

Transaction Cost of Financing Knowledge-Based Companies in Iran

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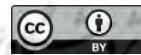
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Abstract

High transaction costs have been cited as limiting access to credit in developing countries. This issue is much more critical for knowledge-based companies due to their position in accelerating economic growth and the particular characteristics of these companies. Therefore, this research aims to evaluate the transaction cost of financing knowledge-based companies from an official fund in Iran that provides financial support for innovations and technologies. The data was collected through interviews and questionnaires in a sampling of knowledge-based companies in 2022. In this study, after

calculating the transaction costs of financing, the effect of the factors affecting it has been investigated. The investigated sample was 123 companies from the fund's customers. The results showed that, on average, the ratio of transaction cost to the facility, transaction cost rate, total cost rate (transaction cost and interest rate), and the ratio of transaction cost to interest rate are equal to 3.33, 7.04, 15.66, and 0.81, respectively. Based on the results, the facility amount, the number of payment steps, the distance between the request for the facility and the contract, the interest rate, and dummy variables for the type of facility have a positive and significant effect on the transaction cost.

Keywords: Transaction Cost, Financing, Knowledge-Based Companies, Iran.

Introduction

Contrary to the opinion of classical economists, who assumed that trade has no additional costs, economic exchanges have exchange or transaction costs. Transaction cost is imposed on the individual, group, or organization to control the behavior and monitor the exchange when doing economic activities with other people (Williamson, 1996). Due to the importance of transaction cost, Coase proposed transaction cost economics in the 60s. This attitude, contrary to the traditional theory of neoclassical economics, assumes that trade or exchange does not occur in a frictionless environment. This branch of new institutional economics teaches that institutions are arrangements that minimize transaction costs. In his study -the discourse of new institutionalists - North introduced the transaction cost as one of the main obstacles to development in third-world countries (Libecap, 2018). Transaction costs play an essential role in economic performance, So the accumulation of knowledge, specialization, division of labor, and the prosperity of trade have an inverse relationship with the per capita costs of exchanges (Fathollahi et al., 2014; Tayebi & Zamani, 2016). Moreover, on the contrary, with the increase in transaction costs, economic efficiency is reduced, and entrepreneurs leave the field of productive entrepreneurship and tend towards unproductive entrepreneurship (Khaleghifar et al., 2014; Nasiri et al., 2016).

By developing and strengthening the position of institutional economics among economic schools, researchers tried to use this literature to use this thinking in various fields, "including monetary and banking issues," and several studies tried to use this new intellectual framework. In this context, Gabre-Madhin (2001) states that in economic systems with high transaction costs, especially in developing countries, inefficiency in credit markets creates problems regarding the customer's ability to benefit from economic situations in the financial market entirely, significantly reducing the markets' efficiency.

Transaction costs in developing countries are high, especially in the credit sector. The high cost reduces the efficiency of the banking system and its performance; on the contrary, reducing transaction costs increases financial development (Arabmazar et al., 2016; Aqeli et al., 2016). In this way, the cost of the exchange imposed on the other side of the exchange, both from the perspective of the general benefit of the society (functioning of the economic system) and from the perspective of the specific benefit of companies and organizations, can be considered and should be taken into consideration. In the context of the credit system, reducing transaction costs can provide increased access to financial services, reducing poverty and welfare (Burgess & Pande, 2005; Suri & Jack, 2016).

Meanwhile, the transaction cost of financing knowledge-based companies is more important for two reasons. First, knowledge and knowledge-based companies are known as the symbol of the presence of knowledge in the economy, the main factor of production, prosperity, and the engine of economic growth in knowledge-oriented and developing societies (Burke, 2000). The economies that use innovation and knowledge grow and develop faster, and the companies with significant financial performance than their competitors use innovation and knowledge (GhaffariFard & MalekiNasr, 2021). Therefore, financing knowledge-based companies is very important because of their position in accelerating economic growth and development, especially in developing countries. Secondly, knowledge-based companies need help accessing financial resources and the usual transaction cost. Some of these problems are self-imposed, and others reflect lending and financing policies that often limit the ability of these companies to access various sources of debt and facilities. Risk assessment methods, especially for lending institutions, are based on traditional models that often emphasize collateral and the company's track record. The main problem of knowledge-based companies is that the capital-based approach to assessing facility risk limits their ability to access bank financing. For many companies, their primary assets are intangible and difficult to value, so they cannot meet the requirements of asset-based security. This problem is exacerbated for the startup company by the need for more history and the difficulty of making reliable estimates of the company's future performance. The final result is the mismatch between organizational guidelines and policies and the reality of the new knowledge-based company (Gorman, 2002), which affects the transaction cost of these companies.

In order to reduce the transaction cost of knowledge-based companies, one should be aware of the structure and amount of their transaction costs. In this regard, first, it should be determined how much cost companies incur on

average to receive facilities (in absolute and percentage form), what components these costs consist of, and what components play a role in determining them. By knowing the transaction costs of the companies by different stages of the processes, it is possible to determine the costlier stages and identify the factors affecting them. In this way, the financing structure of these companies can be revised and redesigned to facilitate and reduce the cost of granting facilities. In this way, to know the current situation, this research seeks to evaluate the transaction costs imposed on the recipients of facilities (knowledge-based companies) from an official fund in Iran that provides financial support for innovations and technologies. Furthermore, it checks the possibility of reducing it by identifying and analyzing these costs.

Literature Review

Considering the nascent nature of institutional economics and transaction cost literature, most early studies were descriptive. They developed theoretical foundations that were considered in the literature review section of this research. After the institutional branch of economics grew and developed, the efforts to use it in empirical studies became more robust. Despite the need for a more specific and comprehensive methodology in this field, several studies have been conducted in recent decades.

The concept of transaction cost - although not explicitly - was introduced in the article "The Nature of Firm" by Coase in 1937 as "the cost of using the price mechanism" (Coase, 1937). He did not define the transaction cost and only mentioned some of the costs or disadvantages of the price mechanism, such as determining the prices, negotiating and concluding the contract, and their implementation. He also stated in his Nobel speech that "I think that what will be focused on in the future as the main contribution of this article will be the inclusion of transaction costs in economic analysis" (Coase, 1992). Arrow, the Nobel Prize in Economics winner in 1972, is one of the pioneers in the field of transaction costs. He believed that "transaction costs cause delays in the formation of markets and, in certain cases, completely prevent this issue. Often - but not always - it is emphasized that the transaction costs are the costs of running the economic system." (Arrow, 1970). According to Arrow, "market failure is a special case in which transaction costs are so high that the existence of the market is no longer profitable." Dahlman (1979), accepting the implicit definition of Coase (1960), categorizes these costs into three groups: search and information costs, bargaining and decision costs, and law enforcement costs. He then argues that their source is the same: "We have to deal with a kind of transaction cost: the waste of resources due to incomplete information.

(Dahlman, 1979).

Williamson (1985a) states that transaction costs have the same role in economics as friction has in physics. He divided these costs into front and back costs, where the first type occurs before the exchange (discussion and conclusion of the contract), and the second type is imposed after the exchange (supervision and follow-up of receiving compensation in case of non-compliance with the contract terms). He says in another place: "Transaction cost is the economic equivalent of friction: do the two trading parties work in harmony or do they have many misunderstandings and conflicts that lead to delays or failures and other problems in trading?" (Williamson, 1985b).

Williamson (1991) preferred Arrow's definition of transaction costs as the costs of operating the economic system, followed by the costs of bargaining, measurement, and non-commitment. From Eggertsson 's point of view, " transaction costs, in general, are the costs that are found when exchanging property ownership rights and exercising these special rights." There is no clear definition of transaction costs, but production costs must also be fully defined in the neoclassical model. (Eggertsson, 1990). He also says: "In the conditions of information being costly, various activities related to trading property rights between individuals cause transaction costs." These activities include: (1) searching for information about the distribution of prices and quality of products and labor inputs and searching for potential buyers and sellers and related information about their behavior and location; (2) bargaining necessary to find the true position of buyers and sellers when prices are endogenous; (3) regulation of contracts; (4) monitoring both parties to the contract to ensure adherence to the terms of the contract; (5) applying the contract and receiving compensation in the conditions of non-compliance of both parties to the obligations; and (6) protection of property rights against encroachment by third parties (thieves or even government expropriation in illegal cases).

Adams and Nahman (1979) consider the credit price the net of real costs imposed on borrowers when receiving a loan. According to them, borrowing costs have three components: the nominal interest paid to the lender, the transaction costs of receiving the loan, and the change in the purchasing power of money during the period of loan consumption. Also, three types of transaction costs for borrowers in low-income countries are considered weak: (1) costs paid to the lender in addition to interest costs (such as filing fees, the obligation to purchase other lender services, compulsory deposits, bribes, and interest deductions at the time of lending)); (2) Expenses paid to third parties (for coordination in order to receive a loan or preparation of technical reports

and bribery) and (3) Expenses spent on the borrower's time and travel during the period of receiving and repaying the loan. Saito and Villanueva (1981) divided the transaction costs of lending into two general parts: administrative cost and non-repayment risk cost. The administrative cost is directly spent on processing, paying, and managing the loans, and the risk of non-receipt is caused by the loans being overdue and burned. Also, administrative expenses are considered to include salary, consumables, and rent, which include direct expenses and a share of the expenses of support departments. Non-repayment risk expenses also include the expenses of doubtful reserves, the expenses of guaranteeing loans, and the real fuel of loans. By improving the accuracy of evaluating requests and monitoring loans, and following up on claims, the costs of the second type are lower, but the costs of the first type are higher. From their point of view, the effective cost of the loan for the borrower (or the effective gross return for the financial institution) has three components: the interest rate paid to the debts, the rate of return on the capital of the owners of the institution, and the administrative costs of managing assets and liabilities. The last part of the administrative costs and the costs of covering the risk of non-collection of loans, the loss of investment in bonds, and any expenses paid for the insurance of loans and deposits are included. Therefore, the effective bank loan rate equals net profit plus interest and transaction costs.

Yedra (1996) calculated the transaction cost of lending in the Philippines and compared his results with findings for Bangladesh and two Latin American countries. The findings showed that for most institutions, the transaction costs of lending are between 11 and 20 percent. Gorman (2002) evaluated the financing of knowledge-based businesses (KBBs) and showed that KBBs need help to obtain financing from formal banks. In addition, KBBs see banks following traditional risk assessment processes emphasizing collateral. Findings show that banks' efforts to provide services to KBB have been less successful.

Rweyemamu et al. (2003) conducted a study in Tanzania to assess the effect of borrowers' transaction costs on loan repayment. The results show that the payment costs have been the highest in three consecutive years, and these costs show an increasing trend over the three years. In the mid-1980s, attention shifted from the transaction costs of lending to specific customers to the transaction costs of borrowing (travel expenses, collecting and presenting documents, and additional legal fees to guarantee the loan and lost income due to inactivity during the negotiation period).

Considering the severity of poverty in Sri Lanka and the importance of micro-businesses in helping to improve the economic situation of people

experiencing poverty, Chulangani and Ariyawardana (2007) have analyzed the costs of receiving facilities by micro-enterprises from public and private financial institutions in Nuwara Eliya, Sri Lanka in 2006. According to them, access to facilities is essential for securing micro-enterprises capital, but these enterprises need help accessing the conventional capital market like large enterprises. Although governments lower the interest rate of facilities for these companies, other requirements, such as filing a case and providing guarantor and collateral, increase the transaction costs and bring the borrowers' costs to the level of the cost of other loans. Due to this issue, in many new plans for granting facilities, efforts are made to reduce the transaction costs of small borrowers. The goal of these researchers is to measure and compare these transaction costs.

Nissanke & Aryeetey (2008) conducted an institutional analysis of African financial markets. In their study, transaction costs for different types of lenders were calculated separately for administrative costs (inspection costs, monitoring costs, and enforcement costs) and non-collection costs. The results of the study mentioned above for the country of Ghana show that commercial banks focus more on inspection costs. Nigerian banks have allocated relatively less share to inspection, and most of their expenditure is related to supervision and enforcement. They allocate less than 15% of the administrative cost of the loan to inspections, and the remaining 85% is split equally between monitoring and loan enforcement.

Kakuru (2008), concerning the financing of small and micro enterprises (SMEs), showed that, in most cases, borrowers who know bank lending guidelines and procedures have easier access to credit than their counterparts who lack this knowledge. They found that for women-owned SMEs (while there is little evidence of formal discrimination against women-owned SMEs by bank lending policies), it was shown that there are systemic, cultural, social, and legal barriers that most companies face. It pushes women-owned SMEs to access lower levels of credit.

Nguvava & Ngaruko (2016) showed that the most critical factors determining transaction cost include a high illiteracy rate (lack of entrepreneurial and financial management skills), weak infrastructure, unclear political will and commitment to rural development, culture barriers (tradition and customs) and the absence of a national identification system. Also, under the credit operations of commercial banks in Tanzania, the monitoring of credit contracts and transaction execution costs have been the highest category of transaction costs.

Liu et al. (2016) have investigated loan guarantees and the cost of debt in China. In their paper entitled "Loan guarantees and the cost of debt: Evidence from China," they examined the potential effect of loan guarantees and the nature and type of ownership on companies' debt cost. For this purpose, they used a sample of Chinese stock companies listed in the Shanghai and Shenzhen stock markets. They show that guaranteeing the debts of other firms significantly increases the debt costs of the guaranteeing firm itself. When companies have contingent liabilities (guaranteed the loans of others), the lending banks demand a higher interest rate to compensate for the risk of guaranteeing the loans of others.

Harder (2017) has evaluated the ability of blockchain technology to reduce transaction costs in financial markets. His results showed that smart contracts reduce moral hazard and adverse selection problems by automating trading processes, reducing information asymmetry, and increasing market transparency. This study highlights that banks can help fintech startups scale and achieve critical mass while benefiting from their technological expertise.

Ahluwalia et al. (2020) studied the impact of blockchain technology on the transaction cost of startup financing. They have used transaction cost theory and the transactional nature of blockchain technology to propose a model to show how and why applications based on blockchain technology are effective. They have concluded that startup financing is an inefficient ecosystem where transaction costs are very high. The prevailing inefficient system has also resulted in a system where locational advantages prohibit the development of entrepreneurial firms in areas needing a solid network of financial stakeholders such as banks. The inefficiency of the ecosystem is partly due to the specialization of financial intermediaries, such as funds and institutions that specialize in a specific industry or stage of entrepreneurial investment. They believe the entrepreneurial ecosystem is ripe for using blockchain technology to address inherent inefficiencies.

Boulahbel (2021) states in his study that in its current form, Islamic finance only exists for financing startups and small companies. In this study, Boulahbel highlighted the development of Islamic crowdfunding, discussed the problematic areas that should be dealt with in the future, and showed the process of Islamic crowdfunding with the case of the "Shekra" platform. This article concluded that startup financing carries the core values of Islamic finance and provides the basis for new developments in this field. However, the number of Islamic investment platforms in Muslim countries is very low, and their growth is due to the lack of a suitable and capable legal framework, problems related to the Internet and digital payment penetration, online legal

transactions, Sharia screening process, and lack of awareness and uncertain trust is limited.

The review of previous studies indicates that despite the researchers' attention to the transaction cost of providing credits and especially the financing of knowledge-based companies, the transaction cost of financing knowledge-based companies has yet to be measured and explained. Therefore, this research accurately calculates the transaction cost of granting facilities to these companies, identifies the processes and factors affecting it, and provides ways to reduce this cost.

Research Methodology

A credit exchange is the payment of a loan item and its collection in one or more installments. Such an exchange starts with receiving and registering the credit applicant's request. After passing through the stages, it reaches the payment of facilities to the applicant (in case of loan approval). A simple picture of the process of a credit exchange of the studied fund can be seen in Figure (1). In this diagram, the flow of credit exchange starts from the application acceptance stage. In this step, the information related to the company, the application, and related documents are completed and received, and finally, the stamped and signed worksheet is sent to the fund. The second step is to evaluate the request for facilities of knowledge-based companies. In this step, the application information (company, application, plan/product, related documents) is carefully examined by an expert. Finally, the proposed facility is sent to the relevant committee, which is the authority to approve the services, according to the various aspects of the plan. (Request evaluation may be done internally or outsourced by fund brokers). The third step of receiving facilities from the fund is the approval process.

At this stage, the credit report of the plan and proposal of the facility is reviewed by the members of the related committee and evaluated and defended by the trustee area. Finally, the relevant approval is issued and communicated to the company by the related deputy. Then, in the fourth step, according to the issued resolution, the contract is concluded. After completing the file, completing the attachments and taking documents, and examining other related legal issues, the contract is signed by the parties. In the next step, if there is no condition for the first payment in the resolution after signing the contract, the first payment is made with the approval of the relevant deputy. Monitoring is carried out if the payment is multi-stage to confirm the following payment stages. In the last stage, after the completion of the payment and the breathing

period according to the decree, the refund is made according to the refund checks received from the recipient of the facility and based on the claims collection process.

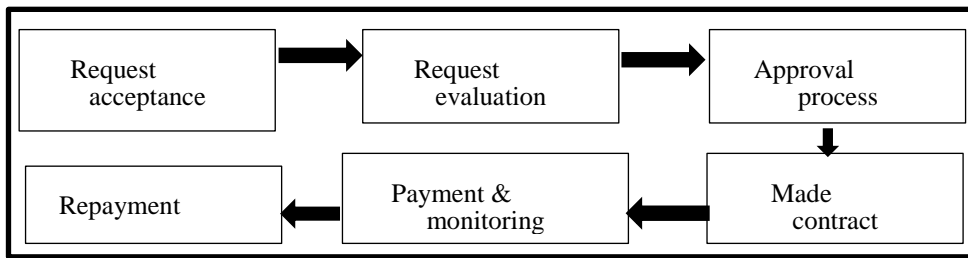


Figure 1. The general process of a credit exchange in the fund

Financial facilities, like any other goods or services, have a profit (or fee) price. Therefore, the transaction cost in the credit market means costs other than the price or profit of the facilities imposed for the exchange of each item of facilities. On the side of the demand or the borrower, these costs are called the transaction cost of borrowing. In terms of nature, these costs can be divided into two general categories: direct costs (cash) and indirect costs (non-cash); the indirect type mainly includes the types of opportunity costs of time spent on obtaining facilities. In more detail, the transaction cost items for receiving facilities are as follows:

- 1) Direct costs of receiving facilities: all costs charged directly during applying to the fund (or bank) and receiving facilities, Such as travel expenses, the cost of preparing the necessary documents for filing the case, and administrative costs.
- 2) Indirect costs (non-cash) of receiving facilities: This part of the costs are the opportunity costs of the time spent to receive facilities, which is caused by lost time. These costs can be divided into two groups: evident and hidden costs. Borrowers have to spend some time to receive facilities, from searching and submitting the application to receiving it and then paying the installments, which could be used in other income-generating options in the affairs of the borrower's business or job. These times include apparent costs. By estimating the total time required for a financial transaction (for example, by multiplying the number of hours per referral by the total number of referrals), it can be multiplied by the opportunity cost of one hour of the customer's time (for example, his average potential salary). The opportunity cost of receiving an item of facilities to achieve, but hidden costs include the time spent waiting to

receive facilities. Considering the time-consuming process of obtaining facilities from the fund and the high inflation of Iran's economy, the opportunity cost of this type of cost is very high, and due to the lack of sufficient data and information, these costs have not been quantified.

If we represent the transaction cost of a customer with TC, this cost will be equal to the sum of various items, each of which we represent with c_i . So we can write:

$$TC = \sum_i c_i ; \quad i = 1, 2, \dots, n \quad (1)$$

In this way, following the evaluation of the transaction costs of receiving facilities for each company, it is time to categorize and collect them. Based on this, the most essential part of the work is the statistics of the cost items and their accurate estimation; the other parts will be easy. Since several companies will be referred, it is possible to average the transaction costs for different facilities and the entire facility. In other words, the average transaction costs of receiving facilities from the studied fund will be equal to the average costs of all the companies in the sample, which can be categorized into different facilities, and the average transaction cost of each facility can be obtained. The transaction cost calculated by the above method for each company is related to the total facilities received. This cost can also be evaluated as a ratio or percentage, which shows how much it costs that company to receive each rial of loan from the fund. The algebraic expression of this issue is in equation 2 (Rojas & Rojas, 1997; Hosseini et al., 2012).

$$TC_p^r = TC_p / L_p \times 100 \quad (2)$$

where p represents the company, r represents the transaction cost percentage, and L also represents the amount of the received loan. So far, it is clear that the path company has incurred a percentage of the transaction cost to receive a loan in the amount of L Rials; Deducting the transaction cost from his loan amount will show the result of the received loan.

Another useful indicator in analyzing the transaction cost of receiving facilities is comparing the transaction cost with the price (profit or fee). The problem is that the transaction cost is calculated at the present time (at the current year's price), and it should be corrected to be comparable with the interest rate. These costs are mainly imposed during the filing period, and the rest of the items will be estimated based on the opportunity cost of the present

time. Therefore, transaction costs are estimated at the current year's price and for the total facility received. It is done in the following manner to convert these costs into an index comparable to the interest rate (or fee). Imposing the amount of TC as a transaction cost at present (or at the time of receiving the loan) on the company can be considered in such a way that the net loan received by him is equal to the difference between the nominal facility and the transaction cost of receiving it:

$$NL = L - TC \quad (3)$$

Finding the interest rate that gives the same installment amount for the net facility is necessary. In other words, the interest rate should be raised so much that the loan installment equal to NL Rials leads to the same number of installments for each borrower. This new interest rate is called the effective interest rate (r^*), and its difference from the official interest rate is called the transaction cost rate. This rate is calculated using Equation 4. In relation α_t , 4 is the repayment of the facility, t is the period, and n is the number of months of the repayment of the facility (Hosseini et al., 2012).

$$NL = \sum_{t=1}^n \left[\frac{\alpha_t}{(1+r^*)^t} \right] \quad (4)$$

$$r_{ic} = r^* - r \quad (5)$$

is the transaction cost rate and is now comparable to the official interest rate. It is also noted that the formula used in some contracts (as well as unequal distribution) is different; therefore, the same formula will be used in this section as well. This rate is also calculated for each company separately, similar to the absolute amount of transaction costs, and then it will be averaged for contracts and all companies. In order to better analyze the transaction cost dimensions of knowledge-based companies, after calculating the transaction cost, the factors affecting it can be investigated in the framework of econometric analysis. Equation 6 shows its general model:

$$TC_p = f(X_p^p, X_p^l) \quad (6)$$

where TC_p is the transaction cost of receiving facilities by company p (or the corresponding rate) and the vectors X_p^p and X_p^l , respectively, indicate the variables of company characteristics (company capital, type of basic knowledge of the company) and loan characteristics (facility amount, the

distance between the application and the conclusion of the contract, interest rate, the type of the facility).

The Statistical population of this research includes all the customers of the studied fund facilities. The intended sample was extracted from among the fund beneficiaries using a multi-stage random sampling method. Because the scope of the research is related to all the payment facilities given to the companies in the form of a contract, the size of the studied facilities is entirely different. It will include all the knowledge-based companies of the applicant. The total number of facilities granted by the fund has been almost 2000, from which information on the facilities of 200 knowledge-based companies has been obtained from the fund. Out of this number, 123 companies were interviewed, and the design questionnaire was completed and entered into the analysis process.

Data Analyses

Descriptive statistics of the facilities provided to the investigated companies according to the type of facilities are reported in Table 1. According to this table, working capital facilities and prototyping include the most significant facilities, accounting for 70.73% of the investigated facilities. The average amount of working capital facilities, industrial production activities, prototyping, and leasing equals 34.34, 67.43, 3.7, and 15.57 billion rials, respectively. The minimum loan amount is related to leasing facilities and equals 0.35 billion Rials. The maximum amount of facilities provided is related to facilities for industrial production activities and is equal to 410 billion Rials. The average interest rate of working capital facilities and industrial production activities is 11 percent, and the average interest rate of prototyping and leasing facilities is 4 and 9.57 percent, respectively.

Table 1. Descriptive statistics of paid facilities by type of facility

Type of facility	Number	Average (billions of Rials)	Min (billion Rials)	Max(billion Rials)	Average interest rate (percentage)
Working capital	49	34	2.3	200	11
Industrial production activities	17	67	2.44	410	11
prototyping	38	3	0.6	17	4
Installment sales (leasing)	19	15	0.35	140	9.57

Source: Research findings

In the following, the transaction cost of the studied companies is presented and analyzed separately by loan size groups. First, the facilities are quartered based on the contract amount and divided into 4 groups. The first group includes facilities less than 2800 million Rials, the second group includes facilities that are between 2800 million Rials and 10 billion Rials, the third group includes facilities that are between 10 billion Rials and 27 billion Rials, and finally, the fourth group of loans Those that are more than 27 billion rials.

By measuring the transaction costs of different stages and separating the results into different groups according to the loan amount size, Table 2 reports the average facility, interest rate, and facility transaction cost and its ratio according to the loan size group.

Based on this table, the average transaction cost ratio to facilities for the studied knowledge-based companies was 3.33%. This means that the companies receiving the facility, in addition to paying the nominal interest rate of the facility, which has different rates depending on its type, also lost 3.33% of the received loan amount due to the transaction cost. Returning the transaction cost to the same rate as the interest rate can give a more accurate picture of transaction costs. The calculation of transaction cost rate for the whole sample was equal to 7.04%, and the average ratio of transaction cost rate to profit rate for the whole sample was calculated as 0.81. However, as can be seen, while the transaction cost for facilities less than 2800 million rials is 78.38 million rials, this amount for loans more significant than 27 billion rials reaches 46411.84 million rials on average.

Despite this direct relationship between the transaction cost and the loan amount, the transaction cost ratio has an inverse relationship with the loan amount, so the highest transaction cost ratio of 5.68 percent, belongs to Group 1 facilities (less than 2800 million Rials) and the lowest transaction cost ratio with 31. 1% is assigned to large loans (more than 27 billion rials). Based on the obtained results, the transaction cost rate of Group 1 is also higher than other groups, and the lowest transaction cost rate is related to Group 4.

As seen in the eighth column of Table 2, the total cost rate of group 3 facilities is higher than other groups and is equal to 19.14%. This rate is the lowest for group 2 facilities, equal to 12%. The ratio of the transaction cost rate to the profit rate, which shows the importance of the transaction cost compared to the nominal cost of the facility, for group one, i.e., facilities less than 2800 million Rials, has the highest value and shows that the transaction cost of this facility On average, it is 154% more than the interest cost of the facility.

Table 2. Average facility, interest rate, and transaction cost estimated by facility group

	Number of facilities	facilities (million Rials)	nominal interest rate (%)	transaction cost (million Rials)	transaction cost to facility ratio (%)	transaction cost rate (%)	Total cost rate (%)	the ratio of the transaction rate to the interest rate
Group 1	31	1471.48	6	78.38	5.68	9.29	15.29	1.54
Group 2	33	4498	6.68	120.36	3.64	5.32	12	0.79
Group 3	29	16085.31	10.20	496.79	3.24	8.94	19.14	0.87
Group 4	30	84822.33	10.8	787.62	1.31	4.90	15.7	0.45
Total	123	3266190	8.62	46411.84	3.33	7.04	15.66	0.81

Source: Research findings

In the following, the results of calculating the transaction cost and its parameters according to the type of facilities are reported in Table 3. As can be seen, the highest average amount of facilities is related to the facilities of industrial production activities. In the same way, the average transaction cost of this type of facility is also higher than other facilities. Based on the obtained results, the transaction cost ratio to the facility amount is higher in prototyping facilities than in other facilities, and leasing facilities are ranked last in this regard.

The facility transaction cost rate results in the eighth column of Table 3 below show that the highest transaction cost rate and the total cost are related to working capital facilities. Also, the lowest transaction and total costs are related to industrial production facilities and prototyping facilities, respectively. The results of the transaction cost rate ratio to the interest rate also show that the transaction cost rate for prototyping facilities is about 2 times the nominal interest rate of the facility. For other facilities, this ratio is less than one.

Table 3. Average facility, interest rate, and transaction cost estimated by type of facility

	Number of facilities	facilities (million Rials)	nominal interest rate (%)	transaction cost (million Rials)	transaction cost to facility ratio (%)	transaction cost rate (%)	Total cost rate (%)	the ratio of the transaction rate to the interest rate
Working capital	49	34348.45	11	597.56	2.85	9.09	20.09	0.82
Prototyping	38	3703.95	4	138.81	4.64	8.06	12.06	2.01
Industrial production activities	17	67438	11	652.08	3.36	4.46	15.46	0.40
leasing	19	15574.73	9.57	55.72	1.9	7.04	16.61	0.73
Total	123	3266190	8.62	46411.84	3.33	7.04	15.66	0.81

Source: Research findings

In the next section, we identify the factors affecting the transaction costs of knowledge-based companies. For this purpose, econometric models are used. Based on this, the econometric models of identifying factors affecting the transaction cost are fitted in two ways. In the first model, the effect of various studied factors on the "transaction cost amount" is investigated. In other words, the dependent variable in the first model is the Riyal amount of costs imposed on companies when receiving facilities. In the second model, the "transaction cost ratio" is included as a dependent variable, and the effect of various factors is measured on it. In this research, different forms of econometric models were used and tested. Finally, the Cobb-Douglas model was recognized as the most suitable form, and all the estimated models follow this form. The logarithm of the variables has been used for the linear estimation of the coefficients of this econometric model. Also, to ensure the results of econometric models, their correctness in terms of collinearity, heterogeneity of variance, autocorrelation and normality, and the form of specification of the model have been considered.

Table 4 shows the results of estimating influencing factors on the amount of transaction cost of the studied companies. As can be seen in this table, the variables of the amount of the facility, the number of payment steps, the

distance between the request for the facility and the contract, the interest rate, the dummy variable of the working capital facility, dummy variable of the prototyping facility and dummy variable of the facility of industrial production activities have a positive and significant effect on the amount of the transaction cost.

In other words, with the increase of the facility, the number of payment steps, and the distance between the application and the contract, the amount of transaction cost of the companies increase. According to the coefficients of these variables, with the increase of each of these variables, the transaction cost increases by 0.35, 0.11, and 0.13%, respectively.

Based on the results of Table 4, the nominal interest rate of the facility has a positive and significant coefficient. This can be since facilities with higher interest rates (working capital and industrial production activities) have much more amounts than facilities with lower interest rates (Prototyping), and this factor has caused that with the increase in interest rates, the transaction cost will also increase. As can be seen in Table 4, dummy variables related to the type of facility are positively significant.

To avoid complete collinearity, the dummy variable of the leasing facility has been removed, and the entered variables show the difference between this facility and the leasing facility. Based on the obtained coefficients, all three facilities have higher transaction costs than leasing facilities, consistent with the results presented in the previous sections. According to the results, none of the variables related to the type of knowledge base of the companies is significant, which shows no difference between the transaction cost of the product knowledge base type 1 company and other companies.¹

¹ It should be noted that there are 5 types of knowledge-based companies in Iran, which include production types 1, 2, and 3, and newbie types 1 and 2. In this model, the dummy variable of the type 1 production company has been removed, and the transaction cost of other companies compared to the type 1 production company has been examined.

Table 4. Results of estimating the Model of factors affecting the amount of transaction cost

Variable	Coefficient	standard deviation	t ratio	P value
Facility amount	0.35	0.07	4.89	0.00
Number of payment steps	0.11	0.03	3.19	0.00
Company capital	0.02	0.02	0.83	0.40
distance between the application and contract	0.13	0.04	2.93	0.00
number of receiving facilities from the fund	0.10	0.11	0.92	0.35
Interest rate	1.11	0.52	2.13	0.02
dummy variable of knowledge-based type (production type 2)	-0.11	0.16	-0.69	0.49
dummy variable of knowledge-based type (production type 3)	0.34	0.73	0.48	0.63
dummy variable of knowledge-based type (newbie type 1)	0.32	0.31	1.04	0.30
dummy variable of knowledge-based type (newbie type 2)	-0.13	0.24	-0.56	0.57
dummy working capital facility	1.65	0.32	5.03	0.00
dummy prototyping facility	2.06	1.07	1.92	0.04
dummy industrial production activities facility	1.62	0.35	4.54	0.00
Intercept	6.83	3.12	2.19	0.02
R ²	0.72	F statistic	20.64	
Adjusted R ²	0.68	P value	0.00	

Source: Research findings

Table 5 shows the results of estimating the Model of factors affecting the transaction cost ratio to facility amount. As can be seen in this table, the amount of the facility, the number of payment steps, the interval between the application and contract, the interest rate, and the dummy variables of the type of facility have a significant effect on the ratio of the transaction cost to the amount of the facility. The coefficient of the facility amount is negative and equal to -0.64. In other words, with a one percent increase in the facility amount, the transaction cost of each facility unit decreases by 0.64 percent. The coefficient of the number of payment steps and the distance between the application and contract is positive and equal to 0.16, 0.05, and 1.10, respectively. In other words, with a one percent increase in each mentioned variable, the transaction cost per facility unit increases by 0.16, 0.05, and 1.10 percent, respectively. Like the previous model, the coefficients of the dummy variables of the types of facilities also indicate that the transaction cost of each facility unit is higher in working capital facilities, industrial production activities, and prototyping compared to leasing facilities.

Table 5. Results of estimating the Model of factors affecting the ratio of transaction cost to the facility

Variable	Coefficient	standard deviation	t ratio	P value
Facility amount	-0.64	0.07	-8.92	0.00
Number of payment steps	0.16	0.05	3.15	0.00
Company capital	0.02	0.02	0.83	0.40
distance between the application and contract	0.05	0.01	2.92	0.00
number of receiving facilities from the fund	0.10	0.11	0.92	0.35
Interest rate	1.10	0.44	2.43	0.01
dummy variable of knowledge-based type (production type 2)	-0.11	0.16	-0.69	0.49
dummy variable of knowledge-based type (production type 3)	0.34	0.73	0.48	0.63
dummy variable of knowledge-based type (newbie type 1)	0.32	0.31	1.04	0.30
dummy variable of knowledge-based type (newbie type 2)	-0.13	0.24	-0.56	0.57
dummy working capital facility	1.65	0.32	5.03	0.00
dummy prototyping facility	2.06	1.07	1.92	0.04
dummy industrial production activities facility	1.62	0.35	4.54	0.00
Intercept	11.43	3.12	3.67	0.00
R ²	0.82	F statistic	26.43	
Adjusted R ²	0.76	P value	0.00	

Source: Research findings

Conclusion

This study aims to investigate the transaction cost of financing knowledge-based companies through an official fund that provides financial support for innovations and technologies. The data used in this study was collected through interviews and questionnaires from 123 knowledge-based companies received from the facility fund and then subjected to descriptive and statistical analysis. In this study, the effective factors on the transaction costs of companies' use of facilities were identified using econometric models. The summary of the relevant results and suggestions is given below.

The results showed that, on average, the ratio of transaction cost to facility, transaction cost rate, total cost rate, and the ratio of transaction cost rate to interest rate are 3.33, 7.04, 15.66, and 0.81, respectively. In other words, in addition to paying the nominal interest rate of the facility, which has different rates depending on its type, the companies that receive the loan also lose 3.33%

of the loan amount due to the transaction cost. The ratio of the transaction cost rate to the interest rate also showed that the transaction cost rate incurred by knowledge-based companies is, on average, equal to 0.81 of the nominal interest rate of the facility. This rate is significant, and it is necessary to revise the process of granting facilities to knowledge-based companies to reduce the transaction cost.

Investigating the transaction cost of financing companies by the size of the facility showed that with the increase in the amount of the facility, the transaction cost of the companies increases on average, and the ratio of the transaction cost to the amount of the facility decreases. Also, micro facilities, i.e., facilities less than 2,800 million Rials, have the highest transaction cost rate to profit rate. Hence, the transaction cost of this facility is, on average, 154% higher than the interest cost of the facility. Therefore, the companies that receive smaller facilities bear a higher transaction cost to receive facilities. Since the companies receiving these facilities are generally newly established and startup companies, revising the mechanism of granting facilities for smaller amounts are suggested. In micro facilities, on average, the highest cost occurs in the stages of filing and accepting applications, as well as guarantee costs, and therefore, speeding up filing and creating diversity and flexibility in the type of guarantee for micro facilities will be effective in reducing the transaction costs of companies.

The results of transaction cost by facility type showed that the highest transaction cost and total cost rate are related to working capital facilities. Also, the lowest transaction and total costs are related to industrial production facilities and prototyping facilities, respectively. The results of the transaction cost rate ratio to the profit rate also show that the transaction cost rate for prototyping facilities is about 2 times the nominal interest rate of the facility. For other facilities, this ratio is less than one. In other words, these results show that even though the prototyping facility is in the form of a loan and is offered at a lower rate than other facilities (4%), the transaction cost of obtaining the facility causes that in practice, the company bears a cost equal to twice the nominal interest rate. Therefore, to reduce the transaction cost of financing knowledge-based companies from the fund, it is suggested to pay more attention to the prototyping facility, and by adjusting the process of accepting the application, evaluating the application, and guarantees, it will reduce the transaction cost.

In the continuation of the research, in order to accurately identify the

factors affecting the transaction cost of companies, 2 econometric models were estimated. The estimation results in the models indicate that the variable of the facility amount is associated with an increase in the transaction cost on the one hand, and on the other hand, it reduces the transaction cost ratio. Although more extensive facilities have a higher transaction cost amount, the more significant the facility amount, the smaller the transaction cost to the loan amount.

The results of the estimation models showed that with the increase in the distance between the request and the contract, more costs are imposed on knowledge-based companies. Although these costs may not necessarily be in the form of cash, in practice, it is an opportunity cost that customers bear. Therefore, it is suggested to seriously reduce the waiting time and take the necessary measures to improve the companies' satisfaction and increase the fund's efficiency.

Based on the results of the model of factors affecting the ratio of transaction cost to the facility rate and the model of factors affecting the amount of the transaction cost, increasing the number of payment stages by increasing the cost of the payment stage and monitoring and the opportunity cost of companies increases the company's transaction cost. Therefore, it is recommended to examine ways to reduce the time and cost of this stage by using the opinions of the evaluation experts of facility files and supervisors.

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