 | 5.08 | 11.54 | 20.77 | 23.45 |
| 1 superprofitable start-up | | | 0.30 | 1.09 | 2.51 | 6.57 | 15.10 | 19.20 |
| Cash flow of the fund generated from operations with innovative enterprises, (M) | 3.00 | 10.93 | 22.42 | 44.34 | 80.60 | 122.59 | 97.67 | 53.47 |

Under the realistic scenario, the IRR of the fund amounts to 43%. Similar calculations show the IRR of the fund accounts for approximately 34%, for the pessimistic scenario and approximately 53% for the optimistic scenario (see Figure 1).

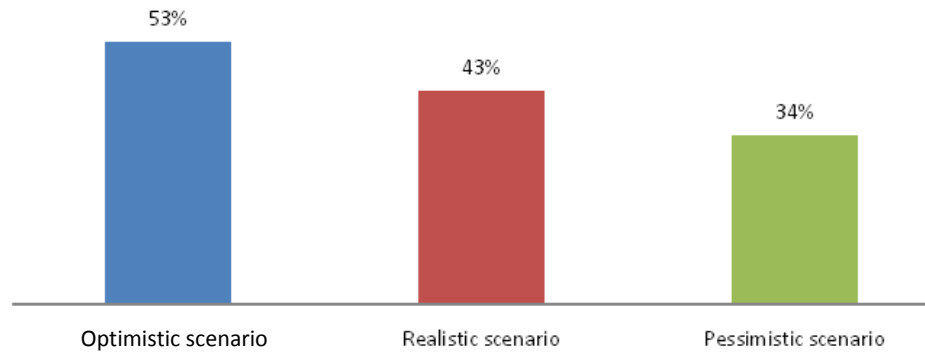


Figure 1. IRR value depending on the scenario

Figure 2 allows comparing the value of different assets under different scenarios.

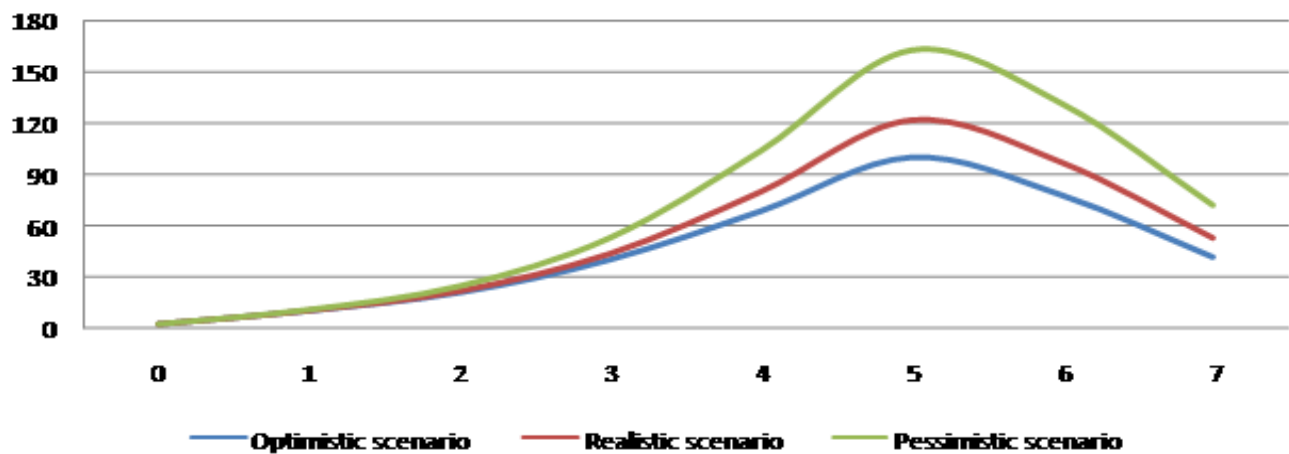


Figure 2. Dynamics of the venture fund assets cost for different scenarios

Basing on the results it is possible to make a conclusion that at the end of the experimental period, the venture fund will be financially robust. Even under the pessimistic scenario without superprofitable projects, venture fund profitability will exceed the profitability of the law-risky portfolio of investment assets.

In the model an aggregate profit of the fund comprises 2 parts: hurdle profit of the government and additional profit. In the model the difference between them is that the hurdle is repaid to the government in the full amount, but AP is divided in correlation of 80/20 between the government and a managing company correspondingly (carried interest, CI).

In the model the hurdle is calculated with the account of annual 7%. The profit S_{hurdle} earned by the enterprise is calculated according to the following equation

$$0 = -I_0 - \frac{I_1}{1 + 0,07} - \frac{I_3}{(1 + 0,07)^3} + \frac{S_{hurdle}}{(1 + 0,07)^5}$$

For the unsuccessful start-up S_{hurdle} is equal to 945.08 million UZS, and for other categories of innovative enterprises the volume accounts for 1.86 billion UZS.

Table 5. Venture fund profit, billion UZS

| Funds received by the government | Year | | |
|--|-------|-------|-------|
| | 5-th | 6-th | 7-th |
| Realistic scenario | | | |
| Cash flow from the fund to the government, F | 44.19 | 50.54 | 51.87 |
| Aggregated Hurdle | 15.86 | 15.86 | 15.86 |
| Additional profit (AP=F-Hurdle) | 28.33 | 34.68 | 36.01 |
| Carried interest (CI=20%*AP) | 5.67 | 6.94 | 7.2 |
| Pessimistic scenario | | | |
| Cash flow from the fund to the government, F | 33.48 | 39.74 | 40.82 |
| Aggregated Hurdle | 15.86 | 15.86 | 15.86 |
| Additional profit (AP=F-Hurdle) | 17.62 | 23.88 | 24.96 |
| Carried Interest (CI=20%*AP) | 3.52 | 4.78 | 4.99 |
| Optimistic scenario | | | |
| Cash flow from the fund to the government, F | 61.37 | 68.71 | 70.49 |
| Aggregated Hurdle | 16.78 | 16.78 | 16.78 |
| Additional profit (AP=F-Hurdle) | 44.59 | 51.93 | 53.71 |
| Carried Interest (CI=20%*AP) | 8.92 | 10.39 | 10.74 |

4.2 ANALYSIS OF BUDGET EFFECTIVENESS

Upon completion of the fund's activities 21 enterprises will appear, 3 of them will be superprofitable, 9 – highly profitable, 9 – medium profitable. As amounts of the profit expected by these enterprises are different, turnovers of these enterprises are also supposed to be different. An approximate annual turnover of the enterprise equals to $2 \times (\text{enterprise cost})$. The following table represents the main characteristics of the enterprise.

Table 6. Market characteristics of the enterprises after 5 years since investing start-ups

| Type of enterprise | Main characteristics | | | |
|--------------------|--|-------------------------|---------------------|------------------------|
| | Cost of share fund (50%) when leaving an innovative enterprise | Price of the enterprise | Turnover= (2×Price) | Profit (30%× Turnover) |
| Medium profitable | 3.61 | 7.22 | 14.44 | 4.33 |
| Highly profitable | 7.82 | 15.64 | 31.28 | 9.38 |
| Superprofitable | 19.20 | 38.4 | 76.8 | 23.04 |

An aggregate annual turnover of the enterprises amounts to: $9 \times 14.44 + 9 \times 31.28 + 3 \times 76.8 = 641.88$ billion UZS. One of the sources of replenishing the budget is the value added tax (VAT) which current rate is 20%. As a consequence, the state budget will receive 128,376 billion UZS.

If the profit of each enterprise is supposed to make 30% from the turnover volume, an aggregate annual profit will be equal to $641.88 \times 30\% = 192.56$ billion UZS and 10% profit tax is levied on this sum. So tax receipts will make $192.56 \times 10\% = 19.256$ billion UZS.

One enterprise is supposed to have 20 employees and an average salary accounts for 1.0 million UZS. In this case an annual salary fund will amount to: $20 \text{ people} \times 21 \text{ enterprise} \times 12 \text{ month} \times 0.001 \text{ billion} = 5.04$ billion UZS. Then taking into consideration regressive tax rates of the income tax paid by individuals in Uzbekistan, a total amount of the income tax will make 564.48 million UZS. Also, social payments in the amount of the salary equal to $5.04 \times (25\% + 7\%) = 1.612$ billion UZS will be accrued.

Hereby, annual receipts from invested enterprises to the budget will make 149.809 billion UZS. So we can make a conclusion, that innovative enterprises prepared by the venture capital fund, will bring significant revenues to the state budget and targeted extrabudgetary funds.

5. Discussions and conclusion

Conclusions made on the review of scientific results of researches conducted by leading economists illustrate that public financing on the grant basis on the initial stages promote innovative enterprise development and its successful transition from seed to start-up stage. However, the most efficient method of innovations financing on start-up stage which involves organization of the overall production and commencing operations in the market, is the financing based on the principles of the venture capital fund.

Taking into account low economic and public benefits from the allocated grants, the Committee of Uzbekistan should stop granting a big number of projects via “Public fund for supporting scientific technical activity”, and it is recommended to finance start-up projects as funds of venture capital. In this case funds given from the state budget will be used more efficiently and effectively (from the point of view of further commercialization of innovations). Our results of empirical analysis showed that the Fund would get its own income and its activity would be more profitable even than medium-profit investment funds. The fund IRR is expected to be 34% under the worst scenario, but in average – 43%.

As a result, if the government leaves the public fund received income, after several years the Fund will be able to hold its own current assets for further investing and not to expect to get additional financial support from the state budget. In future, the government will be able to allocate money only with the aim to promote the increase of the volume fund’s resources and to strengthen its financial stability.

Herewith, the government can reimburse the amounts which are 3.5 times more than the sums of money allocated by the innovative enterprise via the fund in the form of revenues received from investing in innovation start-ups, tax receipts and other compulsory deductions.

This research represented the modeling of the activity of the public fund of venture capital in conditions of Uzbekistan. The author assumes that the results obtained would be more reliable if we took into consideration the results of the practice of the countries which conditions of economic development were closer to our country, like Kazakhstan, Belorussia, Azerbaijan, etc.

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