Université du Québec en Outaouais

ECONOMIC EVALUATION TECHNIQUES: APPLICATION TO A CHINESE AGRICULTURAL DEVELOPMENT PROJECT

THESIS

PRESENTED

AS A REQUIREMENT

FOR MASTER OF SCIENCE IN PROJECT MANAGEMENT

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To my families and friends in China

ACKNOWLEDGMENT

This thesis is the mandate of the master program of science. I also want to send it as a gift to those I love and those who love me. This thesis is delivered not only under my personal endeavour but also with the collaboration and help of many people.

My parents and my beloved wife always support me with their patience and love. They stand besides me, sharing my happiness and my pain; they offer me their advice and experience, guiding me to the success; and they give me a cozy home, taking care of me in my life. Although they are thousands of miles far from me, I can feel the endless love throughout. I cannot find a word to express my gratitude. The successful issue of this thesis is the only gift I can give them.

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LIST OF ABREVIATIONS, INITIALISMS AND ACRONYMS

ADBC	-	Agricultural Development Bank of China
Huabao	-	Huabao Industrial Co. Ltd.
NPV	-	Net Present Value
IRR	-	Internal Rate of Return
BCR	-	Benefit-Cost Ratio
CER	-	Cost-Effectiveness Ratio
PBP	-	Pay-Back Period
ENPV	-	Economic Net Present Value
EIRR	-	Economic Internal Rate of Return
SDR	-	Social Discount Rate
Yuan	-	Renminbi

ABSTRACT

Agricultural Development Bank of China (ADBC) seeks a complete economic evaluation of the Loaning Funds Program to support private agricultural product processing factories. This thesis aims to economically evaluate one loaning project of ADBC for the soybean processing of Huabao Industrial Co. Ltd.

Chapter 1 introduces the Henan agricultural environment and farmers' difficulties to sell grain, and the reasons which have caused these current problems. Also, the mission, purpose and business scope of ADBC are introduced. What should ADBC do to solve the current problem? What choices do ADBC have? What is the best choice?

Chapter 2 introduces Huabao Industrial Co. Ltd. And describer their financial situation and production technology. The limitation of the current project assessment approach of Qinyang Branch is also mentioned in this chapter.

Chapter 3 re-investigates the financial evaluation for Huabao project. This serves as a reference base for the economic evaluation exposed in Chapter 5. Indeed, our financial evaluation results show the decision ADBC made for the first two years is correct for the Huabao project.

Chapter 4 is a preparation of our project economic evaluation. All data used in the next chapter are described in great detail and some missing variables are recovered from available ones. Necessary predictions of future markets are made in the last section of this chapter.

In chapter 5, an economic evaluation model for the ADBC loaning project is established. First, while illuminating the general project economic evaluation methodology, we highlight the goal of the loaning project in both economic qualitative analysis manner. Then, we identify the concerned groups of the

project and quantify the project effects. In the end of the chapter, we calculate the economic net present value and the economic internal rate of return for the proposed project. As well, we carry out a sensitivity evaluation for the project. Our findings are that the proposed project contributes substantially to the social welfare and has very good ability to resist risks.

In Chapter 6, we analyze an alternative project. This analysis is necessary because an economic evaluation is a comparison of the proposed project with its alternatives for the purpose of finding the best choice in view of social welfare. Our overall conclusion is that Huabao project maximizes the collectivity welfare of the Qinyang region.

The techniques introduced in this thesis provide ADBC a set of tools for evaluation of their other loaning projects.

INTRODUCTION

China, the most populous nation in the world, boasts about 1.3 billion people. China also has the largest rural population, numbering more than 60% of the total Chinese population according to the National Population and Family Planning Commission of China (2005). In previous decades, China's GDP has grown at an average rate at above 9% per year. For this reason, China is called the "waking dragon". Starting in 1978, China's economic reform and opening up began in the countryside. The Chinese government focused on strengthening agricultural infrastructure, and encouraged farmers to invest in agro-technological renewal. As a result, the Chinese agricultural production technology has been greatly improved and crop yields have continuously increased.

One might think farmers' income would greatly augment with such a rapid increase of harvesting. In fact is that farmers' revenues were raised only slightly. The problem is that the market demand for crops has increased less rapidly than the supply. Therefore, it has become more difficult for farmers to sell their products.

For their livelihood, a growing number of farmers have abandoned or intended to abandon rural areas and moved into the cities. From an economic perspective, rural population migration to urban areas is a necessary social restructuring development tendency. On the other hand, sudden and unorganized migration will inevitably cause some serious social problems. Sudden migration has at least three negative effects. The first is that most immigrant farmers are worse off since cities' infrastructures are not yet ready to accept so many immigrants in a short time. The second is that the urban security issue becomes severe as the unemployment rate explosively increases and the crime rate increases unexpectedly. The third negative effect is this out- migration of the agricultural labor force leads to unstable agro-production.

Henan is located in the middle part of China, the area south of the Yellow River. Henan province is the central foodstuff base of China. According to the Government of Henan Province [PGHP] (2005), one out of ten Chinese foodstuffs is from this province. It has the largest population (about one hundreds millions), and the largest rural population (about sixty five million) in China. Because of the state of agricultural relations, the farm crises are serious in Henan province.

The key reason for these social challenges is that farmers' incomes are not stable. To solve this particular problem substantially, it is necessary to expand the agricultural sales ditch. For example, investing in the processing of agricultural products is one possible solution. Most agricultural product processing companies are not successful because of a shortage of funding.

The Chinese government established an agricultural policy bank the Agriculture Development Bank of China (ADBC), in 1994. Being a representative of the government, ADBC has a mission to financially support agro-product processing companies.

As an example, Huabao Co. Ltd, a private soybean processing enterprise in Qinyang, faced the problem of insufficient liquidity. The Qinyang Branch of ADBC decided to help Huabao ease their plight with financial support.

As a policy bank, ADBC should have analyzed the project from the point of view of the government. Till now, Qinyang Branch of ADBC has made its loaning decisions simply by a financial evaluation. ADBC (Qinyang Branch) is seeking how currently methods of cost-benefit analysis for their projects from the point of view of the social planner. This thesis aims to propose techniques of project economic evaluation and their application to the loaning project of ADBC for soybean processing of Huabao Co. Ltd.

CHAPTER ONE
Background and Context

1.1 Introduction

The province of Henan (Meaning “River south”) was so named because of its geography. It is located south of the most famous river in China, the Yellow River. According to PGHP (2005), Henan is the most populous province in China with the largest rural population of about 65 million people. With economic development, rapid technological progress has been made in Chinese agriculture. Agricultural technological progress has accelerated the upgrade of Chinese agricultural productivity. Crops have greatly increased all over China, particularly in Henan Province, and agricultural productivity has accelerated. In 2005, around 10% of the total agriculture productivity of China was from this province.

One might think that farmers would be better off as a result of these increased harvests. Indeed, farmers’ revenues have increased, but only slightly. The problem is that the market demand for crops has increased less rapidly than the supply. It has become more difficult for farmers to sell their products, especially soybeans.

Every year in Qinyang, there are thousands farmers waiting outside of grain procurement agencies to sell their soybeans. Many of them wait in queue for more than one day. Some farmers may even wait for several days. They complain of inefficiencies in the grain procurement agencies. Actually, grain procurement agencies have reached their maximum purchase and stockpile capacity, especially that of soybeans.

Take the example of case, Mr. Wenming Zhang, a 52-year old soybean planter from Qinyang, who annually grows 10 Mu* of soybeans: All his household revenues came from soybean cultivation. In 2004, with excellent weather condition, he used well-bred soybeans and had productive year, so this year was a foison year. Because that year was a foison year for soybeans, the grain procurement agencies did not have enough money to purchase the soybeans. If they had enough money to buy those soybeans, the company wouldn't have sold them, because there was not a market for them (Shangqiu News, 2004). The only way to solve the soybean problem is to process the soybeans into soybean oil and meal and then sell these resulting products.

Figure 1.1 Farmers in queue to sell soybeans (Shangqiu News, 2004)

For their livelihood, lots of young farmers have left or intend to leave the countryside and crowd into cities. Such sudden and unorganized migration has the following negative effects: labor force loses in the rural areas cause agricultural production instability and as well as, social problems arising in cities since there are insufficient job opportunities for their sudden influx of rural farmers.

* Mu, also called Shi Mu, is a Chinese unit of area. 1 Mu = 666.66…m^2

Clearly, governments must intervene since severe market failure provokes massive social resource wastes, according to economic theories. What should governments do?

The Government of Henan Province decided to help by eliminating barriers, augment farmers' income, stabilizing agricultural production, and reducing agri-population losses. The Agricultural Development Bank of China has been authorized to carry out this government policy.

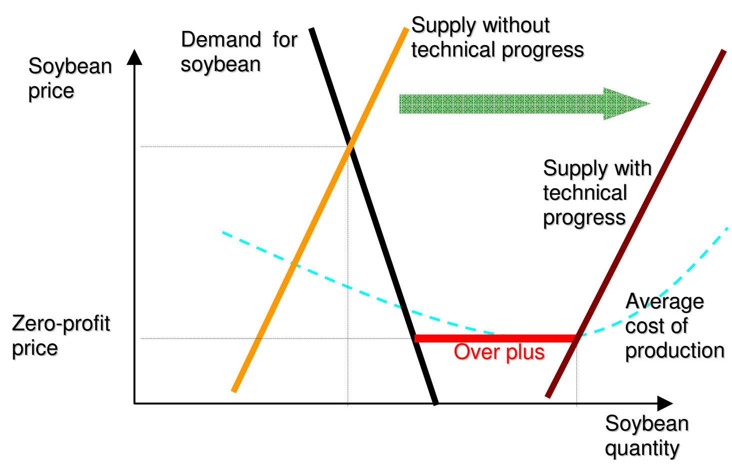

Figure 1.2 Extra Soybean Supply

Figure 1.2 displays the occurrence of extra supply in the soybean market because of increasing productivity in Henan, China.

1.2 Agriculture Development Bank of China (ADBC)

According to the Agriculture Development Bank of China (ADBC, 2005), the bank is "a state-owned agricultural policy bank under the direct administration of the State Council which was established in accordance with the Circular on Establishment of Agricultural Development Bank of China of the State Council."

1.2.1 Purpose and Mission

According to ADBC (2005), the bank's purpose and mission is to "promote development of agriculture and rural areas through the following activities: to raise the funds for agricultural policy businesses based on the state credibility in accordance with the laws, regulations, and policies; to undertake the agricultural policy credit businesses specified by the Central Government; and to serve as an agent for the state treasury to allocate the special funds for supporting agriculture."

1.2.2 Business Scope

According to ADBC (2005) the bank's business scope is "defined and readjusted by the State Council in line with the needs of national economic development and its business capacity over time. Since its inception, its business scope has been readjusted by the State Council for several times.

Currently, the major businesses of ADBC are as follows:

1. Loans for procurement, reserve and marketing of grain, edible oil and cotton in conformity with the State Council's plan.
2. Special loans for national reserve of meat, sugar, tobacco and wool.
3. Disbursement of the central government's subsidies for the above mentioned agricultural products, maintain special accounts for grain risk funds jointly established central and provincial-level governments, and make disbursement.
4. Loans to the processing enterprises for processing grain, cotton and edible oil
5. Loans to the flagship enterprises in the areas of grain, cotton and edible oil industry
6. Deposits from policy – oriented corporate and institutional customers maintaining accounts with ADBC.
7. Settlement for policy-oriented corporate and institutional customers

keeping accounts with ADBC.

8. Issue financial bonds.

9. Intermediary business including serving as an agent of insurance.

10. International settlements for policy-oriented enterprises under import and export account, foreign exchange deposits, foreign exchange remittance, and foreign exchange inter-bank lending, foreign exchange dealing as agent, and foreign exchange purchase and sale.

11. Other business approved by the State Council or the people's Bank of China"

1.3 How Should ADBC Face Current Problems?

Facing these problems caused by the difficulties of farmers in selling crops as described in Section 1.1, what should ADBC do? What is the best choice for ADBC? Basically, there are three alternative choices for ADBC.

A. To finance the existing agencies to build more warehouses.
B. To initiate crop exportation.
C. To encourage grain processing.

Choice A is evidently a temporary strategy, not a good idea for long term. This is because it does not seek salable for excess grains. Without new salable, the considerable stockage loss of grains is a dead loss for the society. Warehouse construction expenditures are also quite high. In short, Choice A is a strategy of short-sighted people without consideration of future development and hence can be ruled out intuitively.

Chinese crops offer no advantages of prices in international markets. For example, according to Soy Stats (2003), the American soybean price was US$202 per ton in 2002 while the Chinese soybean price was US$312.5 per ton (Huabao loaning report [HLR], 2004) for the same year, without consideration of shipping fees. Choice B is evidently ruled out, too.

Choice C may contain several options. For example, processing of which category or categories of crops should be encouraged? Which enterprise or enterprises should be financially supported by ADBC? Clearly, the answer depends on the local situations. Depending on the region, an economic evaluation must be done before ADBC makes its decision.

Qinyang Branch is the only affiliate of ADBC located in the Qinyang area. Farmers in Qinyang are the principal soybean producers of the province. Since 2004, the branch has provided loans to Huabao Ltd., a private agricultural processing enterprise in Qinyang, for its processing of soybeans.

The motivation of Qinyang Branch to propose this project is illustrated in Figure 1.3. Without the proposed project, the only way for soybean farmers to sell their soybeans is to sell directly to customers or to the government grain procurement agencies. The soybean market demand for direct consumption is relatively weak while soybean by-products are very popular in China.

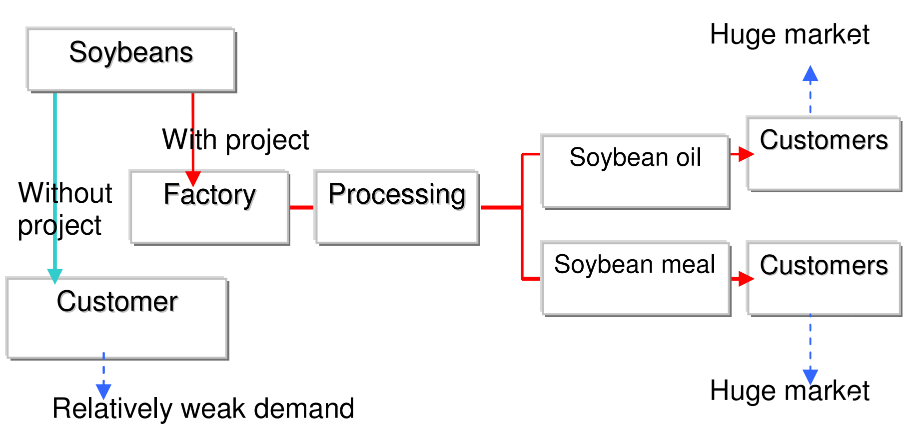

Figure 1.3 Project Motivations

Processed soybean products include soybean oil, soybean meal, tofu, etc. Particularly, soybean oil (cooking oil) and soybean meal (feedstuff) have huge potential market.

CHAPTER TWO
Project Specification

The current social problem and the options for ADBC to solve it have been mentioned in chapter 1. In this chapter, we explain what ADBC has done to solve the current problem.

2.1 Huabao Ltd

2.1.1 An Outlook of the Business

According to HLR (2004), Huabao Ltd. is one of the 500 biggest agriculture companies in China, and one of the 50 biggest in Henan province. The Huabao Industrial Co. Ltd. is located between the cities of Zhengzou, Luoyang and Jiaozuo. It has 300 employees, and 100 technicians. Its registered capital is 10 million Yuan. There are four sub-companies in Huabao Co. Ltd., Huabao Lipid Industrial Company, Huabao Flour Company, Huabao Fodder Company and Huabao Clothing Company.

2.1.2 Huabao's Current Financial Situation

According to HLR (2004), at the end of 2004, the total assets of the company were 37.83 million Yuan. The total liabilities were 11.67 million Yuan, the debt-to-asset ratio was 31%, the liquidity ratio was 129%, and the quick-moving ratio was 91%. The sales revenue was 102.8 million Yuan, and the reported net profit was 3.48 million Yuan.

2.1.3 Huabao Lipid Factory

Huabao Lipid Factory produces soybean oil and soybean meal from soybeans. In 2003, Huabao Lipid Factory processed 100,000 tons of soybeans; the output was 85,500 tons of soybean meal, and 14,500 tons of soybean oil. The product sales rate was 99.8%. Huabao Lipid Factory has a very good reputation; due to the company's high-quality products, its market demand is excellent.

2.1.4 Production Technology

According to HLR (2004), the production factors of Huabao are

Soybeans – raw material

Coal – principal energy

Solvent – expendables

Electricity – auxiliary energy

Labor

Other inputs – water, equipment, transport, etc.

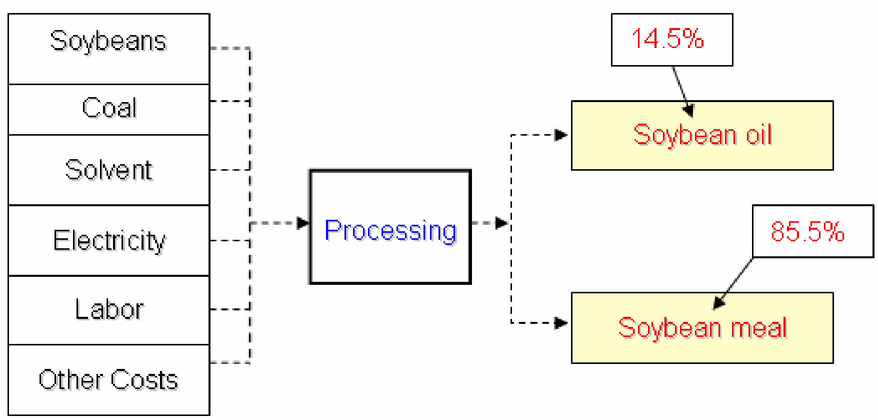

Figure 2.1 Rate of Soybean Oil and Soybean Meal in Huabao's Outputs

The products are it sells soybean oil and soybean meal. Soybean meal is the product remaining after extracting most of the oil from whole soybeans. According to HLR (2004), one unit of soybean yields 14.5% oil and 85.5%

soybean meal. The full production process is illustrated in Figure 2.1.

High in protein and energy, soybean meal is a palatable feedstuff and may be used as the major protein supplement in rations for dairy cattle. See Figure 2.2.

Figure 2.2 Uses of Soybean Meal

2.2 Project Information

According to ADBC Loaning decision report for Huabao project[LDRH], (2004), starting in July 2004, Qinyang Branch loaned 18 million Yuan to Huabao Ltd every year for the use of liquidity in soybean processing on the condition that the business activities of Huabao Lipid Factory lead to anticipated financial profits. Qinyang Branch has been aware of the serious shortcomings of the current project assessment method; The most significant problem with financial analysis is that the selected project does not necessarily maximize the welfare of collectivity. Consequently, a decision made in such a way may systematically deviate from the initial government motivation.

An overview of the project decision process demonstrates this project is somewhat untraditional. It may be renewed if the bank is satisfied with Huabao

Lipid Factory contributions to society. Actually, Huabao reports all its production related data to the Qinyang Branch when it repays the interest to the bank each July. The bank examines the annual report of Huabao and decides if the loaning project will be extended. The project may be broken off or terminated because of project environmental change; for example, a significant augmentation in market demand for raw soybeans and/or weaker long-term oil and meal demands might make the loaning project no longer necessary. The project may also be put to an end simply because of the firm's poor performance. Figure 1.4 shows the bank's decision making process.

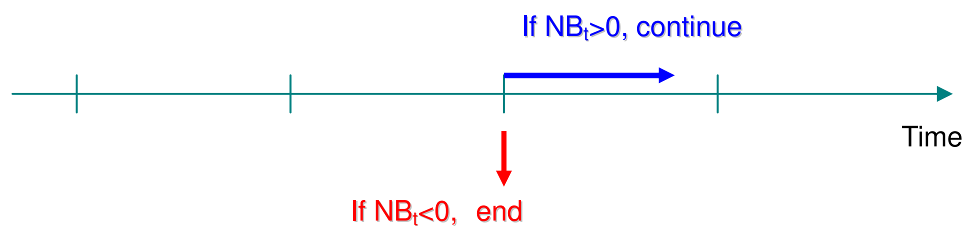

Figure 2.3 Decision Making Process of the Bank

Normally, the loaning period is one year. According to LDRH (2004), the annual interest rate of the loan is 5.76%. This interest rate for liquidity loan is uniform all over China. However, for the purpose of encouraging soybean processing, Qinyang Branch gives Huabao a bonus at the moment of repayment: 600,000 Yuan is subtracted from the interest that Huabao owns the bank (LDRH, 2004). Figure 1.5 shows the loaning project cycle.

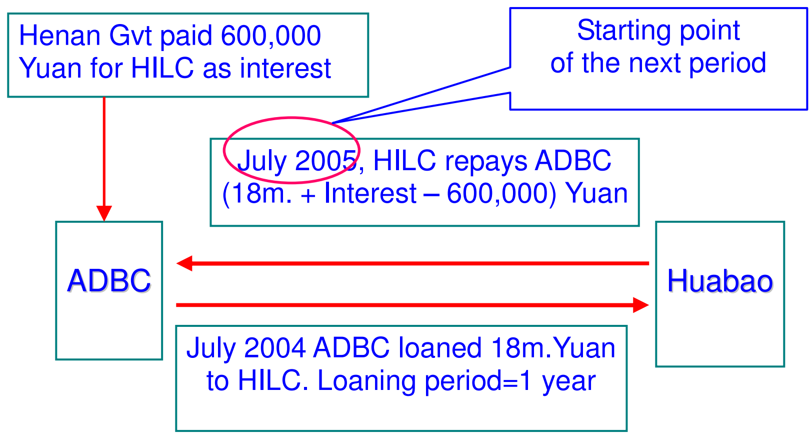

Figure 2.4 Project Lifecycle

2.3 Problems in Current Project Assessment of Qinyang Branch

Until now, Qinyang Branch of ADBC makes its loaning decisions simply by assessing the financial efficiency of the borrowers; that is, the bank loans to agricultural firms at the condition that they run profitably. By only taking this into account, financial analysis is evidently not enough in the evaluation of projects related to the welfare of collectivity. For instance, a financial assessment ignores the external effects (externality) of the project, omits the possibility of job opportunities the project generates, and disregards the interaction of related markets, etc. As result, it is possible that a loan project may be desirable for the firm but undesirable for the collectivity; in contrast, a project may be socially feasible but not profitable for the firm. Being a policy bank, Qinyang Branch seeks to evaluate its projects from the point of view of the social planner, or to choose the option that maximizes the social net benefit. Such an analysis is called economic evaluation of project.

Is it economically feasible to provide loans to Huabao for soybeans processing? Several markets are involved in this project; soybean, soybean oil and soybean meal. How do these markets interact? In the case of multiple outputs and markets, many costs and benefits are indirect; for example, the value of lost time for farmers waiting in queue is intangible. All social benefits and opportunity costs of the project must be incorporated into economic evaluation.

All these questions are answered in the present thesis. We find appropriate monetary measurements for the plus and minus of the loaning project of ADBC (Qinyang Branch) to Huabao.

CHAPTER THREE
Financial Assessment

As mentioned above, Qinyang Branch of ADBC made its loaning decision with the results of a financial analysis and they are aware of limitations of the approach. We do also our financial analysis in this chapter, which serves as a base and reference of our economic evaluation in Chapter 5. Similar to that of Qinyang Branch, our project financial analysis is also based the ADBC loaning directives. The financial analysis we do below is *ex post*.

3.1 Approaches of Financial Assessment

3.1.1 Terminology

The financial analysis of a project aims at ascertaining the most efficient strategy for delivering the desired outputs. In other words, the financial evaluation of a project is a study of the project profitability. The following terms are generally involved in our financial analysis.

Initial investment is the total amount of monetary values of various equipments, buildings, and other inputs put into production at time zero, the starting point of time of the project (Odellion Research [OR], 2006).

Cash outflows are expenditures of the project owner, directly provoked by the project during each period of the project lifecycle (OR, 2006).

Cash inflows are incomes of the project owner, directly generated by the project during each period of the project lifecycle (OR, 2006).

Cash flows are simply the differences: Cash inflows – Cash outflows, for each period. Equivalently, the cash flow in a given period is the net profit. The amortization charge is taken into account of the cash flow for each period.

Discount rate is a measure of *time value of money*. It is calculated by looking at comparable investment alternatives having similar risks. According to OR (2006), the rate of return is "often referred to as the interest rate, hurdle rate, or company cost rate of capital. Companies frequently use a standard rate for the project, as they approximate the risk of the project to be on average the risk of the company as a whole". In our case, the annual discount rate considered 5.76% since this is the interest rate ADBC declines and applicable allover China.

3.1.2 Net Present Value (*NPV*)

According to OR (2006), the *Net Present Value* (*NPV*) is one of the most robust financial evaluation tools to estimate the value of an investment, with consideration of the time value of money in the lifetime of the project. It is defined as the sum of the *present values* of the period-specific cash flows minus the initial investment. The *present value* of a (future) cash flow is the value of the cash flow discounted or adjusted at a given discount rate. Mathematically,

$$
\begin{aligned}
NPV &= -I_0 + \frac{CF_1}{1+r} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_n}{(1+r)^n} \\
&= -I_0 + \frac{CF_1^+ - CF_1^-}{1+r} + \frac{CF_2^+ - CF_2^-}{(1+r)^2} + \ldots + \frac{CF_n^+ - CF_n^-}{(1+r)^n},
\end{aligned}
$$

where I_0 is the initial investment; $CF_t = CF_t^+ - CF_t^-$ is the cash flow occurring in period t; CF_t^+ and CF_t^- are respectively cash inflow and cash outflow occurring in period t and, r stands for the discount rate; n represents the number of periods of the project lifetime.

The *NPV* Rule can be stated as undertake a project if its

$$NPV > 0.$$

A positive *NPV* implies that the project is profitable. *Ceteris paribus*, the decision maker undertakes the project with greatest *NPV* when there are several incompatible choices.

3.1.3 Internal Rate of Return (*IRR*)

According to OR (2006), the *Internal Rate of Return* (*IRR*) is an alternative method of evaluating the profitability of a project. It is defined as the discount rate that makes the project has a zero *Net Present Value (NPV)*. In other words, *IRR* is the solution ρ of equation:

$$NPV(\rho) = -I_0 + \frac{CF_1}{1+\rho} + \frac{CF_2}{(1+\rho)^2} + \ldots + \frac{CF_n}{(1+\rho)^n} = 0. \qquad (1)$$

Note that (1) is equivalent to

$$\frac{CF_1^+}{1+\rho} + \frac{CF_2^+}{(1+\rho)^2} + \ldots + \frac{CF_n^+}{(1+\rho)^n} = I_0 + \frac{CF_1^-}{1+\rho} + \frac{CF_2^-}{(1+\rho)^2} + \ldots + \frac{CF_n^-}{(1+\rho)^n}\,. \qquad (2)$$

This means that *IRR* is just the break-even rate of return. In general, a higher *IRR* implies a stronger ability of the project to reclaim the capital invested but not yet recovered.

The *IRR* Rule states that undertake a project if its

IRR > the desired rate of return.

For the present project, the desired rate of return is the interest rate of the bank loan, 5.76% per year.

However, *IRR* must be used with great caution. Some cash flows may be negative because of reinvestment or other massive inputs in some periods. For example, when Huabao Lipid Factory purchases larger quantity of soybeans in a month, cash outflows overpass cash inflows in that month and therefore the total cash flows are negative in the month. According to Huabao Accounting Data [HAD], 2005), Table 3.1 shows occurrence of negative cash flows in the period from August 2004 to July 2005.

Table 3.1 Cash Flows of the Project from August 2004 to July 2005

I_0	CF_1	CF_2	CF_3	CF_4	CF_5	CF_6	CF_7	CF_8	CF_9	CF_{10}	CF_{11}	CF_{12}
3784	2596	-752	856	-687	940	-737	436	-320	851	-661	659	1393

It is remarkable that in presence of negative cash flows, equation (1) or equivalently, (2) may have more than one root. In this case, it is hard to say which positive root reflects the *true* internal rate of return of the project. Theorem 1 stated below shows that under some strong assumptions, IRR exists uniquely.

Theorem 1 *NPV*(ρ) is strictly decreasing with respect to ρ (>0), provided that the following assumptions are verified,

(i). $-I_0 + \sum_{t=1}^{n} CF_t > 0.$

(ii). $CF_t > 0$, $t = 1, 2, \dots, n$,

Consequently, equation *NPV*(ρ) = 0 has only one solution.

Proof. Condition (i) implies that *NPV*(0) > 0. The first order derivative of NPV is negative under condition (ii). Actually,

$$NPV'(\rho) = -\frac{CF_1}{(1+\rho)^2} - \frac{2CF_2}{(1+\rho)^3} - \dots - \frac{nCF_n}{(1+\rho)^{n+1}} < 0,$$

Since all cash flows are negative. This shows that the continuous function *NPV* (ρ) is strictly decreasing for ρ>0.

On the other hand,

$$lim_{\rho\to+\infty} NPV(\rho) = -I_0 + \frac{CF_1}{1+\rho} + \frac{CF_2}{(1+\rho)^2} + \dots + \frac{CF_n}{(1+\rho)^n} = -I_0 < 0.$$

Now we conclude that *NPV* (ρ) passes the ρ-axis only once, that is, this exists a unique *IRR*. End of proof.

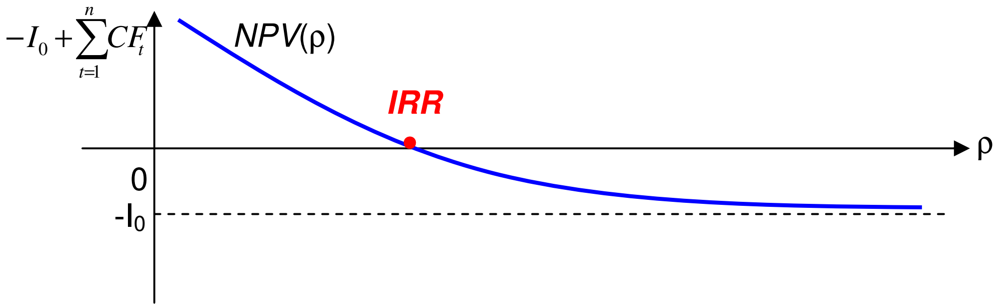

Figure 3.1 Internal rate of return (*IRR*)

Assumption (ii) of this theorem is so strong that the theorem holds only if re-investments and project running costs are relatively small during the project lifetime. For practicality, it is possible to slightly weaken that condition so that only the existence and uniqueness of *IRR* are ensured. In most cases, the strict monotonicity of *NPV*(ρ) is not necessary. We have the following generalization of Theorem 1.

Theorem 2 IRR exists and is unique if

(i). $-I_0 + \sum_{t=1}^{n} CF_t > 0.$

(ii). CF_t changes its sign only once when t takes 1 through n.

For the proof of this theorem, omitted here, we need Descartes Theorem[*] (also called Descartes sign rule). See Kostrikin (1982).

There are still other popular approaches in project assessment, *e.g.* Modified *IRR* in case of multiple roots of (1). We use only *NPV* and IRR in this thesis.

[*] Descartes Theorem states that the number of positive roots of a polynomial with real coefficients is equal to, or is an even number smaller than, the number of changes of sign in the series of its coefficients (each root being counted the number of times equal to its multiplicity); zero coefficients are disregarded in counting changes of sign.

3.2 Financial Assessment for the Project from Aug 2004 to July 2005

3.2.1 Initial Investment

The purpose of this loan is liquidity loans, that is, the loan only can be used to buy variable production factors, such as raw materials (soybeans). Huabao Lipid Factory inputs its existing equipments to soybean processing. This is the only initial investment of the present project, which is valued to be the total assets were 37.83 million Yuan in 2004*.

3.2.2 Cash Outflows

The project financial data that Qinyang Branch provides us are from Huabao's monthly accounting reports (HAD, 2006). For the present project, the cash outflows mainly come from raw material (soybeans), labor, energy, tax, solvent and the repayment for the bank loan plus interests. The depreciation charge of equipments should also be included in the total production costs and should be divided into outflows of every account period.

In the following summary table of monthly cash outflows, equipment depreciation cost is aggregated in "Other costs". According to HLR (2004), the "Other costs" includes also costs of labor force and energy (electricity and coal). We do it in this way because on specific depreciation rate of equipment is reported in the dataset Huabao offered.

"Tax" includes two items: business tax and income tax. In fact, both taxes contain also two parts, which are national tax and provincial tax. In China, these two taxes are paid to the government every month. In the financial analysis of the project, the taxes are added into the firm's cash outflows since they are a cost of the firm's production. This differs from economic analysis as one will see in Chapter 5. According to HAD (2005), the Table 3.2 shows the

* "Huabao Total Assets" mentioned Chapter 2.1.2

monthly cash outflow in the period from August 2004 to July 2005.

Table 3.2 Monthly Cash Outflow Table (Aug 2004 to July 2005)
(Unit: Yuan RMB)

Time	Other costs	Raw material (soybeans)	Tax	Payment for the bank loan	Interest	Total monthly cash outflow
2004.8	464571	82468	500822	0	0	797450
2004. 9	506884	16535303	554532	0	0	17319453
2004.10	537976	39293	502636	0	0	828587
2004.11	568092	16153731	535310	0	0	16989478
2004.12	571757	97849	550176	0	0	944694
2005.1	540503	16699797	524418	0	0	17502509
2005.2	277495	43616	259266	0	0	450744
2005.3	521733	11637318	489544	0	0	12403823
2005.4	513553	51742	483918	0	0	807254
2005.5	486839	14918061	474294	0	0	15642047
2005.6	385404	49408	380088	0	0	624856
2005.7	249817	9905974	255348	18000000	1036800	29320265

3.2.3 Cash Inflows

The project cash inflows are composed of the business sales revenues, the borrowed amount from the bank and the policy bonus the government awards to Huabao. The business sales revenues include sales incomes of soybeans oil and soybeans meal. According to HAD (2005), the Table 3.3 shows the monthly cash inflow in the period from August 2004 to July 2005.

Table 3.3 From Aug 2004 to July 2005 Monthly Cash Inflow Table

(Unit: Yuan RMB)

	Soybeans oil income	Soybeans meal income	Bank loan	Bonus	Total monthly cash inflow
2004.8	2402454	6395927	18000000	0	26798381
2004. 9	2635942	7151487	0	0	9787428
2004.10	2641914	6763807	0	0	9405720
2004.11	2800771	7304035	0	0	10104806
2004.12	2846421	7513797	0	0	10360218
2005.1	2706471	7410567	0	0	10117038
2005.2	1360058	3457292	0	0	4817350
2005.3	2582283	6618950	0	0	9201233
2005.4	2581430	6748901	0	0	9330331
2005.5	2489426	6536315	0	0	9025741
2005.6	1989333	5240223	0	0	7229556
2005.7	1296704	3481957	0	600000	5378661

3.2.4 Interest Rate

In China, the uniform interest rate of bank loan is controlled by Chinese Central Bank (The People's Bank of China). During the period of 2004 to 2006, the annual interest rate for liquidity loan is constant 5.76 % (LDRH, 2006). This is actually the real interest rate because it assumes no inflation during the from year to year. In the present thesis, the time unit is one month; therefore the monthly interest rate is 5.76% divided by 12, i.e. 0.48%/month.

3.2.5 *NPV* of the Project

The initial investment of this project is Huabao's fixed assets at time *t*, denoted by I_0^t. At the end of the project lifetime, a part of the capital remains with a residual values S^t. At the beginning of the next business year, the residual assets of last year are invested as initial investment, $I_0^{t+1} = S^t$. There is no information of new equipment purchase in Huabao accounting data.

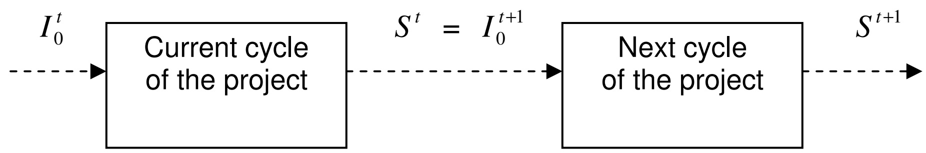

Figure 3.2 Initial Investment and Residuals

One important thing must be done before computing the *NPV* is the elimination of inflation for all monetary variables. The purpose of doing so is to make the present value of money comparable with its future value. For example, today's 101 dollars are equivalent to only 100 dollars in the period of time if the inflation rate is 1% and the actualization rate is 0%.

Let *i* be the average monthly inflation rate and *r* the monthly real interest rate. In presence of inflation, the correct discount rate is the nominal interest rate, that *r*+*i*, according to Fisher's formula:

Nominal interest rate = Real interest rate + Inflation rate.

In fact, there is a slightly different way in which one can actualize a future value: for the cash flow of period *t*, one eliminates at first the inflation and then actualizes the cash flow without inflation. Mathematically,

$$\frac{CF_t/(1+i)^t}{(1+r)^t} = \frac{CF_t}{[(1+r)(1+i)]^t} = \frac{CF_t}{(1+r+i+ri)^t} \approx \frac{CF_t}{(1+r+i)^t},$$

since *r* and *i* are very small and the product r_i is higher order infinitesimal of *r* and *i* when *r* and *i* tend to zero. Consequently, $r_i \approx 0$. Some authors prefer to use

$$\frac{CF_t}{(1+r+i)^t}.$$

We use $\frac{CF_t/(1+i)^t}{(1+r)^t}$ in this thesis. This causes only negligible errors.

According to LDRH (2006), during the period of 2004 to 2006, the annual inflation rate is 1.8% in Qinyang area. The monthly inflation rate is therefore 1.8% divided by 12, i.e. 0.15% per month.

Here is the formula we use to compute the *NPV* of the project.

$$\begin{aligned} NPV &= -I_0 + \frac{CF_1}{1+r} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_{12}+S}{(1+r)^{12}} \\ &= -I_0 + \frac{CF_1^+ - CF_1^-}{1+r} + \frac{CF_2^+ - CF_2^-}{(1+r)^2} + \ldots + \frac{CF_{12}^+ - CF_{12}^- + S}{(1+r)^{12}}, \end{aligned} \tag{3}$$

where *S* represents the residual value of the Capital.

The *NPV* of the project from August 2004 to July 2005 equals 6,903,337 Yuan.

3.2.6 Conclusion by *NPV* Rule

As mentioned above in Chapter 2, the important criterion of project feasibility is based on financial analysis when the bank decides to initiate this project in July 2004. *NPV* is the major index in financial judgment. With a *NPV* as large as 6,903，337 Yuan, the project is undertaken. However, this is only a judgment from the point view of Huabao Ltd.

3.3 Financial Assessment of the Loaning Project of ADBC to Huabao from August 2005 to July 2006

All variables involved in this section were already explained in Section 3.1. We put the cash inflows, outflows, initial investment and residual values all into one table. According to HAD (2006), the Table 3.4 summarizes necessary information for computing *NPV* of the project from August 2005 to July 2006.

Table 3.4 Cash Flows of the Project (August 2005 to July 2006)
(Unit: Yuan RMB)

Time	Initial investment	Residuals value	Cash inflow	Cash outflow	Total cash flow
2005.8	-37830000	0	18060796	-55131	-19824335
2005. 9	0	0	4731359	-4696616	34743
2005.10	0	0	3391562	-254767	3136795
2005.11	0	0	3028157	-5490803	-2462646
200512	0	0	3576301	-208935	3367366
2006.1	0	0	3318884	-6414245	-3095361
2006.2	0	0	2092005	-215013	1876992
2006.3	0	0	3109500	-4786544	-1677044
2006.4	0	0	2877729	-184095	2693634
2006.5	0	0	3540310	-5728572	-2188262
2006.6	0	0	7261840	-416884	6844956
2006.7	0	3783000	9202324	-32470225	13525299

The *NPV* formula is the same as (3). Similar with the approach used in Section 3.2, we have the following result of financial analysis of the loaning project of ADBC to Huabao from August 2005 to July 2006:

$$NPV = 2{,}248{,}944 \text{ Yuan.}$$

In conclusion, as mentioned above in Chapter 2, the important criterion of project feasibility is based on financial analysis when the bank decides to initiate this project in July 2005. *NPV* is the major index in financial judgment. With a *NPV* as large as 2,248,944 Yuan, the project is undertaken. However, this is only a judgment from the point view of Huabao Ltd.

CHAPTER FOUR
Data

In this chapter, as a preparation of our project economic evaluation, all data useful in the next chapter are described in great detail and some missing variables are recovered from available ones. The necessary predictions of future markets are also made in the last section of this chapter.

4.1 Principal Data

As a project of the cooperation research program of Université du Québec en Outaouais with ADBC (Qinyang Branch), the basic data used in our thesis are offered by Qinyang Branch according to "Protocole d'entente cadre entre Banque du Développement Agriculturel de Chine, Branche de Qinyang et l'Université du Québec en Outaouais".

Huabao data are about the production technology of Huabao Lipid Factory and are sufficient for our financial analysis of the project. Actually they were already used in Chapter 3.

Since August 2004, Huabao Lipid Factory reports its monthly business accounting data to Qinyang Branch on the first day of each month. Such dataset includes all items of firm's monthly incomes and expenditures as well as the firm's capital stock. The cash flow tables used in Chapter 3 are in fact already aggregated as cash inflows and cash outflows. The most recent data available in our dataset are those of July 2006.

The original Huabao data are statistically described and separately shown below according to the business year because the single project lifetime is just a business year. Specifically, the descriptive statistic of the Huabao data of business year August 2004 – July 2005 is displayed in Table 4.1 (HAD, 2005) and that of business year August 2005 – July 2006 is displayed in Table 4.2

(HAD, 2006).

Table 4.1 Descriptive Statistic of Huabao Data (August 2004 – July2005)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
PRICE1	12	.40	2.19	2.59	2.3083	.13842
PRICE2	12	.31	5.08	5.39	5.2292	.11973
PRICE3	12	.29	2.19	2.48	2.3350	.09784
RUNCOST	12	5285588	4511139	9796727	8112462	1849656.183
INFLOW	12	2.2E+07	4817350	2.7E+07	1.0E+07	5563388.263
OUTFLOW	12	2.8E+07	450744.0	2.8E+07	9382863	9725454.885

Table 4.2 Descriptive Statistic of Huabao Data (August 2005 – July 2006)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
PRICE1	12	.50	2.11	2.61	2.3633	.15341
PRICE2	12	.71	5.04	5.75	5.1975	.18410
PRICE3	12	.41	2.14	2.55	2.2708	.11285
RUNCOST	12	491667.00	3031.00	494698.00	215216.5	130233.85298
INFLOW	12	8541528	60796.00	8602324	3799231	2241181.871
OUTFLOW	12	7747228	54871.00	7802099	3538500	2041355.224

In these two tables, the unit of measure is Chinese Yuan. The number of observations is N=12.

PRICE1 stands for the purchase price of per kilogram soybeans.

PRICE2 stands for the sale price of per kilogram soybean oil.

PRICE3 stands for the sale price of per kilogram soybean meal.

RUNCOST represents the total variable costs of the production, including the costs of raw material (soybeans), labor, energy, tax, solvent and other factors. It is necessary to point out that the value of stocked soybeans used in current month is also contained in RUNCOST.

INFLOW is the monthly total sales income.

OUTFLOW is the monthly total cash outflow.

According to HLR (2004), the average cost to process 1000 kg soybeans is 150.29 Yuan.

4.2 Other Data

For the economic evaluation of the project, we need also other data in which the sources of available data are stated as below.

The agricultural population of Henan Province of each year is quoted from the government website of Henan Province (See Table 4.3).

The total quantity of arable soil in Henan Province and the average soybean yields per Mu are cited from the Statistical Data published in the website of National Bureau of Statistics of China (See Table 4.3).

The average rate of wage of Chinese farmers is cited from the website of Investigation General Team of Rural Economic Society in State Statistical Bureau of China. See Table 4.3.

Table 4.3 Other Original Data

Agricultural population in Henan(PGHP,2005)	Quantity of arable soil in Henan (PGHP, 2005)	Average soybean yields per Mu (HPS, 2004)	Farmer's average wage rate (SGW, 2005)
65 millions (person)	108 millions (Mu)	250 (Kg)	724 Yuan/month (4.5 Yuan / hour)

All data in this table are those of the year 2004.

4.3 Recovery of Missing Variables

For project economic evaluation, quantity variables are indispensable. For our purpose of analysis, we still need monthly quantity of soybean that Huabao Lipid Factory uses and monthly quantities of soybean oil and soybean meal that Huabao Lipid Factory sells. Unfortunately, these quantity variables are not explicitly reported in the dataset ADBC provided us. However, it is possible to recover them in statistical approach. We do this work separately in the next three subsections. Of course, data recovered by using known relevant average value of some variable are only average ones. This is a possible source of bias in the results.

4.3.1 Recover Monthly Quantities of Soybeans

As mentioned at the end of Section 4.1, the average cost to process 1000 kg soybeans is 150.29 Yuan HLR (2004). This cost does not contain the raw material (soybeans) purchase expenditure. Let us denote by *Q* the monthly quantity of soybeans Huabao Lipid Factory processes and by P_{soybeans} the corresponding price of soybeans in the same month. The following relationship holds.

$$\textit{Monthly Operational Costs} = P_{soybeans} \times Q + (150.29/1000) \times Q.$$

Thus,

$$Q = \textit{Monthly Operational Costs} / [P_{soybeans} + (150.29/1000)].$$

4.3.2 Recover Monthly Quantities of Soybean Oil and Soybean Meal

By the production technology of Huabao Lipid Factory, every 1,000 kg of soybeans yields 145 kg of soybeans oil and 855 kg of soybeans meal. We know that the proportions of the soybean oil and of soybean meal in the outputs are respectively 14.5% and 85.5 % HLR (2004). Because of these proportions, we can easily recover the monthly quantities of soybean oil and soybean meal using the following formulas.

$$\textit{Monthly quantity of soybean oil} = Q \times 14.5\%;$$

$$\textit{Monthly quantity of soybean meal} = Q \times 85.5\%,$$

where *Q* is the monthly quantity of processed soybeans in Huabao Lipid Factory.

The summary of the three recovered quantity variables is shown as

Table 4.4 Recovered Quantity Variables

Time	Quantity of soybeans （Kg）	Quantity of oil（Kg）	Quantity of meal（Kg）
2004.08	3091164	448219	2642945
2004. 09	3372707	489043	2883664
2004.10	3579586	519040	3060546
2004.11	3779969	548096	3231874
2004.12	3804358	551632	3252726
2005.01	3596402	521478	3074924
2005.02	1846400	267728	1578672
2005.03	3471508	503369	2968139
2005.04	3417078	495476	2921602
2005.05	3239328	469703	2769625
2005.06	2564400	371838	2192562
2005.07	1662230	241023	1421207
2005.08	3091164	2925	17246
2005.09	3372707	245354	1446744
2005.10	3579586	179924	1060929
2005.11	3779969	167289	986426
2005.12	3804358	196054	1156045
2006.01	3596402	178118	1050279
2006.02	1846400	111212	655764
2006.03	3471508	168225	991950
2006.04	3417078	159048	937836
2006.05	3239328	196417	1158181
2006.06	2564400	409842	2416657
2006.07	1662230	477285	2814337

4.4 Market Price Forecast

Once more, we would like to emphasize that an economic evaluation is an *ex ante* study of the project feasibility. For this reason, we forecast future market prices of soybean, soybean oil and soybean meal in this section.

4.4.1 Future Market Price of Soybean Meal

We propose the following regression model to forecast the market price of soybean meal.

$$P_{meal} = \alpha_0 + \alpha_1 month + \alpha_2 COS(month) + \varepsilon \text{ ,}$$

where P_{meal} is the meal market price; "month" stands for the time variable; *COS(month)* is the cosine function; the α's are regression coefficients and, ε is a normally distributed error with mean E[ε]=0.

The dataset we use here consists of the monthly observed local market price of soybean meal from August 2004 to March 2007 (HAD, 2007). The data are described in Table 4.5.

Table 4.5 Descriptive Statistic (Meal price; August 2004 to March 2007)

	N	Minimum	Maximum	Mean	Std. Deviation
P_MEAL	32	2.14	2.55	2.3069	.10180
MONTH	32	1.00	32.00	16.5000	9.38083
COS_T	32	-1.00	.99	.0132	.71820

The SPSS outcome of our meal price forecast model is stated in Table 4.6.

Table 4.6 SPSS Outcomes of Meal Price Forecast Model

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.359	.031		76.015	.000
	MONTH	-.003	.002	-.297	-1.959	.060
	COS_T	.076	.021	.536	3.537	.001

Note: The maximal significance level acceptable here is 0.100.

Hence, the prediction function of the meal market price is written as

$$P_{meal} = 2.359 - 0.003 * month + 0.076 * COS(month) . \qquad (4\text{-}1)$$

This is a cosine wave with downward trend. The negative coefficient of "month" shows a downward trend of the meal price with time. The downward trend arises from a *stigma* of the sample. From 2005 to 2006, bird flu burst in almost all regions of China, including Henan. In presence of bird flu, the market demand for soybean meal decreased suddenly and the demand curve of meal drifted downward, which made a decrease in market meal price HLR (2006). With such a dataset, it is understandable that estimated meal price trend is downward. This might be a source of bias in our results.

It is also remarkable that the meal price varies as a downward cosine wave with period 2π. An interesting interpretation of this result is that the soybean price fluctuates periodically with a period of about six months. There are two peaks every year: October and February, which correspond to three most important festivals in China, National Day, Mid-Autumn Festival (Zhong Qiu Jie) and Chinese New Year (Chun Jie). The China's National Day is October 1st and the Mid-Autumn Festival follows the National Day with a delay of several days. When an important festival arrives, the prices of eggs, poultries and cattle augment because of higher market demand. After the festival, there are less poultries and cattle in poultry shelter. The demand of soybean meal (as main feedstuff) runs back and hence the meal price decreases. Figure 4.1 shows the predicted cosine waves with trend of the meal price.

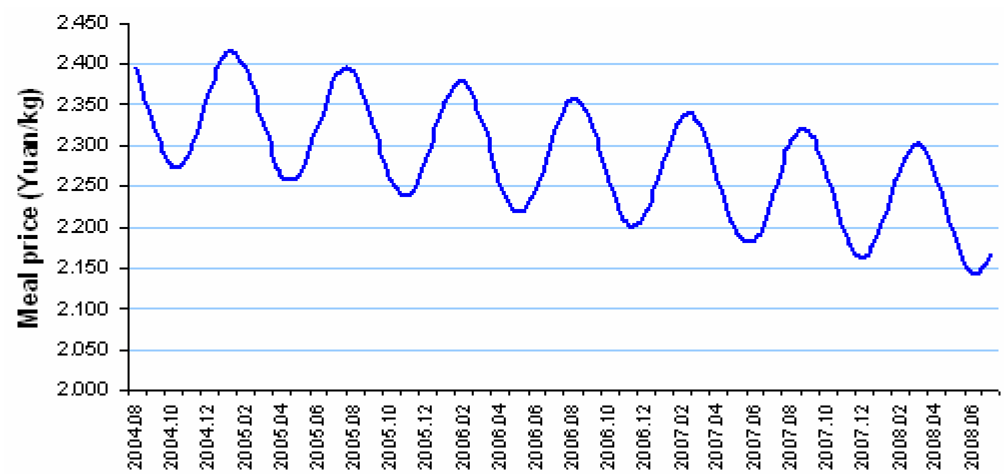

Figure 4.1 Cosine Waves with Trend of Meal Price

4.4.2 Future Market Price of Soybean Oil

Given the impact of Chinese culture on markets, we propose the same functional form for market price of soybean oil.

$$P_{oil} = \beta_0 + \beta_1 month + \beta_2 COS(month) + \nu \ ,$$

where P_{oil} represents the oil market price; β's are regression coefficients and, ν is a normally distributed error with *E[ν]=0.* The dataset consists of the monthly observed local market price of soybean oil from August 2004 to March 2007(HAD, 2007). The data are described in Table 4.7.

Table 4.7 Descriptive Statistic (Oil price; August 2004 to March 2007)

	N	Minimum	Maximum	Mean	Std. Deviation
P_OIL	32	5.04	5.75	5.2000	.13657
MONTH	32	1.00	32.00	16.5000	9.38083
COS_T	32	-1.00	.99	.0132	.71820

The SPSS outcomes are stated in the following table. The prediction function of the market oil price is written as

$$P_{meal} = 5.272 - 0.004 * month + 0.066 * COS(month) \ . \qquad (4\text{-}2)$$

Table 4.8 SPSS Outcomes of Oil Price Forecast Model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.272	.046		114.134	.000
	MONTH	-.004	.002	-.302	-1.795	.083
	COS_T	.066	.032	.347	2.066	.048

Note: The maximal significance level acceptable here is 0.100.

Figure 4.2 shows the predicted curve of the oil market price from August 2004 to July 2008.

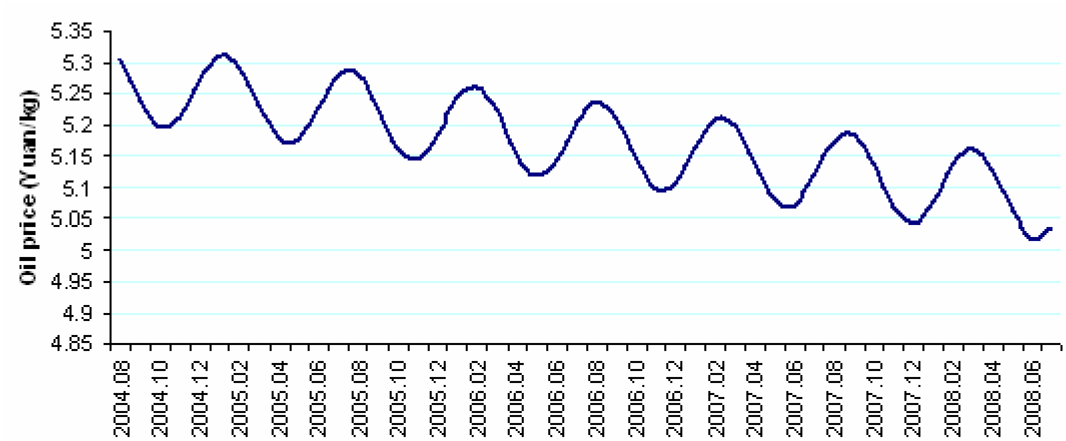

Figure 4.2 Cosine Waves with Trend of Oil Price

4.4.3 Future Market Price of Soybeans

The regression model we propose for soybean market price forecast is

$$P_{bean} = \gamma_0 + \gamma_1 * COS(month) + \eta,$$

where P_{bean} stands for the soybean market price; γ's are regression coefficients and, η is a normally distributed error with E[η]=0. The dataset consists of the monthly observed local market price of soybean from August

2004 to March 2007(HAD, 2007). The data are described in Table 4.9.

Table 4.9 Descriptive Statistic (Soybean price; 08, 2004 to 03, 2007)

	N	Minimum	Maximum	Mean	Std. Deviation
P_BEAN	32	2.11	2.61	2.3134	.13647
COS_T	32	-1.00	.99	.0132	.71820

Table 4.10 shows the SPSS execution outcomes of this model.

Table 4.10 SPSS Outcomes of Soybean Price Forecast Model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.313	.023		101.290	.000
	COS_T	.069	.032	.365	2.150	.040

Therefore the prediction function is

$$P_{bean} = 2.313 + 0.069 * COS(month). \qquad (4\text{-}3)$$

This is a cosine wave without trend. It has no trend since bird flu had almost no effect on the soybean market. The graph of the prediction function is illustrated in Figure 4.3.

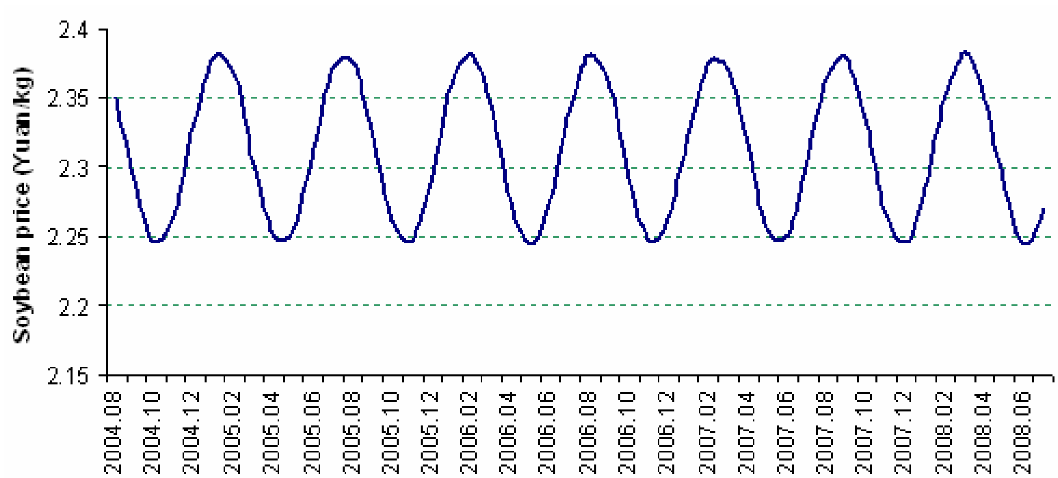

Figure 4.3 Cosine Waves of Soybean Market Price

For Huabao is a competitive firm at the oil and soybean markets, the predicted oil and soybean market prices will be used in our calculation of the costs and benefits of the loaning project in next chapter. However, one will see that the soybean meal price predicted in such a way is really biased and unsuitable for an economic analysis use because Huabao is actually not competitive in meal market. In next chapter, an economic model will be constructed to correctly forecast the soybean meal price.

CHAPTER FIVE
Economic Evaluation

In this chapter, an economic evaluation model for the ADBC loaning project is established. Our model consists of three levels of analysis: qualitative analysis in Section 5.2 through 5.4; quantitative analysis in Section 5.5 through 5.8; sensitivity analysis in Section 5.9.

5.1 Methodology

5.1.1 Overview

In its simplest form, an economic evaluation is to ascertain the project desirability in terms of its net contribution to the economic and social welfare of the country or the economy as a whole.

The economic evaluation is *ex ante* analysis of the project feasibility, that is, it is done before the project execution. The future impacts (both positive and negative) are considered in such an analysis.

The economic evaluation leads to a tradeoff of advantages and disadvantages arising from the project in question. The project is economically feasible if the economic benefits (the plus) generated by the project surpass the economic costs (the minus) provoked by the project. In other words, the project is economically feasible if its net contribution to social welfare is positive. This is the principle of an economic analysis.

Principal criteria of the economic evaluation are

Net Present Value (NPV) – the cumulative discounted net benefits of a proposed project;

- ✧ Benefit-Cost Ratio *(BCR)* – the ratio of the cost and benefits of a proposed project;
- ✧ Internal Rate of Return *(IRR)* – the rate of return at which the gains of a project compensate exactly the costs.
- ✧ Cost-Effectiveness Ratio *(CER)* – the ratio of the cost and effectiveness index of a project;
- ✧ Pay-Back Period *(PBP)* – the amount of time that it takes for a capital budgeting project to recover its initial cost.

NPV is the most widely used criterion when it is possible to monetize all effects of a project. *BCR* is essentially the same criterion with *NPV* but emphasizes the project overall productivity. *IRR* is also widely used but it is not always valid because of its mathematical limitations. *CER* shares the same nature of *BCR* but more popular in cases of impossibility to monetize project outputs. *PBP* may be considered as the simplest evaluation criterion but a project with shortest *PBP* is not necessarily desirable. We choose *NPV* and *IRR* as the economic evaluation criteria in this thesis and denote them by *ENPV* and *EIRR* respectively in order to distinguish them from the financial *NPV* and *IRR*.

5.1.2 Economic versus Financial Analysis

Confusion is often observed between economic analysis and financial analysis. Although the definitions may vary and some concepts associated to each of the two topics may be not so easy to deal with, a rough distinction is established below.

First, a financial analysis consists in comparing revenues and expenses (investment, maintenance and operation costs) reported by the project owner in each project alternative (if any) and, in working out the corresponding financial return ratios. In contrast, the economic analysis aims at identifying and comparing economic and social benefits accruing to all economic agents as a whole, setting aside for example monetary transfers between economic agents. For example, government subsides and taxes are ignored in economic analyses because such transfers do not modify the totality of the social welfare, not at all, *i.e.* transfers are simply “zero-sum games”. Nevertheless, if an increment in gains is generated in the process of transfers, those net benefits must be incorporated into the economic analysis. This is the case of the present loaning project of ADBC. The significance of cash flows in economic analysis differs from that in financial analysis since the economic ones contains also external effects of the project.

Second, a financial analysis is usually a comparison of the state after the project with the state before the project (*status quo*). It can be done for the purpose of examining the feasibility of a project without any other options. Contrastingly, an economic analysis compares the net contributions of the project and its *best* reference or alternative. The best reference or alternative means here the best amongst all options other than the project in question. In economic terms, the opportunity cost of the current project is the net benefits that its alternative can contribute to the collectivity. We illustrate this point in Figure 5.1 and Figure 5.2.

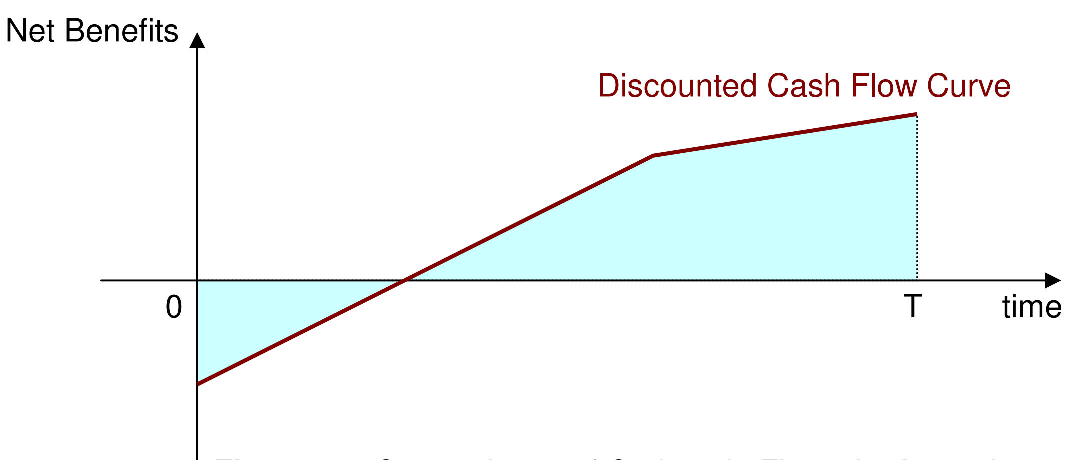

Figure 5.1 Comparisons of Options in Financial Analysis

The financial analysis compares the *algebraic area* between the discounted cash flow curve and the horizontal axis with zero since the net benefit related to the status quo is equal to zero.

The economic analysis compares the *algebraic area* between the two discounted cash flow curves related respectively to the project and its alternative, that is, it is a comparison of states with and without the project.

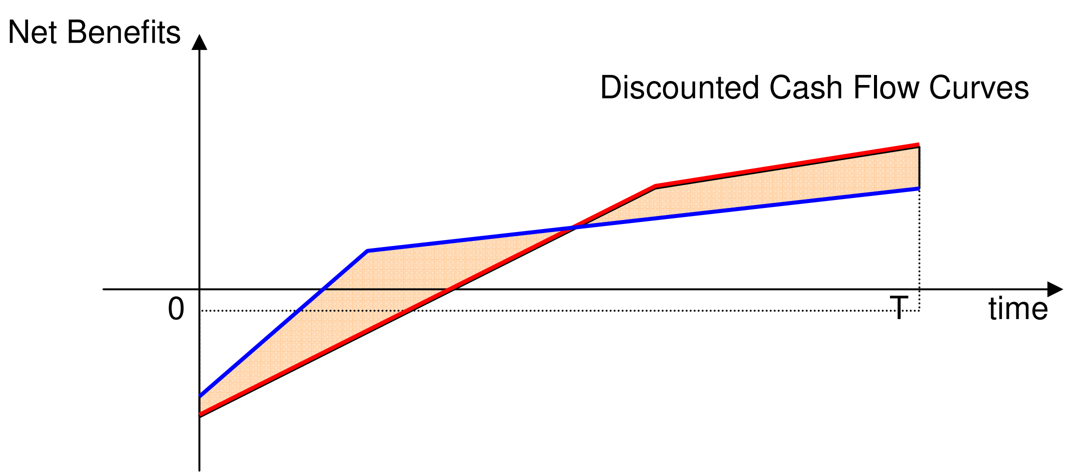

Figure 5.2 Comparisons of Options in Economic Analysis

Third, the economic evaluation of a project takes into account the intangible costs and benefits of the project. Contrarily, the financial analysis considers in general only tangible ones. For instance, the project we study in this thesis can save farmer's time. *Time is money*. The value of saved time is considered as a benefit of the project in the economic analysis while the financial evaluation of project ignores such values. Another example is the consideration of the consumer's surplus which is also ignored in the financial evaluation of project. The consumer's surplus is the most crucial concept in the measurement of social benefits. The consumer's surplus yielded from his consumption of the n^{th} unit commodity is defined as the difference between the consumer's willing-to-pay price for that unit of goods and the market price.

Because the consumer's willing-to-pay price for that unit is higher than the market price, the consumer gains a benefit from his consumption of that unit of goods. Summing up the consumer's surplus of all units of goods he consumed, one gets the total consumer's surplus. It is worth remarking that the computation method of consumer's surplus discussed above is only applicable for indivisible goods. Indivisible goods are those that cannot be bought in fractional units. The counterpart of indivisible goods is divisible goods that can be bought in fractional units. When the commodity is divisible, the exact value of the consumer's surplus is obtained by integrating the benefits over all the *infinitesimal* consumption quantities from zero to the last unit of real consumption. The shadowed area in Figure 5.3 shows the consumer's surplus when the demand is linear and the commodity is divisible.

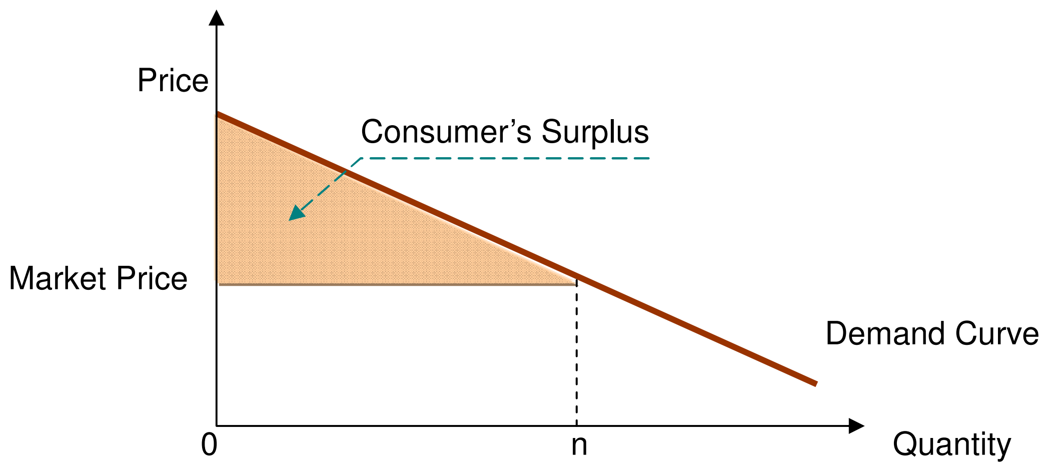

Figure 5.3 Consumer's Surplus

Fourth, although both economic and financial analyses measure costs and benefits of the project in terms of money, the prices used in the financial analysis are all market prices while the prices used in the economic analysis are reference prices because market prices may not reflect the true value of goods and services in presence of market failures (*e.g.* existence of externality), non competitive market or no market price. For this reason, the economic evaluation takes reference prices, also called economic prices, virtual prices or shadow prices. Putting aside the taxes on a price in an economic analysis is just to transform the market price to the reference price.

Finally, the choice of discount rate is different in economic and financial analyses. The economic analysis takes the social discount rate. The financial analysis takes in general the rate of return of the capital. Throughout this thesis, the social discount rate is equal to 10%, which is the social discount rate that most cost-benefit analysts use in China (Peter et al., 1999).

We summarize the main essential differences between economic analysis and financial analysis in the following table.

Table 5.1 Economic versus Financial Analysis

	Financial analysis	Economic analysis
Main analysis point	Company	Country/Society
Price	Market price	Shadow price
Inflation	Include	Exclude
Tax and government subsidies	Include	Exclude
Loans	Include	Exclude*
Interest	Include	Exclude*

5.1.3 General Steps in Economic Analysis

According to Boardman (1996), the general steps in the economic analysis are listed below.

Step 1 Identify the concerned groups of people who will be better off or worse off with the proposed project.

Step 2 Determine alternatives for the proposed project.

* Because in the social way , the Bank and the company it will be same unit.

Step 3 Identify the effects (pros and cons) of the project.

Step 4 Quantify all the effects.

Step 5 Monetize all the effects if possible.

Step 6 Discount the monetary costs and benefits in the project lifetime.

Step 7 Add everything up the discounted net benefits.

Step 8 Analyze the project sensitivity with regard to the most effect on project parameters (*e.g.* total cost, duration, success rate).

Step 9 Pick the best according to the selected evaluation criteria.

Of course, this is only a general recommendation. An analyst can merge some steps in implementing them.

5.1.4 Problematic

The proposed project involves three markets: soybean market, soybean oil market and soybean meal market. In last sections of Chapter 4, we made some forecasts of the prices without specification of their interaction. The prices of the three commodities are not independent in reality. On the contrary, they interact mutually. Without incorporation of the interaction of the three markets, the project evaluation may be misleading. How do the three markets interact? We are going to answer this question in our analysis of Huabao's behavior.

Is Huabao a perfect competitive firm? It seems yes at the oil market and not at the meal market. As a unique meal producer in the region, how does Huabao take its optimal production decision, provided its different roles at the two different markets? An appropriate optimization model for Huabao is necessary to analyze Huabao's behavior.

Huabao produces simultaneously soybean oil and meal. Both of oil buyers and meal buyers will be better off because of Huabao's activities. How can we quantitatively measure these intangible benefits? The variation in the consumer's surplus should be relevant measurement. We shall calculate the increment of Huabao oil consumer's surplus and Huabao meal consumer's surplus as well.

Bird flu occurred in Qinyang region in 2005 affected a lot the soybean meal and oil demands. How can we determine the impacts of bird flu on the economic feasibility of the project? This is a purely technical problem that we have to deal with in our analysis.

We have rejected two alternatives of the project in Section 1.3. To confirm that Huabao loan project is the best choice for the society, we must prove that no other option can provide the society higher welfare? This is our last task before we recognize the optimality of the proposed project.

5.2 Highlight of the Loaning Project Goal

As described in Chapter 1, huge extra soybean supply exists. The motivation of the proposed project is to increase the soybean demand and hence make the over plus of soybeans disappeared. This is exhibited in Figure 5.4. $S_{old\ technology}$ stands for the soybean supply curve with old technology. $S_{new\ technology}$ stands for the soybean supply curve with new technology. $D_{without\ project}$ is the market demand curve of soybeans without the loaning project. $D_{with\ project}$ is the market demand curve of soybeans with the loaning project.

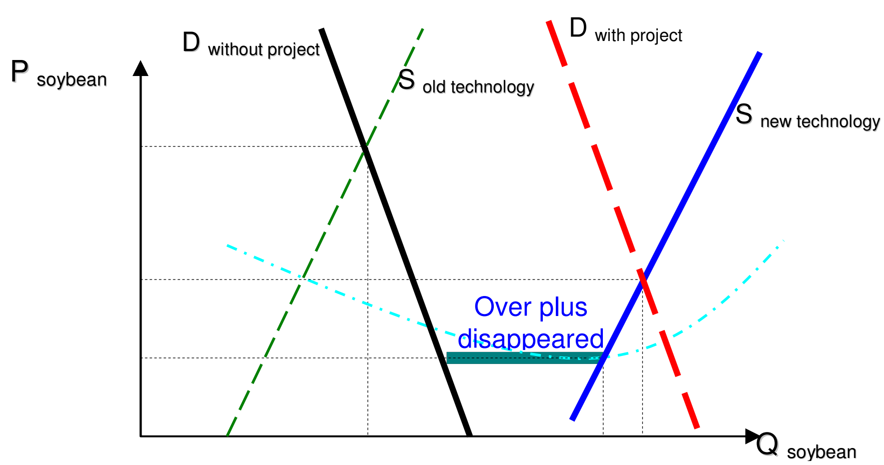

Figure 5.4 Initial Motivation of the Project

Without the project, the only soybean buyers are those who consume soybeans directly. The soybean demand is rigid or inelastic since soybeans are considered as a necessity. However, the market demands for oil and meal are more elastic. Particularly, soybean meal is an intermediate product that is usually used as a production factor, a ration for dairy cattle. Hence, there exists a great potential demand. The proposed project is expected to reduce the over plus of soybean supply. This is possible since Huabao is capable to purchase about 20% of the total soybeans produced in Qinyang region. In short, the motivation of the project is based on the expectation of large project effects. This means that the effects of Huabao's factor demand and product supplies are anticipated to change the current market equilibrium. On the other hand, Huabao is not a monopsonist in the soybean market since there are several crops purchase stations in the region. Actually, the soybean price is controlled by the government in order to stabilize the soybean planters' revenues. Even there is an over plus in soybean supply, a minimum purchase price is usually imposed by the government policy. For the sake of simplicity, we suppose through out this thesis that Huabao buys soybeans at the given market price regardless of whether it is a competitive equilibrium price.

Does the project affect conspicuously the equilibrium of the meal market? The answer is definitive. Huabao is actually the only soybean meal producer in Qinyang region and the majority of its meal is sold within the region. This suggests that Huabao is a local monopolist in the meal market. However, we find that the central tendency of Huabao's meal price is almost always slightly below the national average and the difference is approximately equal to the difference between the local price level and the national one, although Huabao's meal price fluctuates from time to time. Consequently,

- ♦ Huabao has a power on the meal market price in short term;
- ♦ its meal supply affects a lot the equilibrium quantity of the market.

This also suggests a meal demand fairly elastic. Huabao's contribution to the benefit of local meal buyers is considerable.

Intuitively, the project does not have substantial impacts on oil market since Huabao's share in the local oil market is less than 1%. This may be caused by the fact that oil produced in other regions can be easily transported to Qinyang while transportation of meal is relatively costly. With a market share so small, Huabao should be considered a price taker in the oil market. Anyway in this thesis, we take Huabao as a competitive monopolist because we intend to take into account the Huabao's contribution to the local oil supply.

5.3 Identification of the Concerned Groups

With the highlight of the project goal in last section, the concerned groups of the proposed project become evident.

1. Supplier of soybeans – Farmers who produce soybeans in the region;
2. Demander of soybeans – HuaBao, soybean processor;
3. Supplier of soybean oil – HuaBao, soybean oil producer;
4. Consumers of soybean oil – All those who consume Huabao Oil;
5. Supplier of soybean meal – Huabao, soybean meal producer;
6. Consumers of soybean meal – Domestic animal cultivators;
7. Consumers of eggs, chickens, beeves, milk – indirect effects on these people.

In these groups, Huabao plays three roles. The costs and benefits of the project for Huabao will be computed in one step.

5.4 Project Effects on the Concerned Groups

5.4.1 Effects on Soybean Suppliers

Because of the project, soybean farmers' benefits augment in two manners:

- Increment of economic profits by selling more soybeans;

- Time saving as they do no longer need to wait in queue.

However, the farmer's income of soybean sales to Huabao is a cost of Huabao. In other words, the amount of farmers' soybean sales income is just a transfer and does not augment the social welfare. We shall take into account the second one, i.e., the value of saved time for farmers.

5.4.2 Effects on Soybean Demander

With the funds ADBC (Qinyang Branch) provides, it is possible for Huabao to process more soybeans. As a soybean buyer, Huabao benefits from its consumption (purchase) of soybeans. However, this gain can be taken into account in Huabao's net profit and can not be doubly accounted.

5.4.3 Effects on Soybean Oil Supplier

Because of the project, Huabao's production capacity augments. This brings Huabao an amount of producer's surplus[*]. Our computation of the economic NPV will take into account Huabao's producer's surplus.

5.4.4 Effects on Soybean Oil Consumers

With the project, Huabao produces more oil and hence the market oil supply curve moves to the right. At the new equilibrium, the oil market price is smaller and oil consumption quantity is larger than before. As a result, the oil consumer's surplus augments. The increment **B** of the soybean oil consumer's surplus is illustrated in Figure 5.5. The area **A** stands for the without-project consumer's surplus. The oil with-project consumer's surplus is equal to **A**+**B**.

[*] This is an economic concept symmetric with the consumer's surplus. The producer surplus is the amount that producers benefit by selling at a market price that is higher than they would be willing to sell for.

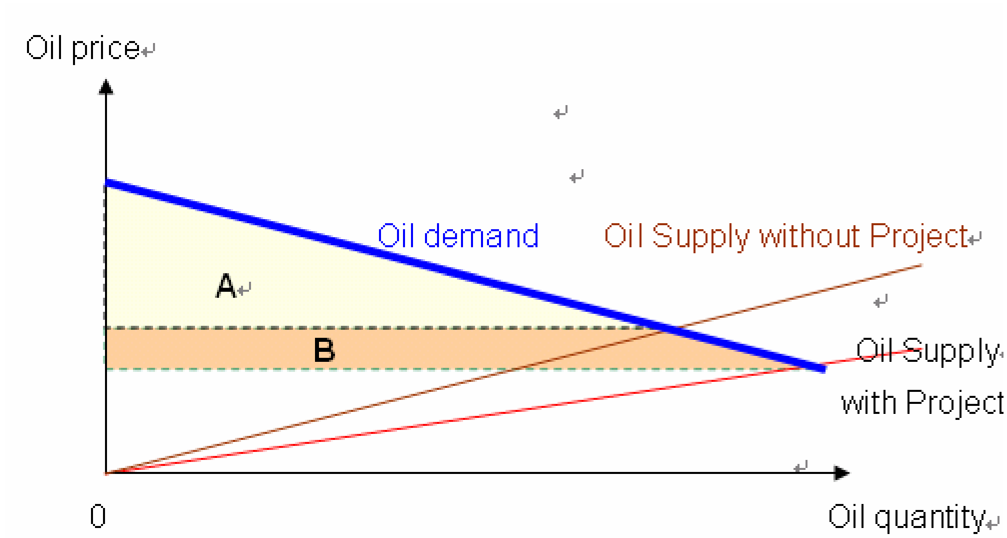

Figure 5.5 Variation in Oil Consumer's Surplus

5.4.5 Effects on soybean meal supplier and consumers

Similar to the effects of the proposed project on oil consumers and supplier, both meal consumer's surplus and meal producer's surplus augment because of the project.

5.4.6 Effects on consumers of eggs, chickens, beeves, milk, etc.

These indirect effects should be taken into account. Unfortunately, there is no available information about relevant markets and we decide to put them aside. Theoretically, this may drive to a biased result. However, a qualitative analysis of these indirect effects (increments of relevant consumer's surplus) can be made with a graph similar to Figure 5.5. Our analysis will show the current project so socially desirable even without consideration of these indirect positive effects.

5.5 Quantification and Monetization of Project Effects

The project effects are quantified and monetized simultaneously in this section.

Most markets of agro-products in China are all competitive, at least approximately. Based on this observation, we can use the soybean and oil market prices predicted in the last three sections of Chapter 4, to value project effects.

However, Huabao seems more likely a local monopolist in the regional soybean meal market. We shall discuss Huabao's behavior in great detail in this section. All forecasts about the quantity variables will also be carried out in the present section.

As pointed out in Section 5.1.2, the inflation must be eliminated before implement of an economic analysis. However, according to LDRH (2006), the price level is quite stable in Qinyang region since several years and the yearly inflation rate is less than 1.5% on average. This implies that only some negligible bias may occur in our analysis of monthly monetary costs and benefits without elimination of inflation since the monthly inflation rate is lower than 0.125% on average. Nevertheless, we shall eliminate the inflation in final computation of the project net present value.

5.5.1 Market Demand for Huabao Soybean Oil

To calculate Huabao oil consumer's surplus, we estimate at first the market demand for Huabao oil from the oil prices and the sold quantity of Huabao oil in the history. Strictly, the soled oil quantities are not the real demanded quantities but censored ones since the true desired quantities at wiling-to-pay price are unobservable for us. A censored regression model (Tobit model) is then involved if one wants an accurate result. See Greene (2002). For the sake of simplicity however, we assume that the unobserved quantity of oil market demand is negligible.

We propose the following regression model:

$$P_{oil} = \phi_0 + \phi_1 \, ln(Q_{oil}) + \delta \,,$$

where P_{oil} stands for the oil price, Q_{oil} for the demanded quantity of Huabao's oil, ϕ's for regression coefficients and δ for a normal error with $E[\delta]=0$.

Using the sample of the monthly observed oil market price and Huabao's oil sold quantity from August 2004 to March 2007(HAD, 2007), we get the estimated demand for Huabao's oil. Table 5.2 displays the descriptive statistic of the sample. The sample size is 32.

Table 5.2 Descriptive Statistic of Oil Demand Sample (08.2004-03.2007)
(Unit of the oil price: Yuan/kg; unit of oil: kg)

	N	Minimum	Maximum	Mean	Std. Deviation
P_OIL	32	5.04	5.75	5.2000	.13657
Q_OIL	32	2925.00	551632.0	371189.3	162275.99935

In this table, *P_oil* represents the oil price and *Q_oil* represents the demanded quantity for Huabao's oil.

The SPSS Outcomes are shown in Table 5.3, in which *LNQ_oil* stands for the logarithm of *Q_oil*. All regressors are proved significant enough.

Table 5.3 SPSS Outcomes of Oil Demand

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	6.276	.257		24.381	.000
LNQ_OIL	-.085	.020	-.608	-4.191	.000

We can now write down the estimated inverse function of the monthly market demand for Huabao's oil.

$$P_{oil} = 6.276 - 0.085*ln(Q_{oil}). \qquad (5\text{-}1)$$

5.5.2 Market Demand for Huabao Soybean Meal

Just as in the computation of oil consumer's surplus, we need the market demand for Huabao meal to estimate the meal consumer's surplus. The modeling of the market demand for Huabao meal is somewhat different from that of the oil demand since meal demand was more significantly affected by bird flu in the period of August 2005 through July 2006. Actually, the meal demand Huabao faces moved entirely to the right in that period. When formulating the meal demand problem, the movement of the meal demand curve must be incorporated into the model. For this reason, we utilize a dummy variable "*Birdflu*" in the following regression. A dummy variable is a numerical variable used in regression analysis to represent subgroups of the sample, often used to distinguish different treatment groups. We define

$$Birdflu = \begin{cases} 0, & \text{bird flu periods,} \\ 1, & \text{otherwise.} \end{cases}$$

Our regression model for meal demand is written as follows.

$$P_{meal} = \mu_0 + \mu_2 Birdflu + \mu_2\, ln(Q_{meal}) + \omega,$$

where P_{meal} stands for the meal price, Q_{meal} for the demanded quantity of Huabao's meal, μ's for regression coefficients and ω for a normal error with $E[\omega]=0$.

The descriptive statistic of our sample used here is displayed in Table 5.4.

Table 5.4 Descriptive Statistic of Oil Demand Sample (08.2004-03.2007)
(Unit of meal price: Yuan/kg; unit of meal: kg)

	N	Minimum	Maximum	Mean	Std. Deviation
P_MEAL	32	2.14	2.55	2.3069	.10180
BIRDFLU	32	.00	1.00	.6250	.49187
LNQ_MEAL	32	9.76	15.00	14.3806	.97263

Table 5.5 shows the SPSS outcomes of the proposed model, in which LNQ_MEAL represents the logarithm of the demanded meal quantity.

Table 5.5 SPSS Outcomes of Meal Demand

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.238	.259		12.506	.000
BIRDFLU	.139	.037	.674	3.736	.001
LNQ_MEAL	-.071	.019	-.676	-3.751	.001

We write down the inverse of the estimated meal demand, according to Table 5.6.

$$P_{meal} = 3.238 + 0.139{*}Birdflu - 0.071{*}\ln(Q_{meal}). \qquad (5\text{-}2)$$

This can be separately written as

$$P_{meal} = \begin{cases} 3.238 - 0.071{*}\ln(Q_{meal}), & \text{for periods 08.2005-07.2006,} \\ 3.377 - 0.071{*}\ln(Q_{meal}), & \text{for other periods.} \end{cases}$$

The graph of the meal demand curve and its movement during bird flu are illustrated in Figure 5.6.

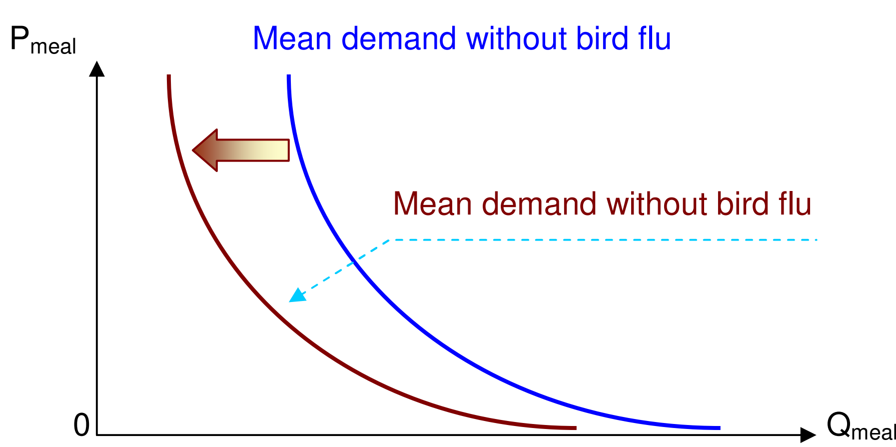

Figure 5.6 Meal Demand and Its Movement during Bird Flu

5.5.3 Huabao's Optimal Choice

The soybean demand of Huabao is a key factor that affects definitively Huabao's profits and soybean planters' revenues as well. Let us find it at first. However, a direct regression of the demanded soybean quantity on the soybean price (or the inverse) is less reasonable since the effect of the prices of oil and meal is ignored. The soybean demand of Huabao is actually a multiple variable function of soybean price, oil price, meal price and price of other factors as energy, labor force, fixed inputs, etc. But if all inputs are incorporated, there are many unknown parameters to be estimated. This may provoke a problem of exactitude in parameter estimates, even a problem of parameter identification since the sample size is only 32, including extremely irregular observations during bird flu. Indeed, an analyst may face to a tradeoff between the lifelikeness (reality) of the model and the computation burden.

On the other hand, the determination of Huabao's soybean demand involves recovery of Huabao's production technology. According to the economic theory on producer's behavior, a firm chooses its production factors that maximize the firm's profit, given the production technology and market environment (Varian, 1992). Production technology is the quantitative relationship between the inputs and the outputs of a production unit.

Provided our data in hand, we are to solve the Huabao soybean demand by the following procedures which are slightly different from a standard profit maximization model:

i). regress the monthly processing costs excluding the cost of soybean purchase on the soybean quantity that Huabao processes every month;

ii). establish a profit maximization model with consideration of Huabao's short-term market power in meal market;

iii). solve the profit maximization problem and find Huabao's soybean demand function.

It is remarkable that a problem of perfect co-linearity arises if one regress the cost on the two outputs since the outputs of oil and meal are always proportional. Indeed, soybean oil and meal are perfectly complementary outcomes in soybean processing: one kilogram of soybeans yields 0.145 kg of oil and 0.855 kg of meal. To avoid this problem, we choose the quantity of processed soybeans as the only independent variable. The specification of our regression model is as below.

Let C be the monthly processing cost excluding the expenditures on soybean purchase and Q the processed soybean quantity. The regression equation is

$$C = \gamma_1 + \gamma_2 Q^2 + \upsilon,$$

where the γ's are regression coefficients and υ is a normally distributed error term with mathematical expectation $E[\upsilon] = 0$.

Table 5.6 displays the descriptive statistic of the sample composed by the monthly processing cost (in Yuan) and the processed soybean quantity (in kg). The sample size is the number of months from August 2004 to March 2007(HAD, 2007).

Table 5.6 Descriptive Statistic of Processing Cost

	N	Minimum	Maximum	Mean	Std. Deviation
C	32	3031.00	571757.0	384731.4	168196.32711
Q	32	20171.00	3804358	2559926	1119145.064

Table 5.7 shows the SPSS outcomes of the above regression model. The explanatory variables, the constant one and Q^2, are significant. The explanatory power (R^2) of this model is 0.97, which is satisfying enough.

Table 5.7 SPSS Outcomes of Processing Cost Function Model

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	129057.9	9809.549		13.156	.000
Q_SQUARE	3.292E-08	.000	.985	30.910	.000

In Table 5.7, *Q_SQUARE* standards for Q^2. The estimated processing cost is written as

$$C(Q) = 129057.9 + 3.292*10^{-8}Q^2. \tag{5-3}$$

The total variable cost is therefore the sum of the processing cost and the soybean purchase expenditures.

Processing cost with purchase of soybeans = PQ + C(Q),

where *P* represents the soybean price predetermined by the government policy or the market. Note that this is not a standard cost function since Q is the soybean quantity, an input, not an output. In economics, a cost function is defined as a function of the factor prices and the output, with some properties such as non-negativity, monotonicity and homogeneity of degree one in prices, etc.

The profit maximization problem of Huabao Ltd can be written as

$$Max_Q \ \pi = \{(0.145P_{oil}Q + 0.855P_{meal}Q) - [PQ + C(Q) + K]\}, \tag{5-4}$$

$$s.t. \quad P_{meal} = 3.238 + 0.139Birdflu - 0.071ln(0.855Q),$$

where K is the fixed cost. The sum

$$PQ + C(Q) + K$$

is just the total cost. The term $0.145P_{oil}Q$ is equal to the firm's income from sales of oil since Q kg of soybeans can yields 0.145Q kg of oil and the term

$0.855P_{meal}Q$ is equal to the firm's incomes from sales of meal since Q kg of soybeans can yields $0.855Q$ kg of meal simultaneously. The constraint is just the market demand for Huabao meal. It is imposed in the model since Huabao is considered as a local monopolist of meal production and therefore Huabao must take into account of two effects at the same time: an augmentation of meal price can increase its income of per unit sale; this augmentation of meal price can also lower the market demand for Huabao meal. In short, (5-5) is a non standard static profit maximization model of monopoly. Non standard, because it uses the non standard cost function *C(Q),* the processing cost being a function of raw material. Static, because there is no capital adjustment in this model. To solve this model, we substitute P_{meal} in the objective with the constraint so that it becomes an unconstraint optimization. The objective of the unconstraint optimization is

$$(0.145P_{oil} + 2.778 + 0.119Birdflu)Q - 0.063Q\,ln(Q) - [PQ + C(Q) + K] \tag{5-5}$$

The first order condition of optimality is

$$0.145P_{oil} + 2.715 + 0.119Birdflu - 0.063ln(Q) - P - 6.584*10^{-8}Q = 0.$$

The second order derivative of the objective function in (5-5):

$$- 0.063/Q - 6.584*10^{-8} < 0, \text{ for any } Q > 0.$$

Thus the solution of the first order condition is the unique maximum. At optimum, Huabao processes soybeans of Q kg that satisfies

$$P = 2.715 + 0.145P_{oil} + 0.119Birdflu - 0.063ln(Q) - 6.584*10^{-8}Q \tag{5-6}$$

This is nothing but the inverse function of Huabao's soybean demand. We illustrate Huabao's soybean demand curves both in normal cases and in the occurrence of bird flu in Figure 5.7.

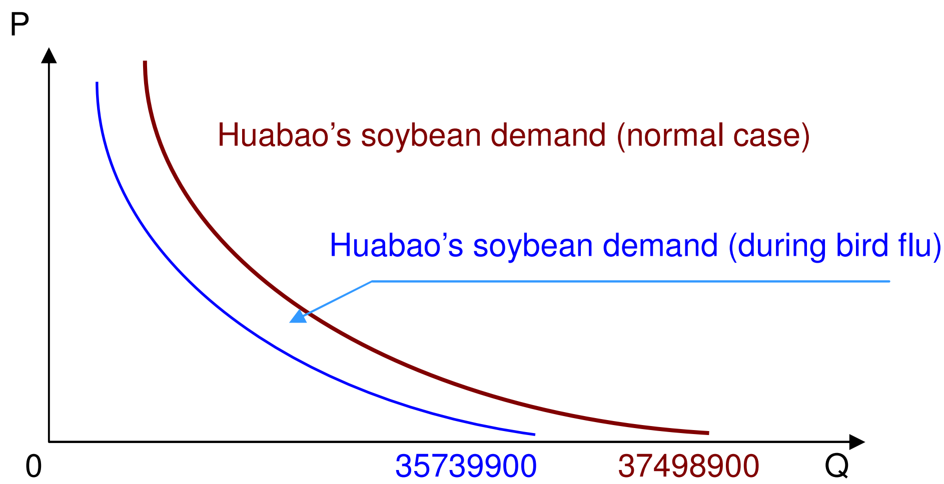

Figure 5.7 Huabao's Soybean Demand

It is notable that for any given oil price above 5.04 Yuan/kg, the minimum since August 2004, the two curves pass through the Q-axis at 37498900 kg and 35739900 kg respectively, which are more than 9 times larger than the historical maximal soybean quantity demanded by Huabao. This suggests that the proposed project has huge potential in soybean processing even during a period as bird flu. The amount of loan ADBC (Qinyang Branch) provides Huabao can be raised greatly if there is still over plus in soybean supply, if ADBC (Qinyang Branch) is capable to provide more loans and if doing so is socially optimal. This fact suggests also the high anti-risk ability of the proposed project.

Using the predicted prices of soybeans and of oil in Section 4.4, we can now compute the Huabao's soybean demand quantities for the periods of March 2007 through July 2008. To facilitate the forecast, we would like find the soybean demand function from (5-6). It seems difficult to obtain the exact explicit form of the soybean demand function. Anyway, we are satisfied an approximate one. For this purpose, we rewrite (5-6) as follows.

$$P = a - b\,ln(Q) - cQ, \tag{5-7}$$

where

a = 2.715 + 0.145P_{oil}+0.119*Birdflu*;

b = 0.063;

c = 6.584*10^{-8}.

$$P = 2.715 + 0.145P_{oil} + 0.119Birdflu - 0.063ln(Q) - 6.584*10^{-8}Q.$$

Now let Q_{max} be Huabao's soybean demand at zero price, that is,

$$Q_{max} = 37498900.$$

Then, (5-7) is equivalent to

$$\begin{aligned} P &= a - b\,ln[Q_{max} - (Q_{max} - Q)] - cQ \\ &= a - b\,ln[Q_{max}(1 - \frac{Q_{max} - Q}{Q_{max}})] - cQ \\ &= a - b\,ln\,Q_{max} - b\,ln(1 - \frac{Q_{max} - Q}{Q_{max}}) - cQ \\ &\approx a - b\,ln\,Q_{max} - b\frac{Q_{max} - Q}{Q_{max}} + \frac{b}{2}(\frac{Q_{max} - Q}{Q_{max}})^2 - cQ. \end{aligned} \tag{5-8}$$

Here we have used the second order Taylor expansion (Wolfram, 2006):

$$ln(1 - x) \approx x - \frac{1}{2}x^2, \text{ for } -1 < x < 1.$$

Furthermore,

$$P = (a - b\,ln\,Q_{max} - cQ_{max}) - (b - cQ_{max})(\frac{Q_{max} - Q}{Q_{max}}) + \frac{b}{2}(\frac{Q_{max} - Q}{Q_{max}})^2.$$

The positive root of this quadratic equation is

$$\frac{Q_{max} - Q}{Q_{max}} = \frac{(b - cQ_{max}) + \sqrt{(b - cQ_{max})^2 - 4 \times \frac{b}{2} \times (a - b\,ln\,Q_{max} - cQ_{max} - P)}}{2 \times \frac{b}{2}}$$

$$= \frac{(b - cQ_{max}) + \sqrt{(b - cQ_{max})^2 - 2b(a - b\,ln\,Q_{max} - cQ_{max} - P)}}{b}.$$

Thus,

$$Q = Q_{max} - \frac{(b - cQ_{max}) + \sqrt{(b - cQ_{max})^2 - 2b(a - b\,ln\,Q_{max} - cQ_{max} - P)}}{b} Q_{max}. \qquad (5\text{-}9)$$

(5-9) provides the analytical approximate solution to the demand function of soybeans. When no bird flu is anticipated, (5-9) describes Huabao's soybean demand with to the dummy variable *Birdflu* equal to one. In presence of bird flu, (5-9) gives Huabao's soybean demand with to *Birdflu* equal to zero. However, (5-9) may be a really rough approximate solution when $(Q_{max}–Q)/Q_{max}$ is large since the approximation of *ln*(1-x) with the quadratic function $[x – (1/2)x^2]$ is satisfying only when x is small enough. In order to have a better approximate demand function of soybeans, one can use a Taylor expansion of order higher than second, at a cost of heavier computational burden. A numerical forecast of demanded soybean quantities of Huabao is shown in Table 5.8. As the deterministic base case, we assume that there would be no bird flu in the future.

Table 5.8 Forecast of Huabao's Soybean Demand (no bird flu)
(April 2007 – July 2008)

Month	Soybean price (Yuan/kg)	Oil price (Yuan/kg)	Meal price (Yuan/kg)	Demanded soybean quantity (kg)
2007.04	2.30	5.14	2.30	4706953.21
2007.05	1.73	5.08	2.23	12404857.82
2007.06	1.69	5.07	2.23	12926585.68
2007.07	2.22	5.12	2.28	5684409.05
2007.08	2.84	5.17	2.56	120804.96
2007.09	2.97	5.18	2.70	17121.46
2007.10	2.50	5.13	2.34	2403479.79
2007.11	1.85	5.07	2.24	10624903.09
2007.12	1.63	5.04	2.22	13686010.48
2008.01	2.04	5.08	2.26	8106895.56
2008.02	2.70	5.14	2.44	644203.35
2008.03	3.00	5.16	2.73	10049.33
2008.04	2.68	5.13	2.43	767487.73
2008.05	2.01	5.06	2.26	8371288.53
2008.06	1.63	5.02	2.22	13683397.70
2008.07	1.87	5.04	2.24	10304672.47

This table shows us at the same time the predicted meal prices in the periods of April 2007 through July 2008. By comparing with the meal prices forecasted in Chapter 4 without consideration of Huabao's monopole role, we find the downward tendency of meal prices is a bias purely caused by the sample in bird flu periods. The meal price curve still appears as cosine waves but with no downward tendency.

5.5.4 Oil Consumer's Surplus

There are two approaches to compute the project contribution to oil consumer's surplus. The first one, as illustrated in Section 5.4.4, is based on the total market demand for oil. This approach is to compute the increment of the total consumer's surplus. The second approach is based directly on the market demand of Huabao's oil. Lack of information about the total market demand for oil, we adopt the second one. Geometrically, the oil consumer's surplus is equal to the area between the oil demand curve and the price axis, above the market price.

The curve of the monthly oil demand and the monthly oil consumer's surplus are illustrated in Figure 5.8.

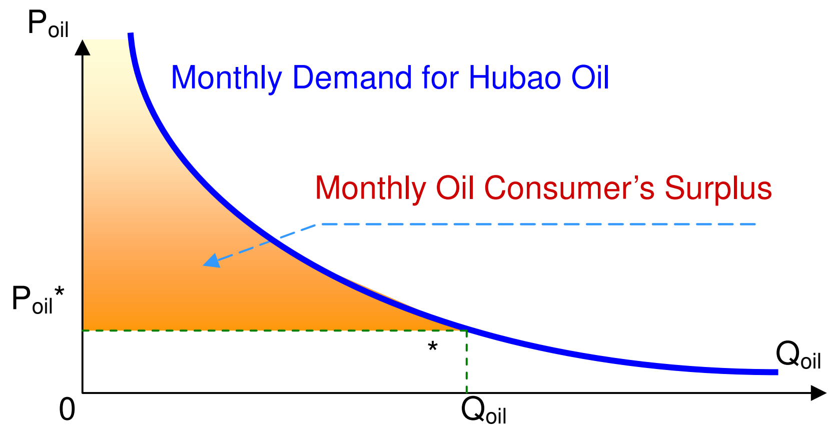

Figure 5.8 Demand for Huabao Oil and Huabao Oil Consumer's Surplus

In this figure, $P_{oil}*$ is the oil market price and $Q_{oil}*$ is the oil quantity demanded in a given month.

It is easy to see that $lim_{Q\to 0+} P_{oil} = +\infty$.

The supreme of the demanded quantity for Huabao oil is $1.1648*10^{32}$ kg since the demand curve passes the quantity axis at $Q_{oil} = 1.1648*10^{32}$.

The Huabao oil consumer's surplus for a given month is

$$\begin{aligned} S_{oil} &= \int_0^{Q_{oil}*} [6.276 - 0.085\, ln(Q_{oil})] dQ_{oil} - P_{oil}^* Q_{oil}^* \\ &= \int_0^{Q_{oil}*} 6.276\, dQ_{oil} - \int_0^{Q_{oil}*} 0.085\, ln(Q_{oil}) dQ_{oil} - P_{oil}^* Q_{oil}^* \\ &= (6.276 - P_{oil}^*) Q_{oil}^* - 0.085[Q_{oil}\, ln(Q_{oil})|_0^{Q_{oil}*} - \int_0^{Q_{oil}*} dQ_{oil}] \\ &= (6.276 - P_{oil}^*) Q_{oil}^* - 0.085[Q_{oil}^*\, ln(Q_{oil}^*) - Q_{oil}^*] \\ &= (6.361 - P_{oil}^*) Q_{oil}^* - 0.085 Q_{oil}^*\, ln(Q_{oil}^*). \end{aligned} \tag{5-10}$$

The passage from the third to the fourth step in (5-10) is due to the limit

$$lim_{Q\to 0+} Q\,ln(Q) = 0.$$

With (5-10), we can compute numerically the oil consumer's surplus for any given month with known oil market price. For instance, the oil market price in August 2004 is 5.36 Yuan/kg. The oil quantity demanded in that month can be gotten from (5-1):

$$Q^*_{oil} = e^{\frac{6.276-P^*_{oil}}{0.085}} = 47880.8345.$$

And the oil consumer's surplus in August 2004 is

$$\begin{aligned} S^{2004.08}_{oil} &= (6.361 - P^*_{oil})Q^*_{oil} - 0.085 Q^*_{oil}\, ln(Q^*_{oil}) \\ &\approx 47927.80 \text{ Yuan.} \end{aligned}$$

Table 5.4 displays the estimated monthly oil consumer's surplus from August 2004 to March 2007. One may be surprised that the oil consumer's surplus in August 2005 was only 297.02 Yuan. What happened in that month? That was in fact the month when bird flu run rampant in Qinyang region. The meal demand fell into its minimum level in the history. Oil is the complement to meal in soybean processing. When little meal is produced, only a small quantity of oil is produced.

Hence in that month, the oil supply moved to the right suddenly (see Figure 5.9) and thus the equilibrium oil price went up immediately to 5.75 Yuan per kg, which is the highest oil price observed up to now. The oil demanded quantity fell. The oil demand is very elastic. In fact, the elasticity-price of the oil demand is

$$\frac{P_{oil}}{Q_{oil}}\frac{dQ_{oil}}{dP_{oil}} \approx -67.65\,, \quad \text{when } P_{oil} = 5.75.$$

This means that a drop of 1% in oil price provokes a fall of 67% in oil demand. Indeed, the predicted oil demand was only about 487 kg in August 2005. This explains why the estimated oil consumer's surplus is so small in that month. The lost oil consumer's surplus provoked by bird flu is illustrated with the dark-colored area in Figure 5.9.

Table 5.9 Oil Consumer's Surplus (Unit: Yuan)

Month	Oil consumer's surplus	Month	Oil consumer's surplus
2004.08	47927.80	2006.08	365164.16
2004.09	32665.46	2006.09	469994.77
2004.10	1458245.20	2006.10	1000405.88
2004.11	1134371.44	2006.11	1653208.55
2004.12	604746.39	2006.12	1286194.30
2005.01	414291.89	2007.01	685911.33
2005.02	1653208.55	2007.02	170954.73
2005.03	882203.90	2007.03	414291.89
2005.04	321838.22	2007.04	786541.72
2005.05	102904.36	2007.05	1653325.49
2005.06	54450.13	2007.06	1819556.86
2005.07	37122.17	2007.07	1006025.28
2005.08	297.02	2007.08	503636.82
2005.09	194044.63	2007.09	452344.57
2005.10	533148.84	2007.10	843163.75
2005.11	1874123.73	2007.11	1922147.79
2005.12	321838.22	2007.12	2634110.39
2006.01	882203.90	2008.01	1703717.99
2006.02	414291.89	2008.02	811535.88
2006.03	2729325.44	2008.03	589776.32
2006.04	469994.77	2008.04	919918.85
2006.05	533148.84	2008.05	2138422.94
2006.06	1286194.30	2008.06	3571790.43
2006.07	1134371.44	2008.07	2807293.81

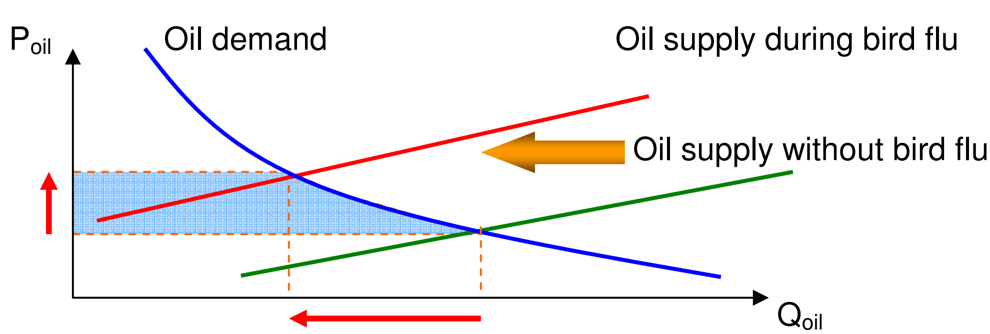

Figure 5.9 Impact of Bird Flu on Oil Market

5.5.5 Soybean Meal Consumer's Surplus

The soybean meal is actually an intermediate product, not final goods for consumption since it is used as a palatable feedstuff for poultries and cattle. A good measurement for the benefit of the Huabao meal buyers is their profit increment or producer's surplus increment. Lack of information on the feeder's production technology, it is impossible for us to compute the benefit of the Huabao meal buyers in view of producers. However, we can think meal buyers as final consumers and calculate their consumer's surplus which is to an approximate valuation of the meal buyer's benefit increment, probably underestimating the indirect benefits of the meal buyers. An underestimate is better than total ignorance of the Huabao meal buyer's benefits obtained from the project.

The computational technique used in (5-10) is applicable to the monthly meal consumer's surplus calculation. We have that

$$\begin{aligned} S_{meal} &= \int_0^{\overline{Q}_{meal}} [3.238 + 0.139\,Birdflu - 0.071\,ln(Q_{meal})]dQ_{meal} - \overline{P}_{meal}\overline{Q}_{meal} \\ &= (3.309 + 0.139\,Birdflu - \overline{P}_{meal})\overline{Q}_{meal} - 0.071\overline{Q}_{meal}\,ln(\overline{Q}_{meal}), \end{aligned}$$

where $\overline{P}_{meal}$ is the meal market price and $\overline{Q}_{meal}$ is the demanded quantity for Huabao meal given the price $\overline{P}_{meal}$.

For a past period, $\overline{P}_{meal}$ takes the observed price and $\overline{Q}_{meal}$ takes the meal quantity such that $\overline{Q}_{meal}/0.855$ maximizes the profit of Huabao as a monopolist. For a future period, $\overline{P}_{meal}$ takes the predicted meal prices of Huabao as a monopolist, *i.e.* computed from the constraint equation of (5-4) with the soybean quantity Q maximizing the monopolist profit, and $\overline{Q}_{meal}$ corresponds to 0.855Q or equivalently is computed from the meal demand

$$\overline{Q}_{meal} = e^{\frac{3.238+0.139Birdflu-\overline{P}_{meal}}{0.071}}. \quad (5\text{-}11)$$

Table 5.10 displays the estimated monthly meal consumer’s surplus from August 2004 to March 2007.

Table 5.10 Meal Consumer’s Surplus (Unit: Yuan)

Month	Meal consumer's surplus	Month	Meal consumer's surplus
2004.08	21779.56	2006.08	18918.25
2004.09	976318.67	2006.09	118050.56
2004.10	482781.27	2006.10	238731.22
2004.11	238731.22	2006.11	976318.67
2004.12	58374.99	2006.12	639862.83
2005.01	1293981.50	2007.01	274838.43
2005.02	736639.70	2007.02	238731.22
2005.03	238731.22	2007.03	180124.48
2005.04	118050.56	2007.04	489691.41
2005.05	77368.35	2007.05	1249059.26
2005.06	33231.80	2007.06	1382160.63
2005.07	1147.18	2007.07	628477.02
2005.08	12574.57	2007.08	251957.73
2005.09	29275.38	2007.09	214540.59
2005.10	137832.97	2007.10	467623.84
2005.11	137832.97	2007.11	1325100.87
2005.12	44669.10	2007.12	1947812.19
2006.01	33703.17	2008.01	1083550.76
2006.02	51425.14	2008.02	406625.70
2006.03	182679.40	2008.03	263511.66
2006.04	210308.98	2008.04	456820.00
2006.05	369428.81	2008.05	1328057.29
2006.06	182679.40	2008.06	2523321.15
2006.07	21779.56	2008.07	1805497.45

Similar to fluctuations of the oil consumer’s surplus, the meal consumer’s surplus fluctuates intensively because of the periodic variation in the price. In addition, the meal consumer’s surplus falls more significantly during the periods of bird flu. The *valley bottom* appears in July 2007, which is only 1147.18 Yuan.

5.5.6 Huabao's Monthly Cash Inflows

Huabao's cash inflows include its incomes from sales of Huabao soybean meal and soybean oil. For each month,

$$Cash\ inflow = P_{oil} \times Q_{oil} + P_{meal} \times Q_{meal}.$$
$$= (14.5\% P_{oil} + 85.5\% P_{meal}) \times Q_{soybean},$$

since

$$Q_{oil} = 14.5\% \times Q_{soybean} \text{ and } Q_{meal} = 85.5\% \times Q_{soybean}.$$

For the periods of August 2004 through March 2007, P_{oil}, P_{meal} and $Q_{soybean}$ are all observed. For the periods of April 2007 through July 2008, P_{oil} takes the forecasted values in Section 4.4.2 and $P_{soybean}$ takes the forecasted values in Section 4.4.3. As to the meal price P_{meal} of April 2007 through July 2008, it is determined by the profit maximization model of Huabao. Precisely, P_{meal} is computed from the constraint of (5-4) with the soybean quantity $Q_{soybean}$ maximizing Huabao's profit, that is, the quantities of soybeans given in Table 5.8. Table 5.11 displays the future monthly cash inflows of Huabao from April 2007 to July 2008.

Table 5.11 Huabao's Monthly Cash Inflows (April 2007– July 2008; Unit: Yuan)

Month	Monthly cash inflow	Month	Monthly cash inflow
2007.04	12764316	2007.12	29075245
2007.05	27486064	2008.01	20111587
2007.06	28181249	2008.02	1967268
2007.07	15009682	2008.03	33295
2007.08	383900	2008.04	2329517
2007.09	56337	2008.05	20528492
2007.10	6925266	2008.06	29030012
2007.11	24616838	2008.07	24006280

5.5.7 Monetary Valuation of Saved Time for Farmers

The proposed loaning project can save the farmers' wait-in-queue time. This is an intangible benefit that the proposed project contributes to the collectivity. How much time can the project save for local farmers? How can we value the saved time? We answer these questions in the present section.

Let us estimate at first the total saved time for local farmers owing to the proposed loaning project. The total arable soil in Henan province is about 108 millions Mu• and the total agro-population in the province is about 65 millions•. The average arable soil per farmer is therefore equal to

$$108 \text{ millions Mu} \div 65 \text{ millions farmers} = 1.66 \text{ Mu.}$$

The soybean is harvested once in a year. The average soybean yield* is 250 kilograms per Mu. Thus, a *typical* (or *average*) soybean farmer can produce

$$250 \text{ kg} \times 1.66 \text{ Mu} = 415 \text{ kg per year.}$$

If Huabao purchases $\mathcal{W}$ kg soybeans in a given month, $\mathcal{W}$/415 farmers will no longer need to waste their time on waiting in queue.

According to Huabao Loaning Report, without the project, a farmer has to wait in queue for about 10 hours HLR (2004) in order to sell his or her 415 kg soybeans produced in a year. Huabao's purchase of $\mathcal{W}$ kg soybeans in the given month can save $10 \times \mathcal{W}/415$ hours in total.

As shown in Table 4.3, the farmer's average wage* is 4.5 Yuan per hour. In the given month,

$$\textit{Value of saved time owing to the project} = 4.5 \times 10 \times \mathcal{W}/415 \textit{ Yuan.} \qquad (5\text{-}12)$$

If $\mathcal{W}$ is the soybean quantity Huabao buys in a month, (5-12) gives the value of saved time of project for farmers in the each month. Therefore we have Table 5.12 that shows the monetary value of saved time of the project for farmers in each month.

• "Agricultural population in Henan", Table 4.3

* "Average soybean yields per Mu", Table 4.3

* "Farmer' s average wage rate" Table 4.3

The harvest of soybeans is once a year, in September in Qinyang region. The reason why we calculate the value of the saved time owing the project monthly is that without the project, the grain procurement agencies reach their maximal purchase and stockpile capacity, on the soybean harvest season. Event thought farmers spend time waiting in queue; they still can not sell their product. With this project, farmers sell their product to Huabao monthly, without spend time in waiting in queue. Therefore, we calculate the value of saved time for farmers monthly instead once a year.

Table 5.12 Monetary Value of Monthly Saved Time for Farmers (Yuan)

Month	Monthly Save Time Value	Month	Monthly Save Time Value
2004.08	335186	2006.08	368108
2004.09	365715	2006.09	366927
2004.10	388148	2006.10	367192
2004.11	409876	2006.11	369470
2004.12	412521	2006.12	370599
2005.01	389971	2007.01	371564
2005.02	200212	2007.02	387089
2005.03	376429	2007.03	360206
2005.04	370527	2007.04	510393
2005.05	351252	2007.05	1345105
2005.06	278067	2007.06	1401678
2005.07	180242	2007.07	616382
2005.08	2187	2007.08	13099
2005.09	183481	2007.09	1857
2005.10	134550	2007.10	260618
2005.11	125102	2007.11	1152098
2005.12	146613	2007.12	1484025
2006.01	133200	2008.01	879061
2006.02	83166	2008.02	69853
2006.03	125802	2008.03	1090
2006.04	118939	2008.04	83222
2006.05	146884	2008.05	907730
2006.06	306488	2008.06	1483742
2006.07	356923	2008.07	1117374

5.5.8 Total Monthly Gross Benefits of the Society

The total monthly gross benefits of society include the monthly soybean oil and soybean meal consumer surplus and monthly cash inflow and the monthly value for saved time for farmers.

Table 5.13 Total Monthly Gross Benefits of the Society (Unit: Yuan)

Month	Monthly Gross Benefits	Month	Monthly Gross Benefits
2004.08	9203274	2006.08	10539148
2004.09	11162126	2006.09	10324612
2004.10	11734895	2006.10	10808498
2004.11	11887781	2006.11	11947156
2004.12	11435860	2006.12	11369744
2005.01	12215283	2007.01	10629653
2005.02	7407410	2007.02	10570058
2005.03	10698596	2007.03	10072233
2005.04	10140747	2007.04	14550941
2005.05	9557265	2007.05	37036630
2005.06	7595306	2007.06	38752850
2005.07	4997173	2007.07	17552176
2005.08	75854	2007.08	1123673
2005.09	5138160	2007.09	721127
2005.10	4197094	2007.10	8167876
2005.11	5165214	2007.11	32559058
2005.12	4089422	2007.12	42045101
2006.01	4367990	2008.01	25302823
2006.02	2640887	2008.02	3112077
2006.03	6147308	2008.03	885353
2006.04	3676973	2008.04	3625427
2006.05	4589771	2008.05	26692066
2006.06	9037203	2008.06	43511456
2006.07	10115399	2008.07	32996329

5.6 Project Costs

5.6.1 Huabao's Monthly Processing Costs

The processing cost includes Huabao's expenditures in labor, energy, solvent and other factors. For the past periods, the monthly processing cost observed (HAD, 2007). For a future month, the processing cost can be computed from the processing cost function (5-3) and Table 5.8.

The Table 5.14 shows the predicted Huabao's monthly processing costs from April 2007 to July 2008.

Table 5.14 Monthly Producing Costs (Yuan)

Month	Processing cost	Month	Processing cost
2007.04	858414	2007.12	6295200
2007.05	5194804	2008.01	2292618
2007.06	5629879	2008.02	142720
2007.07	1192786	2008.03	129061
2007.08	129538	2008.04	148449
2007.09	129068	2008.05	2436041
2007.10	319227	2008.06	6292846
2007.11	3845349	2008.07	3624710

5.6.2 Capital Depreciation Charge

According Huabao's report, the yearly depreciation charge is almost zero. Except for that, no any other information is provided on this topic. For this reason, capital depreciation is totally omitted in our financial assessment of the project. Whereas capital depreciation is a part of the project opportunity cost and cannot be ignored in the project economic evaluation. We can make a *rough* estimation about the Huabao's capital depreciation charge.

According to He (2004), the average annual straight-line aggregated capital depreciation rate is 5.16% in China, under assumption of a salvage value of 5%, that is,

$$\frac{(\text{Capital cost at purchase - Salvage value}) / \text{Life years of capital}}{\text{Capital cost at purchase}} = 5.16\%.$$

From this, we know that

$$\frac{(\text{Capital cost at purchase - } 5\% \times \text{Capital cost at purchase}) / \text{Life years of capital}}{\text{Capital cost at purchase}} = 5.16\%.$$

Therefore in China, the average number of aggregated capital life years is

$$95\% / 5.16\% \approx 18.41 \text{ years.}$$

Generally speaking, the straight-line depreciation is unrealistic. We use the double declining balance depreciation method (DDB) to estimate Huabao capital depreciation charge. This is an accounting methodology in which depreciation is accelerated to twice the rate of annual depreciation by the straight-line method. In addition, the rate is applied to the full purchase cost of the asset, whereas under the straight-line method the rate is applied to the cost net of salvage value.

Huabao's capital is reported to be 37830000 Yuan* at the beginning of every business year. Let us suppose that the life years of Huabao's capital are equal 18.41, the average number of aggregated capital life years in China. The annual depreciation charge with the DDB method is then equal to

$$(2 \times 37830000) / 18.41 \approx 4109722.98 \text{ Yuan.}$$

Hence, the remaining value of Huabao's fixed asset is

For the end of first business year:	33720277 Yuan.
For the end of second business year:	30057020 Yuan
For the end of third business year:	26791728Yuan
For the end of the fourth business year:	23881165 Yuan

5.6.3 Soybean Growing Cost for Farmers

In the economic evaluation, Huabao's soybean purchase costs should not be considered as a cost of the project since such expenditures correspond to the incomes of farmers who sell soybeans to Huabao. They are actually social transfers. However, the cost for farmers to grow soybeans must be thought as an indirect cost of the project. Without the project, the farmers who sell their soybeans to Huabao may leave countryside or grow other crops. It is the proposed project that makes these farmers continue to plant soybeans.

* "Huabao Total Assets" mentioned Chapter 2.1.2

According to Chinese Niangzao (2005), the average cost to grow one kilogram soybeans is 1 Yuan. Table 5.15 shows the monthly cost for farmers to grow soybeans which are sold to Huabao.

Table 5.15 Monthly Soybean Growing Cost (Yuan)

Month	Growing cost	Month	Growing cost
2004.08	3091164	2006.08	3394772
2004.09	3372707	2006.09	3383885
2004.10	3579586	2006.10	3386325
2004.11	3779969	2006.11	3407330
2004.12	3804358	2006.12	3417745
2005.01	3596402	2007.01	3426643
2005.02	1846400	2007.02	3569823
2005.03	3471508	2007.03	3321897
2005.04	3417078	2007.04	4706953
2005.05	3239328	2007.05	12404858
2005.06	2564400	2007.06	12926586
2005.07	1662230	2007.07	5684409
2005.08	20171	2007.08	120805
2005.09	1692098	2007.09	17121
2005.10	1240853	2007.10	2403480
2005.11	1153715	2007.11	10624903
2005.12	1352099	2007.12	13686010
2006.01	1228397	2008.01	8106896
2006.02	766976	2008.02	644203
2006.03	1160175	2008.03	10049
2006.04	1096884	2008.04	767488
2006.05	1354598	2008.05	8371289
2006.06	2826499	2008.06	13683398
2006.07	3291622	2008.07	10304672

Our computation may be unrealistic since farmers' soybean growing costs occur in the months when they are necessary for soybean growing. For example, the cost is usually much higher in the seeding and harvest seasons than in others. To obtain a realistic distribution of the cost, one needs to have information about farmers' technology of soybean growing. No such information available, we decide to estimate the growing cost in each month simply by multiplying the soybean quantity by one. Of course, we are conscious that this may be a source of bias in our result.

5.5.8 Total Monthly Cost for the Society

The total monthly cost for society includes Huabao monthly processing cost, monthly soybean growing cost and the capital depreciation charge. Table 5.16 shows the total.

Table 5.16 the total monthly gross cost of the society

Month	Monthly Gross cost	Month	Monthly Gross cost
2004.09	3879591	2006.09	3892449
2004.10	4117562	2006.10	3895256
2004.11	4348061	2006.11	3919418
2004.12	4376115	2006.12	3931398
2005.01	4136905	2007.01	3941633
2005.02	2123895	2007.02	4106332
2005.03	3993241	2007.03	3821145
2005.04	3930631	2007.04	5565367
2005.05	3726167	2007.05	17599662
2005.06	2949804	2007.06	18556465
2005.07	1912047	2007.07	6877195
2005.08	23202	2007.08	250343
2005.09	1946403	2007.09	146189
2005.10	1427341	2007.10	2722707
2005.11	1327107	2007.11	14470252
2005.12	1555306	2007.12	19981210
2006.01	1413013	2008.01	10399514
2006.02	882245	2008.02	786923
2006.03	1334538	2008.03	139110
2006.04	1261735	2008.04	915937
2006.05	1558181	2008.05	10807330
2006.06	3251294	2008.06	19976244
2006.07	3786320	2008.07	13929382

5.7 Economic Net Present Values *(ENPV)*

In the economic evaluation, the *Economic Net Present Values (ENPV)* formula is similar with that of the financial net present value[*] but the items in the formula are defined differently. In financial *NPV* of the project, the cash inflows and cash outflows are those of the project owner. Here, it is the social benefit and the social cost of the project that are relevant. Besides, the *ENPV* uses the social discount rate (10% per year)[*], instead of the capital's rate of return predetermined by the project owner.

In the *ENPV* formula (5-13), I_0 represents Huabao's initial investment in August of each business year; I_1 represents remaining value of Huabao's fixed asset; *t* represents the time (*t*=1 stands for August, *t*=2 stands for September and so on) and, *r* represents the social discount rate (10%).

$$ENPV = -I_0 + \sum_{t=1}^{12} \frac{\text{monthly benefit} - \text{monthly cost}}{(1+r)^1} + \ldots \frac{\text{monthly benefit} - \text{monthly cost} + I_1}{(1+r)^{12}} \quad (5\text{-}13)$$

Here are the ENPVs in all business years in consideration.

- 08.2004 – 07.2005: *ENPV* = 64,357,826 Yuan.
- 08.2005 – 07.2006: *ENPV* = 27,908,204Yuan
- 08.2006 – 07.2007: *ENPV* = 96,701,151 Yuan.
- 08.2007 – 07.2008: *ENPV* = 104,318,062 Yuan.

All *ENPVs* are positive. Our conclusion is therefore that the proposed project is economically feasible according to the *NPV* rule for the given predetermined parameters.

5.8 *Economic Internal Rate of Return (EIRR)*

EIRR is defined as the discount rate which makes the *economic net present*

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[*] "Net Present Value" mentioned Chapter 3.1.2
[*] "Social discount rate" mentioned Chapter 5.1.2

value (ENPV) of a project equal to zero[•]. Mathematically,

$$ENPV = -I_0 + \sum_{t=1}^{12} \frac{\text{monthly benefit} - \text{monthly cost}}{(1+r)^1} + \ldots \frac{\text{monthly benefit} - \text{monthly cost} + I_1}{(1+r)^{12}} = 0$$

(5-14)

Here are the *ENPVs* in all business years in consideration.

- 08.2004 – 07.2005: *EIRR* = 259%.
- 08.2005 – 07.2006: *EIRR*=108%.
- 08.2006 – 07.2007: *EIRR*= 326%.
- 08.2007 – 07.2008: *EIRR*=312%.

All *EIRRs* are higher than the social discount rate, 10%. Our conclusion is thus that the proposed project is economically feasible according to the IRR rule for the given predetermined parameters.

5.9 Sensitivity Analysis

5.9.1 Identification of Uncertainties

Till now, we have evaluated the proposed project with predetermined parameters. The social discount rate is taken as 10% per year[*]. The ratio of oil and meal in the outputs is 14.5:85.5. The initial investment is 26,791,728 Yuan[*]. The parameters used may change or may be inaccurate. For example, the social discount rate is generally difficult to be measured exactly. The ratio of oil and meal in Huabao production may change with technological progress. Generally speaking, a variation in one or more parameters results in a different value of *ENPV* or *EIRR*. Consequently, a project may not be economically feasible or not socially optimal when parameters vary. The study of how the

[•] “Internal Rate of Return” mentioned Chapter 3.1.3
[*] “Social discount rate” mentioned Chapter 5.1.2
[*] “Fourth business year initial investment” mentioned Chapter 5.6.2

evaluation result change with variations of parameters is called sensitivity analysis. Two types of sensitivity analysis are often used in practice:

- in a one-way analysis, a single parameter is varied;
- in a two-way analysis, two parameters are varied simultaneously.

A more general *N*-way analysis, $N \geq 3$, is hardly used in practice.

Here, we do firstly one-way analysis for the social discount rate, initial investment and ratio of oil and meal. Then, we select the two *most sensitive* factors and carry out a two-way analysis in order to investigate their joint effect on the *ENPV*.

1) Social Discount Rate

   For most sensitivity analyses in project evaluation, the discount rate is an indispensable factor. Social discount rate reflects the expectation of the rate of return of the entire society in capital investment. Under strong assumptions in Theorem 1 in Chapter 4, the *ENPV* is a strictly increasing function of the social discount rate.

2) Initial Investment

   We would like to emphasize that by initial investment, we mean the Huabao's fixed asset put into use in the production at the beginning of the project. Huabao's fixed asset is very important factor for the project because it determines Huabao's firm size and production scale.

3) Output Ratio of Soybean Oil and Soybean Meal

   The ratio of soybean oil and soybean meal has affects on Huabao's sales income directly. Without a doubt, the project feasibility is greatly influenced by the technology as mentioned above.

5.9.2 One-way Sensitivity Analysis

5.9.2.1 Sensitivity to Social Discount Rate (SDR)

We set the social discount rate going up by 4050% and going down by 100%. Table 5.17 shows after discount changed how many *ENPV* changed, here is the result.

Table 5.17 One-way Sensitivity to Social Discount Rate

Change %	SDR	ENPV
-100%	0%	123,182,380
0%	10%	113,325,861
2000%	210%	21,649,340
3000%	310%	4,842,053
4000%	410%	105,772
4050%	415%	-209,515

The Table 5.17 shows us, the social discount rate going up to 415%, or more, the *ENPV* can be negative. It's almost improbable for social discount rate to be 415%, since the current Chinese social discount rate is 10%. According to that result, we can see this project has excellent ability to resist the risk of social discount rate.

5.9.2.2 Sensitivity to Initial Investment

We set the initial investment of Huabao going up by 2500% and going down by 100%. The table 5.18 shows after Initial investment changes how many *ENPV* will change, here is the result

Table 5.18 One-way Sensitivity to Initial Investment

Change %	Initial investment	ENPV
-100%	0	118,237,729
0%	26,791,728	113,325,861
+100%	53,583,456	108,413,992
+200%	80,375,184	103,502,124
+2000%	535,834,560	20,000,362
+2500%	669,793,200	-4,558,980

The Table 5.18 shows us, only the Initial investment going up to 669 million Yuan, or more, the *ENPV* value can be negative. It is almost improbable for Initial Investment going to that amount, since the current Initial Investment is less than 26 million Yuan. According to that result, the project has excellent ability to resist the risk of initial investment.

5.9.2.3 Sensitivity to Oil-Meal Outcome Rate

At the beginning of this chapter, we forecasted the price of soybean oil and meal. The price information shows us the soybean oil price is more than twofold than soybean meal price. Therefore, the more output rate of soybean oil and soybean meal, more soybean oil Huabao can produce, the more profit Huabao can get. Contrarily, less profit Huabao can get. With the current technology, the oil-meal outcome rate is 14.5%:85.5%. Let us denote the proportion of oil by α. The proportion of meal is hence $(1-\alpha)$. When the proportion of oil α goes from 0 to 100%, that of meal $(1-\alpha)$ varies from 100% to 0%. The effect of variation of α on *ENPV* is computed and shown in Table 5.19.

Table 5.19 Sensitivity to Oil-Meal Outcome Rate

Change %	Rate of oil and meal	ENPV
-14.5%	0% : 100%	87,105,833
-4.5%	10% :90 %	105,188,611
+15.5%	30% : 70%	104,318,062.
+35.5%	50% : 50%	119,271,117
+55.5%	70% : 30%	134,224,172
+75.5%	90% :10%	149,177,227
+85.5%	100% : 0%	164,130,281

The Table 5.19 shows us, the value of *ENPV* won't turn into negative, even though the soybean meal output rate is 100%. According to that result, the risk of soybean oil and meal outcome rate doesn't influence the project feasibility.

5.9.3 Pooling Single Factor Sensitivities

The univariate sensitivity analysis is a useful tool to become aware of the single sensitive factors. For the practical way to evaluate the sensitivity of the project, we should examine the sensitivity of decision criteria with cross-link multiple sensitivity factors. The Figure 5.7, a spider plot of *ENPV* curves, shows us the most significant influence on *ENPV*.

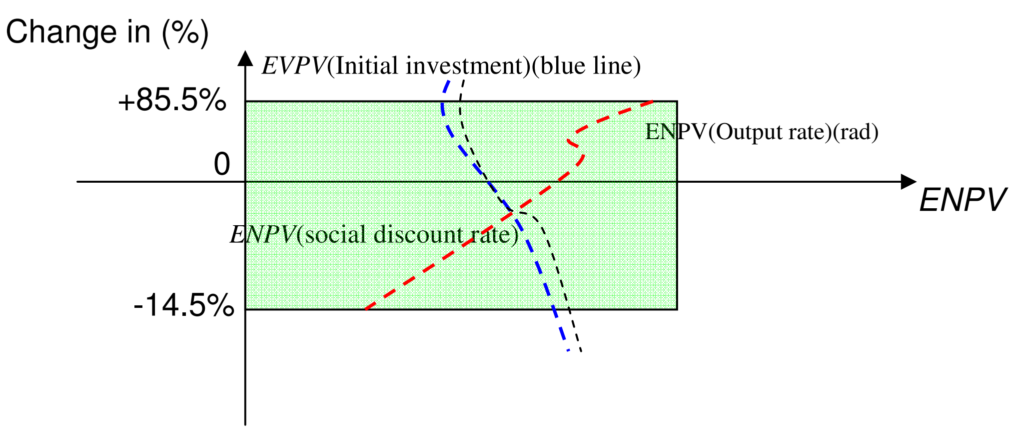

Figure 5.10 Spider Plot of Multi-Factor Sensitivity

The central point of the spider plot is the value of the *ENPV*, when all the factors are at their baseline values. The “tentacles” on the spider shows us how the *ENPV* changes as the values of each factor. The shadow area is taken the each factor change between [+85.5%, -14.5%]

In the shadow area, the shape of each factor “tentacles” shows us the degree of sensitive. If the shape of the “tentacles” more vertically, the factor is less sensitive, unless the factor is more sensitive. According to that, the two most sensitive factors are social discount rate and output rate. However, the output rates of soybean oil and meal in the uncertainty situation the value of *ENPV* can’t less than 0. Therefore, we consider the two more sensitive factors are, social discount rate and Initial investment

5.9.4 Joint Influences of Initial investment and social discount rate

The identified critical combinations of the two uncertainty factors are:

(+2500%, 0%), (+200%, +2000%),
(+100%, +3000%), (+100, +4000%), (0%, 4050%)

Table 5.20 Joint Influence of Initial investment and Social Discount Rate

Initial investment	Social discount rate					
	-100%	0%	+2000%	+3000%	+4000%	+4050%
-100%	126	118	41	27	19	19
0%	123	113	22	8	0.06	-0.2
+100%	120	108	2	-12	-19	-19
+200%	117	103	-17	-32	-38	-39
+2000%	68	20	-346	-368	-366	-365
+2500%	54	-5	-442	-466	-462	-461

In the Table 5.20, the shaded areas show the critical combinations of the two uncertainty factors.

Reading the table from left to right, the first of the combination is when the Initial investment goes up 2500% and the social discount rate is stabilized. When the initial investment goes up 2500%, it means the project Investment will up to more than 669 million Yuan. It is improbable for Initial Investment to go up to that amount, since the current Initial Investment is less than 26 million Yuan.

. The second of the combination is when the Initial investment goes up 100%, and the social discount rate goes up 2000%.Also, the third combination is when the Initial investment is stabilized, and the social discount rate goes up 3000%. The fourth combination is when the Initial investment is stabilized, and the social discount rate goes up 4000%. The fifths combination is when the Initial investment is stabilized, and the social discount rate goes up 4050%. For those four combinations, all the social discount rate is up more than 2000%, which means the social discount rate, will be 210%. It is nearly improbable for the social going to that amount, since the current social discount rate is 10%.

In deed, since all the single uncertainties and the combination of the uncertainties factors can not influence the project feasibility. The project has excellent ability to resist the risk.

CHAPTER SIX
Alternative Project

In this chapter, we analyze an alternative of the proposed loaning project. As pointed out at the beginning of Chapter 5, this analysis is necessary because an economic evaluation is a comparison of the proposed project with its alternatives for the purpose of searching an optimal choice in view of social welfare.

In many cases, there are a number of alternative projects that aim the same goal. For a solution to that problem that Qinyang farmers have difficulty to sell their products, we proposed and intuitively ruled out two alternative projects in Section 1.3. They are

A. To finance the existing agencies to build more warehouses.

B. To incite crop exportation.

So far as to financially assist the crop processing project, ADBC still has an option other than loaning to Huabao. Actually, not only soybean planters face the vexation of difficulties in selling their products but also those who plant wheat. In the July 2004, ADBC (Qinyang Branch) received another loan application from Tianxiang Flour Processing Factory and refused the request of Tianxiang based on a financial assessment. However, a project may be financially unprofitable but economically advantageous since the two approaches have different objectives, are based on different evaluation criteria and use different price definitions. It is hard to affirm or to gainsay the decision of ADBC (Qinyang Branch) simply according to a financial analysis. A comparison of the two options is indispensable from the point of view of social welfare maximization.

According to Tianxiang loaning report, the loans Tianxiang requested also come up to 18 millions Yuan (Tianxiang Loaning Report [TLR], 2004), the same amount with the loans Huabao requested. The totality of policy loans is limited in Qinyang Branch. It is impossible for Qinyang Branch to offer simultaneously the funds that the two firms need. In other words, the two options Qinyang Branch faces are exclusive because of the scarcity of resources. Qinyang Branch has to make a choice.

Because ADBC refused to support Tianxing Flour Processing Factory, Tianxing is not obliged to submit the Bank its monthly financial report after July 2004. For us, there is not sufficient information to carry out a full analysis for Tianxiang project as we have done for Huabao project. In our analysis, we use the basic information of Tianxiang that Qinyang Branch provides us and some technological data of peer firms in the same industry.

6.1 Tianxiang Project

In China, a short-term loan lasts at most one year inclusively. A medium-term loan lasts more than one year but at most three years. A long-term loan lasts more than three years. The loan term of Tianxiang project is 4 years. Tianxiang project is therefore a long-term loan project while Huabao project is a short-term loan one. Besides, Tianxiang requested loans for fixed asset purchases and instead, Huabao for circulating funds. The two projects imply different risks.

The factory is third biggest flour processing factory in Qinyang area. The main products of that factory are flour and bran. Bran is the residue in processing wheat. It is a kind of good feedstuff for cattle. In the year of 2002 and 2003, Tianxiang's production capacity was to process 17 millions kg wheat per year. According to Tianxiang loaning report, after one year construction (August 2004 to July 2005), Tianxiang would be capable to process up to 33 millions kg wheat per year (TLR, 2004).

The production factors consist of electricity, labor, transportation tools, workshops, water, flour processing equipment, *etc*. According to Tianxiang

Profit Rate, the Table 6.1 shows the average cost for processing of 1,000 Kg wheat (TLR, 2004).

Table 6.1 Tianxiang Production Cost (per 1,000 Kg wheat) (Unit Yuan)

Electricity	20 × 0.68 Yuan = 13.6 Yuan
Labor	26.4 Yuan
Other Costs	20 Yuan
Total Average Cost per 10^3 kg Wheat Processing	60 Yuan

According to Tianxiang production technology, one kilogram of wheat yields 0.9 kg of flour and 0.1 kg of bran (TLR, 2004). The production process of Tianxiang is illustrated in Figure 6.1.

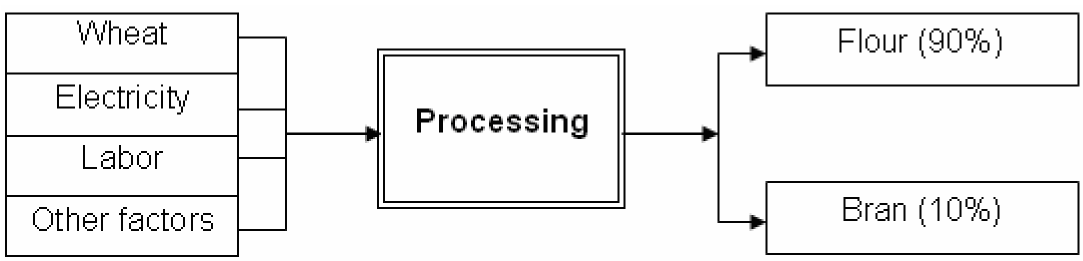

Figure 6.1 Flour Production Process in Tianxiang

6.2 Tianxiang Principal Data

The original Tianxiang data are statistically described and separately shown below according to the business year because the single project lifetime is just a business year. Specifically, the descriptive statistic of the Tianxiang data of business year August 2002 – July 2003 is displayed in Table 6.2 (Tianxiang Accounting Data [TAD], 2003) and that of business year August 2003 – July 2004 is displayed in Table 6.3(TAD, 2004). The unit of measure is always

Chinese Yuan. The number of observations in each business year is 12 since the accounting report is made once every month.

Table 6.2 Descriptive Statistic of Tianxiang Data (August 2002– July 2003)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
PRICE1	12	.04	1.03	1.07	1.0517	.01115
PRICE2	12	.04	1.17	1.21	1.1983	.01337
PRICE3	12	.04	.96	1.00	.9825	.01138
Qwheat	1	.00	1.7E+07	1.7E+07	1.7E+07	.

Table 6.3 Descriptive Statistic of Tianxiang Data (August 2003 – July 2004)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
PRICE1	12	.05	1.04	1.09	1.0650	.01567
PRICE2	12	.03	1.20	1.23	1.2217	.01030
PRICE3	12	.05	.97	1.02	.9958	.01505
Qwheat	1	.00	1.7E+07	1.7E+07	1.7E+07	.

In the above tables, PRICE1 stands for the purchase price of per kilogram wheat; PRICE2 for the sale price of per kilogram flour; PRICE3 for the sale price of per kilogram bran and, Q_{wheat} stands for the quantity of wheat Tianxiang processes during a business year.

6.3 Market Forecast

Just as in the ex ante economic evaluation of the Huabao loan project, we need future market forecasts to analyze the project effects. There are also three markets involved here. Tianxiang is a competitive firm at all markets. Tianxiang is hence always a price taker.

6.3.1 Wheat Price Evolution

A professional wheat market price forecast involves many factors, for example, climate conditions and seed prices. For our purpose, it is sufficient to think the market price a dependent variable of time. The sample of PRICE1 we use to predict future market prices of wheat is a pooling dataset of the two business year and is described in Table 6.2 and Table 6.3.

The regression model is specified below.

$$P_{wheat} = \lambda_1 + \lambda_1 T + \iota,$$

where P_{wheat} is the price of wheat, λ's are regression coefficients, T is the time variable and ι is a normally distributed error term.

Table 6.4 SPSS Outcome of Wheat Price Regression

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.047	.006		178.571	.000
	TIME	.001	.000	.412	2.118	.046

TIME stands for *T* in this table. From Table 6.4, we know that the wheat market price evolves with time on the following straight line.

$$P_{wheat} = 1.047 + 0.001T.$$

6.3.2 Flour Price Evolution

Similar with the specification of the wheat price regression, we set the flour price a dependent variable of time. The relevant sample is the pooling dataset of PRICE2 in the two business years, which is described in Table 6.2 and Table 6.3.

The writing of the flour price regression model is omitted here. The SPSS outcome, shown in Table 6.5, proves a simple linear model.

Table 6.5 SPSS Outcome of Flour Price Regression

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.184	.003		338.606	.000
	TIME	.002	.000	.874	8.420	.000

We give out directly the linear evolution equation of the flour price with time.

$$P_{flour} = 1.184 + 0.002T.$$

6.3.3 Bran Price Evolution

In the same way, we obtain the bran price evolution equation:

$$P_{bran} = 0.978 + 0.001T.$$

The related SPSS outcome is shown in Table 6.6.

Table 6.6 SPSS Outcome of Bran Price Regression

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.978	.006		170.839	.000
	TIME	.001	.000	.430	2.236	.036

6.3.4 Forecast Prices for the Periods of August 2004 through July 2008

The market prices between August 2002 and July 2004 are available. Those between August 2004 and July 2008 must be predicted according to three prediction functions obtained above in order to compare with the Huabao loan project. PRICE1, PRICE2 and PRICE3 are defined in the same way as above. We show the descriptive statistic of our predicted prices in Table 6.7.

Table 6.7 Forecast wheat, flour and bran Price

	N	Range	Minimum	Maximum	Mean	Std. Deviation
PRICE1	48	.05	1.07	1.12	1.0955	.01400
PRICE2	48	.09	1.23	1.33	1.2810	.02800
PRICE3	48	.05	1.00	1.05	1.0265	.01400

It is notable that wheat and flour prices evolve much more stably than soybean prices. This is because the demands for wheat and flour are much more inelastic. In presence of any uncertainty, the Chinese government makes effort to stabilize the prices of wheat and flour at first priority.

6.4 Costs of the Tianxiang Loan Project

6.4.1 Set-up Cost

Tianxiang Flour Factory planed to invest an amount of 37 million Yuan at the beginning of the project for construction, purchase and setting up new equipment. This amount is composed of a loan of 18 millions Yuan from the bank and Tianxiang's existing capital stock valued up to 19 millions Yuan (TLR, 2004).

6.4.1.1 Capital Depreciation Charge

The formula of Tianxiang capital depreciation charge is exactly the same as it used in Huabao capital depreciation charge. After the calculation the remaining value of Tianxiang's fixed asset is

For the end of first business year: 32980445 Yuan.

For the end of second business year: 29397562 Yuan.

For the end of third business year: 26203910Yuan.

For the end of the fourth business year: 23357206 Yuan.

6.4.2 Running Costs

The running costs mainly consist of the processing cost and wheat purchase cost. Table 6.8 shows the projected average monthly processing cost per 1,000 Kg processed wheat.

Table 6.8 Monthly Processing Costs (8.2004 – 7.2008; Unit: Yuan)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
PC_FRIST	12	.00	85000.00	85000.00	85000.00	.00000
PC_SECOND	12	.00	165000.00	165000.00	165000.0	.00000
PC_THIRD	12	.00	165000.00	165000.00	165000.0	.00000
PC_FOURTH	12	.00	165000.00	165000.00	165000.0	.00000

PC_FIRST stands for the monthly processing cost in the first business year (8.2004-7.2005); PC_SECOND stands for or the monthly processing cost for second business year (8.2005-7.2006); PC_THIRD stands for or the monthly processing cost for third business year (8.2006-7.2007); PC_FOURTH stands for or the monthly processing cost for fourth business year (8.2007-7.2008). Tianxiang processing costs include the expenditures in use of electricity, labor and other factors. The values in Table 6.8 are recovered from the reported average processing cost per 1,000 kg wheat in Table 6.1 and the projected processing quantities in each year.

The wheat purchase expenditures of Tianxiang correspond to revenue of wheat farmers since they are paid to farmers ultimately. In the economic evaluation, this cost is not an economic cost but a transfer, only.

6.4.3 Wheat Farmers' Planting Costs

However, the wheat planting costs must be, in stead. Just as the consideration of soybean planting costs in economic analysis of Huabao loan project, we incorporate wheat farmers' planting costs in the current analysis for the investigation of the net benefits generated from the project in question. Without the project, farmers may stop planting wheat and thus there is no cost in wheat planting. Wheat farmers' planting costs are indirect costs of the project.

For an accurate estimation of wheat planting cost, we need more information on farmer's production technology. The planting cost varies from month to month. For example, the cost is higher in the wheat insemination season and much lower in winter. Unfortunately we do not have sufficient information to recover farmer's production technology. Anyway, according to the average cost of wheat to grow per one kilogram, we know the average cost of growing one kilogram wheat to be 0.53 Yuan in China and total quantity of wheat Tianxiang processes (Chinese Xiaomai, 2003). It is then possible for us to estimate the monthly average cost under the assumption that the wheat planting cost is constant through a year. Table 6.9 shows the monthly average wheat growing cost.

Table 6.9 Monthly Average Wheat Growing Cost (Yuan)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
GC_FRIST	12	.00	750833.00	750833.00	750833.0	.00000
GC_SECOND	12	.00	1457500	1457500	1457500	.00000
GC_THIRD	12	.00	1457500	1457500	1457500	.00000
GC_FOURTH	12	.00	1457500	1457500	1457500	.00000

GC_FIRST stands for the monthly average wheat growing cost in the first business year (8.2004-7.2005); GC_SECOND for that in the second business year (8.2005-7.2006); GC_THIRD for the third business year (8.2006-7.2007) and, GC_FOURTH for the fourth business year (8.2007-7.2008).

6.5 Benefits of the Tianxiang Loan Project

6.5.1 Value of the Saved Time for Farmers

In the chapter 1, we mentioned the fact that the Huabao loan project reduces the farmers' wait-in-queue time. The Tianxiang project can also save time for farmers. In the cost-benefit analysis, the value of saved time for farmers must be taken into account. Monetization of this effect is exactly the same with that in Huabao project.

In recent years, the average wheat yields are 700 Kg per Mu in China (China Seed, 2004). The average annual quantity of wheat Tianxiang processed is 17 millions kilograms from August 2002 to July 2005. According to Tianxiang loan request report, the projected annual processing capacity is 33 millions of wheat per year after the construction in August 2005. Due to Tianxiang loan project, how many wheat planters will no longer wait in queue for sales of their wheat? For a given period, this number is equal to

$$\frac{\text{Quantity of wheat demanded by Tianxiang / Average wheat yield per Mu}}{\text{Average arable soil area per wheat planter}}.$$

For the period of Aug 2004 through July 2005, for example, the Tianxiang loan project can release

$$17\text{millions kg} \div 700 \text{ kilograms} \div 1.66 \text{ Mu} = 14{,}630 \text{ farmers}$$

from waiting in queue. The average revenue of a farmer was 4.5 Yuan per hour in that period. It is reported that average wait-in-queue time was 10 hours per wheat planter (TLR, 2004)[1]. The saved time for farmers is worth approximately

$$14{,}630 \text{ farmers} \times 10 \text{ hours} \times 4.5 \text{ Yuan} = 658{,}350 \text{ Yuan},$$

form Aug 2004 to July 2005. We consider the quantity of wheat

Table 6.10 Monetization of the Value of Saved Time (Yuan)

08.2004-07.2005	08.2005-07.2006	08.2006-07.2007	08.2007-07.2008
658,350	1,277,969	1,277,969	1,277,969

Table 6.10 summarizes our computational results about the monetization of the value of saved time due to the Tianxiang loan project. In the construction period, Tianxiang's productivity is about a half of its normal level and hence the value of saved time of farmers is only about 50% of the normal value (1,277,969 Yuan).

6.5.2 Consumer's surplus

The demands for flour and bran are not elastic because flour is goods of the first necessity for life and bran is the most important feedstuff of castle. Tianxiang is a perfect competitive firm at both markets. Intuitively, there is no significant change in flour and bran prices due to the Tianxiang project. The contribution of this project to the flour consumer's surplus is therefore very little, so is that to the benefit of bran buyers. We pass over this part of the project contribution.

6.5.3 Tianxiang's Sales Incomes

As shown in Figure 6.1, the ratio of flour and bran in Tianxiang outputs is 90% of flour to 10% of bran. Therefore, the monthly sales incomes are the flour quantity multiplied by the flour price, plus the bran quantity multiplied by the bran price. Table 6.11 shows Tianxiang's monthly sales incomes.

Table 6.11 Tianxiang's monthly sales incomes (8.2004 – 7.2008)
(Unit: Yuan)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
FIRST	12	29608.00	1715442	1745050	1730246	9704.90857
SECOND	12	57475.00	3392675	3450150	3421413	18839.00541
THIRD	12	57475.00	3455375	3512850	3484113	18839.00541
FOURTH	12	57475.00	3518075	3575550	3546813	18839.00541

FIRST stands for Tianxiang's monthly sales income in the first business year (8.2004-7.2005); SECOND for that in the second business year (8.2005-7.2006); THIRD for that in the third business year (8.2006-7.2007) and, FOURTH for that in the fourth business year (8.2007-7.2008).

6.6 Economic Net Present Value (*ENPV*) and Economic Internal Rate of Return *(EIRR)*

Our computed results with the *ENPV* and *EIRR* are as follows. For the first business year,

ENPV = 3,834,712 Yuan,

EIRR = 22.68%.

For the second business year,

ENPV = 15,598,262 Yuan,

EIRR = 69.12 %.

For the third business year,

ENPV = 16,967,571 Yuan,

EIRR = 82.81 %.

For the fourth business year,

ENPV = 18,265,521 Yuan,

EIRR = 97.82%.

To facilitate the comparison of the two options ADBC (Qinyang Branch) faces, we put together the above results and those of Huabao loan project in Table 6.12.

Table 6.12 Comparison of the Huabao and Tianxiang Loan Projects

	ENPV (Yuan)		EIRR (%)	
	Huabao	Tianxiang	Huabao	Tianxiang
08/2004 - 07/2005	64,357,826	3,834,712	259%	22.68%.
08/2005 - 07/2006	27,908,204	15,598,262	108%.	69.12 %
08/2006 - 07/2007	96,701,151	16,967,571	326%	82.81 %.
08/2007 - 07/2008	104,318,062	18,265,521	312%	97.82%.

For any of the four years, Huabao project has a much higher economic net present value than Tianxiang project. It is also evident that Huabao loan project is better than Tianxiang loan project if we examine their economic internal rate of return. This is true even when bird flu burst in the business year 08/2005 - 07/2006. One can also see the fact that the advantage of Huabao project during bird flu lessened relatively. There are two reasons for this phenomenon: the impact of bird flu on soybean meal trade is greater that on bran trade; the demand for flour is more inelastic than that for oil.

In summary, Huabao loan project is the optimal choice of ADBC (Qinyang Branch) in view of the social welfare of Qinyang region.

CONCLUSION

At the beginning of the thesis, we introduced the context and environment of the project.

Also, the current existing social problems and their reasons were explained. ADBC (Qinyang branch) , a policy bank, has loaned 18 million Yuan to Huabao Ltd, a private agricultural processing company in Qinyang, to solve the social problems caused by the difficulties farmers have encountered selling their products. Until now, ADBC (Qinyang Branch) has made their loaning decision simply by assessing the financial evaluation.

At the beginning of the thesis, we also did a financial evaluation which was similar to what the ADBC did. The objective of doing this was for the financial evaluation to serve as a base and reference of our economic evaluation. Since the NPV was as large as 6,903,337 Yuan and 2,248,944 Yuan for the first and the second business year, the project has been undertaken.

As a policy bank, ADBC should analyze the project from the point of view of the Government. In the traditional economic evaluation, the projects involve one general market, that is, the market of a specific commodity. When a production project has non-negligible effects on several markets, the identification of social costs and benefits can be very complicated since of them are intangible. In our study, we are identifying and monetizing the intangible social cost and benefits for the multiple markets, which are the soybean, soybean oil, and soybean meal markets.

Moreover, in the economic evaluation the prices used shadow prices since market prices do not reflect the true value of goods or production factors in the presence of market failure.

Moreover, we have analyzed some intangible social benefits and costs.

We have calculated the value of the farmers' saved time in the selling process, and the consumer's surplus for the soybean oil and soybean meal as social benefits. However, we have found the soybean growing cost for farmers as a social cost.

Furthermore, the economic evaluation is *ex ante* analysis. Since we have omitted the data interference factor, the bird-flu effect, from Huabao historical data, we forecast the price of the soybean, soybean oil and soybean meal by regress the history of the date and time. The result of the regression shows price of soybean and soybean oil, and soybean meal varies as a downward cosine wave.

In our project economic evaluation, we have found that both of the principal criteria, economic net present value and economic internal rate of return of the project, positively result in an economically desirable proposed project; also, it is financially profitable.

At the end of the thesis, we have found that an alternative, Tianxiang Flour Processing Factory, is undesirable since its economic net present value and economic internal rate of return is less than Huabao's. The Huabao project is the social optimum, since the economic net present value will be 104,318,062 Yuan, and the economic internal rate of return will be 312%, for the fourth business year. As the sensitive analysis shows us, this project has excellent ability to resist risk.

REFERENCES

1. A.I.Kostrikin, “Introduction to Algebra”, Springer (1982).
2. Advantage of the Huabao Project. (2004, July). *Huabao loaning report (p.3-4).*, Henan, China.
3. Advantage of the Tianxiang Project. (2004, July). *Tianxiang loaning report (p.45).* , Henan, China.
4. *Average cost to grow one kilogram by Chinese Xiaomai.* (2003, March 17). Retrieved February 15, 2007, from http://www.xiaomai.cn/show.asp?id=171
5. *Average cost to grow one kilogram soybeans by Chinese Niangzhao.* (2005). Retrieved February 20, 2007, from http://www.niangzao.net/news/464/46455.html
6. Background of Huabao. (2004, July). *Huabao loaning report (p.11-12).* , Henan, China.
7. Bird-flu Effects. (2006, July). *Huabao loaning report (p.61-62).* , Henan, China.
8. *Business Scope of the Agricultural Development Bank of China.* (2005, September 16). Retrieved February 17, 2007, from http://www.adbc.com.cn/en/detail.asp?channelid=110100120&id=457
9. *Chinese Population by the National Population Family Planning Commission of China.* (2005, September 20). Retrieved February11,2007,from http://www.chinapop.gov.cn/rkgk/zgrk2/t20050920_31760.htm
10. *Cost Benefit Analysis: Concepts and practice* by Anthony E. Boardman et al. prentice-hall 1996
11. *Farmers Selling Their Products by Shangqiu News.* (2004, October 10) Retrieved February 18, 2007. from www.SQRB.com.cn
12. Financial Situation. (2004, July). *Huabao loaning report (p.12-13).* , Henan, China.
13. Greene, W.H. Econometric Analysis (Fifth Edition). *Prentice Hall*. 2002. Varian, Hal R. Microeconomic Analysis (Third Edition), *W.W. Norton & Company Inc.* 1992.
14. *Henan Agriculture Economy.* (2005, September 30). Retrieved February 15, 2007. from http://www.henan.gov.cn/hngk/system/2006/09/15/010007070.shtml
15. *Henan Demographic by The People’s Government of Henan Province.* (2005). Retrieved February 23, 2007,from http://www.henan.gov.cn/hngk/system/2006/09/06/010004664.shtml
16. *Henan Labo*r by SanNong Government Web. (2005, June 30). Retrieved February 17, 2007, from http://www.sannong.gov.cn/fxyc/ldlzy/200507110158.htm

17. *Henan Population.* (2005, July 19). Retrieved February 15, 2007, from http://www.henan.gov.cn/hngk/system/2006/09/06/010004663.shtml
18. *Henan Profiles by The People's Government of Henan Province*. (2005). Retrieved February 23, 2007, from http://www.henan.gov.cn/hngk/system/2006/09/19/010008384.shtml
19. *Henan soybean by Henan province Statistic.* (2004). Retrieved February 17, 2007, from http://www.stats.gov.cn/tjgb/ndtjgb/dfndtjgb/t20060227_402308134.htm
20. He, Xinhua. Estimation of China's Production Function and Economic *Growth Rate. World Economic Statistics Research.* 2004, Vol.1, pp. 6-11. (In Chinese).
21. History Price information 2004-2007. (2007, April). *Huabao loaning report (p.41-59).* , Henan, China.
22. Huabao Monthly Accounting Report 2004-2005. (2005, July). *Huabao Accounting data (p.26-38).* , Henan, China.
23. Huabao Monthly Accounting Report 2005-2006. (2006, July). *Huabao Accounting data (p.39-53).* , Henan, China.
24. Huabao Monthly Accounting Report 2004-2006. (2006, July). *Huabao Accounting data (p.26-53).* , Henan, China.
25. Huabao Monthly Accounting Report 2004-2007. (2007, April). *Huabao Accounting data (p.26-62).* , Henan, China.
26. Huabao Project Loaning Interests. (2004, July). *Agricultural Development Bank of China Loaning decision report for Huabao project (p.3-4).* , Henan, China.
27. *Initial Investment by Odellion Research.* (2006). Retrieved February 23, 2007, from http://www.odellion.com/pages/online%20community/IRR/financialmodels_irr_definition.htm
28. *Internal Rate of Return by Odellion Research.* (2006). Retrieved February 23, 2007, from http://www.odellion.com/pages/online%20community/IRR/financialmodels_irr_definition.htm
29. *Introduction of Soy Stats.* (2003). Retrieved February 21, 2007, from http://www.soystats.com/2003/Default-frames.htm
30. Investor Words. (2007). *double-declining balance depreciation method*, Retrieved February 20, 2007, from http://www.investorwords.com/1553/double_declining_balance_depreciation_method.html
31. *Mission and Purpose of the Agricultural Development Bank of China.* (2005, September 16). Retrieved February 17, 2007, from http://www.adbc.com.cn/en/detail.asp?channelid=110100120&id=460
32. *Net Present Value by Odellion Research.* (2006). Retrieved February 23, 2007, from

http://www.odellion.com/pages/online%20community/NPV/financialmodels_npv_equations.htm
33. Peter R. Orszag and Joseph E. Stiglitz. (1999). Proceedings from "*Rethinking Pension Reform:Ten myths about social security systems, presented at the World Bank Conference*.
34. Price History Data of Huabao. (2004, July). *Huabao loaning report (p.41-46).* , Henan, China.
35. Production Technology of Huabao. (2004, July). *Huabao loaning report (p.21-26).* , Henan, China
36. Qinyang Inflation Rate. (2006, July). *Agricultural Development Bank of China Loaning decision report for Huabao project (p.31-32).* , Henan, China.
37. *Rate of Return by Odellion Research.* (2006). Retrieved February 23, 2007, from
http://www.odellion.com/pages/online%20community/NPV/financialmodels_npv_equations.htm
38. *Taylor Series by Wolfram Mathword.* (2006). Taylor Series Retrieved, March 16. 2007, from http://mathworld.wolfram.com/TaylorSeries.html
39. The Bonus for Huabao Project. (2004, July). *Agricultural Development Bank of China Loaning decision report for Huabao project (p.3-4).* , Henan, China.
40. The Project Information of Huabao. (2004, July). *Agricultural Development Bank of China Loaning decision report for Huabao project (p.1-2).* , Henan, China.
41. *The wheat average yield per Mu by China seed.* (2004). Retrieved March 15, 2007, from
http://www.seedol.com/news/pchookup/2006/06/0715540571.html
42. Tianxiang Monthly Accounting Report 2002-2003. (2003, July). *Tianxiang Accounting data (p.15-27).* , Henan, China.
43. Tianxiang Monthly Accounting Report 2003-2004. (2004, July). *Tianxiang Accounting data (p.28-40).* , Henan, China.
44. Tianxiang Production Technology. (2004, July). *Tianxiang Loaning Report (p.11-12).* , Henan, China.
45. Tianxiang Profit Rate. (2004, July). *Tianxiang Loaning Report (p.9-10).* , Henan, China.
46. Tianxiang Project information. (2004, July).*Tianxiang loaning report (p.3-4).* , Henan, China.
47. Total Assets of Huabao. (2004, July). *Huabao loaning report (p.1-2).* , Henan, China.
48. Total Assets of Tianxiang. (2004, July). *Tianxiang Loaning Report (p.1-2).* , Henan, China.