Barriers to Development of Private Sector Investment in Water and Sewage Industry

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Abstract

Privatization is a complex issue in many developing countries; therefore, it is vital to examine the obstacles that prevent its proper implementation. The goal of this study is to identify and analyze the barriers to private sector investment in the Water and Sewage Industry (WSI), and to suggest effective ways to attract the private investors to this sector. The obstacles to private sector investment in the WSI were identified by conducting a desktop literature review and interviewing an expert panel, using the fuzzy Delphi technique. The most important barriers were identified and categorized. A structured survey was then developed and distributed to private sector investment experts. The Fuzzy Analytic Hierarchy Process (FAHP) was applied to further examine the responses and to rank the identified barriers. The results showed that the greatest barrier to privatization is the weakness of insurance companies in controlling investment risks, and the second greatest barrier is the weakness of the country's capitalist culture. A review of recent success stories revealed that these barriers

can be overcome with transparent price policies and increased interaction between the public and private sectors, which motivate private investors to invest in the WSI. The elicitation of this study can be useful to both private and public sectors for the development of infrastructure projects, particularly for the WSI.

Introduction

The economic, managerial and technological changes that have emerged globally alongside the expansion of public services in recent years have had far reaching effects, including increasing the public's cost and creating other economic issues (Haddad and Hornuf, 2019). It is, therefore, necessary to improve the function of governmental agencies. One solution that has gained in popularity is to entrust ownership, such as production and services, to the private sector (Valipour *et al.,* 2015). The Water and Sewage Industry (WSI) in Iran pays particular attention to attracting and developing private sector partnerships to invest in their projects. In this regard, Iran has seen a significant growth in the expansion of private investment in recent years. Privatization covers a range of different policies intended to strike a balance between the public sector and private sector and the services they provide (Kessides, 2004). Although privatization improves infrastructure performance, several issues must be considered and conditions met to achieve their public interest goals. Infrastructure privatization involves issues related to regulations, long-term growth possibilities of the economy, as well as equity considerations (Sheshinski and Lopez-Calva, 2003). Privatization can improve economic performance, but performance improvement relies also on other

structural reforms (Parker and Kirkpatrick, 2005). There is no universal reform model; the objectives, process, approach, mode, and success rate of privatization vary from one country to another, as do the strategies that are employed. Furthermore, the social, political and cultural issues of a country have a great impact (Kessides, 2004). For the WSI, the privatization of public services, infrastructure and facilities has both advantages and disadvantages. Privatization in the WSI should be based on strategic objectives, including reducing the cost of water, creating a competitive environment for water retailers, reducing water waste, improving the quality of drinking water, sanitary disposal of sewage, effective use of sewage, and improving the quality of services to customers. However, critics of widespread privatization argue that private ownership did not necessarily translate into improved efficiency in operations and bring about competition in the sector (Prasad, 2006; Bayliss and Amenga-Etago, 2008; Araral, 2009).

In many developing countries, including Iran, there are many shortcomings and obstacles in the process of private sector participation in the WSI, and neglecting these barriers can pose a serious threat to private sector participation in infrastructure projects. Therefore, identifying the major barriers and the corresponding solutions to achieving the goals of private sector participation in WSI projects are among the issues that should be discussed. Many researches have been done on the involvement of the public and private sectors in various industries. However, the issue of public-private partnerships in the WSI has received little attention from researchers. In addition, most research studies have focused on private sector investment in roads, energy and telecommunications (Valipour *et al.,* 2015). It is also worth noting that the risks in this area are only categorized and analyzed by some basic statistical methods. Therefore, this study has attempted to analyze the barriers to private investment in the WSI using the high-level multi-criteria decision making method. In fact, this ongoing study investigated the current state of the WSI in Iran for the purpose of answering two questions:

(i) What are the barriers to achieving private sector investment in the Iranian WSI? and *(ii)* Which of those barriers have the greatest negative impact to the development of private sector investment in the Iranian WSI? Answers to these questions attempt to clarify the role of private actors in participating in the WSI projects and how to overcome the barriers to private sector participation in the projects. These issues are the most critical for the government.

It has been considered the case of the WSI (Iran), which has not been very successful in attracting private sector investment in their projects. Firstly, as to identify the barriers of the private sector participations in WSI projects, the existing literature has been thoroughly studied (Morisset and Neso, 2002; Azzimonti and Sarte, 2007; Najaf-Beigi and Mahmoudi 2011; Nourali *et al.*, 2014; Babatunde *et al.*, 2015; Edalat and Abdi, 2018; Estrin and Pelletier, 2018; Guntrip, 2018) arriving at a list of barriers of the private sector participations. Then, based on review of the research literature and situation analysis in Iran, the Delphi technique was used to delineate and to match the barriers. Finally, the final questionnaire was administered to 20 experts and data were analyzed as to confirm these barriers. Finally, Fuzzy Analytical Hierarchy Process (FAHP) were used to rank the identified barriers.

Results indicated that the factors belonging to the economic indicators, structural indicators, socio-cultural indicators, legal indicators and political indicators can be considered as key determinants for the private sector participation in the WSI. Findings of this study can provide a sound basis for proper policy-making and removing the major barriers to private sector participation in these projects.

Literature review

Privatization is a means of improving the performance of economic activities by increasing the role of the market potential. It requires that at least 50 percent of the government's

ownership be transferred to the private sector. Additionally, privatization can be defined in a more conceptual way than the transfer of management, or the transfer of ownership from the public sector to the private sector, which involves management contracts, as well as concession and lease contracts (Kessides, 2004). This is one of the principles of dynamic economics and the prerequisite of economic development in less-advanced countries. Economic policies have been the focus of most policymakers in many countries over the past two decades, and the issue of assigning state-owned companies to the private sector is one of the critical issues of the current economy (Valipour *et al.,* 2015). Many countries began considering privatization of public utilities in the late 1980s (Nourali *et al.,* 2014). The growing trend toward privatization can be attributed, to a large degree, to the losses, inefficiency, and productivity of state-owned companies. These problems impose a heavy burden on governments, such as *(i)* lack of incentive and innovation due to lack of personal interest; *(ii)* the inability of companies to compete for their products due to high costs and weak management; *(iii)* burdensome bureaucracy and administrative regulations that impede the dynamism, flexibility, and timely decision-making in these companies; *(iv)* the inability of government to effectively monitor their financial performance; and *(v)* increasing the efficiency and performance of the economic system of a country (Valipour *et al.,* 2015). Therefore, privatization increases competition and encourages private investors to make a greater investment to increase efficiency (Mohajeri and Dierich, 2017). However, an adverse macroeconomic and regulatory environment reduces the benefits of privatization (National Research Council, 2002). Privatization of public utilities was deemed as economically unattractive up until the late 20th century (Parker, 2016), and many experts today believe that it is a new tool to make financing more efficient in developed, as well as developing countries (Estrin and Pelletier, 2018; Guntrip, 2018). The increase in demand for water is making it difficult for the government's budget alone to provide the service for a country

(Luijendijk and Arriens, 2009). Privatization can happen in two ways: privatization of services or ownership of the company, and each way has a different impact on water service provision. In Iran, ownership in the WSI is monopolized by the public sector and privatization is done through services in this industry. However, there are also the potential disadvantages related to privatization. Najaf-Beigi and Mahmoudi (2011) found that privatization of public WSI services decreased productivity in the Chilean water industry, whereas a change in the ownership of the company increased the productivity of the water industry due to technical improvements. There are many obstacles to the privatization of the WSI. According to Luijecdijk and Arriens (2009), the lack of proper knowledge of the locality is a barrier to the privatization of water services. In addition, the public belief that water and Sewage disposal is a human right that the government is responsible to provide (Bos *et al.,* 2016; Mohajeri and Dierich, 2017), as well as the low level of investor confidence (Calabrese, 2008) are the obstacles for privatization.

An investigation of economic developments and policies in Iran over the past three decades indicates that difficulties and inconsistent policies have undermined the productive capacities and forces of the society, and have caused damage to the country's economy and self-esteem. Moreover, their increased population, and climate change are making it difficult for the Iranian government to meet their citizens' daily needs for clean WSI management. For the last couple of decades, Iranian policymakers have considered privatization of this sector, in which the government would have the responsibility for monitoring, and the private sector would have the responsibility for production and service (Edalat and Abdi, 2018).

Research methodology

The current research was conducted to evaluate the barriers to private sector investment in the WSI (Iran), using a descriptive survey method with a practical purpose (Salaria, 2012).

Sarvari *et al.* (2019b) also used the descriptive survey method to evaluate the risk allocation criteria and barriers in Malaysian projects. This study can be divided into three steps (Figure 1). The first step was the identification of the indicators that act as obstacles to the development of private sector investment in the WSI. For this purpose, the existing desktop literature was reviewed, and 20 structured interviews were conducted with private sector investment experts who were academics, professionals from public and private sectors. The study adopted a purposive sampling technique in the selection of target survey respondents as done by other scholars for similar research domains (Olawumi *et al.,* 2018). Table 1 shows the demographic characteristics of the experts who attended the Delphi process. The most important barriers were identified and categorized. In the second step, a survey questionnaire was developed and distributed to the experts to determine the importance of each of the identified barriers. The statistical population for the questionnaire distribution was determined by using a targeted snowball sampling. The questionnaire was prepared, using the Saaty model and Saaty's nine-point scale. The fuzzy Delphi method was conducted to complete the survey. In the third step, the most important barriers were categorized. The FAHP technique was performed for the categorized indicators, then they were prioritized and ranked, based on the results of the analysis.

Figure 1. Overall research framework for the study

Table 1. Demographic and professional characteristics of Delphi expert panel

Targeted Snowball sampling

The targeted snowball approach is an extensively used method for recruiting experts in research. It is a process in which a qualified participant invites similar experts who fulfill the requirements needed for the study (Dusek *et al.,* 2015). For this study, the experts that have awareness and knowledge in the water and sewage industry including private sector

investment (faculty members, experts and authorities, professionals, investors, and contractors) were invited. Generally, snowball sampling is a gradual process, and sampling usually continues until data saturation (Naderifar et al., 2017). Accordingly, two experts were identified and after gathering data, they were asked to recommend others. Outreaching experts were stopped when the factors were saturated. Thus, the data were saturated when no new factors were obtained during the data collection and the previously collected data were repeated (Chan and Choi, 2015). It is notable that many experts believe that data saturation is a subjective phenomenon and also more observations and interviews do not affect the interpretation of the results (Grove *et al.*, 2012; Naderifar *et al.*, 2017). To achieve saturation, a total of 10 different expert opinions were obtained, similar to Chan and Choi (2015).

Questionnaire development

After the literature review and structured interviews, it was determined that 43 indicators may act as obstacles to the development of private sector investment in the WSI. 27 indicators were identified through a desktop review of the literature and another 16 indicators were obtained from structured interviews with the experts (as shown in Table 2). To be more specific and efficient, it was necessary to identify the most important indicators out of these 43 indicators. To conduct the fuzzy Delphi method, a survey was developed to determine which indicators required further analysis to provide insights into the current condition of the privatization of the WSI of Iran. The survey began with some questions that focused on the participants' background information. After what, the experts were asked to rank each indicator using a Saaty's nine-point scale, where 1 indicates very low impact and 9 indicates the greatest impact. Each respondent was asked to identify three numbers based upon their personal understanding, with 1 indicating the optimum value of the indicator's importance, and the other two indicating the minimum and maximum value for an acceptable range of importance for the indicator.

Table 2. List of major indicators of barriers to private sector investment in the water and sewage industry

Fuzzy Delphi method

The Delphi technique is used for determining the importance of criteria and screening key criteria before applying a multi-criterion decision making method. The main purpose of the Delphi technique is to obtain the most reliable set of expert opinions through a series of structured questionnaires with controlled feedback. There are no strong and explicit rules on how to select and recruit experts referred as respondents of the Delphi questionnaires. However, it is worth mentioning that the quality of experts is more important than their quantity, which usually is less than 50, and often from 15 to 20 (Rowe and Wright, 2001). The number of experts depends on factors including: sample homogeneity, Delphi goal, difficulty range, quality of decision, ability of the research team, internal and external validity, time of data collection, available resources, and the scope of the problem (Chan and Chan, 2012). The Delphi method has been used in previous similar contributions. Chan and Chan (2012) applied the Delphi method to identify a performance measurement index for target cost contracts in construction. Sarvari *et al.* (2019a) used the Delphi method to identify the risk identification approaches in public-private partnership (PPP) projects.

When applying the Delphi technique, linguistic variables are used to express the views of experts. Linguistic variables are limited to fully reflecting the respondent's mental state. Using fuzzy sets is more compatible with linguistic variables and sometimes ambiguous human explanations, so it is best to use fuzzy numbers to make decisions in the real world, so the fuzzy Delphi technique is suggested in this study. Also, the Delphi method consumes a noteworthy amount of time, as it requires repetition of the experts' survey multiple times, until the experts arrive at an agreement (Ho and Wang, 2008). The fuzzy Delphi approach

can reduce this time significantly, and hence it was used to sift through the indicators to identify the final indicators of obstacles in the privatization of the WSI. In this study, the semantic variable was adopted to prepare a scale of triangular fuzzy numbers (Ho and Wang, 2008). The nine-point scale for the valuation of indicators is shown in Table 3.

Table 3. Fuzzy nine-point scale for the valuation of indicators

Figure 2 shows the values of the indices relative to each other, using triangular fuzzy numbers.

Figure 2. Valuation of Indices Relative to Each Other Using Triangular Fuzzy Numbers

After aggregating the experts' view by using the triangular fuzzy average method, the decaying of the values was calculated by using the center-level method by Equation (1).

$$DF_{ij} = \frac{\left[\left(u_{ij} - l_{ij} \right) + \left(m_{ij} - l_{ij} \right) \right]}{3} + l_{ij} \qquad (1)$$

Fuzzy Analytic Hierarchy Process (FAHP) technique

When decision-makers and/or experts are unsure of their response to a survey result, the AHP is unable to address this uncertainty. However, fuzzy AHP can take this into consideration when performing pair-wise comparisons. The fuzzy AHP approach has been used by previous researches. For example, Sayed *et al.* (2019) used the fuzzy AHP for prioritizing lean construction barriers in Qatari civil companies. Chen and Wang (2019) applied fuzzy AHP for risk assessment of international construction projects. In this study also FAHP was used to prioritize the barriers of privatization of the WSI. This approach is based on pairwise comparisons based on the experts' point of view. The implementation steps of the FAHP method in this study are as follows (Cheng, 2009): *(i)* Outline the decision tree based on

goals, criteria and sub-criteria; *(ii)* Formation of matrix paired comparisons; *(iii)* Pooling of experts' views using the geometric mean; *(iv)* Calculate the sum of the elements of each row in the pairwise comparisons matrix; *(v)* Normalize the sum of the elements of each row; *(vi)* Defuzzification of values; and *(vii)* Determination of the final weights of the elements.

Results and analyses

Importance score for each indicator

Responses were collected, and three average values (minimum value of importance, optimum values of importance, and maximum value of importance) were determined for each indicator, using a triangular fuzzy average method. These three values created a fuzzy set for each indicator, and the average of the set was the crisp value for that indicator. The threshold is set by experts. This value is usually considered between 5 to 7 (Wu and Fang, 2011). An optimal level is empirically considered to be neither too high nor too low, and therefore a value above the mean threshold of 6 is chosen (Ouma *et al.*, 2015). As this study focuses on the most important barriers to the privatization of the WSI, only the indicators with a crisp value of more than 6 were approved for further study. Accordingly, 17 indicators were removed, and the remaining indicators were used to continue the analysis. Table 4 shows the results of the sifted indicators.

Table 4. Results of sifting indicators

Categorization of the indicators

It was noticed that a few of the indicators hinder privatization more than the others, due to economic reasons. Similarly, a few of them are more relevant to the political field than others. Hence, the indicators were grouped into five categories: *(i)* economic, *(ii)* socio-cultural, *(iii)* structural, *(iv)* legal, and *(v)* political.

Prioritization of the categories

The fuzzy analytic hierarchy process technique (FAHP) was used to determine the priority of the identified indicators. The paired matrix for the categories was obtained after comparing the pair of categories based on the target, and determining their weight, based on the fuzzy geometric average of the expert's choice. The results of the paired comparison of the categories are presented in Table 5.

Table 5. The pairwise comparison matrix for the categories

The fuzzy expansion of the elements of each row was calculated as follows.

$(1, 1, 1) \oplus (6.25, 7.00, 7.69) \oplus (5.22, 6.15, 7.04) \oplus (2.2, 2.46, 2.72) = (16.37, 18.78, 21.02)$

$(0.13, 0.14, 0.16) \oplus (1, 1, 1) \oplus (0.71, 0.92, 1.28) \oplus (0.65, 0.75, 0.86) \oplus (0.46, 0.58, 0.79)$

$= (2.94, 3.4, 4.09)$

$(0.39, 0.46, 0.59) \oplus (0.78, 1.08, 1.41) \oplus (1, 1, 1) \oplus (4.03, 4.74, 5.38) \oplus (1.49, 1.8, 2.05) =$

$(7.69, 9.08, 10.43)$

$(0.14, 0.16, 0.19) \oplus (1.16, 1.33, 1.55) \oplus (0.19, 0.21, 0.25) \oplus (1, 1, 1) \oplus (0.68, 0.85, 1.1) =$

$(3.17, 3.56, 4.09)$

$(0.37, 0.41, 0.45) \oplus (1.27, 1.71, 2.19) \oplus (0.49, 0.56, 0.67) \oplus (1.47, 1.17, 1.47) \oplus (1, 1, 1)$

$= (4.6, 4.85, 5.79)$

A summary of the fuzzy extension of the preferences of each of the main criteria is as follows:

$$\sum\nolimits_{j=1}^{5} X_{1j} = (16.37,\ 18.78,\ 21.02)$$

$$\sum\nolimits_{j=1}^{5} X_{2j} = (2.94,\ 3.4,\ 4.09)$$

$$\sum\nolimits_{j=1}^{5} X_{3j} = (7.69,\ 9.08,\ 10.43)$$

$$\sum\nolimits_{j=1}^{5} X_{4j} = (3.17,\ 3.56,\ 4.09)$$

$$\sum\nolimits_{j=1}^{5} X_{5j} = (4.6,\ 4.85,\ 5.79)$$

The sum of the fuzzy sum of the elements of the column of preferences was calculated using Equation (2).

$$\sum \tilde{S}_i = \sum_{i=1}^{n} \sum_{i=1}^{n} X_{ij} \qquad (2)$$

The total sum of the elements of the preferences column for the main criteria is as follows:

$$\sum_{i=1}^{n} \sum_{i=1}^{n} X_{ij} = (34.77,\ 39.67,\ 45.42)$$

To normalize the preferences of each criterion, the sum of the values of each criterion was divided into the sum of all of the priorities. Because the values were fuzzy, the fuzzy sum of each row was multiplied by the inverse of the sum. The inverse of the sum must be calculated.

$$if\ \tilde{F} = (l,\ m,\ u)\ then\ \tilde{F}^{-1} = \left(\frac{1}{u}, \frac{1}{m}, \frac{1}{l} \right) \qquad (3)$$

Therefore, according to Equation (3):

$$\left(\sum_{i=1}^{n} \sum_{i=1}^{n} X_{ij} \right)^{-1} = (0.022,\ 0.025,\ 0.029)$$

Therefore, the results of normalizing the values obtained were as follows.

$$\tilde{W}_{C1} = (0.36,\ 0.47,\ 0.61)$$

$$\tilde{W}_{C2} = (0.06,\ 0.09,\ 0.12)$$

$$\tilde{W}_{C3} = (0.17,\ 0.23,\ 0.30)$$

$$\tilde{W}_{C4} = (0.07,\ 0.09,\ 0.12)$$

$$\tilde{W}_{C5} = (0.10,\ 0.12,\ 0.17)$$

Each of the obtained values is fuzzy and normalized weight of the main criteria. In this study, the center level method (Eq. (1)) was used for fuzzy decaying. It is worth noting that the calculated weights were non-fuzzy, but should normalize. Table 6 shows the decaying of the final weights of the main criteria.

Table 6. Decaying the final weights of the categories

Accordingly, the special vector is the priority of the main criteria as W_1.

$$W_1 = \begin{bmatrix} 0.468 \\ 0.087 \\ 0.227 \\ 0.090 \\ 0.127 \end{bmatrix}$$

Based on the special vector obtained, the economic category with a normal weight of 0.468 was the highest priority. The legal category with a normal weight of 0.227 was the second highest priority, the political category with a normal weight of 0.127 was the third, the structural category with a normal weight of 0.09 was the fourth, and the social category with a normal weight of 0.88 was the fifth. The inconsistency rate was 0.069 and less than 0.1, meaning that the comparisons are reliable.

Prioritization of the indicators

The FAHP technique was used to determine the priority of indicators within each category. The results and the weights related to the indicators are shown in Table 7.

Table 7. Determination of the final priority of the indicators with the FAHP technique

Discussion of analytical results

In this study, the priority of the categories, as well as the barriers to the privatization of WSI were calculated (see Table 7). The results show that 10 critical barriers to the privatization of

WSI include: the weakness of insurance companies to control investment risks (0.240), economic risks and lack of investment security (0.096), the weakness of organizational culture and investment (0.087), the lack of good prospect in the future of the water market (0.078), exchange rate fluctuations (0.072), low tariff for water services (0.068), instability and insecurity of the country's economy (0.062), extreme fluctuations in inflation (0.050), non-transparency of investment laws (0.047), and weakness in the privatization law (0.046). Among all categories, the economic factors are the most important barriers to the privatization of WSI (0.468). Based on FAHP results, we found the important indicators on economic category are the weakness of insurance companies to control investment risks (0.240), economic risks and lack of investment security (0.096), the lack of good prospect in the future of the water market (0.078), exchange rate fluctuations (0.072), low tariff for water services (0.068), and extreme fluctuations in inflation (0.050) whereas the least important are changes in interest rates on bank facilities (0.087) and the lack of attractiveness of projects in the WSI (0.087) (the incompatibility rate of the comparisons – 0.09, and is within the tolerance of 0.1). For the social category, the weakness of organizational culture and investment in the country was identified as the only indicator. In determining the priority of the category of the legal barriers, the lack of legal transparency and regulations related to investment (0.047) was more important than the other indicators (the inconsistency rate of the comparisons – 0.038, and is within the tolerance of 0.1). In determining the priority of structural indicators, the absence of a strategy for attracting and participating in the private sector at the company level and region (0.023) is more important than the other indicators (the inconsistency rate of the comparisons – 0.037, and is within the tolerance of 0.1). In addition, in determining the priority of the political barriers, the political instability and uncertainty of the economy of the country (0.062) was more important than the other

indicators (the inconsistency rate of the comparisons – 0.04, and is at within the tolerance of 0.1).

In developing countries, including Iran, the privatization program has been adopted as a binding and executive policy for economic development. Reports reveal the wide gap in privatization adoption for infrastructural provisions between the developed and developing economies (Babatunde *et al*., 2015). However, what is the difference in the adoption of the privatization between the developed and developing economies? The slow adoption of privatization in the developing country can be attributed to some inherent challenges due to the peculiar nature of the environment.

The study revealed the 26 barriers to private sector investment in WSI. The identified 26 barriers were classified into five categories. These five categories were interpreted as economic, social, legal, structural, and political issues. It is evident from the study that the aforementioned factors are barriers influencing private sector investment in the WSI of Iran. It is not surprising that the economic category is the most important barrier in the private sector investment in the WSI. The correlation between political and economic factors has been well documented (Valipour *et al.*, 2015). The results reveal that one of the most significant barriers of privatization adoption in developing economy, especially in Iran, is socio-cultural factors. The adaptation and successful implementation of any tool for public benefit without a doubt require consultation among the concerned stakeholders and the public at large (Chen, 2007). Likewise, structural factors identified as a barrier to the development of privatization in the WSI of developing countries. The undesirable state of the organizational structure of government companies has contributed to the issues with PPP tool adoption in developing countries, especially in Iran. Further, the management weakness in applying privatization policies recognized as a challenge militating against the sustainable tool adoption. The legal factors cannot be silenced, as their role is highly significant.

Weaknesses in the privatization law can exacerbate the effects of other barriers, especially economic barriers.

The use of domestic and foreign financial resources (Sharma, 2012) through the participation of the private sector as well as the transfer of new technologies (Khosravi *et al*., 2012) and management capabilities needed to increase the efficiency of activities (Wang *et al*., 2020) are among the effectives solutions in the developed and developing countries. However, as the findings of this study show, the WSI faces several obstacles. Firstly, it is necessary to acquire a thorough understanding of how to implement the projects and to remove the obstacles and threats that may exist along the way before employing the private sector's capacity to execute projects. In addition, some prerequisites such as macroeconomic stabilization (Prasad *et al*., 2006) and liberalization and micro prerequisites such as ensuring post-privatization support (Babatunde *et al*., 2015) should be taken into account when seeking private-sector involvement. If these requirements are not fulfilled, the partnership will not be on the right track.

Given that the most important obstacle to the development of private sector investment in the WSI has been recognized as an economic obstacle, more pressing needs to be addressed for further privatization. In addition, one of the critical administrative tasks of the government is to establish security in this regard (Eckert, 2005). Therefore, to provide greater security in the economic field, it is advocated to eliminate the major barriers and difficulties for economic factors by facilitating and modifying some barriers and regulations (Guislain, 1997), providing conditions for entrepreneurs to enter the economy (Wennekers and Thurik, 1999), and removing abuses and rent-seeking (Cosset *et al*., 2020). It is unpredictable that it disrupts investors' decisions and is the institutionalization and enforcement of property rights in the economy. In addition, changing some of the structures and laws provides the basis for establishing economic security (Khosravi et al., 2020).

These results, mainly underlining the importance of the barriers to private sector investment, are in line with some previous studies of project management and public administration literature. For example, Ross and Yan (2015) stated that government inflexibility is the most important problem of the private sector. Seruvatu and Jayaraman (2001) found that economic variables and policy factors such as government laws and regulations are the main barriers to private sector investment. Babatunde *et al.* (2015) noted that increases in government current spending and interest rates, as well as instability and distrust have a negative effect on private sector investment. Kirama and Mayo (2016) acknowledged that limited planning, short-term contracts, poor enforcement of private sector laws and regulations are significant problems and obstacles. Marin (2009) also concluded that a variety of economic, structural, cultural, social, legal, and political reforms must be undertaken for the private sector to succeed.

Conclusions

In this study, the authors identified the barriers to private sector investment in the WSI, and categorized them as economic, socio-cultural, legal, structural, and political. Among these five categories, the combined effect of economic barriers was deemed the most influential category. The authors also ranked the indicators of each category. For the economic category, weakness of insurance companies to control investment risks, ranked as the barrier that most negatively affects the investment of the private sector in the WSI. Similarly, among legal indicators, it was found that investors become discouraged and reticent to invest when the investment laws and regulations are not transparent. To overcome these obstacles, transparent policies should be implemented, interactions among the sovereign and private sector should be increased, and a slow and steady approach to privatization should be adopted. The result of the current study can be useful to policy-making and to fill the existing gap in knowledge. Since the barriers to development of private sector investment in infrastructure projects

depend on various factors that can be also context-specific, future researchers can examine

the impact of the above across different countries – both developed and developing ones –

and sectors. Another future direction of research may be, in order to overcome the limitations

of this work, to broaden the spectrum of barriers that are critical in attracting private sector

investment, so as to provide the generalizability of research results from a regional

perspective to a global context.

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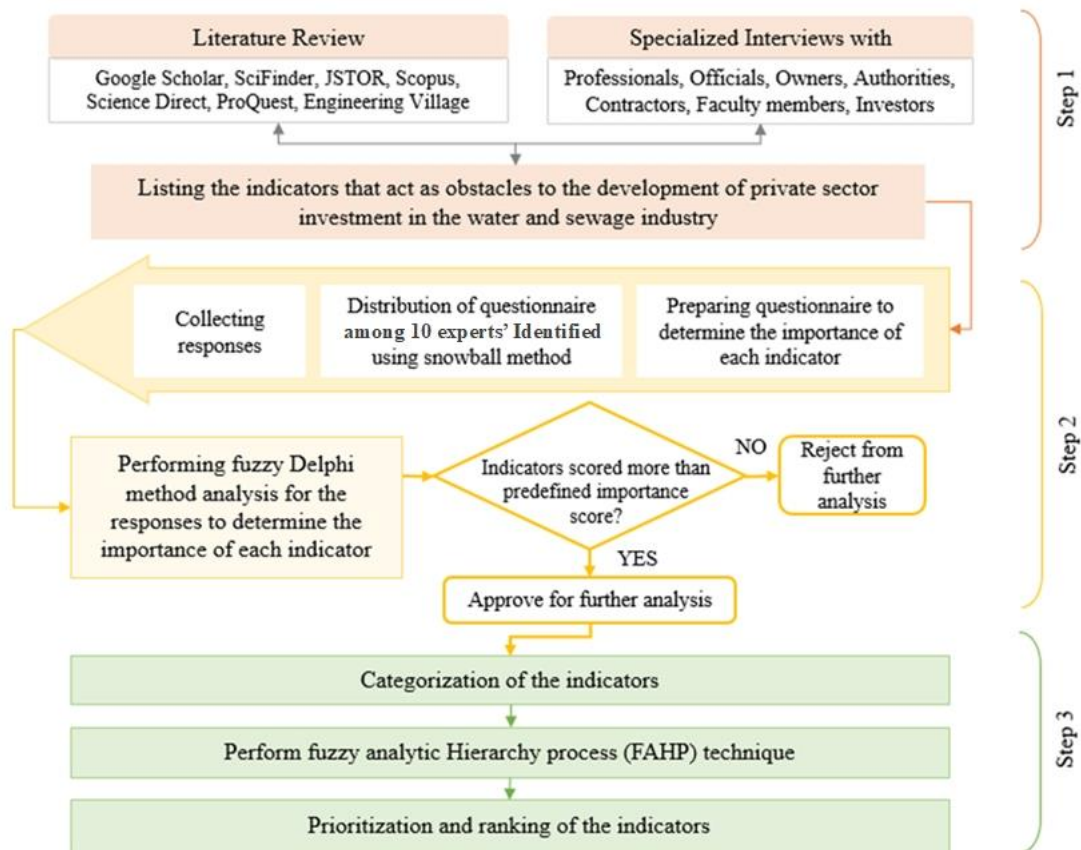
Figure 1. Overall research framework for the study
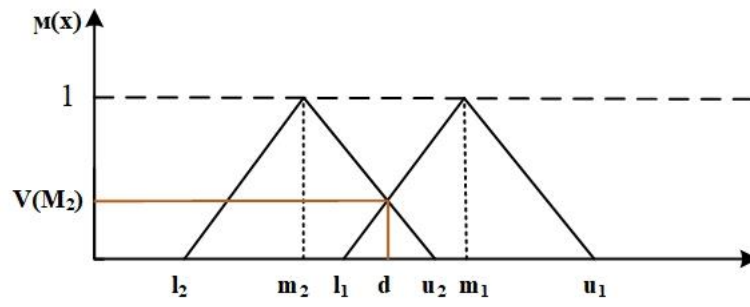
Figure 2. The Distance of Two Triangular Fuzzy Numbers (Sadi-Nezhad et al., 2013)

Table 1. Demographic and professional characteristics of Delphi expert panel

Characteristics		Frequency (%)
Education	Bachelor	9 (45)
	Master	7 (35)
	Ph.D.	4 (20)
Work experience	Below 10 years	4 (20)
	11 - 20 years	9 (45)
	Over 21 years	6 (35)
Sector	Public	9 (45)
	Private	8 (40)
	Academic	3 (15)
Position	Senior manager	5 (25)
	Project coordinator	2 (10)
	Civil engineer	6 (30)
	Financial manager	2 (10)
	Project manager	2 (10)
	Faculty member	3 (15)

Table 2. List of major indicators of barriers to private sector investment in the water and sewage industry

Code	Barriers	Reference	Explanation
B_1	Low tariff for water services	Azzimonti and Sarte (2007); Nourali et al. (2014); Guntrip (2018)	Low fee is charged for water consumption supplied by a private utility.
B_2	The lack of good prospect in the future of the water market	Interview	Due to various future projects, the future prospect of the private sector project may be jeopardized.
B_3	The financial weakness of private sector investors	Azzimonti and Sarte (2007); Najaf-Beigi and Mahmoudi (2011); Edalat and Abdi (2018); Guntrip (2018)	Due to the amount of financial needed to complete or operate the project, the financial strength of investors is low.
B_4	Non-compliance of public sector in its obligations	Nourali et al. (2014); Babatunde et al. (2015); Guntrip (2018)	Public sector companies are delaying or failing to deliver their financial incentives and obligations to the private sector.
B_5	Economic risks and lack of investment security	Morisset and Neso (2002); Najaf-Beigi and Mahmoudi (2011); Guntrip (2018)	Private sector investment is accompanied by financial risks, such as the risk of non-return of invested money or the desired profit.
B_6	The weakness of insurance companies to control investment risks	Najaf-Beigi and Mahmoudi (2011); Valipour et al. (2015)	The investment guarantees by insurance companies have an impact on the stability of the private sector investment. Therefore, their absence increases the investment risk.
B_7	Failure to guarantee a fair price for service purchases	Morisset and Neso (2002); Nourali et al. (2014); Edalat and Abdi (2018)	The private sector does not have an accurate estimate of the amount of revenue generated from the sale of services.
B_8	The lack of attractiveness of projects in the WSI	Najaf-Beigi and Mahmoudi (2011); Babatunde et al. (2015); Edalat and Abdi (2018); Guntrip (2018)	It takes a long time to complete the water and sewer projects and obtain the expected return of revenue and profits.
B_9	Exchange rate fluctuations	Najaf-Beigi and Mahmoudi (2011); Estrin and Pelletier (2018); Guntrip (2018)	The high volatility of the exchange rate, especially in sanctioned countries and increases financial risks.
B_{10}	Changes in interest rates on bank facilities	Interview	If the government sector is not guaranteed, raising the bank interest rate for the investor can lead to high financial risks.
B_{11}	Extreme fluctuations in inflation	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Valipour et al. (2015); Guntrip (2018)	Rising inflation increases project costs higher than expected in all areas.
B_{12}	The negative attitude of public sector towards investors	Azzimonti and Sarte (2007); Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014)	The ruling public sector does not trust the private sector's executive and financial capacity.
B_{13}	The weakness of organizational culture and investment	Interview	The private sector is looking for big profits in a short time. Also, there is no culture of investing in social projects among investors.
B_{14}	The weakness of technical knowledge of private sector	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Estrin and Pelletier (2018)	The private sector does not have the technical and administrative knowledge to execute projects.
B_{15}	The weakness of the private sector in managing projects	Morisset and Neso (2002); Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014)	The private sector does not have the necessary knowledge to manage financial and investment projects.
B_{16}	Envy to entrepreneurs	Interview	Public sector employees are jealous of the progress of

Code	Barriers	Reference	Explanation
			individuals and private sector investors.
B_{17}	Lack of appropriate information on private sector	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Babatunde et al. (2015); Edalat and Abdi (2018)	The investment process is difficult and confusing. The government has limited understanding of private investment.
B_{18}	Awareness of the private sector about contract types	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Valipour et al. (2015)	The scope of responsibilities is not clear, Contract ambiguity and awareness of the private sector about project financing.
B_{19}	The weakness of the licensing process	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Estrin and Pelletier (2018)	The approval process is lengthy. The licensing process is difficult and confusing.
B_{20}	The weakness of the capitalist process and investment	Interview	There is no specific process for investing. The risks between the capable and the investor are not balanced.
B_{21}	The weakness of the anti-monopoly law in the country	Interview	Projects are awarded exclusively to specific companies.
B_{22}	Lack of transparency of investment contracts	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Babatunde et al. (2015)	Non-compliance by the public sector with the implementation of contract provisions due to lack of clear and transparent contracts.
B_{23}	Weakness in the privatization law	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Edalat and Abdi (2018)	Existing privatization-related policies and regulations are unsound, including low legislative level, poor operability, and conflicts.
B_{24}	Non-transparency of investment laws	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Guntrip (2018)	There are many disagreements in the project due to the lack of clear and transparent contracts.
B_{25}	Failure to provide appropriate incentives to investors	Nourali et al. (2014); Najaf-Beigi and Mahmoudi (2011); Edalat and Abdi (2018); Morisset and Neso, (2002)	There are no financial incentives such as tax exemption incentives and clearance exemptions.
B_{26}	Lack of independence of water and wastewater companies	Nourali et al. (2014); Najaf-Beigi and Mahmoudi (2011); Valipour et al. (2015)	Water and wastewater companies have no independence in making decisions.
B_{27}	Disconnection and support of related government agencies	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Babatunde et al. (2015); Edalat and Abdi (2018)	Coordination between government departments is difficult. The coordination ability of the project company is insufficient.
B_{28}	The complexity of the project operations	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Estrin and Pelletier (2018)	Lack of investment attractiveness for the private sector due to the complexity in water and wastewater operations.
B_{29}	Lack of a suitable strategy to attracting the private sector	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Estrin and Pelletier (2018); Guntrip (2018)	The public sector does not pursue a specific strategy for outsourcing projects to the private sector.
B_{30}	Lack of introducing investment opportunities to investors	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Estrin and Pelletier (2018)	Lack of privatization office in the public sector to communicate with the investors and introduce investment opportunities to them.
B_{31}	Climatic conditions of different regions in attracting investors	Azzimonti and Sarte (2007); Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014)	Depending on the climatic conditions, the investor may lose motivation to invest in parts of the country.

Code	Barriers	Reference	Explanation
B_{32}	Failure to delegate powers and responsibilities to investors	Morisset and Neso (2002); Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Babatunde et al. (2015)	Investors do not have the authority to make project decisions.
B_{33}	Failure of project parties to comply with their obligations	Najaf-Beigi and Mahmoudi (2011); Nourali et al. (2014); Valipour et al. (2015)	The public and private sectors do not fulfill the responsibilities and obligations stipulated in the contract.
B_{34}	Uncertainty about water pricing and tariff setting	Interview	There is no right forecast for the parties to the contract regarding water tariff.
B_{35}	Undesirable state of the organizational structure of government companies	Interview	Undesirable state of the financial and organizational structure of state-owned and quasi-governmental companies.
B_{36}	Water change based on annual weather conditions (rainfall)	Interview	Occurrence of seasonal droughts and climate change in the region and its impact on the objectives of water and sewage projects.
B_{37}	Management weakness in applying privatization policies	Interview	Weaknesses in managing and deciding on the proper implementation of projects to the private sector.
B_{38}	Worn-out water supply system	Interview	Worn-out water supply systems that may pose a lot of risks to the private investor.
B_{39}	Instability and insecurity of the country's economy	Interview	Uncertain economic conditions for investors due to unstable economic and political conditions of the government.
B_{40}	Government corruption	Interview	There is corruption in government. The government excessively interference in the construction or operation of the project.
B_{41}	Changes in the mechanism and lows of taxation and insurance	Interview	Risk of changing the regulations and mechanism of taxation and insurance of the country due to the long duration of contracts.
B_{42}	Terminate the contract by the government	Interview	Cancel the rating for various reasons such as social conditions, public opposition or force majeure risks.
B_{43}	Change in ownership and support for the project	Interview	Transfer the ownership and project decisions from a public sector to another. This can lead to financial and management risks.

Table 3. Fuzzy nine-point scale for the valuation of indicators

Definitive equivalent	Linguistic variable	Triangular fuzzy number
1	So trivial	(1,1,1)
2	So trivial to trivial	(1,2,3)
3	Trivial	(2,3,4)
4	Trivial to mediocrity	(3,4,5)
5	Mediocrity	(4,5,6)
6	Mediocrity to important	(5,6,7)
7	Important	(6,7,8)
8	Important to very important	(7,8,9)
9	Very important	(8,9,9)

Table 4. Results of sifting indicators

Barriers	Mean	Crisp	Result	Barriers	Mean	Crisp	Result
B_1	(5.524,6.429,7)	6.32	Approve	B_{23}	(6,7,7.789)	6.93	Approve
B_2	(5.333,6.333,7.238)	6.30	Approve	B_{24}	(5.65,6.65,7.5)	6.60	Approve
B_3	(4.19,5.143,6.048)	5.13	Reject	B_{25}	(6.048,7.048,7.857)	6.98	Approve
B_4	(4.905,5.905,6.524)	5.78	Reject	B_{26}	(4.667,5.667,6.524)	5.62	Reject
B_5	(6.238,7.238,7.952)	7.14	Approve	B_{27}	(5.667,6.667,7.333)	6.56	Approve
B_6	(5.2,6.2,7.05)	6.15	Approve	B_{28}	(5.95,6.95,7.8)	6.90	Approve
B_7	(4.333,5.286,6.143)	5.25	Reject	B_{29}	(5.85,6.85,7.7)	6.80	Approve
B_8	(5.095,6.095,6.952)	6.05	Approve	B_{30}	(5.667,6.667,7.524)	6.62	Approve
B_9	(5.81,6.81,7.476)	6.70	Approve	B_{31}	(3.571,4.571,5.476)	4.54	Reject
B_{10}	(5.429,6.429,7.333)	6.40	Approve	B_{32}	(4.619,5.619,6.571)	5.60	Reject
B_{11}	(5.667,6.667,7.381)	6.57	Approve	B_{33}	(4.19,5.095,5.81)	5.03	Reject
B_{12}	(4.19,5.19,6.19)	5.19	Reject	B_{34}	(4.762,5.762,6.619)	5.71	Reject
B_{13}	(5.667,6.667,7.333)	6.56	Approve	B_{35}	(5.19,6.19,6.952)	6.11	Approve
B_{14}	(4.762,5.714,6.524)	5.67	Reject	B_{36}	(3.952,4.857,5.667)	4.83	Reject
B_{15}	(4.238,5.238,6.19)	5.22	Reject	B_{37}	(5.429,6.429,7.19)	6.35	Approve
B_{16}	(3.381,4.286,5.143)	4.27	Reject	B_{38}	(4.81,5.762,6.429)	5.67	Reject
B_{17}	(4.619,5.571,6.476)	5.56	Reject	B_{39}	(6.476,7.476,8.095)	7.35	Approve
B_{18}	(3.905,4.905,5.81)	4.87	Reject	B_{40}	(6.3,7.25,7.85)	7.13	Approve
B_{19}	(5.667,6.667,7.476)	6.60	Approve	B_{41}	(5.286,6.286,7.143)	6.24	Approve
B_{20}	(5.571,6.571,7.429)	6.52	Approve	B_{42}	(4.619,5.571,6.333)	5.51	Reject
B_{21}	(5.524,6.524,7.286)	6.44	Approve	B_{43}	(5.429,6.429,7.286)	6.38	Approve
B_{22}	(5.095,6.095,6.952)	6.05	Approve				

Table 5. The pairwise comparison matrix for the categories

	Economic (C1)	Socio-cultural (C2)	Legal (C3)	Structural (C4)	Political (C5)
C1	(1, 1, 1)	(6.25, 7.00, 7.69)	(1.69, 2.17, 2.57)	(5.22, 6.15, 7.04)	(2.20, 2.46, 2.72)
C2	(0.13, 0.14, 0.16)	(1, 1, 1)	(0.71, 0.92, 1.28)	(0.65, 0.75, 0.86)	(0.46, 0.58, 0.79)
C3	(0.39, 0.46, 0.59)	(0.78, 1.08, 1.41)	(1, 1, 1)	(4.03, 4.74, 5.38)	(1.49, 1.8, 2.05)
C4	(0.14, 0.16, 0.19)	(1.16, 1.33, 1.55)	(0.19, 0.21, 0.25)	(1, 1, 1)	(0.68, 0.85, 1.10)
C5	(0.37, 0.41, 0.45)	(1.27, 1.71, 2.19)	(0.49, 0.56, 0.67)	(1.47, 1.17, 1.47)	(1, 1, 1)

Table 6. Decaying the final weights of the categories

Factors	Defuzzification value	Normalized value
Economic (C1)	0.480	0.468
Socio-cultural (C2)	0.089	0.087
Legal (C3)	0.233	0.227
Structural (C4)	0.092	0.090
Political (C5)	0.130	0.127

Table 7. Determination of the final priority of the indicators with the FAHP technique

Category	Weight	Indicator	Weight	Rank within category	Final weight	Overall rank
Economic factors	0.468	B_1	0.144	5	0.068	6
		B_2	0.167	3	0.078	4
		B_5	0.205	2	0.096	2
		B_6	0.51	1	0.240	1
		B_8	0.087	7	0.041	12
		B_9	0.154	4	0.072	5
		B_{10}	0.087	7	0.041	13
		B_{11}	0.106	6	0.05	8
Socio-cultural factors	0.087	B_{13}	1	1	0.087	3
Legal factors	0.227	B_{19}	0.132	3	0.03	14
		B_{20}	0.103	7	0.023	18
		B_{21}	0.106	6	0.024	17
		B_{22}	0.122	5	0.028	16
		B_{23}	0.203	2	0.046	10
		B_{24}	0.206	1	0.047	9
		B_{25}	0.129	4	0.029	15
Structural factors	0.09	B_{27}	0.11	4	0.01	26
		B_{28}	0.177	2	0.016	20
		B_{29}	0.258	1	0.023	19
		B_{30}	0.139	3	0.013	23
		B_{35}	0.177	2	0.016	21
		B_{37}	0.139	3	0.013	24
Political factors	0.127	B_{39}	0.489	1	0.062	7
		B_{40}	0.324	2	0.041	11
		B_{41}	0.087	4	0.011	25
		B_{43}	0.1	3	0.013	22