Road Project for Economic Development: Yazd-Abarkouh-Sourmagh Road Project Feasibility Study

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ABSTRACT

In recent decades, importance of roads in economic development of countries has been confirmed by many studies. Roads affect countries in terms of social and economical development. The traffic statistics have shown that the traffic growth rate of Iran is rising up rapidly. In order to meet this rising demand and to improve the traffic condition in Iran, the government is attempting to construct new roads.

This thesis is about integrated investment appraisal of Yazd-Abarkouh-Sourmagh road project with the objective of determining whether the project is feasible or not to be undertaken. The road has 93 km length and is located in Yazd, one of the biggest and important provinces of Iran. It will expand the connection between Yazd, Esfahan, Shiraz and Tehran. Using the data and information from the project owners directly, this thesis appraised the feasibility of a road project under two scenarios.

Scenario one is based on the project owner's assumption where the project is fully financed by the government; without any loan and or toll. The result of this scenario showed that, this project will have negative financial NPV of 29 million USD but positive economic and externalities NPV of 17 and 47 million USD, respectively. The results are as expected for road projects.

The second scenario, which is expected to be the contribution of this thesis, is a Special Purpose Vehicle (SPV) case where private sector will be undertaking the project with support from the government. In this scenario, private sector will finance 50 percent of the project investment cost with and will have toll. The results of the second scenario indicate that both financial as well as economic NPVs are positive; first being 2 and latter being 29 million USD. The analysis also shows that

especially users (consumers) will benefit a lot from this project outweighing the benefits of the other stakeholders i.e. owners, labour. This study in general indicates that with the introduction of SPV's where private sector is also motivated, such big public project can be undertaken without creating too much financial burden to governments.

Keywords: Road project, time saving, net present value, feasibility, integrated investment appraisal

ÖZ

Son yıllarda yapılan çalışmalar ülkelerin ekonomik gelişiminde yolların önemli bir yere sahip olduğunu teyit etmektedir. Yollar, ülkeleri sosyal ve ekonomik gelişmeleri için önemlidir. İran'da trafiğin hızla artığı istatistiklerle görülmektedir. Bu nedenle İran hükümeti, artan talebi karşılama ve trafik şartlarının iyileştirmesi için yeni yollar inşa etmektedir.

Bu tezin amacı Yazd-Abarkouh-Sourmagh yol projesinin uygulanabilir olup olmadığını entegre yatırım/proje değerlendirme yöntemi ile belirlemektir. Bu yol projesi 93 km uzunluğunda İran'ın en büyük ve önemli kentlerinden biri olan Yaz kenti bölgesindedir. Bu proje Yazd, Esfahan, Shiraz ve Tahran arasındaki bağlantıyı artırası beklenmektedir. Bu tez çalışmasında proje sahiplerinden alınan bilgi ve veriler kullanılarak, projenin uygulanabilirliği iki senaryo altında değerlendirilmiştir.

Birinci senaryoda proje sahibinin İran devleti olması, projenin tümüyle İran hükümeti tarafından finanse edileceği, proje için kredi ve yol geçiş ücreti kullanılmayacağını varsaymıştır. Birinci senaryo finansal değerlendirme sonuçlarına göre projenin 29 milyon Amerikan doları negatif finansal net bugünkü değeri oldu tespit edilmiştir. Bunun yanında projenin ekonomik değerlendirme sonuçları 17 milyon Amerikan doları pozitif ekonomik net bugünkü değer olarak hesaplanmıştır. Bu da projenin önemli ekonomik dışsal etkiler yarattığı ve hesaplamaya göre bunun 47 milyon Amerikan doları olduğu tespit edilmiştir. Bu sonuçlar genelde yapılan yol proje sonuçları ile örtüşen ve onları destekler niteliktedir.

İkinci senaryo, projenin İran hükümetinin desteğiyle, özel sektörün yürüteceği ve "Özel Amaçlı Araçlar" (Special Purpose Vehicle) olarak tanımlanan yöntemle

yapılması varsayılmıştır. Bu senaryoda, özel sektör projenin yatırım maliyetinin yüzde 50 sini finanse ederken, buna karşılık yol geçiş ücreti (toll) alacaktır. İkinci senaryonun hem finansal hem ekonomik net bugünkü değerleri pozitif hesaplanmış ve bunlar sırasıyla 2 ve 29 milyon Amerikan dolarıdır.

Analizler, yolu kullanacak olanların (tüketicilerin) bu proje sahiplerinden bile daha fazla fayda elde ettiklerini göstermiştir. Bu çalışma ayrıca, Özel Amaç Araçlarının kullanımıyla büyük altyapı projelerinin özel sektör tarafından da inşa edilebileceği ve bu sayede hükümetler üzerindeki mali yükü azaltabilecekleri tespit edilmiştir.

Anahtar Kelimeler: Yol projesi, zaman tasarrufu, net bugünkü değer, fizibilite, entegre yatırım değerlendirme.

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To My Dear Mom & Dad

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LIST OF ABBREVIATIONS

BCR……...….....Benefit Cost Ratio

ADSCR……Annual Debt Service Coverage Ratio

DR……Discount Rate

EOCK……Economic Opportunity Cost of Capital

IR……..……Iran Rial

IRR……....Internal Rate of Return

LLCR……Loan Life Coverage Ratio

NPV……...Net Present Value

OECD……Organization for Economic Cooperation and Development

PBP……...Pay Back Period

SPV…….Special Purpose Vehicles

VOC…….Vehicles Operating Cost

Chapter 1

INTRODUCTION

1.1 Background

Iran is a country with 1.648 million square kilometers area, located in southwestern Asia and the Middle East. It is in neighborhood of Turkmenistan, Azerbaijan, Armenia and the Caspian Sea, Persian Gulf and Oman Sea, from north and south respectively. From west, it has neighborhood with Iraq and Turkey and from east with Pakistan and Afghanistan (Hamshahrionline, 2008).

According to the latest researches of demographic organizations, annual population growth rate of Iran is approximately 3.6 percent and its annual traffic growth rate is around 6.2 percent. With these annual growth rates, the country requires more and more efficient well-organized roads, to be able to be responsive to the growth of its population's requirements to safe and secure roads. In most countries, as well as Iran, the share of roads in transportation of goods, services and passengers are more than 90 percent. Therefore, it is necessary to pay special attention to road transportation in each country.

In modern world, roads are essential for improvement of society's level of life. The importance of road construction is to build connection and to keep relation between to civilization. Construction of new road reduces poverty, fuel usage and decrease accident probability. In addition, the periodically repair of roads is important to save cost of petrol and maintenance cost of vehicles which are using the road daily and for road equipments company making their product very high

performance and high quality product (Importance Of Road Equipment & Road Construction Machinery, 2005).

Hence, government of Iran is supporting and encouraging private sector to undertake road project by, allocating concessions like loan. The most important problem in the projects construction is the lack of funding and on time fund allocations to projects. It increases of project cost and is a serious obstacle to completing the projects on time.

In general, there are two types of investment for road construction projects:

1. Civil construction projects which are funded from the state budget and the public revenues.
2. Collaborative projects which are funded from banks or other financial institutions.

1.2 Aim of Study

The purpose of this thesis is to appraise the feasibility of a road project which is from Abarkouh in Yazd to Sourmaq in Shiraz. The appraisal will be from both financial and as well economical point of view, to find out whether this road project will contribute to development of Iran's economy or not. The thesis will check the viability of the project from different perspectives such as owners and bankers point of view and will focus on:

1. Studying the financial feasibility
2. Studying the economical feasibility
3. Risk analysis

When the financial and economical parts are done, subsequently, it is the time of using the Monte Carlo simulation, to carry out risk analysis. Risk analysis is used to define the risky variables of the project and help to determine the technique to mitigate their effect. Additionally, the study is executed to find answers for some probable questions at the end of the project. Questions such as:

1. How will the project be able to mitigate the effects of risky variables of the project and make it efficient?

2. If they face with any kinds of increase in cost, how they will sort it out?

3. Will the project's cash flows cover its debt? If not, what is the solution for such problems?

1.3 Method Used in the Study

1.3.1 Data Sources

The required data for this thesis and the needed Information has been taken from the Iranian Ministry of Roads and Transportation and the project's owners. During the period of completion, the study came across with several problems to achieve the needed information to complete thesis spreadsheets. To deal with these limitations, similar projects which had been done before, by World Bank, development banks and other financial institutions used. Also, different and various investment appraisal articles, books and web sources have been used in the stage of research and study.

1.3.2 Study Approach

Integrated financial appraisal analysis is the method, which is used to define the feasibility and viability of project. In the time of completion of project, it is expected that the analysis will provide sufficient outcomes for decision makers to decide whether it is a feasible project to be undertaken or not.

At the start point, the all needed data should be entered in spreadsheet. After that, the financial and economical analysis part shall be carry out to determine NPV, then with the obtained NPV the sensitivity analysis will have carried out to define and identify the risky variables. Determined Risky variables of the project will be used in Monte Carlo simulation to find out whether the project is risky or not and which impacts these variables have on the project viability.

1.4 The Structure of the Thesis

Given the introduction for the study, the thesis will continue by review the literature on roads in chapter 2 with some historical background and also economic implications of roads in development of countries economy. In chapter 3, the data and methodology used in project are described and a general description of project about location and its cost and more about the methodology which included, the financial, economical, sensitivity and risk analysis of the project. The financial analysis of the project will be done in chapter 4 in 2 scenarios, which are with toll and loan and without. Moreover, the obtained NPV illustrates the financial viability of the project.

The study will continue by economic analysis of the project in chapter 5 to achieve the economical value of project and to define the beneficiaries of the project. After that, the risk analysis will carried out in chapter 6 to define the risky variables of the project and at the end of thesis, the result of this study and needed recommendations will be mentioned in chapter 7. Then, comparison between 2 scenarios to achieve to the necessary strategy to mitigate the risk of undertaking bad project or diminish the affect of risky variables.

Chapter 2

IMPORTANCE OF ROADS IN ECONOMIC DEVELOPMENT

Nowadays, the importance of roads is obvious for everyone. Commonly, a road can be defined as an open, general public way for the passage of vehicles, people, and animals (University of Washington - washington.edu).

Roads link cities and villages, allow people to communicate with other people in other places. They have many impacts on people's life, for instance having social and economical effects are some of the most important features of roads. In this chapter, these affects will be explained and a brief history of road transportation in the World and Iran will be studied.

2.1 History of Roads in the World

According to Encyclopedia Britannica 1995, the first road probably was built in southwestern Asia in the area surrounded by the Black and Caspian seas, the Mediterranean Sea, and the Persian Gulf. The first type of transportation was using horses, during the stone ages.

Wheeled vehicles were probably first developed in a broad, roughly trapezoidal area, with its longer base extending from north of the Black Sea to the Caspian Sea, and its shorter base in the northern end of the Persian Gulf, with Lake Van in eastern Minor Asia as the centre (roads and highways, transportation, Britannica 2011).

The modern highway systems are a likely consequence of the earliest road systems. The first long-distance road was the Persian Royal Road, during 3500 to

300 BC. The earliest roads in Europe were the "Amber Routes" probably used by Etruscan and Greek merchants to transport amber and tin from the north of Europe to the Mediterranean and Adriatic between 1900 and 300 BC. Those roads were not in the modern forms and were passing at river crossings and over the mountain passes.

In paralleled to the royal Road, The ancient road system of China was a considerable and significant system. The role of Imperial roads in southeastern Asia was the same as the Roman roads in Europe and Asia Minor. Many of the Chinese roads were wide, well built, and surfaced with stone.

The first roads in Egypt were built by the order of Herodotus to supply a solid track for pulling the enormous sandstone blocks, which were being used for construction of pyramids. There are evidences showing that in Egypt, there were particular roads for religious reasons in 800 BC which were all paved roads leading to the temples. However, there are a few evidence of street surfacing in ancient Egyptian towns (Christian, 2001).

Romans were the first scientific road builders. The Romans had built almost 53,000 miles of roads at the peak of their Empire. Roman roads were notable for preserving a straight line from one place to another place regardless of its difficulties. They were passing over marshes, lakes, ravines and mountains (Liu, 2010, p. 33).

At the time of Marco Polo's travels, the trade road from China to Asia Minor and India was known as the Silk Road. The Silk Road was a wide interrelated network of trade routes across the Asian continent such as Iran, linking East, South, and Western Asia with the Mediterranean world, in addition to North and Northeast Africa and Europe (1995, Encyclopedia Britannica, Inc).

Although many historically roads were simply recognizable routes without any proper structure or maintenance, modern roads are normally smoothed, paved, or

equipped to allow easy travel. For purposes of international comparison, the OECD defines a road as:

> "A line of communication using a stabilized base other than rails or air strips, open to public traffic, primarily for the use of road motor vehicles running on their own wheels" (Glossary of Statistical Terms - Road Definition, 2002).

It should include:

> "Bridges, tunnels, supporting structures, junctions, crossings, interchanges and toll roads but not cycle paths" (Road - Wikipedia, the free encyclopedia).

These days, it is a general policy of most governments of countries in the world to build more and more roads to gain more access to the furthest regions of their countries.

2.1.1 Social Aspect of Roads

Developed and sustainable roads are essential for the well-being of living and future generations. Roads have crucial impacts on people's life and one of them is social impact such as health and environmental. It is for a long time that experts found out the importance of social aspect of roads, but actually, the social advantages and disadvantages of roads are not very clear because they are different with respect to the gender, age, position, profession and location of the road users. Therefore, before the measurement of social benefits and costs of roads the variety of social affects should be recognized (Seddon, 2004).

In this century, by improving in road sector people can benefit from its positive influence, such as decreasing of mortalities. Improvement in transportation infrastructures reduces physical dangers for humans. One example could be that the number of people injured in road accidents, who subsequently die can be reduced

due to the high speed of reaching to the medical facilities by using the developed roads. So, accident injuries will have a greater chance of survival. In addition, time and money that have been saved can be used for other health problems in the society.

Road transportation has also promoted the communication between communities by reduction of distance. It has facilitated the accessibility to the most distant even to the places that were inaccessible before.

During the construction of road, residents may be disturbed and troubled by indirect routes, dots, noise, and heavy equipment traffic on existing roads. In large cities, the observations of these impacts are quietly easier than in small cities. Due to the increasing in the number of road vehicles, long traffic holdup is an ordinary picture in large cities. In most of the developing countries, poor road infrastructures make the problems worsen to a larger degree. Additionally, road traffic is one of the major sources of noise pollution in many of big cities. Upon to all the mentioned disadvantages of social features of roads, many studies proved that roads have huge effects and externalities in people's life and also development of countries. The positive parts play the more important role in people’s life (Stevenson, 1995).

2.1.2 Economical Aspect of Roads

Road and transportation sector can contribute to the economy growth of the countries with use of different opportunities and benefits that are created by this sector. This sector has opened an easy access to each part of country and to the different markets in the world, as well. In addition, it has promoted the employment and level of investment that both can help in increasing the GDP of countries. It is obvious that, each new road that has been built in a region has some significant impacts on the economy of that region; the most significant are affects on employment and alleviation of poverty, which are interrelated.

In the time of construction of roads, it is necessary to provide sufficient amount of raw materials and labor forces to continue the project and complete it on time. Usually, the project contractor hires the necessary labor forces from the project area. The most direct impact of poverty alleviation is to hire the local employment for the construction, improving, and maintenance for the roads and a proper plan, which leads to hire the poor local labors to work on road projects and increase their level of earnings.

Roads can also alleviate the poverty by improving the economics of countries through the:

- "Income distribution in the rural areas in favor of the poor;
- Purchasing power of the poor;
- Sectoral output in favor of the poorer population;
- Agricultural terms of trade;
- Employment of rural migrants and their remittances;
- Access to market centers, public services and utilities" (Regional Road Sector Study - ADB.org, 2011).

On the other hand, if countries' roads have not improved, it can cause missing of some opportunities such as different type of jobs and businesses. The impact of roads and transportation improvement can be divided to direct or indirect. The former reflect on changes in accessibility of people to the large or world's market and an increase in saving of time and cost by use of each new road. The latter affect is various impact of road on economy and drop or increase of price and variety of commodity, goods and services (Rodrigue, 2011).

In the following table 2.1, some of the important aspects of road and transportation roles in improving the level of economy are shown, which are the direct and indirect impacts of road on macro economy and micro economy and direct supply and demand of transport.

Table 2.1: The important aspects of roads in the economy

Direct Transport Supply	Direct Transport Demand	Indirect Microeconomic	Indirect Macroeconomic
Income from transport operations (fares and wages) Access to wider distribution markets and niches	Improved accessibility Time and cost savings Productivity gains Division of labor Access to a wider range of suppliers and consumers Economies of scale	Rent income Lower price of commodities Higher supply of commodities	Formation of distribution networks Attraction and accumulation of economic activities Increased competitiveness Growth of consumption Fulfilling mobility needs

Source: Adapted from the European Conference of Ministers of Transport.

- **Some experiences about road project**

From the road projects which have been done before, two projects are mentioned in this section as examples. The Tunisia VI road project is one of the appraised projects that show a positive NPV equal to 630,896,913 TND. It is a successful experience of investment appraisal with lots of social and economical benefits and without any bad effect on natural protected and sensitive area. Unlike the Tunisia VI project, the Farigdon bypass road project (open in 1978) shows a negative NPV in 3 routs from 4; route 1(393.503), route 2 (465.998) and route 4 (793.249). Having a negative NPV indicates that there have been a huge waste of government's resources, which if the project had been appraised, these wastes wouldn't have happened and could have been used in affording other requirements of society.

2.2 History of Roads in Iran

Since the time that man taught agriculture and lived near his farms, having connections with other farms and villages became an important issue. Therefore, from the same time, some routes and passageways were considered for transitions. In the old Iran, the Persian Royal road, ancient highways, was built by the order of king Dariyush I, in 5 BC. Royal road was linked cities and villages from AFS in today Greece, to the Susa in Iran.

Dariyush built this road to facilitate swift communication all the way through his very large empire. These couriers could travel, 1677 miles, (2699 km) in seven days. Year of 1920 can be set as the start of constructing the new roads in Iran. When vehicles modern reached to Iran, building a vehicle routes became to be on the government's agenda. Sources indicate that building and maintaining the roads were financed by tolls from the passengers. However, by 1925 government decided to introduce a tax on the imports and exports as a road tax to substitute road toll.

From the ancient Iran up to now, many changes have been taken place and it will continue to change, but there is something usual and permanent in all the periods and that is, the element of road maintain always concerned with safety, comfort of people.

Now in Iran, there is a ministry of road and transportation, which is one of the 21 ministries in government. This ministry is responsible for managing the affairs of domestically land, sea, air transportations, and communications between Iran and other countries in the world (Iran Zamin 2, 2006).

Transportation network in Islamic Republic of Iran has length of 185,000 km of roads, 9,036 km railways and 25 domestic destinations for airways. Approximately 110,000 km of land roads are rural roads and the rest are main roads. In Figure 2.1, the total road network in Iran is shown by separation of their types.

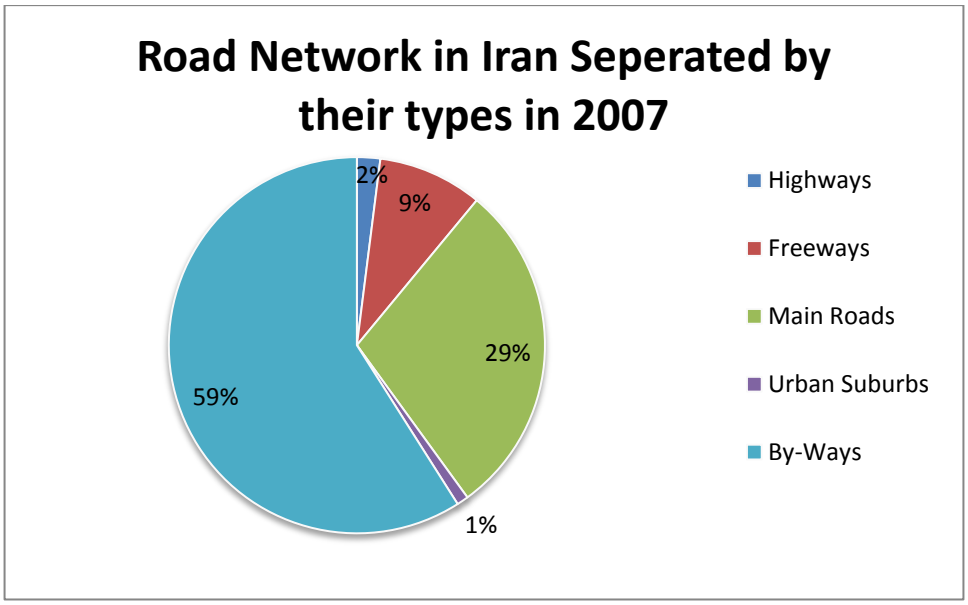

Figure 2.1: Total Road Network in Iran Separated by their types in 2007
Source: Statistical Yearbook of ministry of Road and Transportation of Iran

Over 11,000 km of Asian highways are located in Iran. These international roads are using for trading goods and services within cities in Iran and also boarder countries with Iran. In addition, to have an easy connection with neighbor, countries are important for Iranian people because of their interest for traveling to other countries. It should be mentioned that, about 20,000 km of the road network in Iran are transit roads, which play an important role in Iran transactions. It is also important to note that 90 percent of goods transportations are traded with land roads. This obviously makes road to even more important for the development countries economy (Atrchian, 2007).

The considered value of national roads is 750,000 million IR, approximately 750 million USD. Government policy allocated 4 percent from this amount for maintenance of roads in the annual budget. Statistics show that almost 85 percent of road traffics are in only 25,000 km of roads in Iran. Therefore, the maintenance and safety of these routs should be at priority of the government, as it can reduce the probability of car accidents (Ministry of Roads and Transportation, 2008).

In Iran, around 10 percent of national roads are reaching to saturation, and also there are 8 million vehicles, which are traveling in roads, it seems that constructing of 400,000 km of new roads could solve the problem of traffic in Iran (Aftab News site: 2011).

Chapter 3

PROJECT DATA AND METHODOLOGY

3.1 Project Data and Description

In this chapter, the project will be described in detail, outlining all the data that will be used for project appraisal. Then, the method that will be employed to evaluate the road project will be introduced.

Based on reviews, which were conducted on 8,000 km of main and major roads of Iran; it was declared that, it is essential for the country's road transportation network to be developed and also, new roads to be built. Therefore, road construction is a premier executive program of Iran's Ministry of Road and Transportation. The main reason that motivated the government to take the decision of constructing new roads and considering it as essential are summarized below:

1. Improving traffic safety.
2. Decreasing the travel time by reducing the distance, and increasing the average speed of vehicles.
3. Increasing the transportation speed for the passengers, goods and services.
4. Reducing the vehicles' depreciation cost.
5. Reducing vehicles' fuel and energy consumption.
6. Efficient use of existing resources and services of the country.

This highway road project which will be appraised in this thesis is a crucial path of the country's road network, since it establishes an optimized road connection

between the capital of Yazd province and other economically and socially important cities, such as Shiraz, Esfahan and Tehran and its other around cities.

The Ministry of road and Transportation is authorized to allocate the financing plans and expansion projects to the companies and organizations, which according to the laws are permitted to cooperate with banks and financial institutions to construct and put projects for performance.

This highway project is considered as expansion of the old road, by constructing a new road, switching it to Yazd_Sourmaqe road and connecting it to Shiraz-Abarkouh-Esfahan highway. The road's total length is about 190 km, which this project is 93 km representing its second bond. The starting date of the project was in 2006 from the 60^{th} kilometer and planned to be completed in 2010 in the kilometer of 153 of this path.

As it can be followed by Figure 3.1, the Yazd_Abarkouh_Sourmaq road project is located in Abarkouh region, in the western side of Yazd, one of Iran's big cities. This project is a development of the productive infrastructures and will be one of the most crowded paths of Iran. The length of road is as mentioned before, 93 km and is 50 km shorter than the existing road in the region. The starting point of this road is in Taft in Yazd, and will be ended in Sourmaq in Fars. Construction of this project will save time for vehicles' transportation due to the reduction in length, which will decrease the fuel consumption as well. In addition, this project will be safer than the old road, which will consequently decrease rate of road accidents.

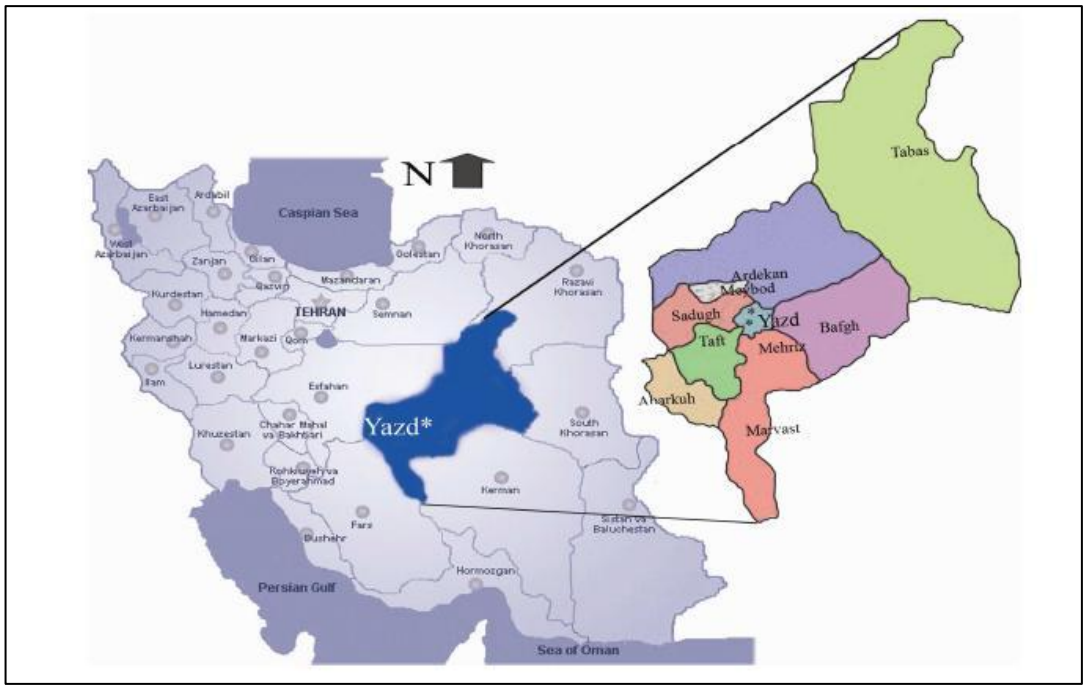

Figure 3.1: The location of project.
Source: (The Morphological Variations of Yazd Province, 2011)

Some of purposes of constructing this road were:

1. Improving transportation safety in accordance with international standards.

2. Increasing safety by reducing rate of accident and providing quick aids in the case of accidents or any other serious problems.

3. Improving the road services in order to assist the economical development.

4. Time saving for vehicles users.

5. Optimizing fuel consumption due to reduction of environmental pollution.

3.2 Project Cost

The elements of road construction projects are:

1. Labor

2. Material

3. Miscellanies

4. Equipment and Machinery

3.2.1 Labor

Labor is a distinct element of any project. Typically, labor parameters describe the number and kind of employees, their wage rates, fringe benefits, insurance and social security payments, expected real wage growth rates and etc. A few parameters will be also needed, for the economic analysis during the estimation of the economic conversion factors, for the different labor types, employed for the project (Jenkins, 2002).

To undertake this project, 200 workers are required. During the period of project construction, which was estimated to take 4 years, this all the labor force has been employed. From these 200 workers, 150 are unskilled and the rest 50 are skilled labors. In addition, four civil engineers, one mine engineer and one mechanical engineer have been working together during the project's construction period.

The payment to the employees of the project is according to the salary table shown in the following:

Table 3.1: Salary table

Description	Number of employees	Monthly salary each (000)	Total monthly salary (000)	Annual salary (000)
unskilled	150	3,627	544,050	6,528,600
Skilled				
worker	44	11,500	506,000	6,072,000
civil engineer	4	13,000	52,000	624,000
mine engineer	1	12,500	12,500	150,000
Mechanical engineer	1	13,500	13,500	162,000
Total	**200**	**54,127**	**1,128,050**	**13,536,600**

Source: These data has obtained from project owner and prepared for analysis.
Note: the numbers are in Rial, which is currency of Iran.

3.2.2 Material

The most important materials that have been used to build the project during the construction period can be stated as the following numbers of cases.

1. Cement
2. Alcantarillas
3. Guardrail

The share of material from the project cost is approximately 22 percent. All the mentioned materials are provided within the country and cities around the project site and so, no material was imported for the construction, according to the documents, data provided by the contractor of the project.

3.2.3 Miscellanies Cost

The miscellanies expenses were expected to be around 20,000 million IR. Even though, these costs will not participate directly in the project outputs and results, their growth will cause of investment costs to rise for the project. One of the importance of such costs is that it's grow may cause the project, not to be completed on time. Some examples of these expenses are the transportation costs of employees and workers, insurance.

3.2.4 Equipment and Machinery

According to the project documents, the cost of equipment and machinery was predicted to be about 161,000 million IR. As an example for equipments and machineries, which are used for the construction in several cases, can be stated respectively as mentioned below:

1. The central construction site, which includes asphalt plants, concrete production site, cutting and bending reinforcement site.
2. Cement storage silo
3. Water tank

4. Scraper (for excavation, loading, soil carrying, grade leveling)

5. Dozer (for digging and transporting of soil and also filling the trench)

6. Grader (for excavation and embankment, leveling the and setting the slope of surface)

7. Road roller (for squashing the soil to reach the desired density)

8. Water cannon machine

3.3 Maintenance Cost

The road project maintenance cost contains two types of expenses, routine and periodic. The routine cost is annual and the periodic one is once in each 8 years. The project useful life is 30 years, which include three periodic maintenances. Maintenance cost of road according to some calculations was forecasted to be 9 million IR and 90 million IR for annual and periodic one, respectively.

3.4 Project financing

Project financing is a new and appropriate financing technique, which has been used in many attractive viable projects. While huge amounts of investment are urgent requirement for infrastructures' development of countries, governments would be unable to provide the necessary financial resources for these projects unless they use a new method of project financing. These methods allow the private sector to participate in public infrastructure projects without being the owner of it.

Some of risks may possibly come across, during the stage of project financing are:

1. Operational risk

2. Interest rate risk

3. Inflation risk

4. Political risk

5. Laws and rules risk

6. Management risk (Molaei, 2010).

The effects of those risks could have results in the following cases:

> "1. The project not being completed on time, on budget or at all.
> 2. The project not operating at its full capacity
> 3. The project failing to generate sufficient revenue to service the debt
> 4. The project prematurely coming to an end" (What is Project Finance, 2011)

In its original form, project has not received any loan. Basically, the toll system is not planned for this project to be implemented in. All of the investment costs are arranged to be paid by the government.

It is the aim of this thesis to examine and appraise the Yazd_Abarkouh_Sourmagh road project in two scenarios, to find out how private sectors can be encouraged by the government, to participate in a civil construction and infrastructure projects' implementation.

With this objective, the thesis is going to evaluate the viability of the project with two scenarios. The scenarios that are developed for the project are:

1. Without toll and loan (all costs are financed by the government)
2. With toll and loan

First scenario will search to determine the feasibility of road project assuming the, without toll and loan, which will totally be, undertake by the government. Total investment cost is 300,000 million IR (about 30 million USD), which the total amount of money is funded by the government. Whereas, the second scenario will assumes if private sector undertaking, finding a proper loan and constructing the road. The 50 percent of investment cost of this scenario will be financed by the government and the rest by loan.

3.4.1 Loan

Loan in two scenarios:

1. Scenario one (without any loan)
2. Scenario two (with loan)

In the second loan's scenario, it is assumed that the project has received loan from a local bank. This loan will cover 50 percent of all of the investment costs, and the remained 50 percent will be funded, by the government. The loan carries an interest rate of 12 percent which is subsidized by the government and the duration of loan repayment is 24 years, with 4 years grace period.

Loan will be disbursed during the first 4 years of the construction period and after the grace period, starting from year 5, project will start to repay its debt of loan, finally by the end of the year 2029, the debt should be paid back entirely.

3.4.2 Toll

Under scenario two, it is also assumed that the project will put toll on road, to cover some of the investors' expenses for project construction, which is also adjusted for inflation.

Vehicles which will use the road are divided into four categories:

1. Cars
2. Buses
3. Truck (2 or 3 axles)
4. Truck (4 or more axles)

The following table represents the proposed toll structure, which is obtained from other available tolled roads for this project:

Table 3.2: Proposed Toll Structure

Vehicles	Cars	Buses	Trucks
Total	17,500	27,500	37,500

Source: Researcher

Discount rate or required rate of return, in project is equal to 15 percent for financial and 13 percent for economical real interest rate, which are the expected rate of return of similar investments in Iran. For justification of discount rates, it should be said that there is no calculated discount rate in Iran, I benefit from the World Bank analysis and educated guess, and it has been decided to use these 15 and 13 percent as project discount rates. It is the rate of return that investors could earn from similar investment.

The discount rate is a key variable in applying investment criteria in the project selection. Its correct choice is critical given the fact that a small variation in its value may significantly alter the result of the analysis and affect the final choice of the project. In financial analysis, the discount rate depends upon the point of view of analysis (Jenkins et al., 2004).

3.5 Methodology

Implementation of infrastructure project such as road project resources is needed huge funding, with a long period for construction, taking long time to come to be completed. To avoid undertaking bad projects, by the investors, there is a vital requirement for financial appraisal, before undertaking a project and start up.

The objective of the thesis is to show whether the chosen project is a viable and sustainable project or not, by analyzing the most important and key variables, in detail, to recognize the efficiency level of variables on the project's NPV. The exact methodology of this thesis includes financial, economical and risk analysis, which will examine the feasibility of the project. It will be employing all the components of integrated investment appraisal developed by Jenkins G.P.

3.6 Financial Analysis of Project under Two Scenarios

The basic financial statements of a project, which should be concentrated when doing the appraisal, are income statement, balance sheet and cash flows. This kind of analysis assists the investors, contractors, equity holders and corporate managers, to know how to make an excellent decision by choosing the most suitable and profitable project. If the financial statements are not accurate enough and carefully prepared, then it leads the investors to choose a bad project, lose their money and fail in project.

For the financial evaluation of a project, at the beginning, the relevant data and information should be collected with a high level of accuracy and attention. In projects' analysis, it is essential to choose variables according to their importance and riskiness. After all, collected data and information will be put in the table of parameters and then project evaluation can be started. This table is the main part of each project's assessment, that if it is made by worthless and wrong data, then the results of appraisal will be a big mistake and can mislead the investors.

- **Scenario one**

Scenario 1 is the original project that does not include toll and loan; also, it is fully funded by the government. When table of parameters is prepared, the analysis starts with inflation, to compute the domestic inflation index and subsequently, investment costs schedule should be adjusted. The operating maintenance costs are the next step in two ways: routine and periodic. After that, estimated demand schedule is constructed which represents total vehicles that would cross the road daily.

The analysis is followed by the loan schedule and then the depreciation schedule, which takes place after the demand schedule in the spreadsheet. After that, it is

continued by estimated revenue and operating expenses schedule. Next steps are cash flows statements, which are divided into two categories:

1. Total investment point of view from nominal and real perspective
2. Equity point of view from nominal and real perspective

Present value of an investment's future net cash flows minus the initial investment gives the NPV of project. If it is positive, the investment should be undertaken, otherwise it should be tried to mitigate the effect of risky variables or, be rejected (What is NPV? definition and meaning, 2011).

There are four different methods used for projects' evaluation:

1. Rate of return (IRR)
2. Payback period (PBP)
3. Benefit cost ratio (BCR)
4. Net present value (NPV)

Among the mentioned methods, NPV has the best result and for projects' evaluation is the most trustable one, as it is more significant and realistic than others. Because IRR, PBP and BCR have some disadvantages which reduce their accuracy.

- **Scenario two**

There are two differences between the scenarios one and two, which are, having loan and proposed toll schedule in scenario two. Thus, scenario two will also follow the same structure of explained for scenario one and in addition, at the end of cash flows statement, the investments' ADSCR and LLCR ratios are calculated. The meaning of ADSCR and LLCR is annual debt service coverage ratio and loan life coverage ratio, respectively. The cash flows statement demonstrates the profit and cost of project, during the construction period. Projects' cash inflows should cover its cash outflows to have a positive NPV.

3.7 Economic Analysis

Economic and financial analysis may look similar to each other in terms of approach however; they differ in concept. The purpose of economic analysis of a project is to recognize the effect of the project on the economic development of the country and its impact on living standard of its society. In such an evaluation, the profitability of the project is important for the entire economy and not only for the project investors. In addition, this analysis determines how beneficial the implementation of project is for each beneficiary (Economic Analysis of Projects - Financial and Economic Analysis - ADB.org, 2011).

To ensure the success of project in achieving its target, there is a need to adjust a demand schedule, to get the critical demand and market for the output of the project.

Assuming that the project is completed on schedule and within budget, its economic viability will depend primarily on the marketability of the project's output. To evaluate marketability, the sponsors arrange for a study of projected supply and demand conditions over the expected life of the project. The planed outputs of the project at a price that will cover full cost of production enable the project to service its debt, and provide an acceptable rate of return to equity investors (Finnerty, 2007).

For starting the economic analysis, first step is to set up the table of parameters. As it is mentioned in financial part, table of parameters should include all necessary required data. The next step is a well-designed conversion factors schedule for the vehicles, materials, tools, and labors. Afterward, all the needed tables for calculation of conversion factors for construction costs come into view. The analysis is followed by a schedule including summary of all conversion factors and table of routine and periodic maintenance costs.

The calculations of vehicles operating cost (VOC) and time saving (with and without) are subsequent stages in the assessment process, to calculate the consumers' surplus. After that, the table of expected normal traffic and generated, the VOC and the value of time in the form of with and without, are prepared in the next step. After that, the analysis continues by the table of incremental benefits of truckers, consumers' surplus, net economic benefits statements and externalities, respectively. The analysis is finished by the table of externalities consolidation and distribution analysis, which in this segment, each beneficiary's share, from total benefit of project, is calculated.

3.8 Sensitivity Analysis

The other component of integrated project appraisal is to do sensitivity analysis to identify risky variables. Sensitivity analysis measures and examines the impacts of the project's inputs, on project's outputs. Also, defines the probable effects of one or more project's variables on the outcomes. In addition, sensitivity analysis illustrates the size of fluctuations in NPV, made by any change in significant variables, while keeping all conditions of project constant and changing only one variable. The condition of project should be considered constant because, sensitivity analysis cannot show the impact of various variables at the same time. Due to this analysis, the profitability or loss of project is determined and it helps in making proper decisions and in avoiding from choosing unprofitable project (Marshall, 2004).

3.9 Risk Analysis

The risk analysis is the study of project's uncertainty to define the risks, which are related to the project and highlighting the risky variables. To solve this problem, the Monte Carlo simulation is used, to achieve to the probability distributions of the

main risky variables of the project**.** This approach helps to not undertake a project, which is not profitable. Risk analysis also, identifies effects of the risky variables and can help develop policies to mitigate determined risks. Risk analysis lets appraiser of a project, see which variables in the model have the greatest impact on the NPV. To do this analysis the Monte Carlo simulation is needed to be used, which assists especially the financial analysts.

For the project plan model, these items can be used to analyze the risks:

1. "List the potential risks.
2. Assign a probability to each risk.
3. Assess the severity should the risk occur.
4. Give each risk a score.
5. For the highest scoring risks, plan how you will prevent them happening." (Project planning: Risk analysis : JISC, 2011).

Chapter 4

FINANCIAL ANALYSIS OF YAZD-ABARKOUH-SOURMAGH ROAD PROJECT

Financial assessment attempts to reveal the efficiency, sustainability, and viability of a project by preparing the financial statement using data and information needed to estimate the NPV of the project and determine its profitability. A project is profitable, if its NPV is greater than zero, in other words, it shows whether the project's cash inflows cover its outflows. The NPV analysis and result assist investors to make proper decisions in choosing the profitable projects and reject those which have NPV less than zero that will cause project failures. In this part of the thesis, first the main parameters that have been used for analysis will be introduced, and then assumption will also be reviewed after that the chapter will be completed by the result of the financial analysis.

4.1 Parameters and Assumptions

4.1.1 Project Operational Life and investment cost

It is planned that 4 years will take to complete the construction of the project. Moreover, this road project is expected to have 30 years of life. The investment cost of project is computed to be 300,000 million IR (about 30 million USD).

Table 4.1: The investment costs of the project

Investment Costs Schedule (million) IR				
Year	**2006**	**2007**	**2008**	**2009**
Equipment and Materials	59,400	67,419	51,013	57,900
Labor Force				
Skilled	6,000	6,810	5,152	5,848
Unskilled	11,070	12,564	9,507	10,790
General Expenses	5,865	6,657	5,037	5,717
Contractor's Profit Margin	7,647	8,679	6,567	7,453
Total	**89,982**	**102,130**	**77,278**	**87,710**

- **Operating Cost**

The operating cost of this project is expected to be 5 percent of the total investment.

- **Depreciation**

Toward the completion of progress of project, the straight-line method is considered, for calculating the project's depreciation.

- **Taxation**

According to obtained data for completion of the project, the general sales tax is 8 percent and personal income tax, 4 percent. (See Appendix 1: Table of Parameters for Financial Part of Scenario One)

This road project is going to appraise under two scenarios, they are:

- Scenario one: In this scenario which is fully funded by the government and does not include toll and loan, the equity discount rate of this project is 15 percent, which is the minimum rate of return on government investment, expected to gain from this operation.

Scenario two: In this scenario, the new special purpose vehicle (SPV) is introduced. In addition, it is assumed that the project is undertaken by the private

sector and its construction cost is funded from two channels: 50 percent of investment cost is financed by the loan that has been taken from the domestic bank and the remaining 50 percent is financed by the government. In addition, the loan interest rate is supposed to be 12 percent (with respect to Iran and World Bank interest rate on loans) with a 24-year repayment and 4-year grace period. (See Appendix 2: Table of Parameters for Financial Part of Scenario Two)

4.2 The Result of Financial Analysis

The financial analysis is important from two viewpoints: first being the bankers, which refers to capability of repaying the debt of project. Financial analysis will show the financial strength of the project and also how viable it is financially. The second viewpoint is owners, which refers to profitability of a project for its owners and equity holders of it. In this perspective, not only the viability of project in regards to loan is studied but also how much profit will be generated. Profitability of the project will also be examined. This specific analysis will show whether equity (owners) will be making profit or loss, which is especially important in decision making.

4.2.1 Total Investment Point of View

Total investment point of view analysis shows the ability of project in repaying its debt from inflows (revenues) and benefits of the project. It measures whether the amount of cash inflows that is generated during the project operation is capable to cover the debt and other financial obligations of the project or not. Moreover, it illustrates the possible degree of the paying all of the received funds including, interest and loans.

In this part, the ADSCR and LLCR will only be calculated for scenario two because scenario one is fully financed by the government.

In this regard, these two important formulas can be applied: the first one is ADSCR and the second is LLCR.

- **Annual Debt Service Coverage Ratio (ADSCR)**

ADSCR refers to the amount of available cash flow, to meet the annual debt repayment of the project. In common, it is calculated by net operating cash divided by total debt service. In the respected year ratio should be greater than 1, but a sound project is expected to have ratio greater than 1.50. If the project's ADSCR is less than 1, it means it is expected that the project net cash flows are not sufficient to cover the debt of that year. This means that the project does not generate sufficient cash to cover its liabilities, loan and other costs. (Jenkins et al., Reading Material 521, p.28)

According to the above mentioned formula, the ADSCR schedule is prepared in following table (table 4.2.) for scenario 2, since for the first scenario is not needed.

Table 4.2: ADSCR Result for Project Financial Analysis

Year	Annual net cash flow in real term (million)	Annual debt repayment in real term (million)	ADSCR
2010	34,776	50,644	0.69
2011	36,386	48,024	0.76
2012	38,070	45,405	0.84
2013	39,833	42,785	0.93
2014	41,678	40,166	1.04
2015	43,608	37,546	1.16
2016	45,629	34,927	1..31
2017	39,373	32,307	1.22
2018	49,957	29,688	1.68
2019	52,274	27,068	1.93
2020	54,699	24,448	2.24

As the table 4.2 shows, in 2010 the ADSCR of project is 0.69, while it is not significant but in each year, the ADSCR has improved by a positive trend until 2020, however does not get to 1.5 before 2018. The last year's ADSCR is 2.24, which is a proper and acceptable ratio and indicates to the project power in covering its debt. From this trend, it can be realized that project will face serious financing problem to pay its debts and expenditures in the initial years. Hence, the owners and contractors of the project must look for some ways to improve and promote the ADSCR of the project.

After applying some polices to solve the problem, if the ADSCR of project's status does not show an improved trend, this indicates that the project will face very serious financial funding problems in repayment of it debt obligations. In order to measure how strong the project is financially, LLCR will be used in the next part.

- **Loan Life Coverage Ratio (LLCR)**

This ratio is used to estimate the capacity of the project in repaying its loan. The loan life coverage ratio is calculated by dividing the discounted net cash flows for debt repayment by the amount of project's discounted debt service. A LLCR greater than 1 indicates that the project is generating sufficient cash flow to pay its debts but the expected rate should be greater than 1.70 to show a good trend for LLCR and being less risky. A LLCR less than 1 should be a reason for alarm, because it indicates that the project is generating negative cash flow.

The PVs of this formula are computed with the real interest rate, which is used to pay the loan of project. The LLCR tells the banker if there is adequate cash, generated by project from its operation, to make bridge-financing in some specific periods, when there is insufficient cash flow to meet the debt. (Jenkins et al., 2004, p. 16)

From the financial analysis, the following LLCR table is obtained:

Table 4.3: LLCR Result

Year	PV of Annual cash flow in real term (million)	PV of Annual debt repayment in real term (million)	LLCR
2010	246,145	247,191	1
2011	243,074	226,029	1.08
2012	237,692	204,704	1.16
2013	229,546	183,194	1.25
2014	218,190	161,470	1.35
2015	202,989	139,499	1.46
2016	183,288	117,245	1.56
2017	158,307	94,666	1.67
2018	136,773	71,712	1.91
2019	99,838	48,328	2.07
2020	102,263	45,708	2.24

The result of table 4.3 shows that LLCR of project is started from 1 and it means that project will have a proper financing situation and enough net cash flow to cover its debt but still the ratios are risky before 2017. This table shows a positive trend for LLCR but being above 1 and below 1.7 makes it risky. According to these ratios the project will face problems in paying back its debt and loan obligation. For improving these ratios, the mentioned three ways for project's ADSCR, should be utilized.[1]

4.2.2 Total Owner's Point of View

Project's owner is the party who invests in a project and supports it financially. The owner can be a private investor, government, or a semi-government institution, which undertakes the project. Project's owner is dealing with all the cash flows, costs and expenditures of project to find out whether the project will generate profit or not.

> The cash flow statement will include the receipt of the loan as an inflow and all subsequent repayments of loan and interest as expenditures. If the project receives any grants or subsidies, these should be included as a cash flow statement, and if the project pays taxes, this should be included as a cash outflow (Glenday, n.d, p. 10).

The NPV shows investor and owners, whether their considered project will increase or decrease value from their investment. Therefore, investor can decide to accept or reject the project by relying on the NPV criteria.

NPV is the difference between the discounted benefits (inflows) from the project operation and its discounted expenses cash flows. The discount rate of NPV formula indicates the minimum rate of return of investment that investors expect to obtain from the project. In this project the equity discount rate is equal to 15 percent.

Since the attractiveness of project for investors is shown by NPV, then, if the NPV is less than zero, it indicates that the project will face with lots of problems in

[1] For more discussion see (Jenkins at al., 2002).

repayment of its debt and they will not obtain the minimum expected return. On the other hand, when the NPV is greater than zero, it tells owner that the project is financially feasible and thus it can be undertaken.

4.2.3 Result

The financial NPV of this project in the first scenario (no toll and no loan) is negative 259,223 million IR, which is equivalent to negative 29 million USD. Since the project is financed by the government and there will not be any charge (such as toll) for using the road. As expected, the NPV is negative, without any doubt, being a road project it will have some benefits to users in the form of time saving, less accidents and other similar benefits. These will be studied under economic analysis. (See Appendix 3: cash flow statement for equity owners)

However, this thesis has thought of introducing new scenario where private sector would also be involved. In this respect, scenario two has been constructed based on parameters that there will be a toll, generating revenues for the project to compensating the investment cost.

The NPV of the second scenario (with toll and loan) is 17,581 million IR which is approximately, 2 million USD. From these NPVs it is obvious that the project with positive NPV is a good case for accepting to be invested on.

These analyses also indicate that with proper vehicles such as toll, even the big public project can be undertaken by the private sector. This in turn, would be able to ease most of the burden on the government in providing infrastructure. In addition, it may create a competitive environment, where private sector would compete with each other, leading to more productive use of resources in the economy and also better services to the citizens.

Aside from the NVP that is the most important criterion, for appraisal of cash flow statement in decision making there is another principle called Internal Rate of

Return (IRR) that is also used. The IRR is the rate which makes NPV of a project zero. In scenario one the IRR of project is not obtained and its reason can be explained by having negative cash flows. Project IRR in scenario two is 16 percent. This (16 percent) rate being greater than the discount rate (15 percent) indicates that it is a feasible project. In addition, the result of IRR analysis confirms the result of NPV analysis and indicator that NPV>0 leads to and IRR>DR.

Table 4.4: The NPV and IRR of project in 2 scenarios

Total	NPV (million)	IRR (%)
Scenario 1	(259,223) IR (29) USD	-
Scenario 2	17,581 IR 2 USD	16%

4.3 Sensitivity Analysis

Projects in their simplest definitions are future investments, in which components are estimated. In other words, all the time there will be a risk whether the estimated numbers will occur or not. Especially in big project like this road project, it requires risk analysis. The first step in risk analysis is to do sensitivity analysis test to identify risky variables of the project.

Sensitivity analysis is a method for examining the impact of changes in projects' key variables on the NPV or IRR of the project. The purpose of sensitivity analysis is to identify the variables, which have a vast impact on the projects result, and to define their effectiveness size on the projects' net benefits. In addition, it sets up a way to diminish the negative effects of these variables on projects' outcome (Economic Analysis of Projects - Uncertainty: Sensitivity and Risk Analysis - ADB.org, 2011).

The parameters identified for sensitivity tests under two scenarios are:

- In scenario one (without toll and loan): cost overrun, equity discount rate routine maintenance, and domestic inflation.
- In scenario two, (with toll and loan): reduction in demand, cost overrun, equity discount rate, routine maintenance, domestic inflation and toll (car, bus, trucks).

When the sensitivity analysis is performed, critical parameters or in other words parameters that project is sensitive to are identified. In scenario one , the sensitive parameters identified are: cost overrun and equity discount rate; whereas in scenario two, cost overrun, equity discount rate, domestic inflation, reduction in demand, car toll and truck (2 or 3 axles) toll found to be the sensitive parameters.

The results of sensitivity analysis, which have been chosen as key variables are shown in the following tables.

4.3.1 Result of Sensitivity Analysis in Scenario 1:

- **Cost Overrun**

The Table 4.5 shows that the project has negative NPV totally, and Cost Overrun has an inverse impact on NPV of project. In other words, when the project costs more than expected, it will lead to lower NPV.

Table 4.5: Result of Sensitivity Analysis (Cost Overrun vs. NPV)

Cost Overrun (million)	
	(259,223)
0%	**(259,223)**
5%	(271,875)
10%	(284,526)
15%	(297,178)
20%	(309,829)
25%	(322,481)
30%	(335,132)

- Equity discount rate

From the result of sensitivity analysis for equity discount rate for scenario 1 it can obtain that the change of discount rate does not have influential impact on the NPV.

This is due to the fact that most of the costs occur in the initial years (during construction of the project) so change in equity discount rate does not lead to significant change as the period is short. However, in scenario 2, where there will be continues inflow of funds from toll, for the whole life of the project, change in the equity discount rate is expected to lead to significant change in the NPV.

Table 4.6: Result of Sensitivity Analysis for Equity Discount Rate

Equity discount rate	**NPV (million IR)**
	(259,223)
12%	(269,413)
15%	**(259,223)**
18%	(250,453)
21%	(242,725)
24%	(235,803)
27%	(229,531)

4.3.2 Result of Sensitivity Analysis in Scenario 2:

- **Demand**

Roads with tolls very much depend on the demand. If there is no enough demand for tolled roads, the project will not be able to generate sufficient funds to finance the expenditure of the project, the project demand depends on the toll demand elasticity. In the case of Yazd-Abarkouh-Sourmagh road project the elasticity is expected to be low, inelastic as there are not much alternative roads to be substituted with Yazd-Abarkouh-Sourmagh road. However tolling the road will make some users unsatisfied and will force them to look for alternative ways. Due to this fact, it is assumed that there will be 30 percent decline in demand with toll. Any change in demand of road will affect the NPV of the project and as the Table 4.7 shows, there is a reversed relation between the demand and NPV of the project. Higher the reduction in demand, lower the NPV be.

Table 4.7: Reduction in Demand of project

Reduction in Demand	NPV (million) IR
	17,581
0%	108,137
10%	77,952
20%	47,767
30%	**17,581**
40%	(12,603)
50%	(42,789)

- **Cost Overrun**

Cost Overrun is one of the most important key variables of the project because it directly affects the NPV. From the Table 4.8, it is obvious that any change in cost overrun causes a large change in amount of NPV. In our case, this variable has a reverse impact on NPV. As the cost overrun increases, the NPV decreases and the other way around. For instance, 10 percent increase in this variable, decrease the NPV and make it negative. For this reason, Cost Overrun is identified to be one of the most important risky variables.

Table 4.8: Result of Sensitivity Analysis (Cost Overrun vs. NPV)

Cost Overrun	NPV (million IR)
	17,581
0	**17,581**
5%	8,209
10%	(1,162)
15%	(10,534)
20%	(19,906)
25%	(29,278)
30%	(38,650)

The following table (Table 4.9) shows the results of sensitivity analysis for cost overrun and its impact on ADSCR of the project. This table reveals that the increase in cost overrun decrease the ADSCR as well as the project's NPV. The increase in cost overrun refers to increase in project expected cost and when the cost of project goes up then its ability to service its debt decrease due to the improper net cash

flows. The results show a positive trend and it observed that only in 2017 ADSCR decreases and its reason can be the increase in some costs like maintenance cost, then again the trend improves. The table explains that, any increase in the cost overrun, decreases the ADSCR and this change reflect in the project capability in paying its debt and servicing its obligations. For instance, if cost overrun were 30 percent, the project will not be able to cover with its debt obligations even for a single year.

Table 4.9: Result of Sensitivity Analysis (Cost Overrun vs. ADSCR)

Cost Overrun	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	ADSCR 2014	ADSCR 2015	ADSCR 2016	ADSCR 2017	ADSCR 2018	ADSCR 2019
	0.69	0.76	0.84	0.93	1.04	1.16	1.31	1.22	1.68	1.93
0%	**0.69**	**0.76**	**0.84**	**0.93**	**1.04**	**1.16**	**1.31**	**1.22**	**1.68**	**1.93**
5%	0.65	0.72	0.80	0.89	0.99	1.11	1.24	1.16	1.60	1.84
10%	0.62	0.69	0.76	0.85	0.94	1.06	1.19	1.11	1.53	1.76
15%	0.60	0.66	0.73	0.81	0.90	1.01	1.14	1.06	1.46	1.68
20%	0.57	0.63	0.70	0.78	0.86	0.97	1.09	1.02	1.40	1.61
25%	0.55	0.61	0.67	0.74	0.83	0.93	1.05	0.97	1.35	1.54
30%	0.53	0.58	0.64	0.72	0.80	0.89	1.00	0.94	1.29	1.49

- **Equity Discount rate**

Equity discount rate is a rate which is used to discount cash flow. This valuation technique helps to find out that the expected future income of the project. In other words, how much it worth’s at present in country's currency. In addition, the high percent of required rate of return is a motivation for businessmen and investors to invest in a project instead of others. From the table below (Table 4.10), it can be realize that with 3 percent change in discount rate, amount of NPV changes with a very huge amount. This finding makes of the equity discount rate to be one of the important risky variables of the project (Discount Rate Definition - ValuAdder, 2011).

Table 4.10: Result of Sensitivity Analysis for Equity Discount Rate

Equity Discount Rate	NPV (million IR)
	17,581
0.12	86,132
0.15	**17,581**
0.18	(22,641)
0.21	(47,129)
0.24	(62,475)

- **Domestic Inflation**

Another parameter in our analysis is domestic inflation rate. In Iran where inflation is two digits, being around 14 percent makes it an important parameter. It is also unpredictable in nature. Domestic inflation has a direct effect on NPV with increasing all the costs and benefits, while inflation increase, NPV increases and it happen because, inflation erodes the value of future money. The inflation will affect the project inflows more positively than its outflows, because as inflation increases toll revenues will increases so project revenues will rise. However, for the reason that most of the cost are in initial years, the cost will not very be affected.

Table 4.11: Result of Sensitivity Analysis (Domestic Inflation vs. NPV)

Domestic Inflation	NPV (million IR)
	17,581
12%	11,926
14%	**17,581**
16%	22,553
18%	26,943
20%	30,838
22%	34,307
24%	37,408
26%	40,192

The Table 4.12 indicates the fact that with each addition to the project's domestic inflation, the ADSCR of project falls considerably. Each decrease in project's ADSCR generates problem of covering the debt, repayment of its loan and less net

cash flow, for the project. Hence, some ways to mitigate the impact of risky variables and increase the ADSCR of project should be tried to be found.

Table 4.12: Result of Sensitivity Analysis (Domestic Inflation vs. ADSCR)

Domestic Inflation	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	ADSCR 2014	ADSCR 2015	ADSCR 2016	ADSCR 2017	ADSCR 2018	ADSCR 2019
	0.69	0.76	0.84	0.93	1.04	1.16	1.31	1.22	1.68	1.93
11.50%	0.70	0.78	0.86	0.95	1.06	1.19	1.34	1.25	1.72	1.98
13.50%	**0.69**	**0.76**	**0.84**	**0.93**	**1.04**	**1.16**	**1.31**	**1.22**	**1.68**	**1.93**
15.50%	0.67	0.74	0.82	0.91	1.01	1.13	1.28	1.19	1.64	1.89
17.50%	0.66	0.72	0.80	0.89	0.99	1.11	1.25	1.16	1.61	1.84
19.50%	0.64	0.71	0.78	0.87	0.97	1.08	1.22	1.14	1.57	1.80
21.50%	0.63	0.69	0.76	0.85	0.95	1.06	1.19	1.11	1.53	1.76
23.50%	0.61	0.68	0.75	0.83	0.92	1.03	1.16	1.09	1.50	1.72
25.50%	0.60	0.66	0.73	0.81	0.90	1.01	1.14	1.06	1.47	1.68

- **Car Toll**

Another important item among risky variables of the project is the toll rate. It is important in a way that, each change in car toll changes the cash flow, as it is the fundamental source of income of the project. From the table below (Table 4.13), it is clear that each small change in car toll, changes the NPV by a very large amount. For instance, a small increase by almost 2000 IR (about 2 Cents), increases the NPV by almost 13,000 million IR.

Table 4.13: Result of Sensitivity Analysis (Car Toll vs. NPV)

Car Toll	NPV (million IR)
	17,581
13,500	(8,710)
15,500	4,435
17,500	**17,581**
19,500	30,727
21,500	43,873
23,500	57,019
25,500	70,165
27,500	83,311
29,500	96,456

The Table 4.14 reveals that, there is a direct relationship between car toll and ADSCR. Increase in ADSCR of toll indicates improving the cash flow of project which, it indicates a positive trend and increase in the revenue of the project.

Table 4.14: result of Sensitivity Analysis (Car Toll vs. ADSCR)

car	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	ADSCR 2014	ADSCR 2015	ADSCR 2016	ADSCR 2017	ADSCR 2018	ADSCR 2019
	0.69	0.76	0.84	0.93	1.04	1.16	1.31	1.22	1.68	1.93
11000	0.60	0.67	0.74	0.82	0.91	1.02	1.14	1.03	1.47	1.69
13000	0.65	0.71	0.79	0.87	0.97	1.09	1.22	1.13	1.58	1.81
15000	**0.69**	**0.76**	**0.84**	**0.93**	**1.04**	**1.16**	**1.31**	**1.22**	**1.68**	**1.93**
17000	0.73	0.80	0.89	0.99	1.10	1.23	1.39	1.31	1.79	2.05
19000	0.77	0.85	0.94	1.05	1.17	1.31	1.47	1.40	1.90	2.18
21000	0.81	0.90	0.99	1.10	1.23	1.38	1.55	1.50	2.00	2.30
23000	0.85	0.94	1.04	1.16	1.29	1.45	1.63	1.59	2.11	2.42
25000	0.89	0.99	1.09	1.22	1.36	1.52	1.71	1.68	2.21	2.54
27000	0.94	1.03	1.15	1.27	1.42	1.59	1.80	1.78	2.32	2.67

- **Truck (2 or 3 axles) Toll**

The truck toll affect in effecting the NPV and ADSCR in the same manner as car toll and in explanation.

Table 4.15: Result of Sensitivity Analysis (Truck Toll vs. NPV)

Truck (2 or 3 axles)Toll	NPV(million IR)
	17,581
28,500	2,618
31,500	7,606
34,500	12,593
37,500	**17,581**
40,500	22,569
43,500	27,557
46,500	32,544
49,500	37,532

Table 4.16: Result of Sensitivity Analysis (Truck Toll vs. ADSCR)

Truck (2 or 3 axles)Toll	ADSCR 2010	ADSCR 2011	ADSCR 2012	ADSCR 2013	ADSCR 2014	ADSCR 2015	ADSCR 2016	ADSCR 2017	ADSCR 2018	ADSCR 2019
	0.69	0.76	0.84	0.93	1.04	1.16	1.31	1.22	1.68	1.93
28,500	0.63	0.70	0.78	0.86	0.96	1.08	1.21	1.11	1.56	1.79
31,500	0.65	0.72	0.80	0.88	0.99	1.10	1.24	1.15	1.60	1.84
34,500	0.67	0.74	0.82	0.91	1.01	1.13	1.27	1.18	1.64	1.89
37,500	**0.69**	**0.76**	**0.84**	**0.93**	**1.04**	**1.16**	**1.31**	**1.22**	**1.68**	**1.93**
40,500	0.70	0.78	0.86	0.95	1.06	1.19	1.34	1.25	1.72	1.98
43,500	0.72	0.80	0.88	0.98	1.09	1.22	1.37	1.29	1.76	2.02
46,500	0.74	0.81	0.90	1.00	1.11	1.25	1.40	1.33	1.80	2.07
49,500	0.76	0.83	0.92	1.02	1.14	1.28	1.43	1.36	1.84	2.12

From this analysis and calculations, with respect to financial NPV, it is clear that the main project (scenario 1), has not sufficient earning to generate profit. However, positive NPV of scenario 2 (with toll and loan) shows that if government motivates the private sector to invest in infrastructure project, the resources will be used in the best way and both government and private sector will benefit from this cooperation and partnership.

4.4 Summery for Financial Analysis

In this chapter a financial analysis of the project has been carried out. The result of this analysis represents that scenario one (no toll no loan) results with a negative financial NPV. The result is quite logical as the whole project is financed by the government. In many experiences it is the case as the purpose of a road project is more to do with contributing to the development of a region and in all the country and not particularly to make financial returns. Whether the project will produce benefits to the economy or not will be the topic of the following chapter.

In order to determine whether such infrastructure projects can also be financially viable or not, a second scenario (scenario 2: with toll and loan) has been introduced. The financial analysis shows that this road project can be financially a viable project. This requires a proper design of a special purpose vehicle (SPV). The proposed

vehicle indicates that there will be some financing problems in the initial years due to high investment cost but with proper finance techniques, the problems can be overcame. In short, SPV does produce a positive financial NPV of 2 million USD and this project can be undertaken by private sector.

The following chapter will appraise the project from the economics point of view to determine whether it creates a positive NPV for the country or not.

Chapter 5

ECONOMIC AND DISTRIBUTIVE ANALYSIS: YAZD-ABARKOUH-SOURMAQE PROJECT

Economic analysis measures the general attractiveness of the project from the country's perspective. It reveals whether the project implementation will simply affect and improve the economy of the region where the project is located and the economy of the whole country, or not. It examines the project from the country's national economy viewpoint. The analysis observes the project's impact level on welfare of people and the entire country from the economic point of view and not only the owner's point of view.

The nature of economic analysis is the same as financial analysis, apart from the benefits and costs that are measured from the country's point of view, not relying on market price for measuring the project cost and benefits. It includes all stakeholders of the project and measures the project's positive and negative impacts on the motivation to pay on any unit of consumption that will increase concern about the implementation of the project. In economic analysis, costs and benefits of projects are calculated using the data and information, which have been organized in the financial analysis part (Economic Analysis of Projects - Financial and Economic Analysis - ADB.org, 2011).

The basic calculation of economic impact is according to following formula:

Overall Economic Impact	=	Changes in benefits (Consumer Surplus)	+	Change in system operating costs and revenues (producer Surplus and Government Impact)	+	Change in costs of externalities (e.g. environmental and health impacts)	−	Investment cost

Source: (Melichar, Ščasný & Navrud, 2004)

To achieve a desired result in the economic assessment, it is required that all the stages of the evaluation are to be completed properly from the beginning. At the starting point, the conversion factors of all economic parameters are needed to be obtained. This will enable the analyst to convert all financial parameters to economic values or economic prices. The obtained NPV, from the economic analysis of cash flow statement, reflects the project's condition in terms of efficiency. A positive economic NPV shows the positive change in the welfare of society and improvement in country's economy. In other words, a positive NPV indicates that the resources are allocated efficiently and effectively leading to productive project, which create value added to the economy.

This chapter will study whether the Yazd-Abarkouh-Sourmagh road project is economically viable or not. In this respect, the project will start by introducing two basic cases, one being with, and the other being without the project. By this approach, the analysis will be able to identify the benefits (if any) with the project.

- **Demand**

The demand model consists of traffic for road. The traffic is divided into two broad groups:

1. Without project: This is subject to existing road and the vehicles, which use the road as a main road for traveling.

2. With project: This is related to the traffic of new road, and it will show the amount of generated traffic, which uses the road after its construction plus the diverted traffic which is about the people who will prefer to use the new road instead of previous or other roads due to the better services and reduction in length. The following table (Table 5.1), shows the forecasted traffic demand daily (with and without project).

Table 5.1: Forecasted traffic demand under 2 Scenarios

Type of Vehicles	With Project				Without Project
			Scenario 1	Scenario 2	
	Generated Traffic	Diverted Traffic	Total	Total (30% reduction)	Total
Cars	250	3290	3540	2478	1725
Buses	45	75	120	84	48
Trucks (2 or 3 axles)	140	890	1030	721	482
Trucks (4 or more axles)	60	450	510	357	245
Total	**495**	**4705**	**5200**	**3640**	**2500**

Source: data is received from the project and self-study.

Constructing new road does not only increase its use by its existing users but also attracts others and creates a diverted traffic. Therefore, this road might have some benefits for users. Some of the benefits created by new or upgraded roads are represented as follows:

- "Reduced vehicle operating costs: fuel and lubricants, vehicle maintenance, depreciation, and interest overheads.
- Reduced journey time for: drivers, passengers and goods.
- Changes in road maintenance costs
- Increased travel" (Hine, pp. 3-5).

Given such benefits, the study will first introduce the parameters of the economic analysis then measure economic NPV. This will be followed by distributive analysis.

5.1 National Economic Parameters

5.1.1 Economic Opportunity Cost of Capital

The Economic Opportunity Cost of Capital (EOCK) is the most appropriate discount rate to be used when the estimation of economic NPV for investment in the project is considered.

> "The economic cost of capital is calculated as a weighted average of the rate of time preference to savers, the gross-of-tax returns on displaced investment, and the marginal cost of foreign capital inflows " (Barreix, Jenkins & Marchesini, 2003, p. 21).

As economic NPV greater than zero states that the project is viable to be undertaken and the NPV less than zero implies that the project should be rejected and the available sources should be invested somewhere else, instead of the current project. In addition, EOCK shows the minimum expected rate of return on investment. For the economy of this project when similar projects in the same rejoin are studied, it is found that 13 percent to be used as EOCK would be appropriate (Kuo, Jenkins & Mphahele, 2003).

5.1.2 The Foreign Exchange Premium (FEP)

This item is needed to be used in the economic analysis of a project which includes foreign currency and exchange rate and it is the economic price of foreign exchange.

Foreign exchange premium affects the economy through influencing supply and demand for foreign currency, as well as import and export which are doing with the foreign currency. Since tax and tariff can also affect similarly the items listed above; they have also a direct impact on FEP. Using the FEP is a very suitable

method to deal with any loss, resulting from fluctuation of foreign currency on international businesses and investments.

The simple formula for foreign exchange premium is FEP= ((Ee/Em)-1). (Ee) is referred to economic values of foreign exchange rates and (Em), refers market foreign exchange rate (Jenkins, Material of Reading, p. 14).

Another important use of (FEP) is for calculating the conversion factors for traded and non-traded goods' price to the project. Foreign exchange premium for this project is considered 12 percent, which implies that economic price of foreign exchange rate cost government 12 percent more than its market price.

5.1.3 Economic conversion factors

Conversion factor is needed at the time of project economic analysis to recognize whether the project which is under construction is viable from the economic point of view or not. Conversion factors act as convertors to convert the financial value of project's cash flows to its economical value, to obtain the economic price of project's output and input. Moreover, this process is done to realize the real cost and benefits of the project (Economic Analysis of Projects - Conversion Factors - ADB.org, 2011).

> Once the economic value is estimated, it is divided by the financial price to arrive at the economic conversion. In this case, of project outputs, the relevant financial price used to calculate the conversion factor is the supply price (Ps) that the project receives. If the item is project input, the relevant price is the demand price (Pd) that the project must pay. Multiplying the entire line of the financial cash flow statement by the conversion factor for that particular good or service will result in the stream of economic costs and benefits due to that good (Jenkins & Harbeger, 2002).

Every single item in financial cash flow of project needs to be adjusted with its conversion factor to set to economic prices.

In this project, conversion factors of items include vehicles' operating cost, construction cost, routine maintenance and periodic maintenance. Tables below illustrate the summary of conversion factors of project in the mentioned order. Construction of this new road has various advantages compared to old one and comparison between these two shows the benefits of the new road and hence, it is important to find old roads data and information.

- Estimating Vehicle Operating Cost (VOC) and Time Saved

In general, the vehicles' operating costs, include fuel, oil, gas, tire wear, insurance, repair and maintenance and depreciation cost. Table 5.2 illustrates the estimations of operating costs for the vehicle types used in the project.

Table 5.2: Existing and Predicted VOC Cost

Category	**Cars**	**Buses**	**Trucks**
Without project	15,000	29,000	36,000
With project	11,000	21,000	30,000
Gain	**4,000**	**8,000**	**6,000**

Source: Obtained by self-study.

Economic benefit of this project is accruing from the saving in time and vehicles' operating cost. Both of these resources are vital for achieving the economical aim of this project. Table below represent that there is a big difference between time cost with and without this road and also this difference is a source of gain of the project to the economy.

Table 5.3: Time Saved (time travel difference between of with and without)

Category	**Cars**	**Buses**	**Trucks**
Without project	27,350	41,250	43,273
With project	16,640	17,540	19,762
Gain	**10,710**	**23,710**	**23,511**

Vehicles' operating cost has a direct relationship with the traffic and any small change in project's traffic, will make the operating cost change significantly. In this project the factor of vehicles' operating cost have been shown in Table 5.4. They are all tradable goods except labor force, which is explained separately. CIF price, handling and freight price are the important items in calculation of conversion factors for project's factors. According to data and information received from the project, any imported materials were not used during the project's construction.

Table 5.4: Summary of Conversion Factors for Vehicles Operating Cost

Component	**Light Vehicles**	**Buses**	**Trucks**	**Weight**	**Light Vehicles**	**Buses**	**Trucks**
Vehicles	0.5297	0.7192	0.7712	55%	0.2914	0.3955	0.4242
Tires	0.7548	0.7548	0.7548	10%	0.0755	0.0755	0.0755
Gasoline	0.8001	-	-	20%	0.1600	-	-
Diesel	-	0.8002	0.8002	20%	-	0.1600	0.1600
Lubricants	0.7548	0.7548	0.7548	3%	0.0226	0.0226	0.0226
Tools	0.7548	0.7548	0.7548	5%	0.0377	0.0377	0.0377
Vehicle Parts	0.7548	0.7548	0.7548	5%	0.0377	0.0377	0.0377
Labor	0.9638	0.9638	0.9638	2%	0.0193	0.0193	0.0193
Weighted Conversion Factor				100%	**0.6443**	**0.7485**	**0.7771**

Construction Cost: in this section all the factors are categorized into tradable goods except, labor.

Table 5.5: Summary of Conversion Factors for Construction Costs

Component	**CF**	**Weight**	**Weighted CF**
Alcantarillas	0.80	13.5%	0.1080
Guardrails	0.80	5.0%	0.0400
Equipment	0.80	53.5%	0.4281
Materials and other	0.80	6.7%	0.0532
Cement	0.96	3.4%	0.0320
Labor:			
Skilled	0.79	6.3%	0.0498
Unskilled	0.77	11.7%	0.0901
Weighted Conversion Factor		100.0%	**0.8012**

Maintenance Cost: all the materials needed for maintaining the road are produced within the country.

Table 5.6: Detailed Conversion Factor of Routine Maintenance

Component	**CF**	**Weight**	**Weighted CF**
Cement	0.96	4%	0.0392
Equipment	0.80	66%	0.5257
Materials and Other	0.80	8%	0.0664
Labor:			
Skilled	0.79	%8	0.0601
Unskilled	0.77	14%	0.1101
Weighted Conversion Factor		100%	**0.8015**

Table 5.7: Detailed conversion factor of periodic maintenance

Component	**CF**	**Weight**	**Weighted CF**
Cement	0.9556	20%	0.1911
Equipment	0.8002	30%	0.2401
Materials and Other	0.8002	22%	0.1760
Labor:			
Skilled	0.7911	9.8%	0.0775
Unskilled	0.7697	18.2%	0.1401
Weighted Conversion Factor		100%	**0.8248**

Labor: labor force, which is used in the project, is from the province of project's location and their salary payment is equal to the salary rate of the province.

5.2 Results

The obtained NPV, in scenario one, is equal to 152,080 million IR which is about 17 million USD and in scenario two, it is equal to 256,517 million IR, approximately 28.5 million USD. (See Appendix 3: summery of preformed cash flow for economic NPV). As it can be recognized from the NPV's both scenarios' are economically viable. Unlike the negative financial NPV of scenario one, scenario two has both a positive financial NPV as well as a positive economic NPV. This indicates that from this road project not only the economy, society and its users will benefit but also the

investors and project owner will benefit. A road project should have at least a high positive economic NPV for being chosen to be executed. Positive economic NPV implies a positive change the wealth of entire economy and increase in the welfare of society.

The distributive analysis in the following part will show. However at this point it can be argued that savings both in VOC as well time cost creates most of the benefits to the economy.

The financial and economical NPV of scenario two compared to scenario one demonstrates that to reach a positive NPV, allocation of loan and toll is required as an essential item. Unlike the scenario one, scenario two shows that both of NPV's are positive and it refers to the viability of the scenario two.

Table 5.8: Economic NPV under Two Scenarios

Total	NPV (million)
Scenario 1	152,080 IR 17 USD
Scenario 2	256,080 IR 29 USD

5.3 Sensitivity Analysis of Economical Variables

Regarding to the sensitivity analysis, it concentrates on identifying the risky economical variables. The parameters of economical analysis of the project, which have been tested under two scenarios, are:

- Scenario 1 :

1. With and without (Traffic growth rate for normal, generated and diverted traffic).
2. With and without (Vehicles operating cost for light vehicles, buses, trucks).
3. With and without (Time cost for light vehicles, buses, trucks).

- Scenario 2:

1. Demand
2. Max.WTP of light vehicles.

3. With and without (Traffic growth rate for normal, generated and diverted traffic).
4. With and without (Vehicles operating cost for light vehicles, buses, trucks).
5. With and without (Time cost for light vehicles, buses, trucks).

After completion of sensitivity analysis, the results show that, in two scenarios, these variables are sensitive: normal traffic growth rate and EOCK in scenario one and in scenario two, max.WTP, normal traffic growth rate, and EOCK. The analysis indicates that any small change in the variables will influence NPV greatly.

5.3.1 Results of Sensitivity Analysis in Two Scenarios

Scenario 1: Results of this analysis explain that change of risky variables in any trend affects the NPV of the project greatly in the same direction. The appraiser of project should find some appropriate ways to mitigate the influence of these variables to reach to a higher NPV. Risky variables of scenario one, are shown in the tables below.

Table 5.9: Sensitivity Analysis of Normal Traffic Growth Rate

Normal Traffic Growth Rate	NPV(million IR)
	152,080
1.00%	122,176
1.50%	131,657
2.00%	141,612
2.50%	**152,080**
3.00%	163,104
3.50%	174,732
4.00%	187,015

As the table below (Table 5.10) shows, the NPV of project changes hugely when the EOCK changes and there is inverse relation between NPV and EOCK, when EOCK decreases, the NPV of project will increase.

Table 5.10: Sensitivity Analysis of EOCK

EOCK	NPV(million IR)
	152,080
7%	579,076
9%	379,665
11%	245,206
13%	**152,080**
15%	85,943
17%	37,876
19%	2,209

Scenario 2: Risky variables of scenario two are shown in the tables below. The degrees of influence of these risky variables are noticeable from the tables below. The results of sensitivity analysis explain that demand plays crucial role in the project and it is accounted as a risky variable of project. And as it said in chapter 4, demand has a direct effect on NPV.

Table 5.11: Reduction in Demand of Project

Decrease in Demand	NPV (million) IR
	256,517
0%	369,611
10%	331,913
20%	294,215
30%	**256,517**
40%	218,819
50%	181,122

The analysis of traffic growth rate and max willingness to pay indicate that NPV will not change with a huge amount in compare to other variables but still it they have important effect on the NPV of project.

Table 5.12: Sensitivity Analysis of Normal Traffic Growth Rate

Normal Traffic Growth Rate	NPV (million) IR
	256,517
1.00%	235,736
1.50%	242,221
2.00%	249,135
2.50%	**256,517**
3.00%	264,410
3.50%	272,860
4.00%	281,919

Table 5.13: Sensitivity Analysis of Max.WTP

Max. WTP (Light Vehicles)	NPV(million) IR
	256,517
21,000	237,811
22,000	242,488
23,000	247,164
24,000	251,841
25,000	**256,517**
26,000	261,194
27,000	265,870
28,000	270,547
29,000	275,223

On the other hands, the sensitivity analysis of EOCK reveals that any small change in its rate, NPV will change by a huge amount. It has a reverse affect on the NPV of project and each time that EOCK increases by 2 percent, NPV of project goes down by around half of amount. For that reason, EOCK is identified as one of important risky variables of the project.

Table 5.14: EOCK

EOCK	NPV (million IR)
	256,517
7%	831,878
9%	562,594
11%	381,563
13%	**256,517**
15%	167,901
17%	103,592
19%	55,900

5.4 Distributive Analysis and Externalities

The externalities of a project refer to any kind of gain or loss of third party or from activity of an external party. In the case of road project, they are divided into two groups: positive and negative. Some of these important items are mentioned below:

- Positive externalities: increase in capability of providing emergency services, increase in land price of residents, density of benefits, and accessibility (easiness of getting from place to place), time saving, decreasing VOC and reduction in accidents.
- Negative externalities: the most important negative externalities is, increase in environmental local pollution (air, light and noise) (Kenneth & Gomezqbanez, 1998).

The aim of distributive analysis is to try to identify the different parties among the project and society with the purpose of determining who are beneficiaries and who are losers from the project and how much.

To reach to the value of project's externalities, the first step is to prepare economical and financial cash flow statement by using the economic discount rate. In the next step, the financial NPV should be subtracted from the economic NPV. The

result of this deduction is project's externalities value (Jenkins, Reading Materials for Investment Appraisal, p. 68) .

5.4.1 Allocation of Externalities

In this stage, tree parties were classified to be allocated in the list of project's externalities. The first is the consumers who will benefit from reduction in VOC and time cost etc. The second is the government. The last one is about truckers and intermediaries who will benefit from project. This new road will develop the connection between cities and some costs are expected to be saved by constructing the new road. The reason is both Fars and Yazd are regarded as big and important cities of Iran and there are lots of factories around these two cities which have large amount of connections with each other. The Tables 5.15 and 5.16 below show the results of project's distributive analysis for both of scenarios.

5.4.2 Reconciliation of the Economic and Financial statement

According to Jenkins, 2004, the reconciliation serves as a check to verify if all the externalities have been accounted for and also if, the difference between the economic and the financial statements is exact due to only externalities whose origins have been identified, or not. This is the general formula:

$$\text{Economic NPV} = \text{Financial NPV} + \sum (\text{PV Externalities})$$

Table 5.15: Result of Distributive Analysis Scenario One (million) IR

Real Term	**Consumers**	**Government**	**Truckers and intermediaries**	**Total**
Consumer Surplus (Generated and Diverted Traffic)	210,156	-	-	210,156
VOC Savings Normal Traffic				
Light Vehicles	11,187	-	-	11,187
Buses	723	-	-	723
Trucks	8,530	-	-	8,530
Value of Time Savings Normal Traffic	92,375	-	-	92,375
Benefits to Truckers and Middleman	-	-	42,178	42,178
Construction Costs	-	51,312	-	51,312
Routine Maintenance	-	863	-	863
Periodic Maintenance	-	580	-	580
Total	322,973	52,755	42,178	417,907
Total in million USD	**36**	**6**	**4.7**	**47**

Table 5.16: Result of Distributive Analysis Scenario Two (million) IR

Real Term	**Consumers**	**Government**	**Truckers and intermediaries**	**Total**
Consumer Surplus (Generated and Diverted Traffic)	50,831	-	-	50,831
VOC Savings Normal Traffic				
Light Vehicles	11,187	-	-	11,187
Buses	723	-	-	723
Trucks	8,530	-	-	8,530
Value of Time Savings Normal Traffic	92,375	-	-	92,375
Benefits to Truckers and Middleman	-	-	42,178	42,178
Construction Costs	-	51,312		51,312
Routine Maintenance	-	863	-	863
Periodic Maintenance	-	580	-	580
Total	163,648	52,755	42,178	258,582
Total in USD	**18.3**	**6**	**4.7**	**29**

From those tables of analysis, it can be easily realized that the main beneficiaries of the externalities of the project are the consumers who will use the road as the main road. In both scenarios, they benefit from saving in time cost and VOC and plus consumers surpluses.

Consumer surplus of scenario one is about 36.3 million USD. In comparison with scenario two, which is about 16.50 million USD, scenarios one shows a bigger amount of consumer surplus. Its reason is the components of the consumer surplus in both scenarios. In scenario one, users will benefit from using a no tolled road.

Tables above show that, the major source of consumers benefit is from the Consumer Surplus (Generated and Diverted Traffic) and also the government and truckers in this term are the next levels of beneficiaries. Generally, from the analysis of scenario one, it is obvious that even though this project does not generate an adequate financial NPV, its economic NPV compensates all these deficiencies by generating a high level of externalities.

Overall, the distributive analysis outlines that the road project will be beneficial to all projects stakeholders. The following chapter will be studying the riskiness of the project based on the identified variables by the sensitivity tests.

Chapter 6

RISK ANALYSIS OF YAZD-ABARKOUH-SOURMAGH ROAD PROJECT

Risk generally describes the possible deviations from the projected outcome. To conduct risk analysis for a project, the first step is to identify the key variables, through the sensitivity analysis. This is to find the main risky variables in the forecasted model to estimate their impact on project's outcome. Selected variables should be important by having large share in project cash flows and also significant degree of variation overtime (Cambridge Resources International, Inc. Cambridge, MA, USA, 2004).

> Once the risky variables are identified, the second step is to select an appropriate probability distribution and risky range of values for each risk variable, based on historical series of value of this variable and the opinions of experts concerned with this variable (Cambridge Resources International, Inc. Cambridge, MA, USA, 2004, p. 13).

After completion of this step, it is time to use Monte Carlo simulation to reach to the probability distribution of projects' outcomes.

> Monte Carlo simulation relies on the process of explicitly representing uncertainties by specifying inputs as probability distributions. If the inputs describing a system are uncertain, the prediction of future performance is necessarily uncertain. That is, the result of any analysis based on inputs represented by probability distributions is itself a probability distribution (Monte Carlo Simulation and Methods Introduction - GoldSim, 2011).

6.1 Selections of Variables and Probabilities

At the beginning point of conducting the risk analysis, risky variables are needed to be chosen from the results of sensitivity analysis of project. This analysis was conducted in chapter 4 and 5. Those obtained, as risky variables, which have significant influences on the NPV of project, should be used in risk analysis, to find the most riskiness variables of the project. From the project's sensitivity analysis, these variables are selected as risky variables:

From scenario one:

1. Economic opportunity cost of capital
2. Normal traffic growth rate
3. Equity discount rate
4. Cost overrun

From scenario two:

1. Economic opportunity cost of capital
2. Normal traffic growth rate
3. Max. willingness to pay
4. Domestic inflation rate
5. Equity discount rate
6. Truck (2 or 3 axles) toll
7. Cost overrun
8. Car toll
9. Demand

6.1.1 Probability Distribution Selection

In risk analysis, to obtain the needed probability distribution of selected risky variables, setting up a range of values and their probability, is a crucial issue. The

needed probabilities distribution should be prepared from the historical values of variables. If the required data and information were not accessible and there was no possibility to get the data, then the expert's opinion should be used to define the appropriate range of values and probability (Savvides, 1994).

All The risky variables of this project, which are listed above, have impact on the NPV of the project. For each of these variables, probability distribution is assigned in risk analysis part. Some of them have greater impact and any small change in them will change the NPV by a great amount. The assigned probability distributions for this project's risky variables are mentioned below:

- **Economic opportunity cost of capital**

EOCK is a variable, which can be change by various factors. Forecasting the volatility of the economic discount rate, to know the size of its effect on the project NPV, plays a crucial role.Appraiser of a project cannot achieve a good prediction due to lots of confusing factors. Consequently, due to lack of historical data to find the related probability distribution for this project, the World Bank and also similar projects are used in this project.

Table 6.1: Probability of EOCK

Triangular distribution with parameters:			
	Minimum		5%
	Likeliest		13%
	Maximum		20%

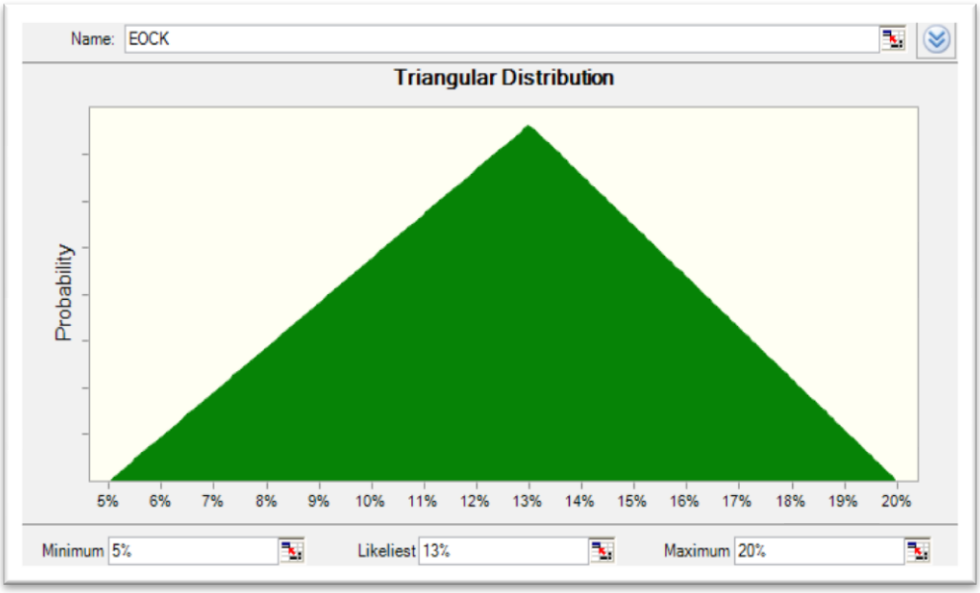

Figure 6.1: Triangular Distribution for EOCK

- **Equity Discount Rate**

Equity discount rate reflects the time value of money and the amount of money that investors have expected to earn from their investment. As this variable has inherent risk, the prediction of trend and percentage of change for it, is a difficult task and so, all of analysis are based on estimations. In this project, the assigned probability distribution for this variable is triangular.

Table 6.2: Distribution of Equity Discount Rate

Triangular distribution with parameters:			
	Minimum		5%
	Likeliest		15%
	Maximum		30%

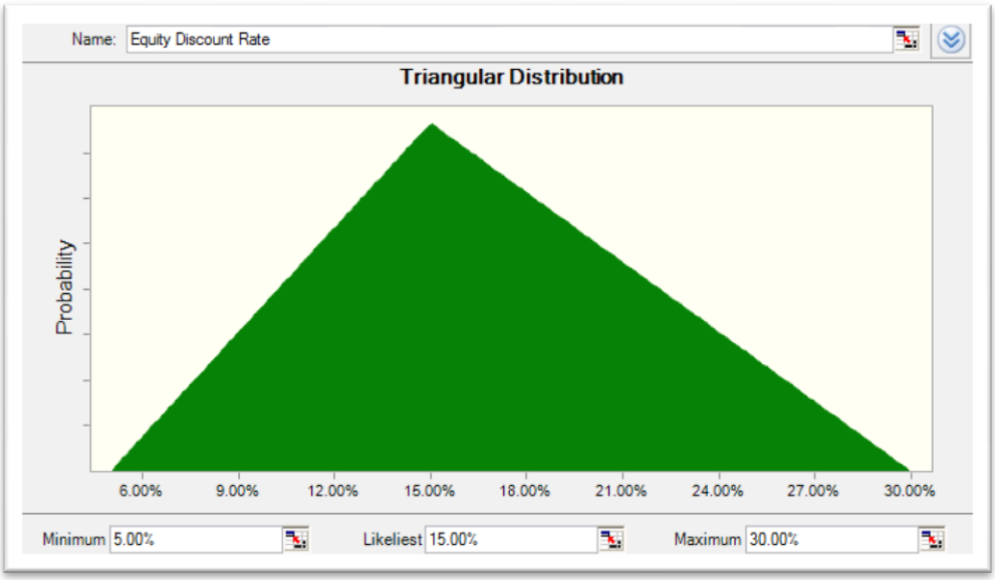

Figure 6.2: Triangular Distribution of Equity Discount Rate

- **Car Toll**

Because the car toll factor is under control of private sector or government, the estimation of its changing probability is possible. Determination of rate of car toll is responsibility of the sector, which will undertake the operation of the tolled road.

Table 6.3: Distribution of Car Toll

Uniform distribution with parameters:			
	Minimum		25,000
	Maximum		45,000

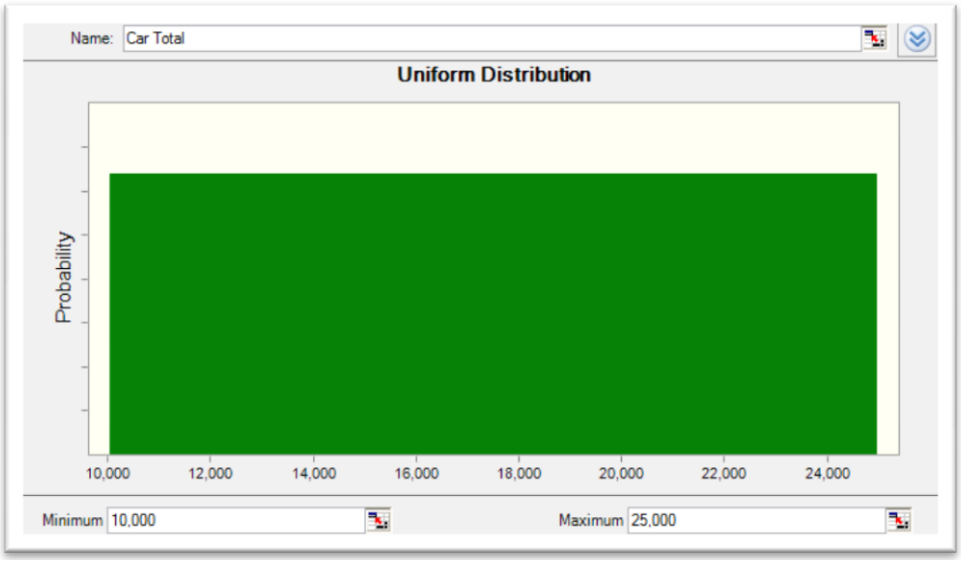

Figure 6.3: Uniform Distribution of Car Toll

- **Cost Overrun**

Cost overrun is another important risky variable of this project that influences the NPV more than other variables. So, if the cost of project is underestimated, the project will face with cost overrun problem and it makes the investment cost of project increase. The probability distribution assigned for this parameter is step distribution.

Table 6.4: Distribution of Cost Overrun

Custom distribution with parameters:			
	Minimum	Maximum	Probability
	0.00	0.05	0.30
	0.05	0.10	0.25
	0.10	0.15	0.20
	0.15	0.20	0.10
	0.20	0.25	0.10
	0.25	0.30	0.05

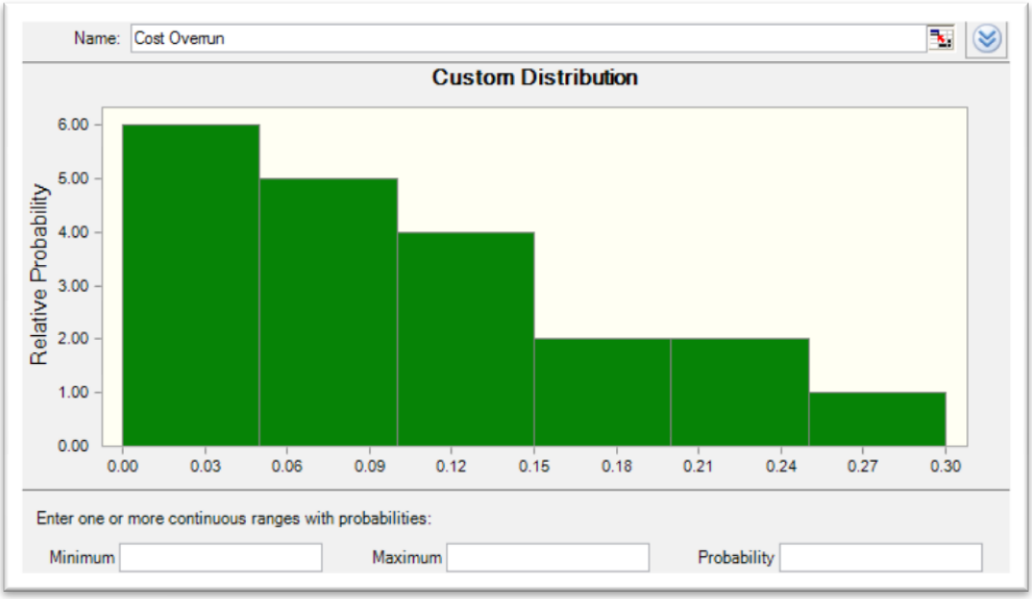

Figure 6.4: Custom Distribution for Cost Overrun

- **Normal Traffic Growth Rate**

Normal traffic growth rate is one other significant variable influencing project NPV. Lots of reason can cause an increase in traffic growth rate, making this variable unpredictable. From the risk analysis of the project it has been recognized that traffic growth rate influences NPV with a huge amount. The correlated probability distribution of this variable is normal distribution.

Table 6.5: Mean and Standard Deviation of Traffic Growth Rate

Normal distribution with parameters:			
	Mean		2.5%
	Std. Dev.		1.0%

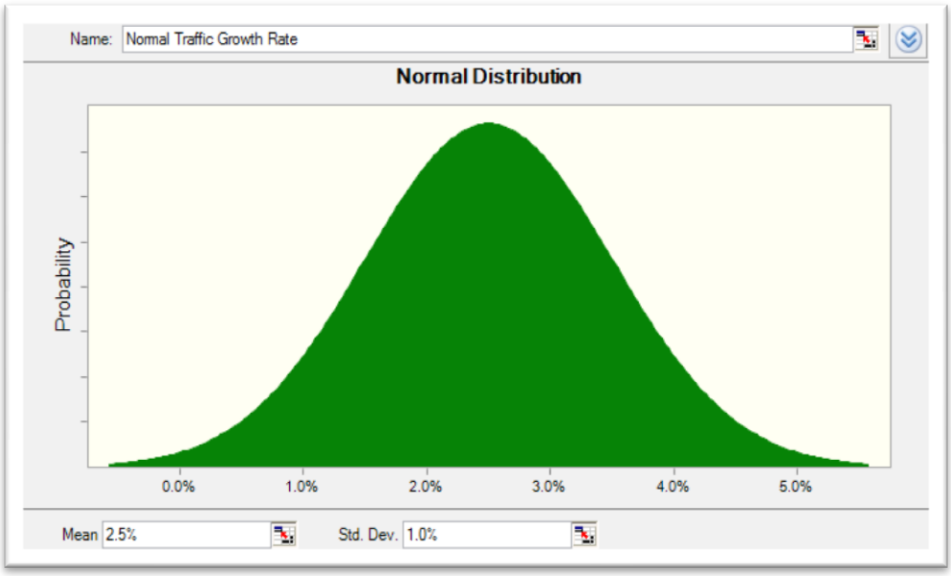

Figure 6.5: Normal Distribution for Traffic Growth Rate

- **Decrease in demand**

Demand is the last variable of project which is defined in process of risk analysis as a risky variable. Demand has normal distribution and it can be predicted that with increasing the toll rate this ratio will increase.

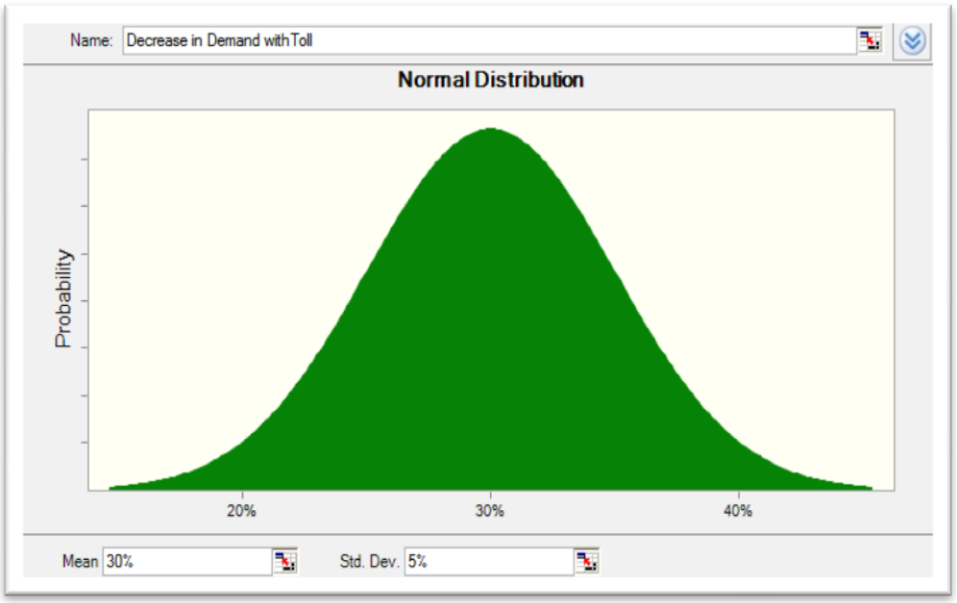

Figure 6.6: Normal Distribution for Decrease in Demand

6.2 Results of Risk Analysis

At the first step of doing the risk analysis for this project, all the uncertain variables are defined as the assumptions with their probability distribution. At the second step some variables should be forecasted to be tested, to obtain their output results according to the specified assumptions. The forecasted variables in the both scenarios of this project are as following:

Scenario one:

1. Economical NPV
2. Externalities NPV

Scenario two:

1. Financial NPV
2. Economical NPV
3. Externalities NPV
4. ADSCR, from year 2010 to year 2017
5. LLCR, from year 2010 to year 2016

At the third step, when selected variables are forecasted then it is the time to run the simulation. For doing the risk analysis of this project, 10,000 trials of Monte Carlo simulation were performed to reach to the accurate result by using the Cristal Ball software. The obtained results are shown below:

6.2.1 Scenario One:

Financial NPV: first variable is the financial NPV. The relevant result shows that its mean is equal to 282,471 million IR and the standard deviation is 25,423 million IR. Also, its amount will be between the minimum of 377,687 million IR and the maximum of 226,242 million IR. The probability of NPV for being between positive range and 0 is 0 percent, as the Figure 6.7 shows. This negative NPV shows that the project's NPV will be below the 0 by 100 percent and it indicates that this project is

not a beneficial project to be undertaken, but in road project, the most important NPV to decide about undertaking, is the economical NPV.

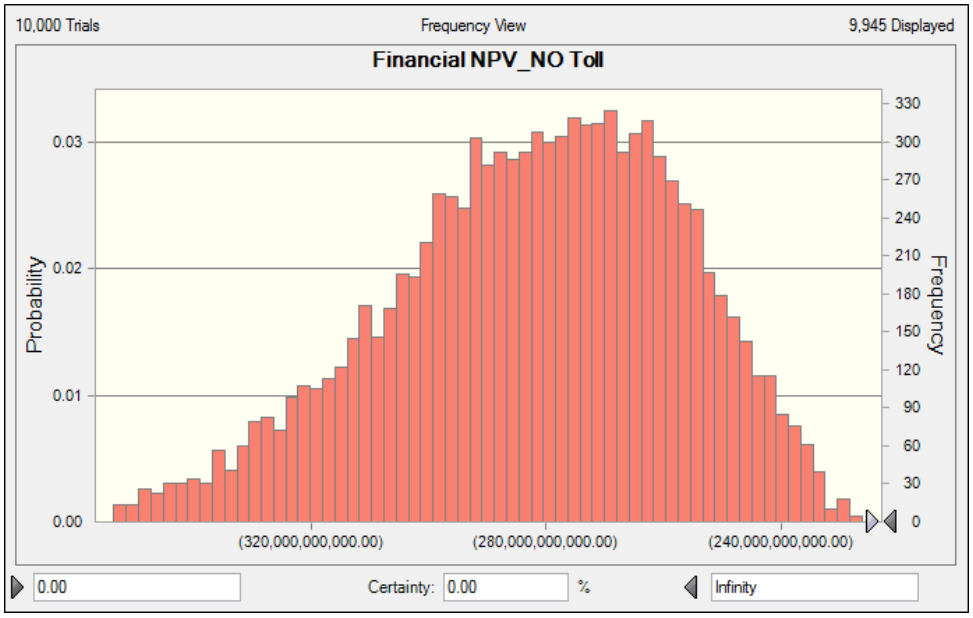

Figure 6.7: Forecast of Financial NPV

Economical NPV: second forecasted variable of this scenario is economic NPV. The result of the analysis shows that the project's mean of NPV is equal to 3,327 million IR (about 373,902 USD), with the standard deviation of 90,198 million IR. The economic NPV is ranged between negative 147,198 and 440,442 million IR as its minimum and maximum amounts, respectively. The probability of the NPV of this scenario to be between 0 and positive range is 40.60 percent. It means that with probability of 40.60 percent, our NPV will be positive. Form the Figure 6.8, it can be recognized that there is a probability of having negative economic NPV. The NPV of scenario 1 indicated that this project with negative financial and positive economical NPV is a proper project to be undertaken by the government, because in the infrastructure projects, especially in road project the most important NPV is the economic NPV.

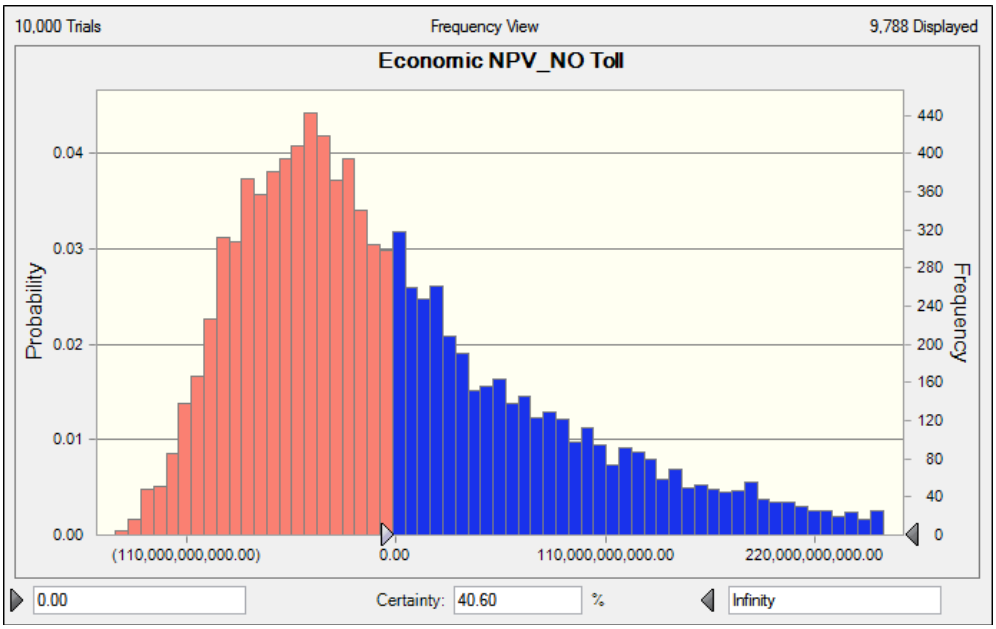

Figure 6.8: Forecast of Economic NPV

Externalities NPV: Another forecasted variable of this scenario is the Externalities NPV. This forecast has a mean and standard deviation equal to 298,821 and 100,670 million IR, respectively. Result of the analysis illustrates that the NPV of the project externalities will be between the minimum of 152,336million IR and the maximum of 750,889 million IR. As the Figure 6.9 shows, the probability of being more then 0 and in positive range, for this variable is 100 percent. This indicates that, this project will have positive externalities NPV by 100 percent. This NPV reveals that all of the road's benefit will be allocated to users of road.

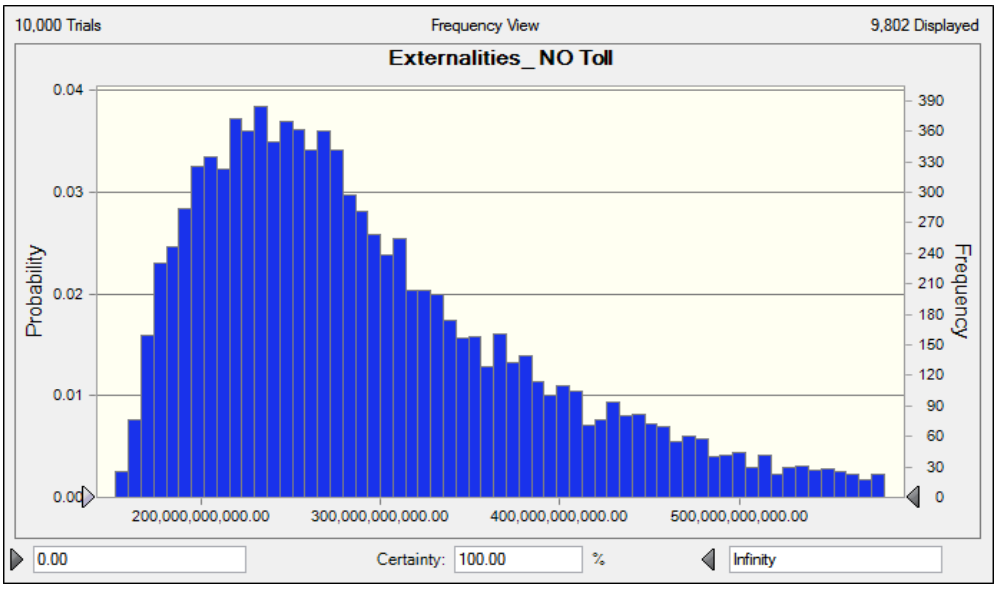

Figure 6.9: Forecast of Externalities NPV

6.2.2 Scenario Two

Financial NPV: After performing 10,000 trials for this scenario, the results show a mean equal to negative 16,860 and standard deviation of 96,584 million IR. In addition, the minimum and maximum of NPV are negative 164,806 and positive 615,912 million IR. As Figure 6.10 shows below, with a probability of 29.71 percent, the NPV will be more than 0 and is in positive range. This rate indicates to the positive NPV but it has a high probability of turning to negative NPV. This positive NPV refers to this point that, it is a good project to be undertaken and invested on.

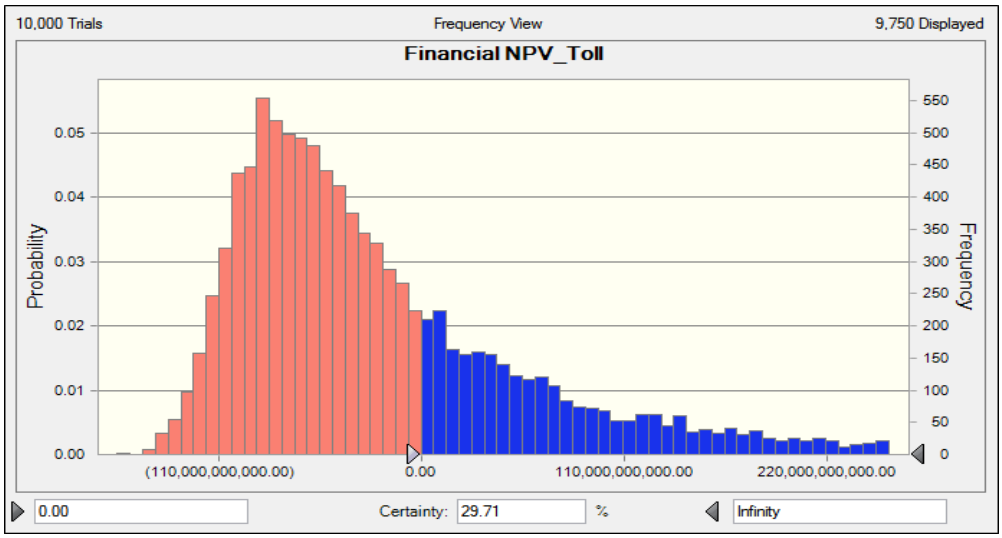

Figure 6.10: Forecast of Financial NPV

Economic NPV: the analysis shows that scenario two has a positive economic NPV. Results of risk analysis show the mean of NPV and a standard deviation equal to 298,080 and 209,556 million IR, respectively. As the Figure 6.11 illustrates, this NPV by a certainty of 99.87 percent and minimum negative 19,704 and maximum 1,335,820 million IR, will range more than 0 and is in positive range. This percentage means that this project is profitable and safe, to be undertaken from the economic point of view.

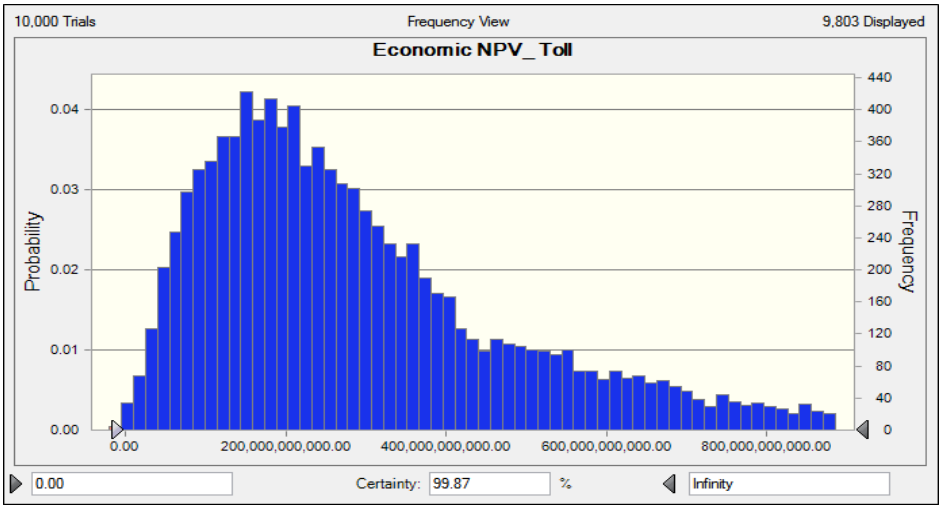

Figure 6.11: Forecast of Economical NPV

Externalities NPV: the result of risk analysis for this variable shows a mean of 299,993and a standard deviation equal to 107,448 million IR. NPV will be placed between minimum and maximum of 129,185 and 872,888 million IR, correspondingly. As Figure 6.12 illustrates, with the probability of 100 percent, NPV will be in the positive range and this positive result indicates a good project to be invested on.

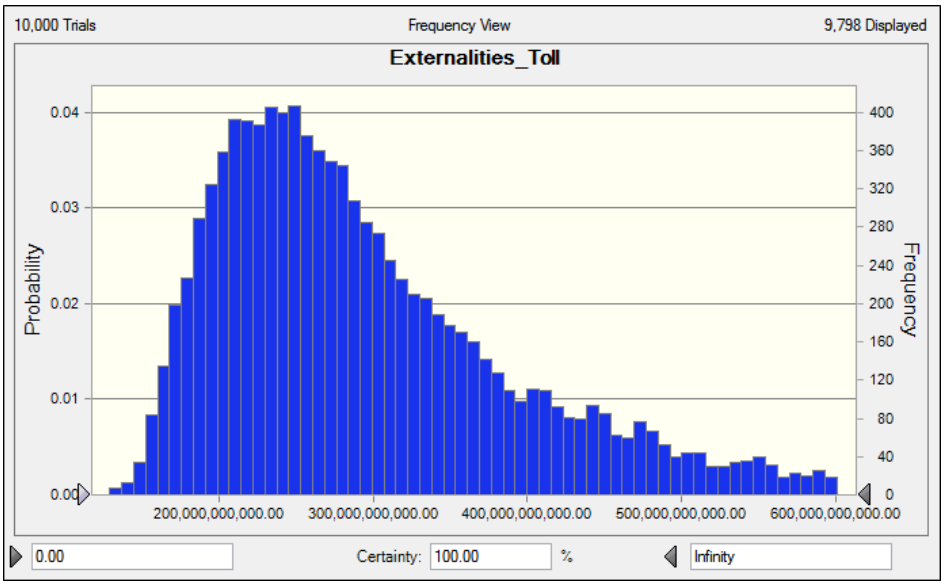

Figure 6.12: forecast of externalities NPV

In this part ADSCR and LLCR graphs are shown with brief explanations. The relevant results of Risk analysis show that in forecasted amounts ADSCR, from 2010 to 2017 and also amounts of LLCR from 2010 to 2016, graphs show that in 5 years, the ADSCR and in 4 years, the LLCR have certainty of 0 percent.

These ratios explain that, in these years, which are five and four years for each of the parameters, probability of being above 1.50 and 1.70 correspondingly, for ADSCR and LLCR of the project is 0 percent. The project will face with serious problems in repayment of its debt obligations in the first years.

In the following section some of the forecasted ADSCR and LLCR graphs with certainty of between 0 and 1.50 and 0 and 1.70 are shown. These graphs explain that the project needs to increase its net cash flows, in these years, in order to be able to cover its debt and liabilities.

Table 6.6: Statistic for ADSCR year 2017

Statistics:		Forecast values
Trials		10,000
Base Case		1.22
Mean		1.15
Median		1.14
Mode		---
Standard Deviation		0.25
Minimum		0.51
Maximum		2.03

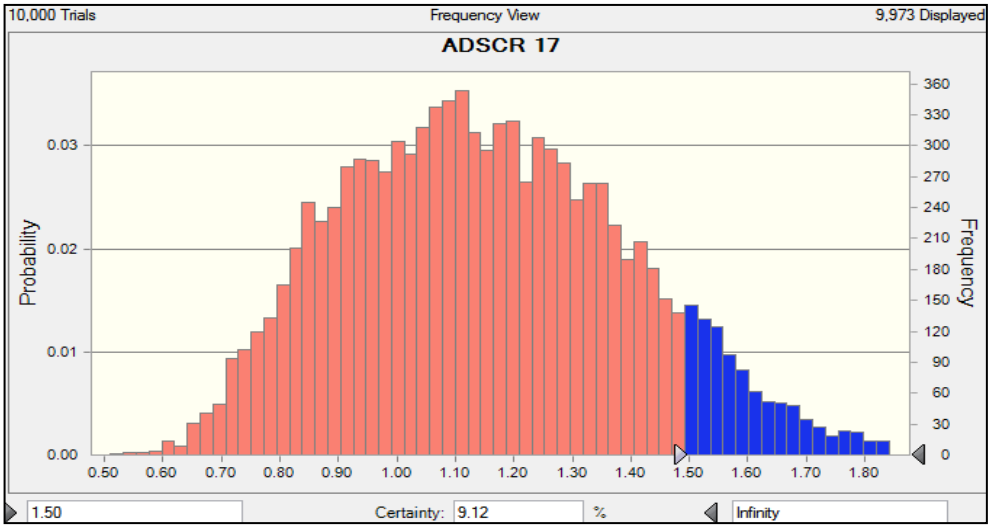

Figure 6.13: Forecast of ADSCR Year 2017

The graph 6.13 shows 9.12% certainty for the year 2017. This ratio means that with the probability of 9.12%, ADSCR of this year will be above 1.50. As it can be observed from the statistic table, ADSCR of this year has a minimum equal to 0.51 and maximum of 2.03. In the next Table and Figure, one of the LLCR with the certainty of between 0 and 1.70 is shown.

Table 6.7: Statistic for LLCR Year 2016

Statistics:		Forecast values
Trials		10,000
Base Case		1.56
Mean		1.48
Median		1.46
Mode		---
Standard Deviation		0.28
Minimum		0.74
Maximum		2.50

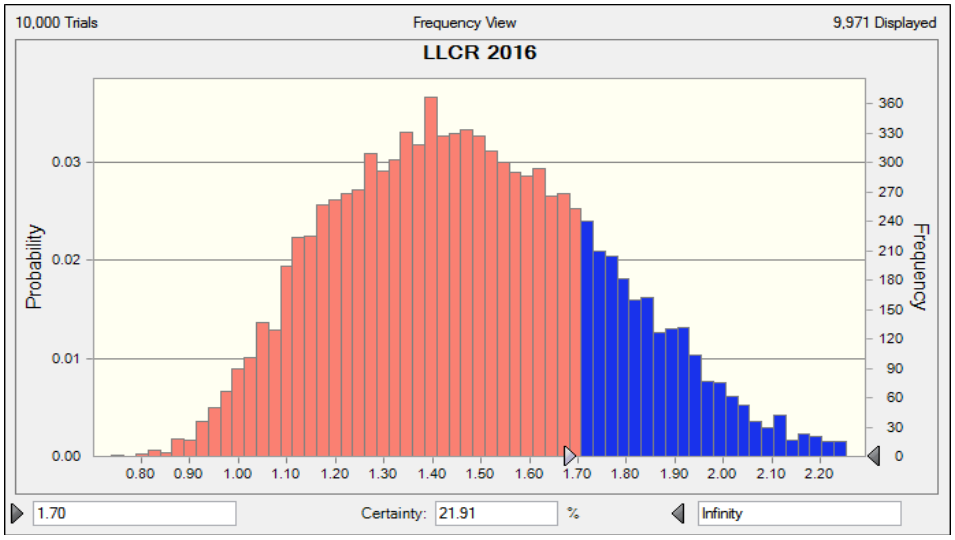

Figure 6.14: Forecast of LLCR Year 2016

Result of risk analysis of forecast of 2016 explains that LLCR of this year will have certainty equal to 21.91 percent. With regard to the maximum and the minimum of this year, which are respectively equal to 0.74 and 2.50, optimistically there is a probability that LLCR of this year goes above the assigned range.

Table 6.8: Trend of Increasing Ceratainety of ADSCR and LLCR in forecasted Years

Year	ADSCR	LLCR
2010	0	0
2011	0	0
2012	0	0
2013	0	1.17%
2014	0.20%	4.09%
2015	2.70%	11.33%
2016	13.27%	21.91%
2017	9.12%	-

From project's financing point of view, due to positive results of ADSCR and LLCR, after last year, the project will be able to service all its debt and liabilities. As it can be seen in table above, project has a positive trend. These growths of ratios make the project be able to face with problems, but still the project is risky and it should consider some arrangement to minimize the project-financing problems and prevent it from being failed. In order to find some way to solve these problems, some policy issue will be outlined in the conclusion part.

Chapter 7

CONCLUSION AND POLICY RECOMMENDATION

7.1 Concluding remarks

In the current century, it is accepted that transportation's infrastructure plays a vital role in development of regions and countries. The improvement and expansion of roads is one of the most important compulsions and responsibilities of government and therefore, an assigned section of annual budget of each country is allocated to the development of roads and highways.

Roads can have positive effect on development of economy by reducing the travel time and vehicle operating cost, increasing the regional employment, increasing the connection between different regions and etc.

The Yazd-Abarkouh-Sourmagh road project is a real project, located in Yazd and fully funded by the government. Construction of this road has a critical role in economic development of country as it will expand the business relations between four major provinces of Iran and it will be one of the most important paths of transportation network of the country.

In the process of analysis of this road project, two scenarios have been done where scenario one is no toll and loan and scenario two is with toll and loan.

- **Scenario one**

Scenario one is the project, itself proposed by the government. a real project, which is funded by the government from the public revenues and the needed data and information for analyzing the project have been taken from the project's employees and contractor. Project does not include any loan and toll. In process of analysis of this scenario, results have shown that scenario one will have negative financial of 29 million USD, but positive economic NPV of 17 million USD and externalities NPV of 47 million USD. When analysis of this project was completed and it was reached to this negative financial NPV, after that the other scenario was decided to be done, to see how the project can made feasible financially and also, how the government can motivate private sector to undertake a road project and cooperate in infrastructure projects.

- **Scenario two**

In this scenario, it is assumed that the project will take loan equal to 50 percent of its investment cost and also the road will have toll. Scenario two is done in the same way of scenario one and after completing the analysis, the results show that the NPV amounts of this scenario are totally positive. According to the positive financial NPV of 2 million USD, economic NPV of 29 million USD and externalities NPV of 29 million USD, this is a valuable, profitable project and it worth to be undertaken. Also, investors will earn back all the investment cost. Although project is profitable, analyses of ADSCR and LLCR have shown that project will have serious problem in financing and servicing its debt in the early years of repayment. To solve these problems some solutions and recommendations are outlined in the next part.

7.2 Policy Recommendations

From the analyses, it is identified that these five variables are more risky than other variables, which highly influence the NPV. To mitigate the affect of these variables and to solve the financing problems of the project, a contract should be set with new provisions. As the result shows, car toll is the most important variable and to mitigate its impact on NPV, it should be mentioned, in contract that the car toll should be associated with the inflation. In order to make the project attractive for investors and financial institutions, improvement of ADSCR and LLCR is required. In the following paragraphs, some ways to raise the project's attractiveness and enabling it to service its debt obligations are introduced:

The project's owner may ask for subsidized interest rate on received loan, in order to enable it to repay the entire loan on time and make the cash flow statement attractive. It will help the ratios look better and make it more attractive for bankers and motivate them to cooperate with the project.

- The investors may ask for decreasing the amount of borrowed loan and debt financing and then increasing the equity in investment. With using this option, the project will be able to service its debt.
- Project's owner may ask financial institutions to increase the duration of loan repayment or, to pay its debt in the year, with a better financing structure.

It is believed that the recommended options above if used can improve the ADSCR and LLCR and make the project's financing stronger.

Overall, the analysis has shown that there is no doubt a feasible project from the economic point of view, contributing the development of the region as well as the country. The study has also introduces a new vehicle which shows that projects that has been known as public projects can also be undertaken by the private sector. Such

initiatives will enable the government to transfer some of its functions to private sector this in turn will create additional fiscal sources for the governments which can be used for other society needs.

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APPENDICES

Appendix 1: Table of Parameters for Financial Part of Scenario One

Highway Maintenance			**Useful Life**	30	Years
Routine Maintenance	9,000,000	IR per km	**Usage per year**	365	Days
every	1	years			
Periodic Mantenance	90,000,000	IR per km			
every	8	years	**Government Contribution**	100.00%	
Length	93	km	**Equity Discount Rate**	15.00%	
			Distribution		
Labor Force			Year 0	30%	
Skilled	25%		Year 1	30%	
Unskilled	75%		Year 2	20%	
			Year 3	20%	
General Expenses	7.67%	of Investment	**Investment Costs**		
			Equipment and Materials		
Contractor's Profit Margin	10%	of Investment	Domestic	198,000,000,000	
			Imported	0	
Domestic Inflation Rate	13.50%		Labor Force		
			Skilled	20,000,000,000	
Sales Tax (IGV)	8%		Unskilled	36,900,000,000	
Cost Overrun Factor	0%		General Expenses	19,550,830,000	
Operating Expenses	5%		Contractor's Profit Margin	25,490,000,000	
			Total	299,940,830,000	

Appendix 2: Table of Parameters for Financial Part of Scenario Two

Highway Maintenance				**Useful Life**		30	Years
Routine Maintenance		9,000,000	IR per km	**Usage per year**		365	Days
every		1.00	years				
Periodic Mantenance		90,000,000	IR per km	**Bank Loan**		50%	
every		8	years	**Government Contribution**		50%	
Length		93	km				
				Interest Rate on Loan		12%	
Labor Force				Grace Years		4	
Skilled		25%		Duration of Loan		15	
Unskilled		75%		Amortization		11	
				Equity Discount Rate		15%	
General Expenses		7.67%	of Investment				
Contractor's Profit Margin		10%	of Investment				
				Investment Costs			
Inflation and Exchange Rate				Equipment and Materials			
				Domestic		198,000,000,000	
Domestic Inflation Rate		13.50%		Imported		-	
Exchange Rate		8,900		Labor Force			
Sales Tax (IGV)		8%		Skilled		20,000,000,000	
				Unskilled		36,900,000,000	
Toll Used		Yes		General Expenses		19,550,830,000	
Car Toll Level		17,500		Contractor's Profit Margin		25,490,000,000	
Operating Expenses		5%		Total		299,940,830,000	
Cost Overrun Factor		0%		**Distribution**			
				Year 0		30%	
				Year 1		30%	
				Year 2		20%	
				Year 3		20%	

Appendix 3: Income Statement – Scenario Two

Year	2006	2007	2008	2009	2010	…	2017	..	2025	..	2033	2038	2039
Receipts													
Toll revenues	0	0	0	0	37,487,551		51,137,843		73,134,223		104,907,856	131,639,178	137,771
Loan	44,991,124	44,991,124	29,994,083	29,994,083	0		0		0		0	0	0
Total Inflows	44,991,124	44,991,124	29,994,083	29,994,083	37,487,551		51,137,843		73,134,223		104,907,856	131,639,178	137,771
Expenditures													
Construction Costs	89,982,249	89,982,249	59,988,166	59,988,166	0		0		0		0	0	0
Routine Maintenance	0	0	0	0	837,000		837,000		837,000		837,000	837,000	837,000
Periodic Maintenance	0	0	0	0	0		8,370,000		8,370,000		8,370,000	0	
Operating Expenses	0	0	0	0	1,874,377		2,556,892		3,656,711		5,245,392,819	6,581,958,903	6,888,572
Loan Repayment	0	0	0	0	0		0		0		0	0	0
Interest	0	0	0	0	17,363,338		2,602,133		0		0	0	0
Principal	0	0	0	0	13,154,044		5,421,110		0		0	0	0
Total Outflows	89,982,249	89,982,249	59,988,166	59,988,166	33,228,761		19,787,136		12,863,711		14,452,392	7,418,958	7,725,572
Net Cash Flow	(44,991,124)	(44,991,124)	(29,994,083)	(29,994,083)	4,258,790		31,350,706		60,270,512		90,455,463	124,220,219	130,045,872

Appendix 4: Cost and Benefit

Year		2006	2007	2008	2009	2010	...	2017		2025	…	2033	…	2038	2039
Benefits															
Toll revenues		0	0	0	0	37,487		51,137		73,134		104,907		131,639	137,771
Change in Accounts Receivable		0	0	0	0	0		0		0		0		0	0
Consumer Surplus (Generated and Diverted Traffic)		0	0	0	0	7,780		9,589		12,233		15,680		18,356	18,947
VOC Savings Normal Traffic															
Light Vehicles		0	0	0	0	1,791		2,128		2,658		3,160		3,575	3,665
Buses		0	0	0	0	115		137		171		204		231	236
Trucks		0	0	0	0	1,365		1,623		2,02		2,409		2,726	2,794
Value of Time Savings Normal Traffic		0 0	0	0	0	14,788		17,578		21,953		26,095		29,524	30,262
Benefits to Truckers and Middleman		0	0	0	0	2,600		5,747		15,939		35,236		62,098	69,549
Total Benefits		0	0	0	0	65,929		87,944		131,861		187,694		248,151	263,228
Costs															
Construction Costs		72,097	72,097	48,065	48,065	670		670		670		670		670	670
Routine Maintenance		0	0	0	0	0									
Periodic Maintenance		0	0	0	0	6,903		6,903		3,903		6,903		6,903	6,903
Operating expences		0	0	0	0	1,874		2,556		3,656		5,245		6,581	6,888
Total Costs		72,097	72,097	48,065	48,065	2,545		10,131		4,495		12,819		7,252	14,463
Net Economic Benefits		(72,097)	(72,097)	(48,065)	(48,065)	63,383		77,812		127,365		174,874		240,898	248,765