BOT FINANCIAL MODEL: TAIWAN HIGH SPEED RAIL CASE

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ABSTRACT: Owing to the high cost of large construction projects in recent years, build-operate-transfer (BOT) contracts are getting popular in the global construction market, especially in infrastructure construction. With BOT, the government is able to put projects on track without concerning itself too much about raising funds. On the other hand, due to the fact that the concessionaire who is awarded the project is responsible for the operation of the end facility for a certain period of time, reliable quality of the facility and effective operation could be expected. This paper introduces the financial model used by the Bureau of Taiwan High Speed Rail for its BOT projects. The parameters and variables of the model are presented. Its basic assumptions, input data, cost requirement, self-financing ability analysis, financial statements, and indices are discussed. The scenario analysis is used to highlight the application of the model.

INTRODUCTION

Financing is one of the most significant issues in the build-operate-transfer (BOT) contract delivery system. Only with sufficient capital can a BOT project be successfully carried out (Tiong 1995). However, in the process of financial planning, there are so many details included that appropriate financial planning procedures and financial assessment methods should be developed in order to evaluate the viability of a project and come up with the best scenario. To meet this need, the Bureau of Taiwan High Speed Rail (BOTHSR) developed a model for financial planning and evaluation of bidders' proposals (Chen 1999). The purpose of this paper is to introduce the financial model.

This paper will begin with the general concepts of financial planning for BOT projects. Then, the financial model will be presented. Next, a detailed description of the model in terms of its basic assumptions, data input, cost requirements, self-financing ability analysis, some key statements of income, equity, and cash flows, balance sheet, and financial indices will be provided. Finally, the results from the scenario analysis on five cases will be compared and conclusions will be drawn.

FLOW OF FINANCIAL PLANNING

Fig. 1 shows the flow of financial planning, which presents the tasks to be done and their related sequences (Chen 1998). First, planners must set up all parameters and needed information (such as debt/equity ratio, annual cash inflows and outflows, and so forth) so as to calculate the self-financing ratio (SFR). With the SFR, the cost percentages of the government and the concessionaire can be decided. For the private investment, the financial reports (including the statement of cash flows, the balance sheet, and the income statement), the financial indicators [such as the net present value (NPV), the internal rate of return (IRR), and the payback period method (PBY)], and financial curves can be utilized to check if the scenario is feasible under the current assumptions. If the scenario works, further analysis upon financing and the payback abilities of the concessionaire can be conducted. As for the government investment, use of the governmental budget is necessary to cover the non-self-financing part of the construction cost (Mao 1998). Different assumptions and information could be input to determine the best scenario.

PARAMETERS AND VARIABLES

Parameters are usually kept constant in the financial feasibility analysis. Unlike parameters, variables vary with different scenarios. Through trial and error, the best variable mix that comes up with the best result can be determined. The parameters and the associated variables adopted in the financial model are defined in the following paragraphs.

Parameters

A number of parameters are to be considered in the process of financial planning. They are as follows:

- *Debt/equity ratio:* This constructs the capital structure. With it, the concessionaire can decide how much of the required capital should be borrowed from banks and how much of the capital is to be raised from the public.
- *Interest rates of term loans:* Long-/medium-term loans are usually the main capital sources. However, to meet the capital requirement in a short period of time (less than

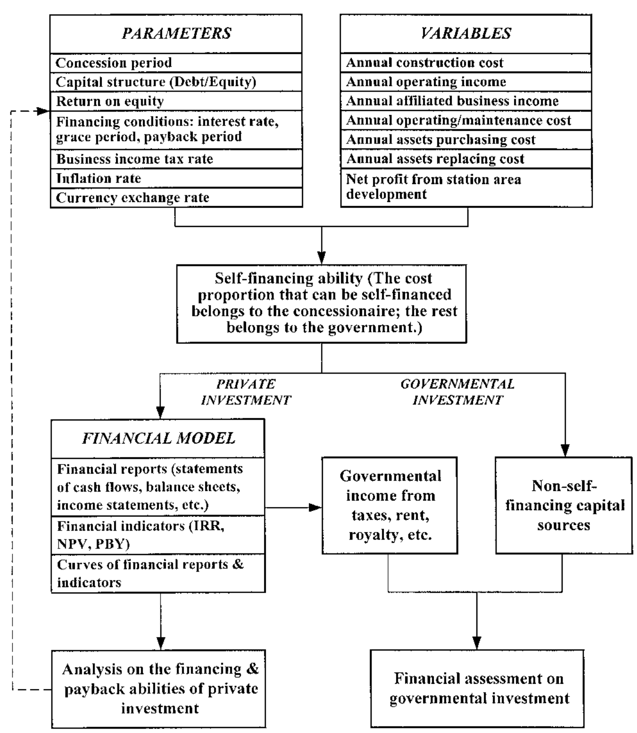

FIG. 1. Flow of Financial Planning

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one year), short-term loans may be needed, especially during the construction period. Reasonable interest rates of both long-/medium-term and short-term loans should be estimated.

- *Grace period:* The grace period, usually accompanying long-/medium-term loans, indicates the period during which the loan borrower (the concessionaire in this case) only has to pay the interest, not the principal. This is significant to the concessionaire in the construction period, because in a BOT project revenues start in the operating period. The flexibility of the grace period could release much of the concessionaire's financial load during the construction period.
- *Debt repayment period:* The debt repayment period refers to the time needed for the loan borrower to pay off all the interest and principal. It comes after the grace period.
- *Payback period:* The payback period is ''defined as the expected number of years required to recover the original investment'' (Brigham et al. 1997). It takes account of all cash flow regarding debt, stocks, revenues, etc.
- *Concession period:* The concession period defines the time span in which the concessionaire has the right to develop and operate the infrastructure facility before it is transferred back to the public owner.
- *Design/build period:* This regulates the period of the first stage of a BOT project. The end of this period indicates the beginning of the operating period.
- *Tax rates:* These affect the net income and the outcomes of the financial reports in a project. In the Taiwan High Speed Rail project, both the business income tax and the value-added tax are considered. The business income tax comes with the income of a business entity (a company, a store, etc.), while the value-added tax accompanies the sales of goods or products.
- *Interest rate of deposit:* The interest rate of the deposit is another basic factor in financial planning. It relates to earnings from the deposit.
- *Return on common equity (ROE):* Equity is mostly raised by issuing stocks. Thus, the rate of return on the common equity (or the rate of return on the stockholder's investment) becomes crucial, for it influences the willingness of the public to invest on the project. Preferred stocks are not considered in the financial model developed by BOTHSR.
- *Inflation rate:* Most of the time, a BOT project may last for decades. Therefore, the inflation should be taken into account.
- *Distant rate:* In the real world, the currency value usually depreciates year by year. Accordingly, the value of time should not be neglected. The discount rate is determined by the interest rate of the long-/medium-term loan, the return on equity, and the debt/equity ratio (Chen 1998). It can be presented as the following equation:

$$\text{Discount rate} = (\text{Interest rate of long-/medium-term loan}) \cdot \text{Debt percentage} + (\text{Return on equity}) \cdot \text{Equity percentage}$$

- *Earning reserve:* Due to contracts or laws, the earning reserve from the net income is sometimes required. It ensures the continuing operation of a business, without sharing all the profits with the stockholders, and is often a fixed proportion of the net income.
- *Ticket price in a specific year:* The purpose of this item is to compute the future ticket revenue in the operating period.
- *Royalty:* The royalty, sometimes called the balance fund, is a means used by the government to prevent the concessionaire from gaining unreasonable excess profits. In the Taiwan HSR project, the concessionaire has to pay the royalty only when the payback period ends and the net main business income (Main business income = Operating revenue + Revenue from affiliated business − Operating/maintenance cost − Depreciation) is greater than zero. The payment is usually made on a yearly basis and the amount is usually a percentage of the annual operating income or net profit. The government can change the royalty based on the profit level of the concessionaire.
- *Interest rate and period of bond:* ''Like a term loan, a bond is a long-term contract under which a borrower agrees to make interest and principal payments, on specific dates, to the holder of the bond'' (Brigham et al. 1997). The difference between the two is that ''a bond issue is generally advertised, offered to the public, and actually sold to many different investors'' (Brigham et al. 1997). Certainly, both the interest rate of the bond and when it matures should be known.
- *Currency exchange rate:* In a big project such as HSR, there might be international companies or bidders joining the project, so the setting of the currency exchange rate is necessary.

Variables

The following items are considered as variables that need to be built into the financial model. The variables change with the scenario and include:

- Annual construction cost requirement in each construction/engineering item
- Investment percentages for both the concessionaire and the government in each construction/engineering item
- Annual operating income and affiliated business income in the operating period
- Annual operating/maintenance cost, assets purchase cost and assets replacement cost in the operating period
- Annual net profit from station area development

MODEL DESCRIPTION

The financial model of the Taiwan High Speed Rail project is an important tool for the Bureau of Taiwan High Speed Rail (BOTHSR) in evaluating bidders' proposals and laying the foundation for negotiating concession agreements. The following text demonstrates the basic concepts of the model. The readers need to be advised that sample data are used throughout the paper (Chen 1998). They are not the real data used either in the government's final plan or in the concessionaire's proposals.

BASIC ASSUMPTIONS

Most values in this section are based on the rates in Taiwan. For the convenience of explanation, sample data may be taken from the base case (Case A in the scenario analysis) as an example.

Private Capital Structure

Private capital structure relates to the equity percentage and debt percentage of the concessionaire's capital.

Private Debt Arrangement

The major debt source comes from the long-/medium-term loans, and the corresponding interest rate should be estimated for computation. It is estimated at 9% in this model. In the Taiwan HSR project, the grace period starts from 1996 to January 2003, which is counted as eight years. The payback period starts in 2004 and lasts for 12 years. The interest rate for the short-term loans (within one year) in this model is estimated to be 8.025%.

Operations

In this project, the concessionaire is granted a concession period of 30 years, which comes right after the construction period. The concessionaire is responsible for the operation and maintenance of the HSR during the concession period. At the end of the concession period, the HSR will be transferred to the government.

The total design/build period is assumed to be 14 years and starts in 1990. The operating period starts in 2003 and lasts for 30 years. (This period coincides with the concession period.)

Some other rates are listed below:

- Business income tax = 25%
- Value-added tax = 5%
- Royalty (in the base case) = 0%
- Earning reserve (after the trust fund) = 20%
- Deposit interest rate = 6.5%
- Return on equity (before taxes) = 24%
- Discount rate (in the base case) = 13.5%
- Inflation rate = 3.5%
- Ticket rate in 1994 = US$0.15/mile/person (NT$3.11/km/person)

Governmental Capital Arrangement

The capital source of the government is the A-Bond, which is issued by the government and is repaid with the governmental budget. The A-Bond has an interest rate of 6.9% and a period of 15 years. The government pays interest to the owners of the A-Bond every year for the first 14 years and pays both the last interest and the entire principal to the owners of the A-bond at the end of the 15th year. The issuing fee for A-Bond is 0.2% for the first issue and 0.1% for the principal repayment.

BASIC DATA INPUT

The annual ridership (person-mile/year) forecast plays an important role in estimating the financial requirements and the self-financing ability. With a precise forecast of the ridership, the annual operating revenues in the operating period can be computed by multiplying the annual ridership by the annual ticket rate.

On the other hand, possible income sources (such as the affiliated business, the land development, and the sale of equipment) and possible cost sources (such as the maintenance cost, the cost of asset purchase, and the cost of asset replacement in the operating period) should all be estimated.

DEVELOPMENT COST REQUIREMENTS

In the Taiwan High Speed Rail project, the ''Self-Financing Ratio'' is an important indicator. It estimates the percentage of possible private investment with the premise of satisfying the financing conditions of the capital market and the return on private investment. It can be defined as follows:

Self-financing ratio (SFR) = Net present value (NPV) of cash

flows at the start of the operation period

/Net future value (NFV) of development costs at the end of

the construction period

The cash flows in the operating period are calculated according to the following equation: Cash flows in operation period = Operating income + Affiliated business income + Revenues from the sale of assets − Operating cost excluding depreciation and interest − Affiliated business cost excluding depreciation and interest − Cost of assets purchase and replacement. After the value of SFR is calculated, the approximate percentage of the total project cost that the concessionaire is willing to take can be finalized.

Most monetary outflows occur in the construction period and thus, detailed monetary information is crucial in the assessment of the financial conditions in this period. Annual cost requirements and investment ratios of the governmental investment to the private investment for different construction items are shown in Table 1. The government/private ratios shown in Table 1 are referred to the base case.

Once the costs and the investment ratios are determined, the individual investments of both the government and the concessionaire can be obtained. These are key to later calculation.

SELF-FINANCING ABILITY ANALYSIS

The self-financing ability is used to assess how much or what percentage of the cost spent in the development/construction period can be recovered through the net income earned in the operating period. The higher the percentage is, the better the return on investment. Also, a higher self-financing ability represents a more stable financial status in the operating period.

In this model, the self-financing ability is presented in two aspects, the overall investment and the private investment. Their calculation methods are almost the same. The self-financing ability is computed by dividing the total net cash inflow in the operating period by the total development cost: Total net cash inflow = Operating income + Affiliated business income + Revenue from land development − Operating maintenance cost − Asset purchase cost − Asset replacement cost − Royalty. This value is effective for both aspects. The difference between the two aspects is the amount of the cost in the development/construction period. The overall investment uses the overall development/construction cost, while the private investment uses only the construction cost invested by the concessionaire.

The self-financing ratios in the base case (including the land development) for the overall and private investments are 60.16 and 100%, respectively. It stands to reason that the self-financing ratio for private investment should be 100% or approaching 100% so that private sectors are willing to take over the project. The non-self-financing part of the overall invest-

TABLE 1. Costs and Investment Ratios on Different Items

Items	Costs (million USD)	Costs (million NTD)	Government/ private ratios
Taipei area underground rail	611	20,171	100/0
Civil construction	5,291	174,606	12.89/87.11
Rail construction	567	18,713	0/100
Station construction	435	14,353	0/100
Maintenance depot construction	401	13,226	0/100
Electricity engineering	243	8,010	0/100
Ticketing engineering	31	1,036	0/100
Mechanical/electrical core system	2,305	76,081	0/100
Environmental protection engineering	303	10,001	0/100
Contingency	545	17,998	0/100
Design and supervision	479	15,817	100/0
Land acquisition and compensation	2,179	71,909	100/0

Note: USD = U.S. dollars.

TABLE 2. Cost Requirement of Taiwan HSR Project by Year

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total
1. Taipei area underground rail	0	0	0	0	0	59	80	59	97	117	102	67	26	4	611
2. Civil construction	0	0	0	0	0	0	23	45	328	1,082	1,717	1,256	578	262	5,291
3. Rail construction	0	0	0	0	0	0	0	0	1	32	166	221	116	30	566
4. Station construction	0	0	0	0	0	0	0	0	11	54	115	137	91	26	434
5. Maintenance depot construction	0	0	0	0	0	0	0	9	38	74	97	95	65	22	400
6. Electricity engineering	0	0	0	0	0	0	0	6	20	34	43	49	59	33	244
7. Ticketing engineering	0	0	0	0	0	0	0	1	1	1	3	11	11	3	31
8. M/E core systems	0	0	0	0	0	0	0	51	71	70	133	411	949	621	2,306
9. Environmental protection engineering	0	0	0	0	0	0	0	9	33	56	64	62	54	25	303
10. Contingency	0	0	0	0	0	1	3	10	36	84	131	124	103	53	545
11. Design and supervision	4	13	46	37	3	42	72	54	41	42	45	41	30	11	481
12. Land acquisition and compensation	0	0	0	0	0	532	1,090	558	0	0	0	0	0	0	2,180
Total	4	13	46	37	3	634	1,268	802	677	1,646	2,616	2,474	2,082	1,090	13,392

Note: Unit = million U.S. dollars. Exchange ratio: USD:NTD = 1:33.

TABLE 3. Governmental and Private Investment Percentage

Item	Total	Government investment proportion	Private investment proportion	Government investment amount	Private investment amount
1. Taipei area underground rail	611	100%	0%	611	0
2. Civil construction	5,291	12.89%	87.11%	682	4,609
3. Rail construction	566	0%	100%	0	567
4. Station construction	434	0%	100%	0	435
5. Maintenance depot construction	400	0%	100%	0	401
6. Electricity engineering	244	0%	100%	0	243
7. Ticketing engineering	31	0%	100%	0	31
8. M/E core systems	2,306	0%	100%	0	2,305
9. Environmental protection engineering	303	0%	100%	0	303
10. Contingency	545	0%	100%	0	545
11. Design and supervision	481	100%	0%	479	0
12. Land acquisition and compensation	2,180	100%	0%	2,179	0
Total	13,396	30%	70%	3,952	9,440

Note: Unit = million U.S. dollars.

ment (39.84%) stands for the cost paid by the government on the Taipei area underground rail, design and supervision, land acquisition and compensation, and part of the civil construction cost (Tables 2 and 3). These are primarily the responsibility of the government.

INCOME STATEMENT

The income statement is focused on the revenues and costs from the main business (HSR operation revenue and costs, affiliated business revenues, and depreciation) and other businesses (land development, sales of equipment, interest, and so forth) in the operating period. Additionally, the royalty and taxes are also taken into account. This statement shows the net income after tax and the effectiveness of management in the operating period. High after-tax net income is favorable.

STATEMENT OF EQUITY

This statement relates much to the stockholders' interest. It also comprises part of the balance sheet. Stocks, retained earnings, trust funds, earning reserves, and the net income available are all components of the statement of equity. In this project, due to different financial regulations in Taiwan, there are several terms that need to be clarified. The trust fund in Taiwan refers to the fund companies have to raise from the net income according to the financial laws. The earning reserve is regulated by companies themselves and does not always exist. It can be used to pay debt. Once the amounts of the trust fund and the earning reserve are set, the net income available to stockholders can be calculated and the dividends can be determined. The retained earning is the sum of the trust fund, the earning reserve, and the net income available. Furthermore, the sum of the stocks and the retained earning forms the equity.

BALANCE SHEET

The balance sheet focuses on the assets, liabilities, and equity conditions of a project. The amount of the assets should equal the sum of the liabilities and the equity. If the amounts are not equal, measures should be taken (i.e., taking either more assets or more debts) to balance the sheet.

Assets

Assets include liquid assets and fixed assets. Cash and receivables are considered liquid assets, while fixed assets contain all the construction and engineering costs mentioned before, minus depreciation.

Liabilities

Liabilities include liquid liabilities and long-term liabilities. Liquid liabilities have two components: short-term loans and payables.

Equity

Equity refers to the retained earning and the equity.

STATEMENT OF CASH FLOWS

This statement deals with all cash inflows and cash outflows throughout the project. Cash flows in three different kinds of activities are calculated. The three different activities are the business activity, the investment activity, and the financing activity. The purpose of this statement is to know the cash requirement and/or surplus at each different point in time. If the cash on hand is not enough, some financing measures are needed to meet the financial needs.

Business Activity Cash Flows

The operating revenues (excluding the 5% value-added tax), the affiliated business revenues, the interest received, and the revenues from the land development are the positive items in this group. Negative items here are the operating/maintenance costs, the interest costs, the royalty, and the business income tax. The sum of all the items is the net cash inflow in the business activity.

Investment Activity Cash Flows

The investment activity includes almost all cash outflows. They are the construction costs and the financing costs (the capitalized interest) in the construction period, the assets purchase costs, and the assets replacement costs. The only cash inflow considered here is the sale of assets. Again, the net cash flow can be acquired by adding all of these items together.

Financing Activity Cash Flows

The financing activity net cash flows can be obtained by adding the long-term loans, the short-term loans, and the equity, then subtracting the issued dividends and the amount of earning reserve used to pay debts.

FINANCIAL INDICES

All the financial statements and sheets discussed before are crucial and necessary to a business entity. However, it is not easy to make a quick and wise decision with merely these financial reports. Thus, some financial indices are introduced to help users grasp the key of the financial analysis and make a quick and correct decision. Four financial assessment methods are available in this model, namely, the net present value method (NPV), the internal rate of return method (IRR), the payback period method, and the discount payback period method. They can be defined (Brigham et al. 1997) as follows:

- *Net present value* (*NPV*) *method:* This method is to discount all the cash flows back to the present year (or a specific year). A zero value of NPV represents the break-even point of a project. If the value of NPV is zero or positive, the project is worth investing. Conversely, if the value of NPV is negative, it is better to decline the project.
- *Internal rate of return (IRR) method:* IRR is the rate of return that assumes the NPV value of a project to be zero. To evaluate a project with IRR, just compare it to the estimated cost of capital. If the IRR is greater than the weighted average interest rate, the project is acceptable. Otherwise, it is a better idea to reject the project.
- *Payback period method:* This method involves adding the cash inflows and outflows together year by year without discounting. When the sum of zero is reached, the payback period is found. The shorter the payback period is, the faster the recovering of the investment and the more feasible the project.
- *Discount payback period method:* This is almost the same as the payback period method but discounting all cash flows back to a specified year (usually the first year of the period of concern). Also, it is better to have a shorter discount payback period.

SUMMARIZED DATA

Case A is the base case in the financial modeling of the Taiwan HSR project. All the other cases are modified based on Case A. Table 2 demonstrates the construction costs of each construction item. These assumed costs are fixed throughout the financial planning of the Taiwan High Speed Rail project. Table 3 shows the investment percentages of the government and the concessionaire. The parameter information of Case A is shown as follows:

- Debt/equity ratio = 70/30
- Operating period = 30 years
- Financing interest rate = 9.0%
- Concession period = 30 years
- Business income tax rate = 25%
- Grace period = 8 years
- Value-added tax rate = 5%
- Discount rate = 13.5%
- Deposit interest rate = 6.5%
- Inflation rate = 3.5%
- Design/construction period = 14 years
- Debt repayment period = 12 years
- Debt sources = medium-/long-term loans
- Royalty (% of the operating revenue) = 0%
- Return on equity (before taxes) = 24%
- Earning reserve (after the trust fund) = 20%
- Short-term load interest rate (within a year) = 8.025%
- Start/end year of grace period = 1996/January 2003
- Start year of development period = February 1990
- Start year of operating period = February 2003
- Start year of debt repayment period = 2004
- Ticket price in 1994 (USD/mile) = 0.151

With this information, the development cost invested by the government and by the concessionaire can be calculated. Table 4 lists the construction cost invested by the concessionaire item by item.

TABLE 4. Construction Cost Invested by Concessionaire by Year

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total
1. Taipei area underground rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Civil construction	0	0	0	0	0	0	20	40	285	942	1,496	1,094	503	229	4,609
3. Rail construction	0	0	0	0	0	0	0	0	1	32	166	221	116	30	566
4. Station construction	0	0	0	0	0	0	0	0	11	54	115	137	91	26	434
5. Maintenance depot construction	0	0	0	0	0	0	0	9	38	74	97	95	65	22	400
6. Electricity engineering	0	0	0	0	0	0	0	6	20	34	43	49	59	33	244
7. Ticketing engineering	0	0	0	0	0	0	0	1	1	1	3	11	11	3	31
8. M/E core systems	0	0	0	0	0	0	0	51	71	70	133	411	949	621	2,306
9. Environmental protection engineering	0	0	0	0	0	0	0	9	33	56	64	62	54	25	303
10. Contingency	0	0	0	0	0	1	3	10	36	84	131	124	103	53	545
11. Design and supervision	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12. Land acquisition and compensation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	1	23	126	496	1,347	2,248	2,204	1,951	1,042	9,438
Total future value of 2003	0	0	0	0	0	1	54	269	935	2,237	3,287	2,838	2,216	1,042	12,879

Note: Unit = million U.S. dollars.

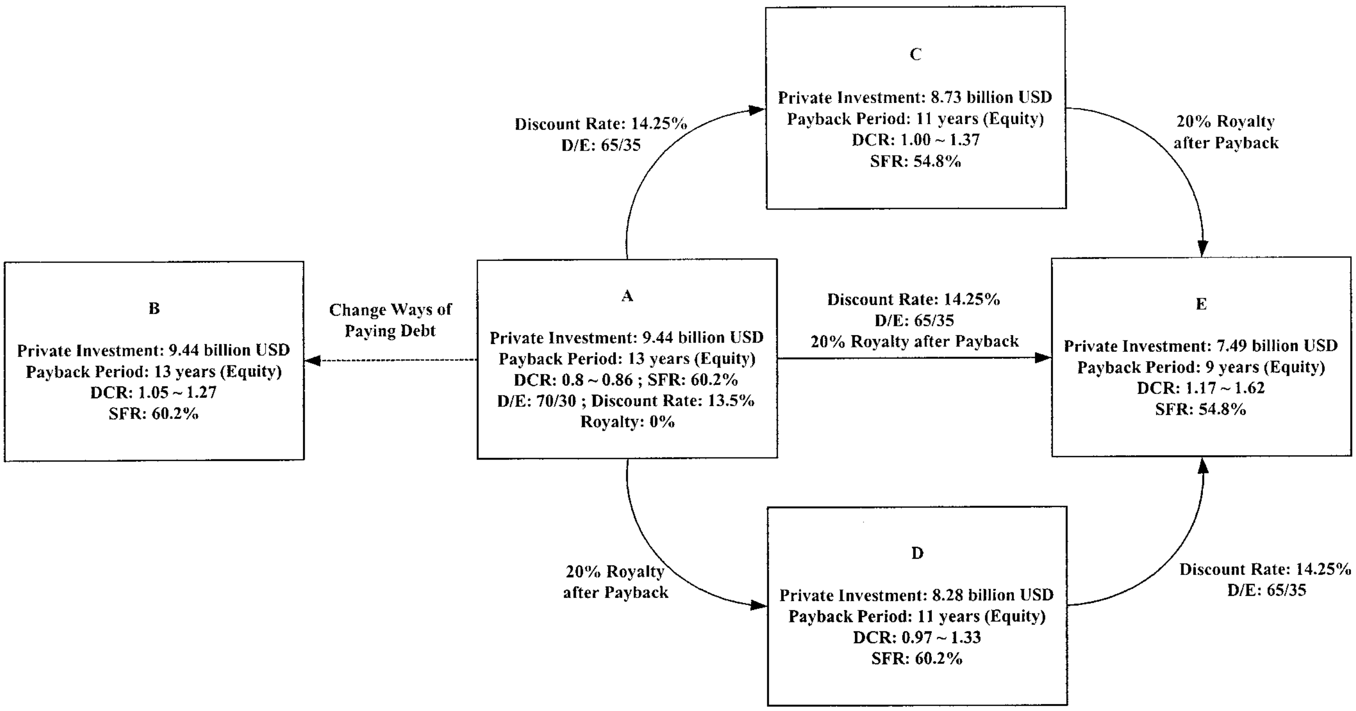


FIG. 2. Scenario Diagram

SCENARIO ANALYSIS

The rationale of the financial model developed by the Bureau of Taiwan High Speed Rail (BOTHSR) has been described. However, what is more important is how to use this financial model to evaluate scenarios of different kinds of capital and revenue combinations. In this paper, practical applications of the financial model are to be introduced. Five representative scenarios are demonstrated in the following sections (Chen 1998).

Case A is the base scenario and all other scenarios are slightly changed based on Case A. (Variables are kept constant, but parameters are slightly changed.) Fig. 2 shows the relationship among the five scenarios. Case B is basically the same as Case A except for the way of paying debt. The debt/equity ratio is changed from 70/30 to 65/35 in Case C. A royalty of 20% is added to Case D. Case E is the combination of Cases C and D.

THREE VIEWPOINTS

Each case can be evaluated from three different points of view: (1) overall cash flows; (2) equity; and (3) dividends (Chen 1999).

Viewpoint of Overall Cash Flows

The viewpoint of overall cash flows encompasses the annual construction cost invested by the concessionaire in the construction period (as shown in Table 4) and the preliminary net profit in the operating period (Fig. 3). The preliminary net profit is calculated by using the following equation:

$$\text{Preliminary estimated net profit} = \text{Estimated net income} - \text{Royalty} - \text{Business income tax} - \text{Earning reserve}$$

The estimated net income refers to the net income computed from the estimated raw revenues and costs, with no complex financing factors involved. In other words, no equity raising or debt borrowing is considered in the construction period. Therefore, in Fig. 3, only the term "construction cost" is used, without "equity" or "debt" specified. There are also no interest or dividends involved in the operating period. Thus, the net profit in the operating period is called "preliminary net profit." The viewpoint of overall cash flows provides a simple and quick way (only with raw input data) to help the concessionaire find out the number of years required to recover the original investment.

Viewpoint of Equity

The viewpoint of equity takes account of the equity invested in the construction period and the total net profit before dividends are given to stockholders in the operating period. The total net profit here comes from the statement of cash flows, which considers financing-related items such as loans, interest,

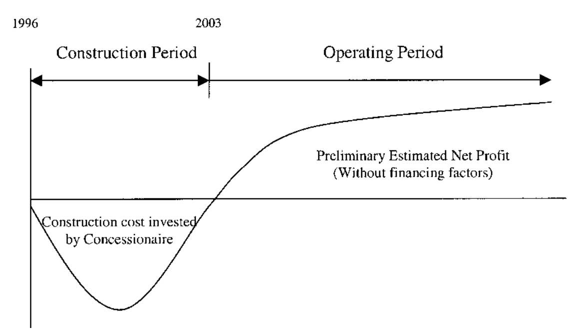


FIG. 3. Cash Flow Concept—Viewpoint of Overall Cash Flows

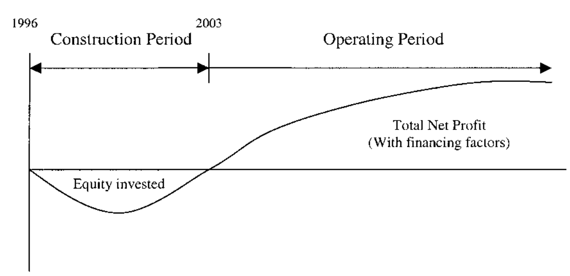


FIG. 4. Cash Flow Concept—Viewpoint of Equity

stocks, dividends, and so forth. Fig. 4 simply depicts the concept of cash flows from this viewpoint. The purpose of this viewpoint is to serve as a reference for stockholders. (The concessionaire is also a stockholder.) In this way, the concessionaire will know how long it will take for their investment to be recovered with the total net profit in the operating period.

Difference between Viewpoint of Overall Cash Flows and Viewpoint of Equity

The purpose of the viewpoint of overall cash flows is to provide a simple and quick way to help the concessionaire gain an idea about the payback period of its investment with the raw input data. The purpose of the viewpoint of equity is to help stockholders (including the concessionaire) understand how long it will take for their equity investment to be recovered with the total net profit.

The difference between the preliminary net profit from the viewpoint of overall cash flows and the total net profit from the viewpoint of equity is as follows: The preliminary net profit is calculated based on the raw input data, without financing factors involved, while the total net profit is computed based on the statement of cash flows and involves financial factors such as loans, interest, stocks, and dividends.

Viewpoint of Dividends

From the viewpoint of dividends, the equity invested in the construction period and the dividends paid to stockholders in the operating period are considered. This viewpoint also provides information to stockholders about the length of time during which the dividends given to stockholders in the operating period can recover the equity investment (by stockholders) in the construction period. Fig. 5 depicts the cash flow concept from this viewpoint.

Difference between Viewpoint of Equity and Viewpoint of Dividends

From the viewpoint of equity, stockholders could know how long it would take for their investment to be recovered with the total net profit (before dividends are given to stockholders), which indirectly represents the concessionaire's profit-making ability to earn back the stockholders' investment. From the viewpoint of dividends, stockholders are able to know how long it would be before they could get back their investment (the amount of capital they spent) in the form of dividends.

DEBT COVERAGE RATIO

In addition to the three points of view, the debt coverage ratio (DCR) is also used to evaluate the five scenarios. The debt coverage ratio (DCR) is defined as follows:

Debt Coverage Ratio = (Earnings before interest & taxes (EBIT) + Depreciation)/Principal & interest paid

EBIT is the remainder of the net sales subtracting the costs,

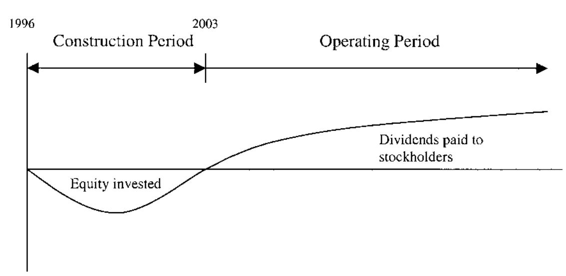


FIG. 5. Cash Flow Concept—Viewpoint of Dividends

which include depreciation. However, depreciation is not a real cash outflow. It represents the wearing-out of the equipment. Therefore, to present the concessionaire's available capital to pay debt, depreciation is added back to EBIT. Debt coverage ratio shows the concessionaire's ability to pay debt. The higher the debt coverage ratio, the better the concessionaire's debt-paying ability. The debt coverage ratio influences the willingness of banks to loan money to the concessionaire. Generally speaking, a debt coverage ratio at least equal to or larger than 1.0 is acceptable (Brigham et al. 1997).

CHECK INDEX

The last thing to mention is the check index of the financial model. The BOTHSR uses the check index to prevent the existence of unreasonable access profits made by the concessionaire when conducting financial planning. The check index is like a monitor that examines and controls the profit level of the concessionaire. The value of the check index should always be kept at 1. That is why it is named the ''check index.'' When the check index equals 1, the concessionaire makes the exact amount of profit as the return on equity (ROE) set by the concessionaire itself. The check index is defined as follows:

Check Index = NPV of operating revenues at the start of operating period from the standpoint of the concessionaire /NFV of construction costs invested by concessionaire at the end of the construction period

The operating revenues in the equation are the amounts of the estimated net income minus the royalty. In financial planning, the setting of the check index to 1 makes the profit level of the concessionaire equal to its return on equity (ROE). Return on equity is a component of the discount rate; therefore, the ROE is implicitly included in the calculation of NPVs and NFVs. In this situation, the project is ''exactly profitable'' to the concessionaire. The concessionaire earns only the return on equity (ROE) set in the financial model and no excess profits exist. Every time a new scenario is entered, the check index should be adjusted to 1. The adjustment is made by changing the investment percentages between the government and the concessionaire (as shown in Table 3). In the Taiwan HSR project, the BOTHSR only changes the investment percentage of ''Civil Construction'' to adjust the check index to 1, because it is the most expensive item in the project. When the check index is less than 1, the investment of the government should increase so that the construction cost invested by the concessionaire will decrease and raise the value of the check index. Another way of thinking of this is: For the concessionaire, a check index less than 1 means the project is not profitable enough (i.e., it cannot reach the profit level of ROE); therefore, the amount of investment should decrease. Likewise, when the check index is greater than 1, the investment of the concessionaire should increase. A check index greater than 1 makes the concessionaire willing to invest more. On the other hand, the excess profits make the government unwilling to provide as much financial support and the investment of the government would be reduced (Chen 1999).

CASE A

Case A is the base case of the financial modeling, and the parameters are reasonably assumed based on the taxes and rates in Taiwan. Because the emphasis is placed on the comparison of results from different parameter assumptions, the parameters and the results for each case are listed in Table 5. Fig. 6 depicts the graphical results from the viewpoints of

TABLE 5. Summary Table of Parameters and Results

Item	Case A	Case B	Case C	Case D	Case E
(a) Parameters					
Debt/equity ratio	70/30	70/30	65/35	70/30	65/35
Debt arrangement:					
Interest rate	9%	9%	9%	9%	9%
Grace period	1996–2003	1996–2003	1996–2003	1996–2003	1996–2003
Debt repayment period	12 years	12 years	12 years	12 years	12 years
Return on equity (before taxes)	24%	24%	24%	24%	24%
Discount rate	13.5%	13.5%	14.25%	13.5%	14.25%
Royalty	0%	0%	0%	20%	20%
Concession period	30 years	30 years	30 years	30 years	30 years
Inflation rate	3.5%	3.5%	3.5%	3.5%	3.5%
Business income tax	25%	25%	25%	25%	25%
Value-added tax	5%	5%	5%	5%	5%
Earning reserve	20%	20%	20%	20%	20%
Deposit interest rate	6.5%	6.5%	6.5%	6.5%	6.5%
(b) Results					
Self-financing ratio	60.2%	60.2%	54.8%	60.2%	54.8%
% of private investment	70.5%	70.5%	65.2%	61.8%	50.3%
Amount of governmental investment	3.95 billion USD	3.95 billion USD	4.66 billion USD	5.11 billion USD	5.90 billion USD
Amount of private investment	9.44 billion USD	9.44 billion USD	8.73 billion USD	8.28 billion USD	7.49 billion USD
Debt coverage ratio	0.8 ∼ 0.86	1.05 ∼ 1.27	1.00 ∼ 1.37	0.97 ∼ 1.33	1.17 ∼ 1.62
Payback period					
Viewpoint of overall cash flows	9 years	9 years	9 years	8 years	8 years
Viewpoint of equity	13 years	13 years	11 years	11 years	9 years
Viewpoint of dividends	14 years	14 years	13 years	13 years	13 years

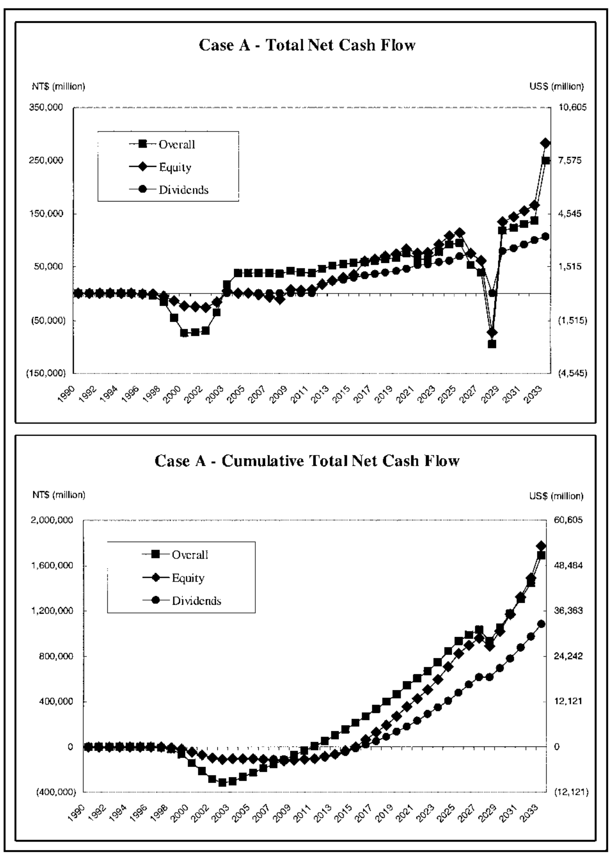


FIG. 6. Case A—Three Viewpoints

overall cash flows, equity, and dividends. The results of the debt coverage ratios are shown in Fig. 7.

In Fig. 6, a negative net cash flow occurs in the year 2028. This arises from the capital investment in maintenance and renewal before the transfer of HSR to the government in 2033. The negative net cash flow in 2028 also appears in all the other cases.

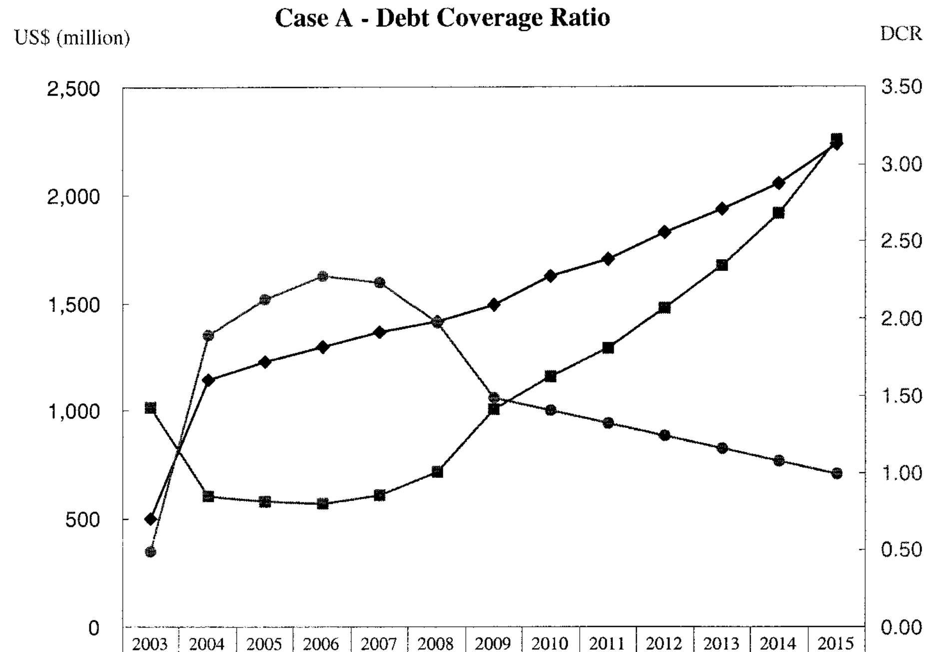
From the viewpoint of overall cash flows, the payback year is 2011. From the viewpoint of equity, the concessionaire can take back the amount of equity invested in the construction period in the year of 2015. From the viewpoint of dividends, the amount of the cumulative dividends at the end of 2016 can cover all the equity investment in the construction period (Fig. 6). This means that, by the end of 2016, stockholders will have taken back their investment on the Taiwan HSR project in the form of dividends. After 2016, even if the concessionaire goes bankrupt, stockholders will not have any loss. The lowest debt coverage ratio is 0.80, which occurs in the year of 2006. After 2008, the debt coverage ratio remains above 1.0 (Fig. 7).

SUMMARY

The purpose of the scenario analysis is to find the relationship between the change of parameters and the result of evaluation. The scenario diagram in Fig. 2 integrates all the cases and their interrelationship. In the scenario diagram, only the payback periods from the viewpoint of equity are shown. The range of the debt coverage ratio in each case is spanned by the four lowest values of debt coverage ratio in the corresponding case. The parameters and results of the five cases are summarized in Table 5.

Case A is the base case in the scenario analysis. The other four cases are slightly different from Case A in either the parameters (debt/equity ratio or royalty) or the way of paying debt. When a change is made to Case A, the check index should be adjusted to 1. This ensures that the concessionaire's profit level equals the return on equity (ROE) set by the concessionaire itself.

In Case B, the way of paying debt (including both the principal and interest) is changed from paying more debt (both the principal and interest) in the first few years of the operating period to paying the same amount of debt each year. This makes large amount of the debt paid at later points in time and devaluates the cost of the payments. Thus, the concessionaire has more net income available in the first few years of the operating period. This explains why the debt coverage ratio (DCR) in Case B is higher than in Case A in the first few years of the operating period (2004 ∼ 2008). For example,



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Annual Earning Before Interest & Taxes (EBIT) + Depreciation	500	1,143	1,229	1,295	1,365	1,415	1,492	1,625	1,702	1,827	1,936	2,055	2,237
Annually Paid Principal & Interest	351	1,352	1,519	1,623	1,596	1,408	1,060	1,001	943	884	826	767	709
Debt Coverage Ratio	1.42	0.85	0.81	0.80	0.86	1.01	1.41	1.62	1.81	2.07	2.35	2.68	3.16

FIG. 7. Case A—Debt Coverage Ratio

the DCR of Case B in 2004, 1.05, is greater than the DCR of Case A in 2004, 0.85.

The change of the debt/equity ratio from 70/30 to 65/35 forms Case C. Because the increase in equity and the fact that the return on equity (24%) is greater than the debt interest rate (9%), the discount rate is raised from 13.5 to 14.25%. (Discount rate = ROE · % Equity + Debt Interest Rate · % Debt.) The raise of the discount rate makes the NPV of the operating income smaller and the NFV of the construction cost larger. Consequently, the self-financing ratio is lowered and the check index is less than 1. In order to raise the check index to 1, the investment by the concessionaire would be reduced. The decrease of the debt percentage and the reduction of the concessionaire's investment both diminish the debt. Thus, the smaller debt results in higher debt coverage ratios (DCR) and a shorter payback period.

Royalty is used in Case D in order to reduce the excess profits made by the concessionaire. However, the effect of royalty brings about a lesser investment by the concessionaire. The smaller investment amount causes a smaller amount of debt and shortens the payback period. Also, the decrease of debt makes a higher debt coverage ratio.

Case E is the combination of Cases C and D and inherits the advantages from both cases. Among all the cases, Case E has the shortest payback period, the greatest debt coverage ratio, and the least amount of private investment.

With the scenario analysis, the government or the concessionaire can easily find out a better scenario with merely a little change in parameters or variables. As Case E mentioned above, changing the debt/equity ratio and adding royalty to Case A brings about a better solution with a shorter payback period, less private investment, and greater debt coverage ratio.

CONCLUSIONS

Due to the high cost involved in the Taiwan HSR project, a financial model is developed by the Bureau of Taiwan High Speed Rail (BOTHSR) for financial planning and examination of bidders' proposals. With easy input of parameters and variables, the financial model can come up with useful financial reports and graphs to help users know more about the result of the scenario according to the input data. Users can try different scenarios by applying the financial model to find the most optimal solution. This model is originally designed for BOT projects. It takes account of the investment proportions of the government and the concessionaire, the concession period, and other items featured in BOT projects.

The developed financial model provides a useful mechanism to the government. With it, the government will be able to map out the optimal blueprints for the best interest of the public while developing policies and negotiating with the concessionaire.

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