A FINANCIAL EVALUATION OF THE EUROTUNNEL PROJECT

by

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ABSTRACT

Recently, project financing based on privatization has become one of the critical issues for the construction of infrastructure. The Channel Tunnel between the United Kingdom and France was not able to be constructed for a long time due to the difficulty in its funding, although it has been possible technically.

At present, the tunnel is being constructed by Eurotunnel, a private sector Anglo-French group, without any government funding but with private financing. In particular, the success of public issues of shares of Eurotunnel determined the further existence of the project.

This thesis examines the financing of the Eurotunnel Project from the equity-holders' perspective, which represents Eurotunnel's position by employing the Valuation-by-Components Method accompanied with the Capital Asset Pricing Model. Floating interest rates based on risk-free forward rates are also adopted, and some sensitivity analyses have been done.

Adjusted Net Present Values have been obtained as results which show the financial viability of the project. Also, an option model valuation analysis of warrants on Eurotunnel shares is performed.

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Mr. Fumio Sugimoto, a candidate for doctor's degree, offered me the document summarizing the Eurotunnel project at the early stage of the preparation of my thesis. In my thesis, I referred Mr. Hirokazu Onozaki's thesis, which served me as a bench mark for my thesis preparation. Mr. Eiichi Nishikawa and his wife, Toshiko, invited me for dinner every time after the meeting with our thesis advisor, Professor Paddock, and gave me some interesting suggestions.

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SHINICHI OKANO

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CHAPTER 1. INTRODUCTION

Recently, project financing based on privatization has become one of the critical issues for the construction of infrastructure projects. The Channel Tunnel between the United Kingdom and France was not able to be constructed for a long time due to the difficulty in its funding, although it has been possible technically.

At present, the tunnel is being constructed by Eurotunnel, a private sector Anglo-French group, without any government funding but with private financing. Especially, the success in public issues of shares of Eurotunnel determined the further existence of the project.

In this chapter the history and the recent moves of the English Channel link are described. Also, the organization of this paper is described.

1.1 History of Channel Tunnel

Although there have been several approaches to link the United Kingdom and Europe, all of them have failed. The first plan of tunneling beneath the English Channel was made under the order of Napoleon Bonaparte in 1801.[1] The actual

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[1]"A Chunnel at last," Engineering News Record, January 23 1986, p. 164.

boring, about 4.8 kilometers from the British Island was tried by an English engineer in 1881. However, that trial was interrupted by the UK government. Afterwards, several groups planed to bore the tunnel in vain.

In 1971, the move to realization of the tunnel occurred both in the UK and France. Then, in 1974, the boring was started by both countries. The UK bored about 370 meters, while France could not dig the main bore because of accidents of the boring machine. Meanwhile, this plan was canceled due to the depression in the UK.

1.2 Recent Moves to the Realization of the Link between the English Channel

For nearly two centuries the idea has suffered mainly from political objections. More recently, financing became the major factor. As described in the previous section, work started in the early 1970's only to be halted quickly by the UK, which withdrew financial support during a time of economic difficulty. To avoid that happening again, the UK has since insisted that the project be financed privately with no government guarantees at all.

1.2.1 Moves in the First Half of 1980's

In the 1980's, the move occurred again. The European Economic Community launched its own feasibility study in the late 1970's. Also, British Rail reported the possibility of

a Channel tunnel as a privately financed project.[1] During the first half of the 1980's, several proposals for the English Channel crossing went to Britain's Department of Transport. The first proposal which was based on totally private financing and provided sufficient detail for serious consideration was made by the British contractor Tarmac, Ltd. and the banker Robert Fleming in 1981.[2]

In May 1984, the UK government rejected results of a two-year study by five major British and French banks. They concluded that some government backing was needed to bore twin railway tunnels, which they called "the only scheme that is both technically acceptable and financially viable." The French government took the same reaction as that of the British government's, and refused to support any scheme that depends on public funds, but pointed to possible support by the European Economic Commission.[3]

On the other hand, in 1983 the European Economic Community pointed out that the objectives of the study should be to assess whether the Common Market could offer a guarantee.[4] In November, 1984, both governments agreed that

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[1]"Channel tunnel reviving," ibid., January 3 1980, pp. 15-16.

[2]"Private Chunnel plan proposed," ibid., January 22 1981, p. 5.

[3]"Pessimistic report: Governments refuse backing for English Channel crossing," ibid., May 31 1984, p. 31.

[4]"Old dream rekindled: Common Market may revive English Channel crossing," ibid., March 10 1983, p. 23.

any such project should be built without government funding or financial guarantees.[1]

Channel crossing moved dramatically in the direction in favor of its realization that year. The switch by France to require private rather than public funds for the project helped negotiations immensely. Also, Thatcher, formerly cool to the project, became an enthusiastic backer.[2]

1.2.2 Proposals

In October, 1985, 10 groups vying to build and operate it submitted proposals to the French and British government.[3] The two proposals appeared to have a clear lead because they already had the backing of major companies and were based on proven technology.

The one from Britain's Channel Tunnel Group Ltd. (CTG) and its French counterpart, France Manche SA, offered a $3.3-billion twin tunnel carrying highway vehicles on rail cars, as well as through freight and passenger trains.

A more ambitious $7.5-billion, multifaceted plan by Euroroute Ltd. (UK) and its counterpart, Euroroute France, avoided loading delays, providing greater capacity. It

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[1]"English Channel tunnel revives," ibid., November 22 1984, pp. 18-19.

[2]"Channel crossing moves: Designers, contractors, banks scurry to put together packages," ibid., December 13 1984, p. 17.

[3]"English Channel link: not whether but which," ibid., November 7 1985, pp. 10-11.

included a four-lane bridge-tunnel plus a two-track rail tunnel. Choosing between the two was a classic case of balancing greater benefits against greater financial risk; that is, Euroroute's proposal had greater benefits, while CTG's and France Manche SA's proposal had a financial advantage.

Another proposal from British Ferries Ltd. had twin bored tunnels costing $3 billion. Rail tracks were embedded in the floor so traffic could alternate between vehicles and trains. Lack of a French partner was a serious handicap. Eurobridge Studies Group led the back of the field with a high-volume, high-tech plan costing $8.5 billion. Road traffic was on a string of seven suspension bridges with spans up to 3 miles long. Synthetic fiber cables carried three decks with six lanes each.

Also, included was a single-track rail bore. Other proposals included a number of bridges with turbines in their piers to generate electricity from tides. Finally, there was a double-deck bridge for rail and highway traffic. Its promoter's secret weapon was an airship that could assemble 1-mile suspension spans in 400-ton sections. Steel suspension rods, rather than cables, slash the cost to about $1.4 billion.

1.2.3 Decision of the Governments

On January 20, 1986, both governments announced that they had decided to choose the proposal from the partnership

of the Channel Tunnel Group Ltd.(CTG) of Great Britain and France Manche SA, its French counterpart, who were to build and operate twin 31-mile rail tunnels under the English Channel. They were to complete the $3.7-billion project by 1993. The partners included five major contractors as well as investment banks in each country.

Neither the French nor British government was entirely satisfied with their compromise decision, because "The least bad choice" was made.[1]

In the early stages, the French championed a $5.3-billion plan for bridge spans linked with sunken tube tunnels to carry road and rail traffic. It was put forward by Euroroute, another bi-national group. The British supported a scheme called the Channel Expressway, proposed by British Ferries Ltd., a Bermuda subsidiary of the mainly U.S.-owned firm Sea Containers Inc. It called for twin tunnels carrying both highway and rail traffic.

Soon after submitting proposals in October, both promoters modified them to add twin-bored rail tunnels. But the French rejected the Channel Expressway on technical grounds, in particular that its $3-billion price was unrealistically low. The British, meanwhile, maintained that Euroroute's string of 1,600-ft bridges and artificial islands would be vulnerable to bad weather.

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[1]"Chunnel decision is a compromise," ibid., January 30 1986, p. 13.

With the two governments unable to agree on a drive-through option and both in need of an employment-generating project to bolster declining popularity of their governments, the safe option (CTG's and France Manche SA's proposal with technical simplicity and strong financing) won out.

Besides technical simplicity, a big factor favoring the CTG/France Manche group was its strong financing. The three French and two British banks participating from the start enlisted 26 more banks, including 12 Japanese firms. They would provide a total of $5.9 billion in loans. With the $1.4 billion the group planed to raise in equity financing, promoters would be close to the $7.6 billion needed for construction and initial interest rates.

1.3 Establishment of Eurotunnel

On February 12, 1986, the treaty between the UK and France, which is the basic instrument authorizing and regulating the construction and operation of the System was signed by both governments, and the project actually started. Following the agreement of the treaty, Eurotunnel was established as a joint-venture of CTG and France Manche SA. On March 14, 1986, the concession agreement, under which Eurotunnel undertakes to carry out the development, financing, construction, and operation of the System until July 28, 2042, was made among four parties: both governments, CTG and France Manche SA. On August 13, 1986, a construction

contract between Eurotunnel and the contractor, which was a joint venture of ten major construction companies, was made.

In order to finance its project, although Eurotunnel went into a credit agreement with bankers in November 1987, drawing from the loan was conditioned to be available only after its total expenditure exceeds £700 million. Therefore, in September, 1986, Eurotunnel raised £47 million through the first issue of its founders' shares. Then, the second issue took place in the next month, by which it raised £206 million from institutional international investors.

1.4 Issue of Equity 3: Eurotunnel's Final Issue of Shares

Finally, as the last issue of Eurotunnel's shares, Eurotunnel offered public issues in the UK and France, together with an international issue in November 1987, through which it expected to raise a total amount of £770 million to be paid directly for digging the tunnels.

It could be said that the further existence of the project depended mainly on the success of this equity issue. Only a year before, the attempt of a £253 million private equity placement for Eurotunnel was a near-disaster in Britain. That early test of institutional investment interest in Eurotunnel went smoothly in Paris, but nearly flopped in London. Only after an unusual arm-twisting

campaign by the British Government did London institutions eventually invest in the project.[1]

In addition, this share issue was seen as a test for privatization of infrastructures. The Economist reported, just a month before the placement of issue, as follows:[2]

> The next step is to take "privatization" beyond going concerns and into utilities that are not yet building-sites. New crossings of the Thames at Dartford, and of the river Severn, are obvious British candidates. Airports and power stations (in a suitable privatized electricity industry) are other possibilities. The test is whether they can run themselves and charge fees to customers who have some measure of choice.
>
> In America that test could produce many projects - such as a new, fast train service between Boston and New York. Air links between the two cities are saturated. A French-style fast train would transform travel between them, just as it has done between Paris and Lyons. The state authorities could follow the channeling motions of the governments of Britain and France - define their needs, invite proposals, give permission to a chosen favorite, and insist that it persuade the market to provide risk capital.
>
> Japan could improve parts of its awful infrastructure in the same way, and the approach can work in the capital-hungry developing world too - through so-called BOT deals (build, operate, transfer). Bechtel of America, for example, is to build a power station in Turkey and run it for profit for 15 years, after which Turkey will have the right to buy it. This deal will bring Turkey $100m of inward investment - which, using traditional methods, is as much as it would get from all foreign firms in a whole year.

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[1]"Eurotunnel's Day of Reckoning," The New York Times, November 15 1987, p. 34.

[2]"Lots more chunnels," The Economist, October 10 1987, p. 13.

1.5 Organization of the Paper

In the previous sections, through the description of the history and the recent moves of the English Channel link, it has been disclosed that recently, financing has become the major factor for the construction of infrastructure, for even when technically viable, governments tend to avoid bearing the risk itself and insist that the project be financed privately with no government guarantees at all.

In order to actualize the project, privatizations are supposed to be the last way, so they are becoming important. The viability of the privatization of projects lies in the financial aspect of projects, especially in the placing of equity issues, through which funds to finance projects are raised at the very early stage of the construction when drawing from debts is not available. If the placement failed, in that case, it means that there is no one who is willing to be the owner of the project, nor willing to bear solely the risk for the return from it. In short, the success in the placement of equity issues determines not only the financial viability of the project but also the existence of it.

The objective of this paper is to examine the financial aspect of the Eurotunnel project, which provides a typical privatization case of a infrastructure.

In the next chapter, Eurotunnel's financial scheme is described. In Chapter 3, a financial analysis of a simplified base case is performed, and an adjusted net

present value of the cash flows is obtained as a result, which summarizes the financial viability of the project. The result together with assumptions made are discussed, and several sensitivity analyses are done in Chapter 4, followed by Chapter 5, where conclusions are given.

CHAPTER 2. PROJECT OUTLINE

The source of the following project outline is the prospectus for the equity issue 3, Eurotunnel: Offer for Sale, November 16, 1987, which is hereinafter called the Prospectus, unless otherwise described. Unless specified, all figures have been expressed in £ according to the Prospectus, in which the rates FRF10=£1 and US$1.50=£1 are used by Eurotunnel based on the latest (when the Prospectus was issued) exchange rate of £1=FRF10.1140 as of November 12, 1987.

2.1 General Project Outline

Eurotunnel System, planned to open in May 1993, will link the road and rail networks of Great Britain to those of France and the rest of continental Europe. The system will incorporate: twin rail tunnels (to be used by shuttles operated by Eurotunnel and through trains by both the British Railways and la Société Nationale des Chemins de Fer Français) and a service tunnel; terminals near Folkestone in the UK and at Coquelles near Calais in France with connections to national road and rail networks; specially-designed shuttles to carry passenger and freight vehicles between the terminals; and clearance depots for freight

adjacent to the France terminal and at Ashford near the UK terminal.

Eurotunnel is a private sector Anglo-French group which has been granted a concession to develop, finance, construct and operate the Channel Tunnel between the United Kingdom and France by both governments. Eurotunnel consists of Eurotunnel P.L.C. (hereinafter called EPLC) and Eurotunnel S.A. (hereinafter called ESA) as its UK and French parts respectively.

2.2 Concession Agreement

Under the terms of both the Treaty between the UK and France and the Concession Agreement, Eurotunnel is free to determine its own commercial policy, including the setting of tariffs. The Concession is in force for a period of 55 years from July 29, 1987 to July 28, 2042. In this agreement, the following terms are included:

- until the end of 2020, no second fixed link by others is to be facilitated by the governments;
- the UK part of the tunnel, the terminal and the freight depot will be owned by the UK State and grant leased to Eurotunnel;
- the French part of the tunnel including the terminal is owned by the French State and made available to Eurotunnel;

- there will be no discrimination in taxation relating to users of the system and the competitors;
- each of the concessionaires will be taxed only in its country of residence in respect of profits from the system.

2.3 Financing Requirement

Eurotunnel's financing requirement up to June 30,1993, which is shown below, will include all construction and overhead costs to be incurred during the construction phase as well as the financing costs incurred during construction.

Table 2.1 Financing Requirement

	(Unit: £ million)
Construction costs (at July, 1987 prices)	2,788
Eurotunnel's corporate and other costs (at July, 1987 prices)	642
Provision for inflation (in nominal terms; up to May 15, 1993)	469
Net financing costs (in nominal terms; up to June 30, 1993)	975
Total cost (in nominal terms)	4,874

The further breakdown and explanation of construction costs are shown in the subsequent section "Construction Contract". Eurotunnel's corporate and other costs include

management, operational, and administrative expenses together with provisional sums to cover expected additional project costs to be incurred by Eurotunnel prior to the start of operations. Net financing costs represent interest paid (net of interest earned) and bank fees.

2.4 Construction Contract

Eurotunnel has entered into a construction contract with a joint venture of ten major companies to design, construct, test, and commission a fully operational system for delivery by May 15,1993. The major items of construction expenditure (at July, 1987 prices) are estimated as follows:

Table 2.2 Construction Contract

in real terms	(Unit: £ million)
Target works:	1,367
Lump sum works:	1,169
Procurement items:	252
Total	2,788

2.4.1 Target Works

The tunnels and other underground structures are being constructed on a target cost basis with the Contractor being reimbursed for actual costs incurred plus a fixed fee of 12.36 per cent of the target cost. The contractor's profit share is 50 percent of the cost saved when the actual cost in real terms at completion is less than the target cost. On

the other hand, the Contractor will meet 30 percent of the excess in the actual cost over the target cost up to a point where the Contractor has borne an excess equal to six percent of the target cost.

2.4.2 Lump Sum Works

The buildings and all related infrastructure for the terminals, the fixed equipment, and the mechanical and electrical elements of the System will be constructed on a lump sum basis except for overruns caused by variations, additions, or inflation.

2.4.3 Procurement Items

The Contractor will conclude sub-contracts for the supply and installation of procurement items, principally the locomotives and shuttles. The Contractor will be reimbursed for its costs and will be paid a fee of 11.5 percent of the cost of the procurement items purchased.

2.4.4 Construction Program

The Contractor's time table for the expected start of operations is as follows:

December 1987	Main construction begins;
1988-1991	Boring of tunnels;
Autumn 1990	Breakthrough of the service tunnel;
Summer 1991	Breakthrough of the main tunnels;
1990-1992	Fitting out of the tunnels;

Autumn 1992	Commissioning of railway and other equipment begins, followed by a period of operational trials;
May 15, 1993	System opens.

If these milestone dates are not met, payments to the Contractor will be reduced. One half of such reductions will be repaid if the delay is recovered and the completion date is met.

The Contractor was given the order to start design and construction work in May 1986. As of November 1987, certain operations were behind schedule. The view of the Maître d'Oeuvre, whose major function is to monitor the design, development, and construction of the works, was that the project was, at that time, about three months late and that the working programme would indicate a maximum delay of not more than five months in the completion of the System. Eurotunnel and the Maître d'Oeuvre were discussing with the Contractor improvements to those parts of the working programme which were capable of accelerating overall progress. Thus, Eurotunnel intended that the project opening date of May 1993 would be achieved.

2.4.5 Penalties on Delay of Completion

Against the delay of the completion, the Contractor will suffer financial penalties at an initial rate of £354,000 per day, to be increased after six months to £536,000 per day up to £165 million (all at September 1985 prices).

2.4.6 Performance Bonds and Guarantees

The performance bonds have been provided in an amount equal to ten percent of the total amount of the contract. Retainage of five percent from payments due to the Contractor during the construction period is specified in the contract.

Also, Eurotunnel has obtained guarantees of the Contractor's obligations from the parent companies of the Contractor. The joint liability of the French guarantors and the several liabilities of each of the UK guarantors, which consist of five companies, are respectively limited to 50 percent and 10 percent of all liabilities, loss, and damages under the contract. The guarantees will expire ten years after completion of the System.

2.5 Financing

To meet the estimated financing requirement of £4,874 million (at July, 1993 prices) and to provide a margin for contingencies, Eurotunnel has arranged financing as below.

Table 2.3 Financing (in nominal terms)

	£ million	£ million
Equity		
- Already raised	253	
- to be raised through the November 1987 issue of the New Units	770	
Total equity		1,023
Credit facilities		
- main	4,000	
- standby	1,000	
		5,000
Total financing		6,023

The excess of £1,149 million (=6,023-4,874) in total financing (£6,023 million) over the estimated total financing requirement (£4,874 million) has been arranged to cover any unexpected costs not included in the latest cost estimates.

2.6 Equity Funds

One Unit of Eurotunnel's equity share consists of one share with a par value of 40 pence in EPLC, which is the UK part of Eurotunnel, and one share with a nominal value of FRF10 in ESA, the French part of Eurotunnel. Initial equity funds of £47 million were provided by the Founder Shareholders and in October 1986 a placing of Units with institutional and other investors raised a further £206

million. In November 1987, the estimated amount of £770 million was raised through the public issue of the New Units (Equity 3) with New Warrants.

Following the issue, the 332,376,780 existing and New Units are expected by Eurotunnel to have a market capitalization of £1,163 million in November 1987 as below:

Existing Units	112,376,780 Units x £3.50
New Units	220,000,000 Units x £3.50
Breakdown of New Units:	
UK offer	101,000,000 Units x £3.50
French offer	101,000,000 Units x FRF35
International offer	18,000,000 Units x (£1.75+FRF17.5)

Where, the prices of the unit are Eurotunnel's offer prices for November 1987.

Further amounts of equity finance are expected to be raised through the exercise of warrants as follows:

Table 2.4 Equity Financing through the Exercises of Warrants in nominal terms (Unit: £ million)

November 1992, New Warrants	101
December 1994, Founder Shareholder Warrants	52
June 1995, Bank Warrants	25

The conditions, the exercisable periods, the numbers of the Units to be issued through the exercise of the warrants, and the exercise prices are as follows:

New Warrants

- are traded separately from the New Units at any time after the Issue;
- 10 Warrants, when exercised together, can buy one Unit;
- are exercisable at any time between November 15, 1990 and November 15, 1992;
- The number of Units to be issued through the exercise is 22,000,000 Units;
- The exercise price is £2.30 plus FRF23;

Founder Shareholder Warrants

- one Warrant can buy 10 Units;
- are exercisable at any time between July 1st, 1989 and June 30, 1995;
- The number of Units to be issued through the exercise is 26,520,000 Units;
- The exercise price is £0.972 plus FRF10;

Bank Warrants

- one Warrant can buy one Unit;
- are exercisable at any time between April 1st, 2000 until June 30, 2000;
- The number of Units to be issued through the exercise is 7,142,857 Units;
- The exercise price is £1.75 plus FRF17.5.

Furthermore, Eurotunnel intends to grant options in November, 1987 to its employees to subscribe up to a maximum of 2,200,000 Units under the share option scheme as below.

Share Option Scheme

- this option can be granted only to full time employees of Eurotunnel;
- the maximum number of Units over which options may be granted in the 10-year period (during September 25, 1987 and September 24, 1997) is five percent of the Units in issue at the date they are first listed (2,200,000 Units are only some portion of this maximum number of Units that Eurotunnel can grant through options);
- options are not transferable;
- the exercise price will be the highest of: the nominal par value of a Unit, the market value of a Unit at the date of the grant of option, or 80 percent of the average middle market quotation for a Unit on the 20 dealing days immediately preceding the date of grant of the option;
- the exercisable period is between the third and tenth anniversaries of the date of grant.

Although Eurotunnel expects raising funds through the exercise of these warrants or options, there is no guarantee that these warrants or options will be exercised fully, so Eurotunnel may not get the capital inflow.

2.7 Credit Facilities

On November 4, 1987, Eurotunnel entered into the Credit Agreement for project finance credit facilities with an international group of lending banks for the provision, in six tranches, of loan and letter of credit facilities of the equivalent of £5,000 million (of which 20 percent is a standby element). The credit facilities consist of £2,600 million, FRF21,000 million, and US$450 million.

Since part of these facilities will be used to secure loans from the European Investment Bank and Crédit National, these two loans are not additional to the facilities of £5,000 million provided for under the Credit Agreement.

2.7.1 Credit Agreement

It is a condition of the Credit Agreement that total expenditure exceeds £700 million before loan drawdowns can begin. The agreement includes the items below.

1) Availability of facilities

Drawing may take place from July 1st, 1988. The facilities will be available for drawing thereafter for maximum period of approximately seven years.

2) Repayment

Repayment will commence after the availability period, and the principal must be fully repaid by November 15, 2005.

3) Fees and interest

a) An arrangement fee of 1/4 percent and an initial fee of 7/8 percent of the total amount of the facilities are payable.

b) A commitment fee at the base rate of 1/8 percent per annum on undrawn commitments is payable. However, a higher commitment fee of 1/4 percent per annum is payable on the amounts undrawn up to the amount of estimate that Eurotunnel is supposed to make each half-year. Also a higher commitment fee of 5/16 percent per annum is payable on the excess amount over the estimate from the beginning of the half-year. A commitment fee of 1/8 percent per annum was payable from March 14, 1986 to November 4, 1987.

c) Interest will be based on reference rates designed to reflect the lenders' cost of funds, which will differ according to the currency and market of drawing, plus margins which will vary according to the amount of the facilities which have been drawn and the time at which they are outstanding. The margins per annum will be as in Table 2.5, where, margins for the portion of the stand-by element, which corresponds to the excess of amount withdrawn over £4,000 million, are higher than those for the main facilities. Also margins after the completion of the System are lower than those before the completion if the condition of repayment of the principal is met.

Table 2.5 Margins of Credit Facilities

	on main facility	on standby
Before completion	1 1/4 %	1 3/4 %
After completion	1 %	1 1/4 %
From three years after completion, if the conditions to refinance are not satisfied	1 1/4 %	1 1/2 %
On borrowings which exceed a schedule of maximum outstandings	1 1/4%	-

Standby margins above will be increased by 1/8 percent per annum if the total principal outstanding exceeds 90 percent of its maximum amount. Completion for these purposes is expected to be 45 days after the start of commercial operation.

Fees for the letter of credit will be payable at the same rates as these margins.

4) Default

The Credit Agreement contains a number of events of default, the occurrence of any of which would entitle the banks to take various actions. These events include:

- the default cover ratio tests not being met;
- the opening of the system being delayed beyond July 29, 1994;
- the banks' reasonable belief of delay or cost overrun;
- an unremedied breach of Eurotunnel's obligation;

- the amounts outstanding exceeding a specified level after commencement of the repayment.

a) Bank debt cover ratio

$$\frac{\text{PV of forecast net cash flow up to 11/15/2005 after payment to refinancing creditors and EIB} + \text{Cash balance} + \text{Interest reserve}}{\text{Expected max. amount of debt due to the banks}}$$

Eurotunnel will not be entitled to:

- make drawings if the ratio is below 1.2;
- refinance borrowing if the ratio is below 1.3;
- pay dividend if the ratio is below 1.25.

If the ratio remains below 1 for 90 days or more, this will be an event of default.

b) Total debt cover ratios

$$\frac{\text{PV of forecast net cash flow up to 12/31/2020} + \text{Cash balance} + \text{Interest reserve}}{\text{Aggregate max. amount of debt due to the banks} + \text{Refinancing creditors and EIB}}$$

Eurotunnel will not be entitled to:

- make drawings if the ratio is below 1.9;
- refinance borrowing if the ratio is below 1.95.

If the ratio remains below 1.3 for 90 days or more, this will be an event of default.

c) Debt service cover ratio

$$\frac{\text{Forecast net cash flow during any annual period}}{\text{Interest and principal payments on both Credit Facilities and refinancing debt during the same year}}$$

A ratio at least of 1.1 must be satisfied for refinancing to take place.

2.7.2 European Investment Bank Agreement

Eurotunnel has entered into an agreement with the European Investment Bank which provides a framework for the European Investment Bank to make available to Eurotunnel loans amounting in aggregate to the greater of £1,000 million and FRF10,000 million.

During the construction period, the risk is borne only by the banks under the Credit Agreement, and after the opening of the System the European Investment Bank will be exposed to the revenue risk of the project.[1] That is, before the opening, the loans from the European Investment Bank will be secured by means of letter of credit issued by the banks under the Credit Agreement and thus will not be additional to the facilities of £5,000 million provided for under that agreement. In return, there is provision for letters of credit to be released by the European Investment Bank shortly after completion of the system, whereupon the European Investment Bank would share in the security over the assets

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[1]"EIB agrees Channel Tunnel co-financing," Financial Times (London), November 8 1987, p. 6.

of Eurotunnel on the same basis as the banks under the Credit Agreement.

The deal between Eurotunnel and the European Investment Bank is more generous than that with the banks under the Credit Agreement. Maturity and interest terms will be fixed at the time of drawdown. The first repayment date for the loans is not to be earlier than the first half of 1999 and they are expected to have an average final maturity of between 15 and 25 years.

They are likely, for the most part, to be fixed rate loans at levels of interest fixed, in accordance with normal European Investment Bank practice, by reference to its cost of funds and margin designed to cover its administrative costs, which is currently 0.15 percent per annum.

2.7.3 Crédit National Agreement

Eurotunnel is also negotiating, as of November, 1987, an agreement with Crédit National which is intended to be entered into before the end of 1987. The agreement will provide a framework for Crédit National to make available to Eurotunnel FRF4,000 million. These loans will be secured by letters of credit issued by the banks under the Credit Agreement and thus will not be additional to the facilities of £5,000 million provided for under that agreement. Although further detail is not given in the Prospectus, Eurotunnel is supposed to be improving the conditions of loans through this agreement.

2.8 Debt Instruments

Eurotunnel intends that when the System is operational it will refinance the Credit Facilities in order to increase the amount of cash available for the payment of dividends to Unit holders. An assumption that such refinancing will take place between 1995 and 1998, as summarized below at lower interest rates than under the Credit Facilities has been made for the purposes of the financial projections.

Table 2.6 Debt Instruments	(in nominal terms)
1995	£776 million
1996	£352 million
1997	£361 million
1998	£451 million

Table 2.7 Interest Rates of Debt Instruments assumed by Eurotunnel

until 12/31/1999	9.75 % per annum
thereafter	9.25 % per annum

2.9 Operating Revenues and Costs

For the purpose of forecasts of traffic and revenue during the Concession period starting from July 29, 1987 and ending on July 28, 2042, which were reported on July 24, 1987, Eurotunnel has made certain macro-economic assumptions, the most important of which relates to the growth in the UK gross domestic product. It has been assumed that the UK

gross domestic product will grow at 2.15 percent per annum between 1985 and 2003 and at 2.00 percent per annum between 2003 and 2013. After 2013 a decreasing growth rate in traffic volumes has been assumed, declining to zero by 2042.

Based on the assumptions, Eurotunnel has estimated that in 1993, when the System is planned to become operational, the cross-Channel market will have increased to approximately 67 million passengers and 84 million tonnes of freight. Its forecasts for 2003 and 2013 are approximately 94 million passengers and 123 tonnes of freight and 119 million passengers and 170 million tonnes of freight, respectively.

2.9.1 Operating Revenue

Eurotunnel's operating revenues are expected to arise from operating shuttle services, payments by the railways, and ancillary activities. The payments by the railways consist of railway usage charges and contribution to operating costs relating to through trains, which have been agreed for the whole of the Concession period and will be governed by the terms of the railway usage contract. Ancillary activities represent catering, duty-free sales, and payments in respect of the use of the tunnel as a conduit for cables. Eurotunnel's estimate of operating revenues at July 1987 prices are as below:

Table 2.8 Operating Revenues at July 1987 Prices (Unit: £ million)

	Shuttle	Rail	Ancillary	Total Operating Revenue
1993	184	142	31	357
1994	265	217	44	526
1995	276	222	46	544
1996	285	226	47	558
1997	293	230	49	572
1998	301	235	50	587
1999	309	237	52	598
2000	318	240	53	611
2001	326	243	54	623
2002	334	247	55	635
2003	342	250	56	648
2013	403	272	64	739
2023	450	268	70	788
2033	476	259	74	808
2041	476	247	74	796

Note: The figures for 1993 represent trading only from the opening date in May to December.

2.9.2 Operating Cost

Eurotunnel's estimation of operating costs at July 1987 prices is as follows:

Table 2.9 Operating Costs at July 1987 Prices (Unit: £ million)

	Fixed Expenses	Variable Expenses	Total Operating Costs
1993	39	24	63
1994	61	39	100
1995	60	41	101
1996	61	42	103
1997	62	44	106
1998	64	49	113
1999	65	46	112
2000	67	48	114
2001	68	49	117
2002	70	50	120
2003	71	53	124
2013	72	72	144
2023	72	82	154
2033	72	88	160
2041	72	89	161

Note: The figures for 1993 represent trading only from the opening date in May to December

2.10 Capital Expenditure During the Operation Period

Capital expenditures will be incurred after the start of operations in respect to the replacement of assets and of new equipment to meet increases in traffic demand. Eurotunnel's estimate of the capital expenditures is as follows:

Table 2.10 Purchase of Fixed Assets at July 1987 Prices

	(Unit: £ million)
1993	192
1994	26
1998	21
2002	4
2003	44
2013	52
2023	133
2033	46

2.11 Eurotunnel's Financial Projection

In addition to the items described in the preceding sections, the following are involved in Eurotunnel's profit and cash flow projections.

2.11.1 Inflation

Inflation will increase revenues, overheads, operating costs and capital expenditure at the following rates per annum:

Table 2.11 Eurotunnel's Inflation Rates

1987	4.0 %
1988	4.5 %
1989	5.0 %
1990	5.5 %
1991 - thereafter	6.0 %

2.11.2 Taxation

The cost of the fixed assets will be recorded in the books of EPLC and ESA and divided equally between them. Also the overheads including interest on long-term loans incurred in the design and construction of the System up to the start of operations will be capitalized in the books.

In the case of EPLC (UK), provision for deferred taxation, such as accelerated depreciation, will be made, whereas no deferred taxation will be provided in ESA (France). For the taxation of ESA, the straight-line basis both over the remaining period of the concession for non-renewable fixed assets including the capitalized costs, and over estimated useful lives for renewable fixed assets will be applied.

According to the result of Eurotunnel's profit projections, the corporate income tax rates are found to be as in Table 2.12, where profits before taxation (for accounting report purpose) are net of operating revenues, operating costs, depreciation write-off, and interest payments. The corporate income tax rate for each year has been calculated as the amount of the tax for accounting report purposes divided with the profit before taxation.

Table 2.12 Corporate Income Tax Rates

	Profit Before Taxation (£ million)	Tax Rates
1993	70	10.00%
1994	108	16.67%
1995	199	19.10%
1996	273	19.41%
1997	350	19.71%
1998	422	20.85%
1999	508	38.98%
2000	614	39.09%
2001	716	38.97%
2002	823	39.00%
2003	927	38.94%
2013	2,410	38.76%
2023	4,879	38.80%
2033	9,152	38.76%
2041	14,453	38.56%

The corporate income tax rates which Eurotunnel used for its financial projection will increase along with the increase in the amount of taxable income. That is, the rate is between 10 percent and 20 percent for income lower than £500 million, while it is about 40 percent for a higher level of income.

2.11.3 Interest on Cash Balance

Eurotunnel assumed that interest would be received on cash balances at a rate of 8.5 percent per annum throughout the Concession period.

2.11.4 Interest on Credit Agreement

According to the Japanese newspaper Asahi, 23.3 percent of the total amount of £5,000 million comes from Japanese banks, and the reference rates will be determined as LIBOR.[1]

Eurotunnel assumed the reference rates of interest on drawings from the Credit Agreement would be 9 percent per annum throughout the Concession period, which was an average of the projected rates for £ and FRF. Also, Eurotunnel reported that on November 12, 1987, the reference rates which would be applicable under the Credit Agreement were approximately 9.0 percent for £ and approximately 9.9 for FRF.

2.11.5 Long-Term Debt Principal Inflows and Outflows

Since all the financial requirements (£4,874 million at July 1993 prices) during the construction period is financed with raisings from equity issues (£1,023 million through issues of Units and £101 million through exercises of New Warrants) and drawings from Credit Facilities, the total amount of drawings from Credit Facilities during the construction period will be £3,750 million.

According to Eurotunnel's cash flow projection, after the construction period, £321 million will be drawn from Credit Facilities in 1993. The amounts of drawings from Debt

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[1]"Tokyo Money," Asahi Shimbun (Tokyo), November 2 1987, p. 9.

Instruments are shown in the preceding section "Debt Instruments".

Repayments of principals of both Credit Facilities and Debt Instruments are as follows, where the figures for other years are not available in Eurotunnel's cash flow projection.

Table 2.13 Repayments of Credit Facilities

	(£ million)
1995	799
1996	493
1997	478
1998	561
1999	111
2000	102
2001	111
2002	122
2003	133

Table 2.14 Repayments of Debt Instruments

	(£ million)
2013	97
2023	55
2033	55
2041	55

2.12 Project Risks

According to the Prospectus, factors on market price of Units until the start-up period, which is the period of construction and initial operation up to mid-1995, is as follows:

- the successful completion of the system;
- the initial levels of traffic through the system;
- the approaching payment and value of expected future dividends;

- the prevailing yields on comparable securities;
- stock market conditions.

In addition, unexpected changes in inflation rates and exchange rates, together with the changes in tax regulations and tax rates are listed up. As for the political risk, this risk can be neglected, because Eurotunnel has been granted the Concession from both governments, and both governments are politically stable.

The assumptions made by Eurotunnel are different from those made by banks with which Eurotunnel entered into the Credit Agreement. Subject to the differences, the banks' assumptions for their analysis are as follows:

- six-month delay of opening;
- cost overruns to be caused by the delay of opening;
- lower operating revenues.

Therefore, it can be said that the serious project risks lies in the matters as a delay of completion, cost overruns, and level of the revenues.

CHAPTER 3. EVALUATION OF THE EUROTUNNEL PROJECT

In this chapter, a financial evaluation of the Eurotunnel project has been done for a simplified base case from the viewpoint of Eurotunnel, in other words, Eurotunnel's equity holders.

3.1 Analytical Method

The analytical method used is the Valuation-by-Components (VC) Method accompanied with the Capital Asset Pricing Model, and floating interest rates based on risk-free forward interest rates. As a result, an adjusted net present value has been obtained.

The Valuation-by-Components Method, which discounts each cash in/out flow with adequate discount rates reflecting each risk of such in/out flow and results in an adjusted net present value, is a recent extension of the net present value method.[1] The simplicity and the transparency of its calculation process together with the theoretical correctness of this method enable financial evaluations of international projects, which often involve complex cash flows. Therefore,

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[1]As for VC analysis method, see Donald Lessard, Eugene Flood Jr., James Paddock, International Corporate Finance, draft Chapters 7 and 8, (New York: McGraw-Hill Book Company, in press, 1988/89).

this method has advantages over conventional methods, such as "payback," "internal rate of return," and "net present value with a single discount rate (Weighted-Average-Cost-of-Capital Method)," which have less theoretical meaning or require special conditions on cash flows, and thus are restricted in their applications only to the domestic projects.

3.2 Setting of Cash Flows

3.2.1 General

The origin of the cash flows is set as of June 30, 1987 and cash flows are calculated up to July 28, 2042 when the Concession agreement (from July 29, 1987 up to July 28, 2042) will expire.

The start of the operation is assumed to be on May 15, 1993. Cash in and out flows are assumed to occur at the end of each year.

3.2.2 Nominal Risk-Free Forward Interest Rates and Inflation Factors

1) Eurotunnel's Inflation Factors

As described in Section 2.11.1, the following inflation rates are assumed by Eurotunnel:

1987	1988	1989	1990	1991 - thereafter
4.0 %	4.5 %	5.0 %	5.5%	6.0 %

According to Eurotunnel, £1 in July 1987 is approximately equivalent to 1.04 (= $(1+0.04)^{1/2}(1+.045)^{1/2}$) in July 1988 and 1.09 (= $(1+0.04)^{1/2}(1+0.045)^{1/2}$ x $(1+0.045)^{1/2}(1+0.05)^{1/2}$) in July 1989. Eurotunnel's assumed inflation factors are as follows.

Table 3.1 Inflation Factors by Eurotunnel
(Reference: £1 on July 1st, 1987)

	Inflation Rates	Inflation Factors
1987	4.00%	1.00
1988	4.50%	1.04
1989	5.00%	1.09
1990	5.50%	1.15
1991	6.00%	1.22
1992	6.00%	1.29
1993	6.00%	1.37
1994	6.00%	1.45
1995	6.00%	1.53
1996	6.00%	1.63
1997	6.00%	1.72
1998	6.00%	1.83
1999	6.00%	1.94
2000	6.00%	2.05
2001	6.00%	2.18
2002	6.00%	2.31
2003	6.00%	2.45
2004	6.00%	2.59
2005	6.00%	2.75
2006	6.00%	2.91
2007	6.00%	3.09
2008	6.00%	3.27
2009	6.00%	3.47
2010	6.00%	3.68
2011	6.00%	3.90
2012	6.00%	4.13
2013	6.00%	4.38
2014	6.00%	4.64
2015	6.00%	4.92
2016	6.00%	5.22
2017	6.00%	5.53
2018	6.00%	5.86
2019	6.00%	6.21
2020	6.00%	6.59
2021	6.00%	6.98
2022	6.00%	7.40
2023	6.00%	7.84
2024	6.00%	8.31

2025	6.00%	8.81
2026	6.00%	9.34
2027	6.00%	9.90
2028	6.00%	10.50
2029	6.00%	11.13
2030	6.00%	11.79
2031	6.00%	12.50
2032	6.00%	13.25
2033	6.00%	14.05
2034	6.00%	14.89
2035	6.00%	15.78
2036	6.00%	16.73
2037	6.00%	17.73
2038	6.00%	18.80
2039	6.00%	19.93
2040	6.00%	21.12
2041	6.00%	22.39
2042	6.00%	23.73

2) Nominal Risk-Free Forward Interest Rates

Nominal risk-free forward interest rates based on UK Government bonds are shown in Table 3.2, where Y.T.M.'s (yield to maturity) which seem to be appropriate are selected from various bonds by the author because there was no detailed description of each government bond in the source of information. As for "Year Yield", interpolation has been employed for the years 1998, 2000, 2005, and 2006, and nine percent has been assumed for the years after 2008.

In Table 3.2, a "Forward Interest Rate" of nine percent has been assumed for 1987, based on the rate on November 12, 1987. (See Section 2.11.4) For the other years forward interest rates have been calculated as follows:

$$\text{Forward Interest Rate}_n = \frac{(1 + \text{Year Yield}_n)^n}{(1 + \text{Year Yield}_{n-1})^{n-1}} - 1.$$

Also, discount factors are calculated as follows:

$$\text{Discount Factor}_{1987} = \frac{1}{(1+\text{ Forward Interest Rate}_{1987})^{1/2}};$$

$$\text{Discount Factor}_{n} = \frac{\text{Discount Factor}_{n-1}}{1+\text{ Forward Interest Rate}_{n}},$$

(n = 1988 through 2041);

$$\text{Discount Factor}_{2042} = \frac{\text{Discount Factor}_{2041}}{(1+\text{ Forward Interest Rate}_{2042})^{7/12}}.$$

Table 3.2 Nominal Risk-Free Forward Interest Rates

	Year	Observed Y.T.M. 1)	Year Yields	Forward Rates	2) Discount Factors
0	1987			9.00%	0.9578
1	1988	8.63%	8.63%	8.63%	0.8817
2	1989	8.68%	8.68%	8.73%	0.8109
3	1990	8.82%	8.82%	9.10%	0.7433
4	1991	8.85%	8.85%	8.94%	0.6823
5	1992	8.87%	8.87%	8.95%	0.6262
6	1993	8.91%	8.91%	9.11%	0.5740
7	1994	8.99%	8.99%	9.47%	0.5243
8	1995	9.12%	9.12%	10.03%	0.4765
9	1996	9.27%	9.27%	10.48%	0.4313
10	1997	9.28%	9.28%	9.37%	0.3943
11	1998		9.28%	9.28%	0.3609
12	1999	9.28%	9.28%	9.28%	0.3302
13	2000		9.24%	8.70%	0.3038
14	2001	9.19%	9.19%	8.61%	0.2797
15	2002	9.19%	9.19%	9.19%	0.2562
16	2003	9.14%	9.14%	8.39%	0.2363
17	2004	9.12%	9.12%	8.80%	0.2172
18	2005		9.08%	8.40%	0.2004
19	2006		9.04%	8.32%	0.1850
20	2007	9.00%	9.00%	8.24%	0.1709
21	2008		9.00%	9.00%	0.1568
22	2009		9.00%	9.00%	0.1438
23	2010		9.00%	9.00%	0.1320
24	2011		9.00%	9.00%	0.1211
25	2012		9.00%	9.00%	0.1111
26	2013		9.00%	9.00%	0.1019
27	2014		9.00%	9.00%	0.0935
28	2015		9.00%	9.00%	0.0858
29	2016		9.00%	9.00%	0.0787
30	2017		9.00%	9.00%	0.0722
31	2018		9.00%	9.00%	0.0662
32	2019		9.00%	9.00%	0.0608
33	2020		9.00%	9.00%	0.0557
34	2021		9.00%	9.00%	0.0511
35	2022		9.00%	9.00%	0.0469
36	2023		9.00%	9.00%	0.0430
37	2024		9.00%	9.00%	0.0395

38	2025	9.00%	9.00%	0.0362
39	2026	9.00%	9.00%	0.0332
40	2027	9.00%	9.00%	0.0305
41	2028	9.00%	9.00%	0.0280
42	2029	9.00%	9.00%	0.0257
43	2030	9.00%	9.00%	0.0235
44	2031	9.00%	9.00%	0.0216
45	2032	9.00%	9.00%	0.0198
46	2033	9.00%	9.00%	0.0182
47	2034	9.00%	9.00%	0.0167
48	2035	9.00%	9.00%	0.0153
49	2036	9.00%	9.00%	0.0140
50	2037	9.00%	9.00%	0.0129
51	2038	9.00%	9.00%	0.0118
52	2039	9.00%	9.00%	0.0108
53	2040	9.00%	9.00%	0.0099
54	2041	9.00%	9.00%	0.0091
55	2042	9.00%	9.00%	0.0087

Source: Financial Times (London), November 12 1987, P. 45.

Notes:

1) The following bonds are used for "Y.T.M."'s:

Treas 9 3/4pc Cv '88	Treas 9 1/2pc Cvn 1989
Treas 10pc Cv 1990	Treas 11 3/4pc 1991
Treas 10 1/2pc Cv 1992	Treas 10pc 1993
Treas 10pc Ln.1994	Treas 12 3/4pc 1995
Treas 14pc '96	Treas 13 1/4pc 1997
Treas 10 1/2pc 1999	Treas 10pc 2001
Treas 9 3/4pc 2002	Treas 10pc 2003
Treas 10pc 2004	Treas 11 3/4pc 2003-07

2) Discount factors are calculated as follows:

$$\text{Discount Factor}_{1987} = \frac{1}{(1+\text{Forward Interest Rate}_{1987})^{1/2}};$$

$$\text{Discount Factor}_{n} = \frac{\text{Discount Factor}_{n-1}}{1+\text{Forward Interest Rate}_{n}},$$

(n = 1988 through 2041);

$$\text{Discount Factor}_{2042} = \frac{\text{Discount Factor}_{2041}}{(1+\text{Forward Interest Rate}_{2042})^{7/12}}.$$

3) Inflation Factors Based on UK Government Bonds

Inflation factors shown in Table 3.3 are calculated from nominal risk-free forward interest rates based on UK Government bonds of Table 3.2. In Table 3.3, the real risk-free interest rate is assumed as 2.83 percent (=1.09/1.06-1) in order to obtain the same inflation rates as those of Eurotunnel's estimation (6 percent) for the years after 2008,

when nominal risk-free interest rates are 9 percent both in the case of Eurotunnel's projection and in the case based on UK government bonds. Inflation rates are calculated by the formula below:

$$\text{Inflation Rate}_n = \frac{1 + \text{Nominal Risk-Rree Interest Rate}_n}{1 + \text{Real Riskless Interest Rate}} - 1.$$

Inflation factors are calculated as follows:

$$\text{Inflation Factor}_{1987} = (1+\text{Inflation Rate}_{1987})^{1/2};$$

$$\text{Inflation Factor}_n = \text{Inflation Factor}_{n-1} \times (1+\text{Inflation Rate}_n), \quad (n = 1988 \text{ through } 2041);$$

$$\text{Inflation Factor}_{2042} = \text{Inflation Factor}_{2041} \times (1+\text{Inflation Rate}_{2042})^{7/12}.$$

Table 3.3 Inflation Rates and Inflation Factors based on UK Government Bonds

(Reference: £1 on July 1st,1987)

	Nominal Risk-Free Forward Rates	Inflation Rates	Inflation Factors
1987	9.00%	6.00%	1.03
1988	8.63%	5.64%	1.09
1989	8.73%	5.74%	1.15
1990	9.10%	6.10%	1.22
1991	8.94%	5.94%	1.29
1992	8.95%	5.95%	1.37
1993	9.11%	6.11%	1.45
1994	9.47%	6.46%	1.55
1995	10.03%	7.01%	1.66
1996	10.48%	7.44%	1.78
1997	9.37%	6.36%	1.89
1998	9.28%	6.27%	2.01
1999	9.28%	6.27%	2.14
2000	8.70%	5.70%	2.26
2001	8.61%	5.62%	2.39
2002	9.19%	6.18%	2.53
2003	8.39%	5.41%	2.67
2004	8.80%	5.81%	2.82
2005	8.40%	5.42%	2.98
2006	8.32%	5.34%	3.14
2007	8.24%	5.26%	3.30
2008	9.00%	6.00%	3.50

2009	9.00%	6.00%	3.71
2010	9.00%	6.00%	3.93
2011	9.00%	6.00%	4.17
2012	9.00%	6.00%	4.42
2013	9.00%	6.00%	4.68
2014	9.00%	6.00%	4.96
2015	9.00%	6.00%	5.26
2016	9.00%	6.00%	5.58
2017	9.00%	6.00%	5.91
2018	9.00%	6.00%	6.27
2019	9.00%	6.00%	6.64
2020	9.00%	6.00%	7.04
2021	9.00%	6.00%	7.47
2022	9.00%	6.00%	7.91
2023	9.00%	6.00%	8.39
2024	9.00%	6.00%	8.89
2025	9.00%	6.00%	9.42
2026	9.00%	6.00%	9.99
2027	9.00%	6.00%	10.59
2028	9.00%	6.00%	11.23
2029	9.00%	6.00%	11.90
2030	9.00%	6.00%	12.61
2031	9.00%	6.00%	13.37
2032	9.00%	6.00%	14.17
2033	9.00%	6.00%	15.02
2034	9.00%	6.00%	15.92
2035	9.00%	6.00%	16.88
2036	9.00%	6.00%	17.89
2037	9.00%	6.00%	18.96
2038	9.00%	6.00%	20.10
2039	9.00%	6.00%	21.31
2040	9.00%	6.00%	22.59
2041	9.00%	6.00%	23.94
2042	9.00%	6.00%	24.78

Note: The real risk-free interest rate is assumed as 2.83% (=1.09/1.06-1).

3.2.3 Construction Contract and Eurotunnel's Corporate Costs

At first, the amounts of "Construction Contract" (£2,788 million) and "Corporate Costs" (£642 million) at July 1987 prices are distributed over the construction period so as that the amount of "Provision for Inflation"(£469 million) shown and discussed previously in Section 2.3 is incurred in

these costs against the Eurotunnel's inflation rates. Then, the figures at July 1987 prices are converted into nominal terms for future years, using inflation rates based on UK government bonds.

1) Construction Contract

Real costs on the construction contract described in Section 2.4 are distributed over the construction period as shown in Table 3.4.

- Target works: the total of £1,367 million is distributed equally over the period from July 1987 to June 1991 when the main tunnels are broken through.

- Lump sum works: the total of £1,169 million is distributed equally over the period from July 1988 to June 1992 when the tunnels are fitted out.

- Procurement works: the total of £252 million is distributed equally over the period from July 1989 to May 1993 when the System opens.

Table 3.4 Real Costs on Construction Contract

(Unit: £ million at July 1987 prices)

	Target Works	Lump Sum Works	Procurement Items	Total of Construction Contract
Total	(1,367)	(1,169)	(252)	(2,788)
1987	(171)			(171)
1988	(342)	(146)		(488)
1989	(342)	(292)	(33)	(667)
1990	(342)	(292)	(65)	(699)
1991	(171)	(292)	(65)	(528)
1992		(146)	(65)	(211)
1993			(24)	(24)

Nominal costs on the construction contract are calculated as shown in Table 3.5, by using the inflation factors based on Uk Government bonds in Table 3.3.

Table 3.5 Nominal Costs on Construction Contract

(Unit: £ million)

	Target Works	Lump Sum Works	Procurement Items	Total of Construction Contract
Total	(1,579)	(1,430)	(325)	(3,333)
1987	(176)			(176)
1988	(372)	(159)		(531)
1989	(393)	(336)	(37)	(767)
1990	(417)	(357)	(79)	(853)
1991	(221)	(378)	(84)	(683)
1992		(200)	(89)	(289)
1993			(35)	(35)

2) Eurotunnel's Corporate Cost

Real corporate costs are shown in Table 3.6.

Table 3.6 Eurotunnel's Real Corporate Costs

(Unit: £ million at July 1987 prices)

Total	(642)
1987	(60)
1988	(109)
1989	(109)
1990	(109)
1991	(109)
1992	(109)
1993	(35)

At first, the total of £642 million is distributed equally over the period from June 1987 to May 1993. Then, the amounts for 1987 and 1993 are adjusted so that the amount of "Provision for Inflation" (£469 million) shown in the Prospectus is incurred to the sum of costs on the construction contract and Eurotunnel's corporate costs. These costs and provision for inflation in nominal terms for

which Eurotunnel's inflation factor (Table 3.1) are applied are shown in Table 3.7.

Table 3.7 Provision for Inflation on Construction Contract and Corporate Costs

(Unit: £ million)

	Sum of Contract and Corporate Costs In Real Terms	Sum of Contract and Corporate Costs In Nominal Terms 1)	Provision For Inflation
Total	(3,430)	(3,899)	469
1987	(231)	(231)	
1988	(597)	(623)	
1989	(776)	(847)	
1990	(808)	(929)	
1991	(637)	(775)	
1992	(320)	(413)	
1993	(60)	(81)	

Note 1) The figures are based on Eurotunnel's inflation rates.

Nominal corporate costs calculated with inflation factors based on UK Government bonds (Table 3.3) are shown in Table 3.8.

Table 3.8 Eurotunnel's Nominal Corporate Costs

(Unit: £ million)

	Corporate Costs
Total	(782)
1987	(62)
1988	(119)
1989	(126)
1990	(133)
1991	(141)
1992	(150)
1993	(51)

3.2.4 Credit Facilities and Financing Costs other than Credit Facilities

Floating interest rates on the Credit Facilities are calculated as follows. First, the reference rates which are

supposed to be as LIBOR are assumed to be identical to those of UK Government bonds. Second, as margins, 1.25 percent up to June 30, 1993 and 1.00 percent thereafter are applied for simplicity although higher rates are to be applied to the stand-by portion. (See Section 2.7.1) Finally, the interest rates together with the discount factors which are calculated from the interest rates are obtained as below.

Table 3.9 Nominal Floating Interest Rates on Credit Facilities

	Nominal Risk-Free Forward Rates	Interest Rates up to June 30, 1993 1)	Interest Rates after July 1st, 1993 2)	Discount Factors 3)
1987	9.00%	10.25%		0.9524
1988	8.63%	9.88%		0.8667
1989	8.73%	9.98%		0.7881
1990	9.10%	10.35%		0.7142
1991	8.94%	10.19%		0.6481
1992	8.95%	10.20%		0.5881
1993	9.11%	10.36%	10.11%	0.5335
1994	9.47%		10.47%	0.4830
1995	10.03%		11.03%	0.4350
1996	10.48%		11.48%	0.3902
1997	9.37%		10.37%	0.3535
1998	9.28%		10.28%	0.3206
1999	9.28%		10.28%	0.2907
2000	8.70%		9.70%	0.2650
2001	8.61%		9.61%	0.2418
2002	9.19%		10.19%	0.2194
2003	8.39%		9.39%	0.2006
2004	8.80%		9.80%	0.1827
2005	8.40%		9.40%	0.1688

Notes:

1) Interest rates are calculated as risk-free rates plus 1.25%.
2) Interest rates are calculated as risk-free rates plus 1.00%.
3) Discount factors are calculated as follows:

$$\text{Discount Factor}_{1987} = \frac{1}{(1+ \text{Interest Rate}_{1987})^{1/2}};$$

$$\text{Discount Factor}_{n} = \frac{\text{Discount Factor}_{n-1}}{1+ \text{Interest Rate}_{n}}, \qquad (n = 1988 \text{ through } 2004);$$

$$\text{Discount Factor}_{2005} = \frac{\text{Discount Factor}_{2004}}{(1+ \text{Interest Rate}_{2005})^{10.5/12}}.$$

All the costs during the construction period and sources of funds together with Eurotunnel's cash balances in nominal terms are shown in Table 3.10. The amount of the financing costs other than for the Credit Facilities is determined so that the specified net financing cost of £975 would be incurred in the sum of "Fees and Interest on Credit Facilities" and "Financing Costs other than Credit Facilities" if Eurotunnel's inflation rates and fixed interest rates of 10.25 percent were applied to the costs and to the interest rate of the Credit Facilities respectively.

As for the fees and interest on the Credit Facilities, further description is given in the latter part of this section. The amount of the principal inflow from the Credit Facilities in each year has been calculated from the amounts of total investments and funds raised through issues of shares and exercises of warrants. On the other hand, fees on the Credit Facilities for each year, which are one element of the total investments, have been calculated from the principal inflow from the Credit Facilities in the same year. That is, the principal inflows from and fees on the Credit Facilities for each year depend on each other, so iteration has been done between them, and the calculation converged to one set of figures.

The sum of the costs on the construction contract and Eurotunnel's corporate costs is £4,116 million and the sum of the costs for the Credit Facilities and the financing costs other than for the Credit Facilities is equal to £1,088

million (=914+174), although according to Eurotunnel these figures are £3,899 million and £975 million respectively. The difference between these figures is attributed to the different inflation rates from those of Eurotunnel's which are adopted in this calculation and also that for this calculation floating interest rates are applied, whereas Eurotunnel employed fixed interest rates.

Consequently, there is difference in total principal inflows from the Credit Facilities during the construction period between this calculation and the Prospectus: the former is £4,080 million, while the latter is £3,750 million.

Table 3.10 Calculation on Principal Inflows from Credit Facilities in Nominal Terms (Unit: £ million)

	Sum of Construction Contract & Corporate Costs	Financing Costs other than Credit Facilities	Fees and Interest on Credit Facilities	Total Investment
Total	(4,116)	(174)	(914)	(5,204)
1987	(238)	(174)	(11)	(423)
1988	(649)		(7)	(656)
1989	(892)		(22)	(914)
1990	(986)		(118)	(1,104)
1991	(824)		(227)	(1,051)
1992	(439)		(329)	(768)
1993	(87)		(200)	(287)

(Table 3.10 Calculation on Principal Inflows from Credit Facilities - continuing) (Unit: £ million)

	Raisings From Shares and Warrants	Principal Inflows From Credit Facilities	Movement in Cash Balances	Cash Balances
Total	1,124	4,080		
1987	1,023		600	600
1988		57	(600)	
1989		914		
1990		1,104		
1991		1,051		
1992	101	667		
1993		287		

Nominal cash flows on the Credit Facilities during the construction period are shown in Table 3.11. The rates of fees adopted to the calculation of cash flows are as follows:

- Arrangement fees: 1/4 % of the amounts drawn;
- Initial fees: 7/8 % of the amounts drawn;
- Commitment fees: 1/8 % per annum on undrawn amount from £5,000 million from March 14, 1986 to June 30, 1995.

Table 3.11 Nominal Cash Flows on Credit Facilities during the Construction Period (Unit: £ million)

	Principal Inflows	Principal Outstanding	Arrangement and Initial Fees	Commitment Fees	Interest Payments	Total Financing Costs
1987				(11)		(11)
1988	57	57	(1)	(6)		(7)
1989	914	971	(10)	(6)	(6)	(22)
1990	1,104	2,075	(12)	(5)	(100)	(118)
1991	1,051	3,126	(12)	(4)	(211)	(227)
1992	667	3,793	(7)	(2)	(319)	(329)
1993	287	4,080	(3)	(1)	(196)	(200)

Nominal cash flows on the Credit Facilities during the operation period are shown in Table 3.12. The amounts of the principal inflow in 1993 and principal repayments between

1995 and 2003 given in the Prospectus are used. As for the principal repayments in 2004 and 2005, the un-repaid amount is divided equally between these years.

Table 3.12 Nominal Cash Flows on Credit Facilities During Operation

(Unit: £ million)

	Principal Inflows	Repayment of Credit Facilities	Principal Outstanding	Arrangement and Initial Fees	Commitment Fees	Interest Payments
1992			4,080			
1993	321		4,401	(4)	(1)	(206)
1994			4,401		(1)	(461)
1995		(799)	3,602			(486)
1996		(493)	3,109			(413)
1997		(478)	2,631			(322)
1998		(561)	2,070			(270)
1999		(111)	1,959			(213)
2000		(102)	1,857			(190)
2001		(111)	1,746			(178)
2002		(122)	1,624			(178)
2003		(133)	1,491			(153)
2004		(745)	745			(146)
2005		(745)				(61)

3.2.5 Operating Revenues and Costs

Nominal net operating revenues are calculated from those in real terms by multiplying inflation factors based on UK Government bonds (Table 3.3) as shown in Table 3.13. Real net operating revenues are calculated from real operating revenues and costs shown in Section 2.9 for 1993 through 2003, 2013, 2023, 2033, and 2041. For other years, interpolation or extrapolation is applied. The figure for 1993 represents trading only from the opening date in May to December. The figure for 2042 represents trading from January to the end of the concession agreement in July.

Table 3.13 Net Operating Revenues

(Unit: £ million)

	Inflation Factor	Net Operating Revenues in Real Terms		Net Operating Revenues in Nominal Terms
1993	1.45	294		428
1994	1.55	426		659
1995	1.66	443		734
1996	1.78	455		809
1997	1.89	466		881
1998	2.01	474		953
1999	2.14	486		1,039
2000	2.26	496		1,121
2001	2.39	506		1,206
2002	2.53	515		1,305
2003	2.67	524		1,399
2004	2.82	531	*	1,501
2005	2.98	538	*	1,603
2006	3.14	545	*	1,711
2007	3.30	552	*	1,824
2008	3.50	559	*	1,958
2009	3.71	567	*	2,102
2010	3.93	574	*	2,256
2011	4.17	581	*	2,421
2012	4.42	588	*	2,597
2013	4.68	595		2,786
2014	4.96	599	*	2,973
2015	5.26	603	*	3,172
2016	5.58	607	*	3,385
2017	5.91	611	*	3,611
2018	6.27	615	*	3,853
2019	6.64	619	*	4,110
2020	7.04	623	*	4,385
2021	7.47	627	*	4,678
2022	7.91	631	*	4,990
2023	8.39	635		5,323
2024	8.89	636	*	5,654
2025	9.42	637	*	6,007
2026	9.99	639	*	6,381
2027	10.59	640	*	6,779
2028	11.23	642	*	7,201
2029	11.90	643	*	7,650
2030	12.61	644	*	8,127
2031	13.37	646	*	8,633
2032	14.17	647	*	9,171
2033	15.02	649		9,742
2034	15.92	647	*	10,300
2035	16.88	645	*	10,890
2036	17.89	644	*	11,513
2037	18.96	642	*	12,173
2038	20.10	640	*	12,869
2039	21.31	639	*	13,606
2040	22.59	637	*	14,384

2041	23.94	635	15,207
2042	24.78	370 *	9,157

Note: The figures with * are obtained by interpolation or extrapolation.

3.2.6 Purchases of Fixed Assets

Purchases of fixed assets at prices in nominal terms are calculated from those in real terms shown in Section 2.10 by multiplying inflation factors based on UK Government bonds (Table 3.3), as shown in Table 3.14.

Table 3.14 Purchase of Fixed Assets

(Unit: £ million)

	Inflation Factors	Purchase of Fixed Asset in Real Terms	Purchase of Fixed Asset in Nominal Terms
1993	1.45	(192)	(279)
1994	1.55	(26)	(40)
1998	2.01	(21)	(43)
2002	2.53	(4)	(10)
2003	2.67	(44)	(118)
2013	4.68	(52)	(243)
2023	8.39	(133)	(1,114)
2033	15.02	(46)	(695)

3.2.7 Debt Instruments

The floating interest rates, which are shown in Table 3.15, are calculated as nominal risk-free forward interest rates (Table 3.2) plus 0.75 percent per annum until December 31, 1999 or 0.25 percent per annum thereafter, because Eurotunnel has used fixed interest rates of 9.75 percent and 9.25 percent for those periods and the average of it's projection of LIBOR was 9.00 percent.

Table 3.15 Nominal Floating Interest Rates on Debt Instruments

	Nominal Risk-Free Forward Rates	Interest Rates up to December 31, 1999 1)	Interest Rates after January 1st, 2000 2)	Discount Factors 3)
1987	9.00%	9.75%		0.9545
1988	8.63%	9.38%		0.8727
1989	8.73%	9.48%		0.7971
1990	9.10%	9.85%		0.7256
1991	8.94%	9.69%		0.6615
1992	8.95%	9.70%		0.6030
1993	9.11%	9.86%		0.5489
1994	9.47%	10.22%		0.4980
1995	10.03%	10.78%		0.4495
1996	10.48%	11.23%		0.4042
1997	9.37%	10.12%		0.3670
1998	9.28%	10.03%		0.3336
1999	9.28%	10.03%		0.3032
2000	8.70%		8.95%	0.2783
2001	8.61%		8.86%	0.2556
2002	9.19%		9.44%	0.2336
2003	8.39%		8.64%	0.2150
2004	8.80%		9.05%	0.1971
2005	8.40%		8.65%	0.1814
2006	8.32%		8.57%	0.1671
2007	8.24%		8.49%	0.1540
2008	9.00%		9.25%	0.1410
2009	9.00%		9.25%	0.1291
2010	9.00%		9.25%	0.1181
2011	9.00%		9.25%	0.1081
2012	9.00%		9.25%	0.0990
2013	9.00%		9.25%	0.0906
2014	9.00%		9.25%	0.0829
2015	9.00%		9.25%	0.0759
2016	9.00%		9.25%	0.0695
2017	9.00%		9.25%	0.0636
2018	9.00%		9.25%	0.0582
2019	9.00%		9.25%	0.0533
2020	9.00%		9.25%	0.0488
2021	9.00%		9.25%	0.0446
2022	9.00%		9.25%	0.0409
2023	9.00%		9.25%	0.0374
2024	9.00%		9.25%	0.0342
2025	9.00%		9.25%	0.0313
2026	9.00%		9.25%	0.0287
2027	9.00%		9.25%	0.0263
2028	9.00%		9.25%	0.0240
2029	9.00%		9.25%	0.0220
2030	9.00%		9.25%	0.0201
2031	9.00%		9.25%	0.0184
2032	9.00%		9.25%	0.0169
2033	9.00%		9.25%	0.0154

2034	9.00%		9.25%	0.0141
2035	9.00%		9.25%	0.0129
2036	9.00%		9.25%	0.0118
2037	9.00%		9.25%	0.0108
2038	9.00%		9.25%	0.0099
2039	9.00%		9.25%	0.0091
2040	9.00%		9.25%	0.0083
2041	9.00%		9.25%	0.0076
2042	9.00%		9.25%	0.0072

Notes:

1) Interest rates are calculated as risk-free rates plus 0.75%.
2) Interest rates are calculated as risk-free rates plus 0.25%.
3) Discount factors are calculated as follows:

$$\text{Discount Factor}_{1987} = \frac{1}{(1+\text{Interest Rate}_{1987})^{1/2}};$$

$$\text{Discount Factor}_{n} = \frac{\text{Discount Factor}_{n-1}}{1+\text{Interest Rate}_{n}}, \qquad (n = 1988 \text{ through } 2041);$$

$$\text{Discount Factor}_{2042} = \frac{\text{Discount Factor}_{2041}}{(1+\text{Interest Rate}_{2042})^{7/12}}.$$

The cash flows on the Debt Instruments are shown in Table 3.16. The amounts of issues given in Section 2.8 are used. Also, the amounts of repayments for 2013, 2023, 2033, and 2041 shown in Section 2.11.5 are used. Repayments for other years are calculated so that all the amount of the debt is repaid fully until the end of the concession.

Table 3.16 Nominal Cash Flows on Debt Instruments

(Unit: £ million)

	Principal Inflows	Principal Repayments	Principal Outstanding	Interest Payments
1995	776		776	
1996	352		1,128	(87)
1997	361		1,489	(114)
1998	451		1,940	(149)
1999			1,940	(195)
2000			1,940	(174)
2001			1,940	(172)
2002			1,940	(183)
2003			1,940	(168)
2004			1,940	(176)
2005			1,940	(168)
2006			1,940	(166)
2007		(41)	1,899	(165)
2008		(41)	1,857	(176)

2009	(41)	1,816	(172)
2010	(41)	1,775	(168)
2011	(41)	1,733	(164)
2012	(41)	1,692	(160)
2013	(97)	1,595	(157)
2014	(55)	1,540	(148)
2015	(55)	1,485	(142)
2016	(55)	1,430	(137)
2017	(55)	1,375	(132)
2018	(55)	1,320	(127)
2019	(55)	1,265	(122)
2020	(55)	1,210	(117)
2021	(55)	1,155	(112)
2022	(55)	1,100	(107)
2023	(55)	1,045	(102)
2024	(55)	990	(97)
2025	(55)	935	(92)
2026	(55)	880	(86)
2027	(55)	825	(81)
2028	(55)	770	(76)
2029	(55)	715	(71)
2030	(55)	660	(66)
2031	(55)	605	(61)
2032	(55)	550	(56)
2033	(55)	495	(51)
2034	(55)	440	(46)
2035	(55)	385	(41)
2036	(55)	330	(36)
2037	(55)	275	(31)
2038	(55)	220	(25)
2039	(55)	165	(20)
2040	(55)	110	(15)
2041	(55)	55	(10)
2042	(55)		(3)

3.2.8 Depreciation (For Tax Payment Purposes)

Although UK and French tax laws are to be applied, the detailed information about the costs during the construction period has not been available. For simplicity, therefore a straight line basis has been adopted for depreciations as follows.

All of the costs incurred during the construction period except for "Procurement Items" are depreciated equally over

the period from July 1993 to June 2042. (See Table 3.17) As for "Procurement Items" and "Purchase of Fixed Assets" during the operating period, a depreciation period of ten or nine years is assumed. (See Table 3.18) Total amount of depreciation to be written off each year is shown in Table 3.19.

Table 3.17 Depreciation of Assets Capitalized During Construction in Nominal Terms

(Unit: £ million)

	Target Works	Lump Sum Works	Procurement Items	Corporate Costs	Net Financing Cost	Total Depre-ciation
Total	1,579	1,430	325	782	1,088	5,204
Depreciation Period	49	49	10	49	49	
1993	16	15	16	8	11	66
1994	32	29	33	16	22	132
1995	32	29	33	16	22	132
1996	32	29	33	16	22	132
1997	32	29	33	16	22	132
1998	32	29	33	16	22	132
1999	32	29	33	16	22	132
2000	32	29	33	16	22	132
2001	32	29	33	16	22	132
2002	32	29	33	16	22	132
2003	32	29	16	16	22	116
2004	32	29		16	22	100
2005	32	29		16	22	100
2006	32	29		16	22	100
2007	32	29		16	22	100
2008	32	29		16	22	100
2009	32	29		16	22	100
2010	32	29		16	22	100
2011	32	29		16	22	100
2012	32	29		16	22	100
2013	32	29		16	22	100
2014	32	29		16	22	100
2015	32	29		16	22	100
2016	32	29		16	22	100
2017	32	29		16	22	100
2018	32	29		16	22	100
2019	32	29		16	22	100
2020	32	29		16	22	100
2021	32	29		16	22	100
2022	32	29		16	22	100

2023	32	29	16	22	100
2024	32	29	16	22	100
2025	32	29	16	22	100
2026	32	29	16	22	100
2027	32	29	16	22	100
2028	32	29	16	22	100
2029	32	29	16	22	100
2030	32	29	16	22	100
2031	32	29	16	22	100
2032	32	29	16	22	100
2033	32	29	16	22	100
2034	32	29	16	22	100
2035	32	29	16	22	100
2036	32	29	16	22	100
2037	32	29	16	22	100
2038	32	29	16	22	100
2039	32	29	16	22	100
2040	32	29	16	22	100
2041	32	29	16	22	100
2042	16	15	8	11	50

Table 3.18 Depreciation of Assets Capitalized During Operation in Nominal Terms

(Unit: £ million)

Assets Purchased in	1993	1994	1998	2002	2003	2013	2023	2033	Total Depre-ciation
Total	279	40	43	10	118	243	1,114	695	2,541
Depreciation Period	10	10	10	10	10	10	10	9	
1993	14								14
1994	28	2							30
1995	28	4							32
1996	28	4							32
1997	28	4							32
1998	28	4	2						34
1999	28	4	4						36
2000	28	4	4						36
2001	28	4	4						36
2002	28	4	4						37
2003	14	4	4	1	6				29
2004		2	4	1	12				19
2005			4	1	12				17
2006			4	1	12				17
2007			4	1	12				17
2008			2	1	12				15
2009				1	12				13
2010				1	12				13
2011				1	12				13
2012					12				12
2013					6	12			18

2014		24		24
2015		24		24
2016		24		24
2017		24		24
2018		24		24
2019		24		24
2020		24		24
2021		24		24
2022		24		24
2023		12	56	68
2024			111	111
2025			111	111
2026			111	111
2027			111	111
2028			111	111
2029			111	111
2030			111	111
2031			111	111
2032			111	111
2033			56	39 94
2034				77 77
2035				77 77
2036				77 77
2037				77 77
2038				77 77
2039				77 77
2040				77 77
2041				77 77
2042				39 39

Table 3.19 Total Depreciation in Nominal Terms (Unit: £ million)

	Depreciation of Assets Capitalized During Construction	Depreciation of Assets Capitalized During Operation	Total Depreciation
1993	66	14	80
1994	132	30	162
1995	132	32	164
1996	132	32	164
1997	132	32	164
1998	132	34	166
1999	132	36	168
2000	132	36	168
2001	132	36	168
2002	132	37	169
2003	116	29	145
2004	100	19	119
2005	100	17	117
2006	100	17	117
2007	100	17	117
2008	100	15	114
2009	100	13	112

2010	100	13	112
2011	100	13	112
2012	100	12	112
2013	100	18	118
2014	100	24	124
2015	100	24	124
2016	100	24	124
2017	100	24	124
2018	100	24	124
2019	100	24	124
2020	100	24	124
2021	100	24	124
2022	100	24	124
2023	100	68	167
2024	100	111	211
2025	100	111	211
2026	100	111	211
2027	100	111	211
2028	100	111	211
2029	100	111	211
2030	100	111	211
2031	100	111	211
2032	100	111	211
2033	100	94	194
2034	100	77	177
2035	100	77	177
2036	100	77	177
2037	100	77	177
2038	100	77	177
2039	100	77	177
2040	100	77	177
2041	100	77	177
2042	50	39	88

3.2.9 Corporate Income Tax

The corporate income tax rate of 40 percent has been used because as shown in Section 2.11.2, this figure is the approximation of tax rates for the most of the years of the operation period which have been adopted by Eurotunnel. The amounts relating to income taxes are shown in Table 3.20.

Table 3.20 Taxation in Nominal Terms (Unit: £ million)

	(1-T) Net Operating Revenues	Interest Tax Shield On Credit Facilities	Interest Tax Shield on Debt Instruments	Depreciation Tax Shield
1993	257	82		32
1994	396	184		65
1995	440	194		66
1996	486	165	35	66
1997	529	129	46	66
1998	572	108	60	66
1999	623	85	78	67
2000	672	76	69	67
2001	724	71	69	67
2002	783	71	73	67
2003	840	61	67	58
2004	900	58	70	47
2005	962	25	67	47
2006	1,026		67	47
2007	1,094		66	47
2008	1,175		70	46
2009	1,261		69	45
2010	1,353		67	45
2011	1,452		66	45
2012	1,558		64	45
2013	1,672		63	47
2014	1,784		59	50
2015	1,903		57	50
2016	2,031		55	50
2017	2,167		53	50
2018	2,312		51	50
2019	2,466		49	50
2020	2,631		47	50
2021	2,807		45	50
2022	2,994		43	50
2023	3,194		41	67
2024	3,393		39	84
2025	3,604		37	84
2026	3,829		35	84
2027	4,067		33	84
2028	4,321		31	84
2029	4,590		28	84
2030	4,876		26	84
2031	5,180		24	84
2032	5,503		22	84
2033	5,845		20	78
2034	6,180		18	71
2035	6,534		16	71
2036	6,908		14	71
2037	7,304		12	71
2038	7,722		10	71
2039	8,163		8	71

2040	8,631	6	71
2041	9,124	4	71
2042	5,494	1	35

Note: A corporate income tax rate of 40 percent is used.

3.3 Discount Rates

3.3.1 Risk-Free Interest Rates

As described in Section 3.2.2, risk-free forward interest rates (R_f) are calculated from interest rates on UK Government bonds. These rates together with the discount factors calculated from these interest rates are shown in Table 3.2.

3.3.2 Discount Rates for Net Operating Revenues

Discount rates (R) for net operating revenues are calculated by using a capital asset pricing model as below:

$$R = R_f + ß \cdot (R_m - R_f)$$

Where, ß represents the riskiness of a stock relative to the risk in the stock market as a whole.

The market risk premium rate ($R_m - R_f$) of 8.0 percent[1], which is a figure for the UK, is adopted, for simplicity, although as a further approach, an adoption of different market premium rates based on different currencies between the Uk and France are pointed out.

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[1]See Hirokazu Onozaki, An Evaluation of Financial Packages: New Bosporus Bridge Case, (S.M. thesis in Civil Engineering, MIT, June 1987), p. 46.

As for the ß, a figure of 0.61, as an unlevered asset beta of the railroad industry in the US, is adopted for that in the UK because an appropriate ß was not found.[1] Here, the riskiness of the railroad industry without any debt compared with the total stock market in the UK has been simply assumed to be the same as that in the U.S.

Discount rates and discount factors for net operating revenues are shown in Table 3.21.

Table 3.21 Nominal Discount Rates For Net Operating Revenue

	Nominal Risk-Free Forward Rates (R_f)	Discount Rates 1)	Discount Factors 2)
1987	9.00%	13.88%	0.9371
1988	8.63%	13.51%	0.8255
1989	8.73%	13.61%	0.7267
1990	9.10%	13.98%	0.6375
1991	8.94%	13.82%	0.5601
1992	8.95%	13.83%	0.4921
1993	9.11%	13.99%	0.4317
1994	9.47%	14.35%	0.3775
1995	10.03%	14.91%	0.3285
1996	10.48%	15.36%	0.2848
1997	9.37%	14.25%	0.2492
1998	9.28%	14.16%	0.2183
1999	9.28%	14.16%	0.1913
2000	8.70%	13.58%	0.1684
2001	8.61%	13.49%	0.1484
2002	9.19%	14.07%	0.1301
2003	8.39%	13.27%	0.1148
2004	8.80%	13.68%	0.1010
2005	8.40%	13.28%	0.0892
2006	8.32%	13.20%	0.0788
2007	8.24%	13.12%	0.0696
2008	9.00%	13.88%	0.0611
2009	9.00%	13.88%	0.0537
2010	9.00%	13.88%	0.0471
2011	9.00%	13.88%	0.0414

[1]See Richard Brealey and Stewart Myers, Principles of Corporate Finance, Second Edition, (New York: McGraw-Hill Book Company, 1984), p. 173.

2012	9.00%	13.88%	0.0364
2013	9.00%	13.88%	0.0319
2014	9.00%	13.88%	0.0280
2015	9.00%	13.88%	0.0246
2016	9.00%	13.88%	0.0216
2017	9.00%	13.88%	0.0190
2018	9.00%	13.88%	0.0167
2019	9.00%	13.88%	0.0146
2020	9.00%	13.88%	0.0129
2021	9.00%	13.88%	0.0113
2022	9.00%	13.88%	0.0099
2023	9.00%	13.88%	0.0087
2024	9.00%	13.88%	0.0076
2025	9.00%	13.88%	0.0067
2026	9.00%	13.88%	0.0059
2027	9.00%	13.88%	0.0052
2028	9.00%	13.88%	0.0045
2029	9.00%	13.88%	0.0040
2030	9.00%	13.88%	0.0035
2031	9.00%	13.88%	0.0031
2032	9.00%	13.88%	0.0027
2033	9.00%	13.88%	0.0024
2034	9.00%	13.88%	0.0021
2035	9.00%	13.88%	0.0018
2036	9.00%	13.88%	0.0016
2037	9.00%	13.88%	0.0014
2038	9.00%	13.88%	0.0012
2039	9.00%	13.88%	0.0011
2040	9.00%	13.88%	0.0010
2041	9.00%	13.88%	0.0008
2042	9.00%	13.88%	0.0008

Note:

1) Discount rates are calculated as $R_f + 0.61 \times 8\%$.
2) Discount factors are calculated as follows:

$$\text{Discount Factor}_{1987} = \frac{1}{(1+ \text{Interest Rate}_{1987})^{1/2}};$$

$$\text{Discount Factor}_{n} = \frac{\text{Discount Factor}_{n-1}}{1+ \text{Interest Rate}_{n}}, \quad (n = 1988 \text{ through } 2041);$$

$$\text{Discount Factor}_{2042} = \frac{\text{Discount Factor}_{2041}}{(1+ \text{Interest Rate}_{2042})^{7/12}}.$$

3.3.3 Discount Rates for Credit Facilities and Debt Instruments

As discount rates for cash flows of the Credit Facilities and the Debt Instruments, their own interest rates are used. In general, discount rates for debts are the

interest rates at which Eurotunnel can borrow from the market because such interest rates are supposed to reflect both systematic and non-systematic risk of the debts. Therefore, in this particular case, it is assumed that the interest rates of the Credit Facilities and the Debt Instrument are properly priced at market interest rates, and there is no subsidy in these debts. The interest rates and discount factors are shown in Table 3.9 for the Credit Facilities and in Table 3.15 for the Debt Instruments.

3.3.4 Discount Rates on other Cash Flows

Discount rates for other cash flows are selected as below among three discount rates for: Net Operating Revenues, the Credit Facilities, and the Debt Instruments.

Discount rates on cash flows	
Principal inflows, principal repayments, and interest repayments on the Credit Facilities:	
before June 30, 1993	Rf + 1.25 %
thereafter	Rf + 1.00 %
Net Operating Revenues:	Rf + 4.88 % (ß=0.61)
Principal inflows, principal repayments, and interest repayments on the Debt Instruments:	
until December 31, 1999	Rf + 0.75 %
thereafter	Rf + 0.25 %

Construction Contract:	the same as the Credit Facilities
Eurotunnel's Corporate Costs:	the same as Net Operating Revenues
Financing Costs other than the Credit Facilities:	the same as the Credit Facilities
Fees and interest tax shield on the Credit Facilities:	the same as the Credit Facilities
(1-T) x Net Operating Revenues:	the same as Net Operating Revenues
Purchases of Fixed Assets during the operation period:	the same as Net Operating Revenues
Depreciation Tax Shield:	the same as the Debt Instruments
Interest Tax Shield on the Debt Instruments:	the same as the Debt Instruments

Discount rates for each of the cash flows are given in Table 3.22. Also, for reference purposes, three discount factors for Net Operating Revenues, the Credit Facilities, and the Debt Instruments together with risk-free discount factors based on UK Government bonds are shown in Table 3.23.

Table 3.22 Nominal Discount Rates

	Construction Contract	Corporate Costs	Financing Costs Other than Credit Facilities	Fees & Interest Tax Shield On Credit Facilities
1987	10.25%	13.88%	10.25%	10.25%
1988	9.88%	13.51%	9.88%	9.88%
1989	9.98%	13.61%	9.98%	9.98%
1990	10.35%	13.98%	10.35%	10.35%
1991	10.19%	13.82%	10.19%	10.19%
1992	10.20%	13.83%	10.20%	10.20%
1993	10.24%	13.99%	10.24%	10.24%
1994				10.47%
1995				11.03%
1996				11.48%
1997				10.37%
1998				10.28%
1999				10.28%
2000				9.70%
2001				9.61%
2002				10.19%
2003				9.39%
2004				9.80%
2005				9.40%

(Table 3.22 Nominal Discount Rates - continuing)

	(1-T) Net Operating Revenues	Depreciation Tax Shield	Purchase of Fixed Assets	Interest Tax Shield on Debt Instruments
1987	13.88%	9.75%	13.88%	9.75%
1988	13.51%	9.38%	13.51%	9.38%
1989	13.61%	9.48%	13.61%	9.48%
1990	13.98%	9.85%	13.98%	9.85%
1991	13.82%	9.69%	13.82%	9.69%
1992	13.83%	9.70%	13.83%	9.70%
1993	13.99%	9.86%	13.99%	9.86%
1994	14.35%	10.22%	14.35%	10.22%
1995	14.91%	10.78%	14.91%	10.78%
1996	15.36%	11.23%	15.36%	11.23%
1997	14.25%	10.12%	14.25%	10.12%
1998	14.16%	10.03%	14.16%	10.03%
1999	14.16%	10.03%	14.16%	10.03%
2000	13.58%	8.95%	13.58%	8.95%
2001	13.49%	8.86%	13.49%	8.86%
2002	14.07%	9.44%	14.07%	9.44%
2003	13.27%	8.64%	13.27%	8.64%
2004	13.68%	9.05%	13.68%	9.05%
2005	13.28%	8.65%	13.28%	8.65%
2006	13.20%	8.57%	13.20%	8.57%

2007	13.12%	8.49%	13.12%	8.49%
2008	13.88%	9.25%	13.88%	9.25%
2009	13.88%	9.25%	13.88%	9.25%
2010	13.88%	9.25%	13.88%	9.25%
2011	13.88%	9.25%	13.88%	9.25%
2012	13.88%	9.25%	13.88%	9.25%
2013	13.88%	9.25%	13.88%	9.25%
2014	13.88%	9.25%	13.88%	9.25%
2015	13.88%	9.25%	13.88%	9.25%
2016	13.88%	9.25%	13.88%	9.25%
2017	13.88%	9.25%	13.88%	9.25%
2018	13.88%	9.25%	13.88%	9.25%
2019	13.88%	9.25%	13.88%	9.25%
2020	13.88%	9.25%	13.88%	9.25%
2021	13.88%	9.25%	13.88%	9.25%
2022	13.88%	9.25%	13.88%	9.25%
2023	13.88%	9.25%	13.88%	9.25%
2024	13.88%	9.25%	13.88%	9.25%
2025	13.88%	9.25%	13.88%	9.25%
2026	13.88%	9.25%	13.88%	9.25%
2027	13.88%	9.25%	13.88%	9.25%
2028	13.88%	9.25%	13.88%	9.25%
2029	13.88%	9.25%	13.88%	9.25%
2030	13.88%	9.25%	13.88%	9.25%
2031	13.88%	9.25%	13.88%	9.25%
2032	13.88%	9.25%	13.88%	9.25%
2033	13.88%	9.25%	13.88%	9.25%
2034	13.88%	9.25%	13.88%	9.25%
2035	13.88%	9.25%	13.88%	9.25%
2036	13.88%	9.25%	13.88%	9.25%
2037	13.88%	9.25%	13.88%	9.25%
2038	13.88%	9.25%	13.88%	9.25%
2039	13.88%	9.25%	13.88%	9.25%
2040	13.88%	9.25%	13.88%	9.25%
2041	13.88%	9.25%	13.88%	9.25%
2042	13.88%	9.25%	13.88%	9.25%

Table 3.23 Nominal Discount Factors

	Risk-Free	Net Operating Revenues	Credit Facilities	Debt Instruments
1987	0.9578	0.9371	0.9524	0.9545
1988	0.8817	0.8255	0.8667	0.8727
1989	0.8109	0.7267	0.7881	0.7971
1990	0.7433	0.6375	0.7142	0.7256
1991	0.6823	0.5601	0.6481	0.6615
1992	0.6262	0.4921	0.5881	0.6030
1993	0.5740	0.4317	0.5335	0.5489
1994	0.5243	0.3775	0.4830	0.4980
1995	0.4765	0.3285	0.4350	0.4495
1996	0.4313	0.2848	0.3902	0.4042
1997	0.3943	0.2492	0.3535	0.3670

1998	0.3609	0.2183	0.3206	0.3336
1999	0.3302	0.1913	0.2907	0.3032
2000	0.3038	0.1684	0.2650	0.2783
2001	0.2797	0.1484	0.2418	0.2556
2002	0.2562	0.1301	0.2194	0.2336
2003	0.2363	0.1148	0.2006	0.2150
2004	0.2172	0.1010	0.1827	0.1971
2005	0.2004	0.0892	0.1688	0.1814
2006	0.1850	0.0788	.	0.1671
2007	0.1709	0.0696	.	0.1540
2008	0.1568	0.0611	.	0.1410
2009	0.1438	0.0537	.	0.1291
2010	0.1320	0.0471	.	0.1181
2011	0.1211	0.0414	.	0.1081
2012	0.1111	0.0364	.	0.0990
2013	0.1019	0.0319	.	0.0906
2014	0.0935	0.0280	.	0.0829
2015	0.0858	0.0246	.	0.0759
2016	0.0787	0.0216	.	0.0695
2017	0.0722	0.0190	.	0.0636
2018	0.0662	0.0167	.	0.0582
2019	0.0608	0.0146	.	0.0533
2020	0.0557	0.0129	.	0.0488
2021	0.0511	0.0113	.	0.0446
2022	0.0469	0.0099	.	0.0409
2023	0.0430	0.0087	.	0.0374
2024	0.0395	0.0076	.	0.0342
2025	0.0362	0.0067	.	0.0313
2026	0.0332	0.0059	.	0.0287
2027	0.0305	0.0052	.	0.0263
2028	0.0280	0.0045	.	0.0240
2029	0.0257	0.0040	.	0.0220
2030	0.0235	0.0035	.	0.0201
2031	0.0216	0.0031	.	0.0184
2032	0.0198	0.0027	.	0.0169
2033	0.0182	0.0024	.	0.0154
2034	0.0167	0.0021	.	0.0141
2035	0.0153	0.0018	.	0.0129
2036	0.0140	0.0016	.	0.0118
2037	0.0129	0.0014	.	0.0108
2038	0.0118	0.0012	.	0.0099
2039	0.0108	0.0011	.	0.0091
2040	0.0099	0.0010	.	0.0083
2041	0.0091	0.0008	.	0.0076
2042	0.0087	0.0008	.	0.0072

3.4 VC Analysis

A VC analysis has been done on the base case as shown in Table 3.24. As discount rates and interest rates are equivalent, net present values of principal inflows, interest payments, and principal repayments on both the Credit Facilities and the Debt Instruments are zero. Therefore, these columns are not included in the table. However, the present values of the interest tax shield on the Credit Facilities and the Debt Instruments have positive values, so these columns are given in the table.

As an adjusted net present value, a positive value of £413 million has resulted for this base case as shown at the end of Table 3.24.

The sum of the present values of the cash flows which correspond to "all equity cases," in other words the case in which all investments are paid by the equity funds, is a negative value of -£100 million (= Construction Contract [-2,472] + Corporate costs [-508] + (1-T) Net operating revenues [2,703] + Depreciation tax shield [356] + Purchase of fixed assets [-179]). This implies that the project is not profitable if it is financed only by the equity holders.

The side effects of the debts have increased the net present value of the project. That is, the present values of "Financing cost other than Credit Facilities" (-166), "Interest tax shield on Debt Instrument" (274), "Fees on Credit Facilities" (-60-3), and "Interest tax shield on Credit Facilities" (467) total £512 million. The side

effects of debts of £512 million have offset the negative value of the "all-equity case" (-100) and have resulted in a positive value of £413 million.

Among the side effects of the debts, the present value of the interest tax shield on the Credit Facilities (£467 million) is extremely large, and it exceeds the adjusted net present value of £413 million. Therefore, it can be said that the Eurotunnel's financial scheme and its profitability largely depend on the debts under the Credit Facilities.

Table 3.24 "Base Case" VC Analysis (Unit: £ million)

	Construction Contract	Corporate Costs	Financing Costs other than Credit Facilities
PV=	(2,472)	(508)	(166)
1987	(176)	(62)	(174)
1988	(531)	(119)	
1989	(767)	(126)	
1990	(853)	(133)	
1991	(683)	(141)	
1992	(289)	(150)	
1993	(35)	(51)	

Note: All figures are in nominal terms.

(Table 3.24 "Base Case" VC Analysis - Continuing) (Unit: £ million)

	(1-T) Net Operating Revenues	Depreciation Tax Shield	Purchase of Fixed Assets	Interest Tax Shield on Debt Instruments
PV=	2,703	356	(179)	274
1987				
1988				
1989				
1990				
1991				
1992				
1993	257	32	(279)	
1994	396	65	(40)	
1995	440	66		
1996	486	66		35

1997	529	66		46
1998	572	66	(43)	60
1999	623	67		78
2000	672	67		69
2001	724	67		69
2002	783	67	(10)	73
2003	840	58	(118)	67
2004	900	47		70
2005	962	47		67
2006	1,026	47		67
2007	1,094	47		66
2008	1,175	46		70
2009	1,261	45		69
2010	1,353	45		67
2011	1,452	45		66
2012	1,558	45		64
2013	1,672	47	(243)	63
2014	1,784	50		59
2015	1,903	50		57
2016	2,031	50		55
2017	2,167	50		53
2018	2,312	50		51
2019	2,466	50		49
2020	2,631	50		47
2021	2,807	50		45
2022	2,994	50		43
2023	3,194	67	(1,114)	41
2024	3,393	84		39
2025	3,604	84		37
2026	3,829	84		35
2027	4,067	84		33
2028	4,321	84		31
2029	4,590	84		28
2030	4,876	84		26
2031	5,180	84		24
2032	5,503	84		22
2033	5,845	78	(695)	20
2034	6,180	71		18
2035	6,534	71		16
2036	6,908	71		14
2037	7,304	71		12
2038	7,722	71		10
2039	8,163	71		8
2040	8,631	71		6
2041	9,124	71		4
2042	5,494	35		1

Note: All figures are in nominal terms.

(Table 3.24 "Base Case" VC Analysis - continuing) (Unit: £ million)

	Fees during Construction on Credit Facilities	Fees during Operation on Credit Facilities	Interest Tax Shield On Credit Facilities	ANPV
PV=	(60)	(3)	467	413
1987	(11)			
1988	(7)			
1989	(16)			
1990	(17)			
1991	(15)			
1992	(10)			
1993	(4)	(4)	82	
1994		(1)	184	
1995			194	
1996			165	
1997			129	
1998			108	
1999			85	
2000			76	
2001			71	
2002			71	
2003			61	
2004			58	
2005			25	

Note: All figures are in nominal terms.

CHAPTER 4. RESULTS AND IMPLICATIONS

In Chapter 3, a financial evaluation of the Eurotunnel project was presented for a simplified base case from the viewpoint of Eurotunnel, and as an adjusted net present value, a positive value of £413 million has resulted. During the analysis, simplifications are made, and those which may differ from the actual ones are as follows:

a) A uniform distribution of costs over the construction period, which might be different from actual distribution, is adopted for each element of Construction Contract, and for Eurotunnel's corporate costs, whereas minor adjustments have been done so that the totals of real amounts (£2,788 million plus £642 million) and inflation incurred (£469 million) are the same as those specified by Eurotunnel respectively;

b) As margins over the reference rate of the interest on the Credit Facilities which are shown in Table 2.5, only those for the main facilities are used, whereas higher rates are applied to the portion of the drawing which exceeds £4,000 million. Also, the debt cover ratios are not calculated, although it is

confirmed by the author that negative total cash inflows never occur in the calculations in Chapter 3;

c) A corporate tax rate of 40 percent is used, whereas the actual tax rates increase along with the increase in taxable income and at times are actually smaller than 40 percent, especially in the early period of operation;

d) The straight-line method is used for depreciation write-off, whereas the actual one in the UK seems to be of the accelerated depreciation;

e) As a proxy for the unlevered ß in the UK and France, the figure in the US is used.

It seems that the difference between these simplifications and those of the actual case does not influence the adjusted net present value significantly, although the obtained adjusted net present value is a little less due to items c) and d). Therefore, the obtained net present value is valid (at least, in terms of a first-order approximation of the actual one).

In this chapter, some discussion on exchanges between the £ and the FRF are presented. Then, several sensitivity analyses have been performed against the base case, by increasing construction costs, by assuming delays in the opening of the System, and by decreasing the operating revenues, respectively. In each of these cases, two discount

rates for costs on the Construction Contract are adopted. Also, the same simplified model is used as that in Chapter 3. At the end of this Chapter, warrants of the Eurotunnel are discussed.

4.1 Purchasing Power Parity Between £ and FRF

In Chapter 3, where a VC Analysis was done for the base case, a purchasing power parity between the UK and France is assumed. In this section, that assumption is discussed.

Real exchange rates between the £ and the FRF during a period from 1971 to the end of the third quarter in 1987 are calculated in Table 4.1, where a consumers' price index of the two countries has been converted by changing the reference year to 1971 from 1963, 1975, and 1980. The real exchange rates are obtained as follows:

$$\text{Real Exchange Rate} = S_{\frac{£}{FRF}} \times \frac{\text{French CPI}}{\text{UK CPI}}$$

where, $S_{\frac{£}{FRF}}$ stands for a nominal exchange rate in terms of £ per 1 FRF.

At the end of Table 4.1, the differences in real exchange rates compared with the previous years are calculated, and it is found that such differences are large, usually in the range of 10 percent with the maximum being about 20 percent. That is, in the short term, the purchasing power parity between £ and FRF has not been maintained.

Table 4.1 Real Exchange Rates between £ and FRF

	United Kingdom			
	CPI (1963=100)	CPI (1975=100)	CPI (1980=100)	CPI (1971=100)
1971	151.8			100.0
1972	163.5	63.6		107.7
1973		69.4		117.5
1974		80.5		136.3
1975		100.0		169.4
1976		116.5		197.3
1977		135.0		228.6
1978		146.2		247.6
1979		165.8		280.8
1980		195.6	100.0	331.3
1981			111.9	370.7
1982			121.5	402.5
1983			127.1	421.0
1984			133.5	442.2
1985			141.6	469.1
1986			146.4	485.0
1987III			152.8	506.2

(Table 4.1 Real Exchange Rates between £ and FRF - continuing)

	France			
	CPI (1963=100)	CPI (1975=100)	CPI (1980=100)	CPI (1971=100)
1971	141.1			100.0
1972	150.8	73.3		106.9
1973		78.7		114.7
1974		89.5		130.5
1975		100.0		145.8
1976		109.6		159.8
1977		119.9		174.8
1978		130.8		190.7
1979		144.8		211.1
1980		164.1	100.0	239.3
1981			113.4	271.3
1982			126.8	303.4
1983			139.0	332.6
1984			149.3	357.2
1985			157.9	377.8
1986			161.9	387.4
1987III			167.9	401.7

(Table 4.1 Real Exchange Rates between £ and FRF - continuing)

	$S\ \frac{FRF}{£}$ 1)	$S\ \frac{£}{FRF}$	Real Exchange Rates (£/FRF) 2)	Difference in Real Exchange Rates 3)
1971	13.3125	0.0751	0.0751	0.0%
1972	12.0150	0.0832	0.0826	9.9%
1973	10.9138	0.0916	0.0895	8.3%
1974	10.4137	0.0960	0.0919	2.8%
1975	9.0375	0.1107	0.0953	3.6%
1976	8.4487	0.1184	0.0959	0.6%
1977	9.0075	0.1110	0.0849	-11.5%
1978	8.5050	0.1176	0.0906	6.7%
1979	8.9325	0.1120	0.0842	-7.1%
1980	10.8200	0.0924	0.0668	-20.7%
1981	10.9215	0.0916	0.0670	0.4%
1982	10.9100	0.0917	0.0691	3.1%
1983	12.0880	0.0827	0.0653	-5.4%
1984	11.1717	0.0895	0.0723	10.6%
1985	10.8485	0.0922	0.0742	2.7%
1986	9.4549	0.1058	0.0845	13.8%
1987III	9.9687	0.1003	0.0796	-5.8%

Sources:

International Monetary Fund, International Financial Statistics, 1973 supplement (Washington, D.C.: 1973), pp. 138-139, pp. 444-445.
Ibid., vol. 33, no. 1 (1980), pp. 156-157, pp. 400-401.
Ibid., vol. 35, no. 12 (1982), pp. 166-167, pp. 422-423.
Ibid., vol. 41, no. 2 (1988), pp. 218-219, pp. 518-519.
Bank of England, Bank of England Quarterly Bulletin, vol. 13, no. 4 (London: 1973), table 28.
Ibid., vol. 14, no. 4 (1974), table 29.
Ibid., vol. 15, no. 4 (1975), table 28.
Ibid., vol. 17, no. 4 (1977), table 29.
Ibid., vol. 22, no. 4 (1982), table 18.
Ibid., vol. 27, no. 4 (1987), table 18.

Notes:

1) The figures represent middle-market telegraphic transfer rates as recorded by the Bank of England during the late afternoon on the last working day of year.

2) The figures are calculated as: $S\ \frac{£}{FRF} \times \frac{\text{French CPI}}{\text{UK CPI}}$.

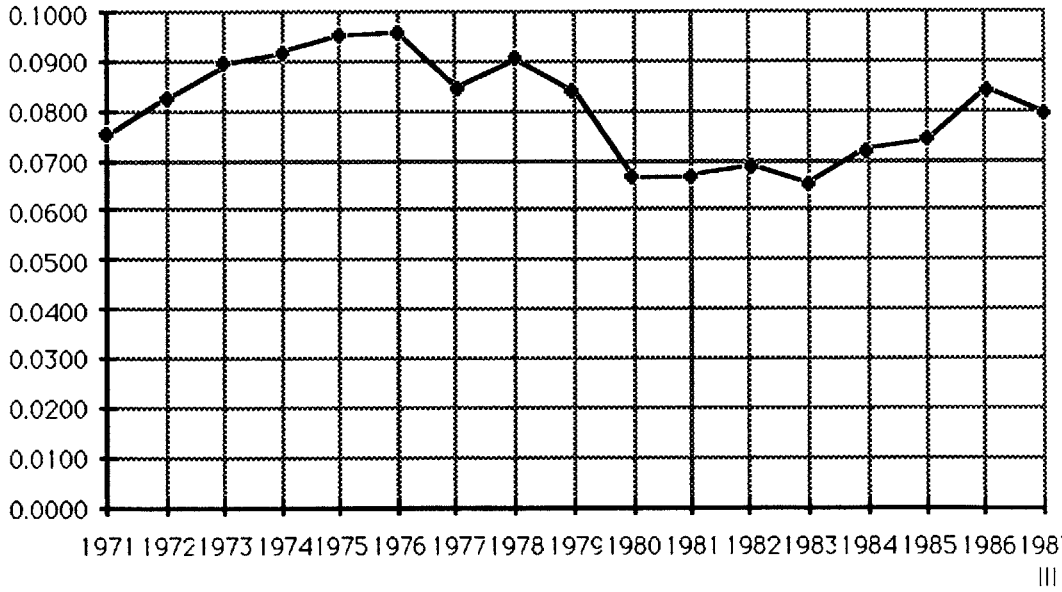
3) The figures represent changes from the previous year.

In Figure 4.1, the obtained real exchange rates are plotted. Compared with the reference year of 1971, the real £ depreciated against the real FRF during the periods of 1971 through 1979 and 1986 through 1987, whereas it appreciated

from 1980 to 1985. The maximum depreciation of the £ against the FRF occurred in 1976 (0.0959 £/FRF) and was 27.7 percent (=0.0959/0.0751-1), compared with the rate in 1971 (0.0751 £/FRF). Its maximum appreciation over the FRF occurred in 1983 and was -13.0 percent (=0.0653/0.0751-1).

It might be said that in the long term, the purchasing power parity between the £ and the FRF has been kept within a band of the fluctuation of +/-20 percent (= (13.0 % + 27.7 %)/2) over a 15-year period.

Figure 4.1 Real Exchange Rates (£/1 FRF)



However, since the short-term purchasing power parity has not been kept between the £ and the FRF, and the author therefore assumes it probably will not be maintained during the life of the project, the cash flows of the Eurotunnel

project should be expressed in two portions: the £ portion and the FRF portion. For example, real costs on the construction contract, Eurotunnel's real corporate costs during the construction period, real costs for purchase of fixed asset during the operation period, and real operation costs are paid equally in £s and FRFs. The amounts of drawings from debts will vary between the £ and the FRF portions, for different nominal costs in £s and FRFs will be incurred due to the different inflation rates between the £ and the FRF. Therefore, the interest payments and fees will differ between them.

The amounts of depreciation in the £ and the FRF portions differs due to the difference in nominal costs between them. The total amount of depreciation is divided equally between EPLC and ESA, which are the UK portion and the French portion of Eurotunnel respectively, so EPLC owns its depreciation both in £s and in FRFs and ESA also owns its depreciation in two currencies. Thus, when depreciation is written off, the relevant amount of EPLC's FRF portion will be exchanged to £s by using the spot rate of that time. Similarly, ESA will exchange its £ portion of depreciation write-off to FRF.

The real operating revenues cash inflows in £s and FRFs will occur in a different proportion. Nominal operation revenues are divided between the EPLC and ESA equally; thus, each party owns its own revenue both in £ and FRF portions. The shareholders in the UK own the portions of EPLC and ESA

in an equal proportion, and also the shareholders in France own similarly. In short, each shareholder has his/her shares which consist of the £ portion and the FRF portion. As each shareholder expects to receive the dividends and the capital gain in the currency in his country of residence, the operating revenues for each year during the operation period should be exchanged by using expected spot rates, so that the proportion of the cash balances in the £ portion and the FRF portion will be the same as that of shareholder's commitments in currencies.

The VC analysis will be done against these two portions separately, that is the £ portion and the FRF portion, not the EPLC and the ESA portions, using different discount rates which reflect risks in terms of each currency. Two adjusted net present values will be obtained. The adjusted net present value for the aggregated shareholders will be obtained as the sum of the two results by converting in one currency using a spot exchange rate at the year of origin.[1]

> For example, suppose that the real £ continues to appreciate over the real FRF, that is:
> the nominal exchange rates are £1 = FRF10 at present and £1 = FRF100 ten years from now, and there is no inflation in two countries during these

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[1]The use of this rate assumes the purchasing power parity will hold over the project life, even though actual purchasing power parity does not hold. Otherwise, the forecast of the real exchange rate would be needed to be done, and that is beyond the scope of this thesis.

ten years. Also, assume that all revenue in the next ten years is obtained in FRFs and is FRF1,000, and that the nominal discount rates for this cash flow in £ terms and in FRF terms are 10 percent and 20 percent respectively. Half of this cash flow (FRF500) is exchanged to £s for dividend payment to UK shareholders. Then the aggregate present value in £ terms of this cash flow for aggregate investors is as follows:

$$\frac{\text{FRF500}}{1.2^{10}} \times \frac{\text{£1}}{\text{FRF10}} + \frac{\text{FRF500} \times \frac{\text{£1}}{\text{FRF100}}}{1.1^{10}} = \text{£10.00}$$

Alternatively, the value in FRF terms is

$$\frac{\text{FRF500}}{1.2^{10}} + \frac{\text{FRF500} \times \frac{\text{£1}}{\text{FRF100}}}{1.1^{10}} \times \frac{\text{FRF10}}{\text{£1}}$$

$$= \text{FRF100.03}$$

From the UK shareholder's perspective, a VC analysis is done using the discount rates as follows:

1. For the contractual cash flows, which include Construction Contract, Financing Costs, Fees on Dept, Depreciation Tax shield, Interest Tax Shield, two set of nominal interest rates on debts in terms of the £ and the FRF respectively will be applied as discount rates. Then, the present values of these cash flows are converted to £s by using a spot exchange rate at the year of origin.

2. For the other cash flows, that is, Eurotunnel's Corporate Costs, Operating Costs, Operating Revenues, and Purchase of Fixed Assets, the discount rates which are specific in the UK are applied after converting these cash flows in £ terms by using the expected spot exchange rates for each year. This means that UK shareholders will expect the same return as that of the railroad industry only within the UK because the high risk of the purchasing power parity between the £ and the FRF will make them unable to expect an exact figure of the return in France. In the case of the example discussed in the previous paragraph, the present value of the revenue ten years from now is calculated as follows:

$$\frac{\text{FRF500} \times \frac{\text{£1}}{\text{FRF100}}}{1.1^{10}} + \frac{\text{FRF500} \times \frac{\text{£1}}{\text{FRF100}}}{1.1^{10}} = \text{£3.85}$$

Although the discount rate in £ terms (10%) is smaller than that in FRF terms (20%), the present value from the UK shareholder's perspective (£3.85) is smaller than that from the aggregate shareholder's perspective (£10.00). That is, if the real £ continues to appreciate over the real FRF, the UK investor's profit will decrease.

The adjusted net present value from the UK shareholder's perspective is obtained as the sum of the present values described above in 1. and 2.

A similar method is also adopted for the adjusted net present value from the French shareholder's perspective. In the previous example, the present value of the revenue in the next ten years is calculated as follows:

$$\frac{\text{FRF500}}{1.2^{10}} + \frac{\text{FRF500}}{1.2^{10}} = \text{FRF161.50}$$

Although the discount rate in FRF terms (20%) is larger than that in £ terms (10%), the present value from the French shareholder's perspective (FRF161.50) is larger than that from the aggregate shareholder's perspective (FRF100.03). That is, if the real £ continues to appreciate over the real FRF, the French investor's profit will increase.

Further discussion of the currency exchange is suspended in this paper, and it is left for future studies. In this paper, the assumption of the purchasing power parity between £ and FRF is simply continued. It must be added that the analysis in this paper is done from the perspective of the UK investors because, as for discount rates, those stated in £s are used.

4.2 Discount Rates for the Construction Costs

For the base case in Section 3.4, the cash outlays of the Construction Contract have been discounted with the interest rates for the Credit Facilities (in Section 3.3.4) because the risk under the Construction Contract is covered by the Credit Facilities and thus their pricing (interest rates). This coverage of the risk by the Credit Facilities means that the construction companies will be able to receive the payments from Eurotunnel at least until the end of the construction period, whereas after June 30, 1995, when the repayments of the principal are planned to start, there is a possibility that the banks will not be able to receive repayments from Eurotunnel, which represents the default.

Therefore, it can be said that the interest rates for the Credit Facilities are the maximum rates for the discount rates of cash outlays under the Construction Contract. On the other hand, the minimum rates for the discount rates are apparently the risk-free interest rates. Consequently, the correct discount rates are supposed to be at some rates between the risk-free interest rates and the interest rates of the Credit Facilities.

In Section 3.4, as the discount rates for the cash outlays under the Construction Contract, the interest rates of the Credit Facilities have been employed as maximum rates, which means that the resulting adjusted net present value of £413 million is larger than the correct one.

In this section, the case in which the risk-free interest rates (Table 3.2) are employed as the discount rates for the Construction Contract, is adopted and the result is shown in Table 4.2 below.

Table 4.2 VC Analysis, in Case that Discount Rates for the Construction Contract are Risk-Free Rates

(Unit: £ million)

PV of Construction Contract	ANPV
(2,559)	326

The resulting positive adjusted net present value of £326 million is considered to be the lowest figure. Therefore, the correct figure of the adjusted net present value is supposed to be between £326 million and £413 million, provided that the other assumptions hold. The difference here of £87 million is due to the lower discount rates (risk-free) being used on the construction outlays.

4.3 Construction Cost Overruns

In this section, the cases in which the construction costs under the Construction Contract are increased by 5, 10, 15, 20, 25, and 30 percent from the amounts of the base case in Table 3.5 are considered.

The calculation of an adjusted net present value in the case of a 10%-cost overrun is shown in Table 4.3.

Table 4.3 VC Analysis, in Case of 10 % Construction Cost Overrun

(Unit: £ million)

	Construction Contract	Corporate Costs	Financing Costs other than Credit Facilities
PV=	(2,719)	(508)	(166)
1987	(194)	(62)	(174)
1988	(584)	(119)	
1989	(843)	(126)	
1990	(938)	(133)	
1991	(751)	(141)	
1992	(318)	(150)	
1993	(39)	(51)	

Note: All items are in nominal terms.

(Table 4.3 VC Analysis - Continuing) (Unit: £ million)

	(1-T) Net Operating Revenues	Depreciation Tax Shield	Purchase of Fixed Assets	Interest Tax Shield on Debt Instruments
PV=	2,703	380	(179)	274
1987				
1988				
1989				
1990				
1991				
1992				
1993	257	34	(279)	
1994	396	69	(40)	
1995	440	70		
1996	486	70		35
1997	529	70		46
1998	572	71	(43)	60
1999	623	72		78
2000	672	72		69
2001	724	72		69
2002	783	72	(10)	73
2003	840	62	(118)	67
2004	900	51		70
2005	962	50		67
2006	1,026	50		67
2007	1,094	50		66
2008	1,175	49		70
2009	1,261	48		69
2010	1,353	48		67
2011	1,452	48		66
2012	1,558	48		64
2013	1,672	50	(243)	63
2014	1,784	53		59
2015	1,903	53		57

2016	2,031	53		55
2017	2,167	53		53
2018	2,312	53		51
2019	2,466	53		49
2020	2,631	53		47
2021	2,807	53		45
2022	2,994	53		43
2023	3,194	70	(1,114)	41
2024	3,393	88		39
2025	3,604	88		37
2026	3,829	88		35
2027	4,067	88		33
2028	4,321	88		31
2029	4,590	88		28
2030	4,876	88		26
2031	5,180	88		24
2032	5,503	88		22
2033	5,845	81	(695)	20
2034	6,180	74		18
2035	6,534	74		16
2036	6,908	74		14
2037	7,304	74		12
2038	7,722	74		10
2039	8,163	74		8
2040	8,631	74		6
2041	9,124	74		4
2042	5,494	37		1

Note: All items are in nominal terms.

(Table 4.3 VC Analysis - continuing) (Unit: £ million)

	Fees during Construction on Credit Facilities	Fees during Operation on Credit Facilities	Interest Tax Shield On Credit Facilities	ANPV
PV=	(63)	(2)	536	256
1987	(11)			
1988	(8)			
1989	(17)			
1990	(18)			
1991	(16)			
1992	(10)			
1993	(4)	(4)	91	
1994			203	
1995			214	
1996			186	
1997			147	
1998			126	
1999			103	
2000			93	
2001			88	
2002			89	
2003			78	
2004			76	
2005			32	

Note: All items are in nominal terms.

In Table 4.3, the construction cost for each year under the Construction Contract is uniformly increased by ten percent. Consequently, the total cost together with the amount to be capitalized during the construction period, and the total amount to be raised from the Credit Facilities have been increased. The adjusted figures in Table 4.3 from the base case (Table 3.24) are those in the columns of: "Construction Contract", "Depreciation Tax Shield", "Fees during Construction on Credit Facilities", "Fees during Operation on Credit Facilities", and "Interest Tax Shield on Credit Facilities". The same discount rates as those of the base case are adopted. The positive adjusted net present value of

£256 million has resulted. Thus the decrease in adjusted net present value of £256 million is due to this overrun possibility.

In Table 4.3, the interest rates of the Credit Facilities are adopted as the discount rates for the cash outlays under the Construction Contract. For the case in which risk-free interest rates are adopted as the discount rates for the Construction Contract, the result of the VC Analysis is shown in Table 4.4.

Table 4.4 VC Analysis, in Case of 10 % Construction Cost Overrun, with Risk-Free Discount Rates for the Construction Contract (Unit: £ million)

PV of Construction Contract	ANPV
(2,815)	160

In Table 4.4, the positive adjusted net present value of £160 million has resulted. This figure is considered to be the lowest figure, and the difference here of £96 million is due to the lower discount rates being used on the construction outlays.

From the discussion in Section 4.2, it can be said that the correct adjusted net present value lies between £160 million and £256 million, if the construction cost is increased by ten percent without any further change from the base case.

For the cases of 5%-, 15%-, 20%-, 25%- and 30%-cost overruns[1] incurred by Eurotunnel, the calculations of adjusted net present values are done similarly. The summary of the results are shown in Table 4.5.

Table 4.5 ANPV in Case of Construction Cost Overruns

(Unit: £ million)

Cost Overrun	0%	5%	10%	15%	20%	25%	30%
Maximum ANPV 1)	413	334	256	178	99	21	(57)
Minimum ANPV 2)	326	243	160	78	(5)	(88)	(170)
Principal Outstanding of Credit Facilities in 1993 & 1994	4,401	4,623	4,845	5,067	5,290	5,512	5,734
Net Cash Inflow							
in 1993	203	197	192	187	181	176	170
in 1994	196	184	173	162	150	139	128

Notes:
1) The interest rates of the Credit Facilities are used as discount rates for cash outlays on the Construction Contract.
2) The risk-free forward interest rates are used as discount rates for cash outlays on the Construction Contract.

In these calculations, for simplicity, the maximum limit of the available amount of draw from the Credit Facilities (that is, £5,000 million) has been neglected. In this case, obtained outcomes should not be seriously affected, as increases in interest rates will slightly increase Eurotunnel's value through increase in the amount of interest

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[1]As described in Section 2.4.1, 30 percent of the cost overrun up to six percent of the target cost under Target Work, which includes tunneling and other underground structures and consists of 49 percent of the total work on the Construction Contract, is to be paid by the Contractor. The cost overrun in this section represents only the portion which is to be paid by Eurotunnel. For example, the cost overrun of 5 percent in Table 4.5 does not include another 0.88% (= 0.49 x 6% x 0.3) which is to be paid by the Contractor. Therefore, the total cost overrun is higher by 1.26 percent than those in Table 4.5.

tax shield, if Eurotunnel can borrow a larger amount than £5,000 million. Also for the portion of the draw from the stand-by of the Credit Facility, which is the excess over £4,000 million, the same interest rates as for those for the main facility of the Credit Facilities are adopted. The maximum amount of principal outstanding of the Credit Facilities, which occurs at the ends of 1993 and 1994, together with the total net cash in-flows are shown in Table 4.5.

From these figures, it can be said that if cost overruns which are larger than 20% occur, Eurotunnel cannot draw from the Credit Facilities, because the principals outstanding in 1994 and 1995 exceed its limit of availability of £5,000 million even if all the total net cash in-flows were invested.

Also, it has been found that positive adjusted net present values can be obtained if overruns are less than 15%, but not if more. In addition, both the maximum and the minimum adjusted net present values decrease lineally along with the increase in the amount of cost overrun. That is, an increase in the cost by five percent causes a decrease in adjusted net present value by about £79 million in the maximum value and £83 million in the minimum values at each level of cost overrun between 0 percent and 30 percent.

4.4 Delay of Opening of the System

In this section, cases in which, delays occur in the opening of the system are considered. Three cases where the delay is six months, twelve months, and eighteen months are assumed.

The case of a six-month delay, in which the delayed opening will be on November 15, 1993, is as follows. According to the Prospectus, an additional £30 million in real terms will be incurred in Eurotunnel's corporate costs. The calculation by VC Analysis for this case of the delay, combined with additional corporate costs, is shown in Table 4.6.

Table 4.6 VC Analysis, in Case of Six-Month Delay of System Opening

(Unit: £ million)

	Construction Contract	Corporate Costs	Financing Costs other than Credit Facilities
PV=	(2,472)	(526)	(166)
1987	(176)	(62)	(174)
1988	(531)	(119)	
1989	(767)	(126)	
1990	(853)	(133)	
1991	(683)	(141)	
1992	(289)	(150)	
1993	(35)	(95)	

Note: All items are in nominal terms.

(Table 4.6 VC Analysis - Continuing) (Unit: £ million)

	(1-T) Net Operating Revenues	Depreciation Tax Shield	Purchase of Fixed Assets	Interest Tax Shield on Debt Instruments
PV=	2,614	354	(179)	274
1987				
1988				
1989				
1990				

1991				
1992				
1993	51		(279)	
1994	396	67	(40)	
1995	440	68		
1996	486	68		35
1997	529	68		46
1998	572	69	(43)	60
1999	623	70		78
2000	672	70		69
2001	724	70		69
2002	783	70	(10)	73
2003	840	72	(118)	67
2004	900	50		70
2005	962	49		67
2006	1,026	49		67
2007	1,094	49		66
2008	1,175	48		70
2009	1,261	47		69
2010	1,353	47		67
2011	1,452	47		66
2012	1,558	47		64
2013	1,672	49	(243)	63
2014	1,784	52		59
2015	1,903	52		57
2016	2,031	52		55
2017	2,167	52		53
2018	2,312	52		51
2019	2,466	52		49
2020	2,631	52		47
2021	2,807	52		45
2022	2,994	52		43
2023	3,194	69	(1,114)	41
2024	3,393	87		39
2025	3,604	87		37
2026	3,829	87		35
2027	4,067	87		33
2028	4,321	87		31
2029	4,590	87		28
2030	4,876	87		26
2031	5,180	87		24
2032	5,503	87		22
2033	5,845	80	(695)	20
2034	6,180	73		18
2035	6,534	73		16
2036	6,908	73		14
2037	7,304	73		12
2038	7,722	73		10
2039	8,163	73		8
2040	8,631	73		6
2041	9,124	73		4
2042	5,494	37		1

Note: All items are in nominal terms.

(Table 4.6 VC Analysis - continuing) (Unit: £ million)

	Fees during Construction on Credit Facilities	Fees during Operation on Credit Facilities	Interest Tax Shield On Credit Facilities	ANPV
PV=	(62)	(2)	457	293
1987	(11)			
1988	(7)			
1989	(16)			
1990	(17)			
1991	(15)			
1992	(10)			
1993	(7)	(4)		
1994			195	
1995			205	
1996			177	
1997			139	
1998			118	
1999			95	
2000			85	
2001			81	
2002			81	
2003			70	
2004			68	
2005			29	

Note: All items are in nominal terms.

In Table 4.6, the corporate cost in 1993 has been increased by £30 million in real terms (at prices in effect for July 1987) from the base case in Table 3.24, and this has raised the amounts of draw from the Credit Facilities.[1] Due to the delay of the opening, the net operating revenue in 1993 has been reduced, and the write off of the depreciation has started six months later than the base case. Also, the interest rate of the Credit Facilities during the period from

[1]In the calculation, penalties on the Construction Contract, which has been described in Section 2.4.5, is neglected. If the penalties were included in the calculation, the resulting adjusted net present value would increase.

July 1st, 1993 to December 31, 1993 is raised by 0.25% caused by the change of the classification of the period from "After completion" to "Before completion". (See Section 2.7.1) Accordingly, the discount rates of the Credit Facilities in 1993 have been changed. As a result, the positive adjusted net present value of £293 million has been obtained.

The decrease in adjusted net present value from the base case is £120 million. The decrease in the present value of "(1-T) Net Operating Revenues" by £89 million, the increase in the present value of "Corporate Costs" by £18 million, and the decrease in the present value of "Interest Tax Shield on Credit Facilities" by £10 million, which is caused by the absence of revenue in 1993, are the main reasons.

In Table 4.6, the interest rates of the Credit Facilities are adopted as the discount rates for the cash outlays under the Construction Contract. For the case in which risk-free interest rates are adopted as the discount rates for the Construction Contract, the result of the VC Analysis is shown in Table 4.7. The positive adjusted net present value of £206 million is obtained. The decrease of £87 million is attributed to the use of lower discount rates which are risk-free, and the adjusted net present value of £206 million is considered to be the minimum value.

Table 4.7 VC Analysis, in Case of Six-Month Delay of System Opening, with Risk-Free Discount Rates for the Construction Contract

(Unit: £ million)

PV of Construction Contract	ANPV
(2,559)	206

The other cases are calculated similarly. The summary of the results of the calculation is shown in Table 4.8 below.

Table 4.8 ANPV in Case of Delay of System Opening

(Unit: £ million)

Delay	0 month	6 months	12 months	18 months
Maximum ANPV	413	293	179	70
Minimum ANPV	326	206	92	(17)

It must be noted that in the case of an 18-month delay, the principal outstanding of the Credit Facility in both 1993 and 1994 are £5,156 million, and the total net cash in-flows in these years are £39 million and £10 million respectively.

From Table 4.8, it is found that positive adjusted net present values can be obtained if the delay is 12 months or less.

4.5 Changes in Operating Revenues

In this section, changes of the operating revenues are considered. VC analyses have been done for the cases of decreases in operating revenues by 5 percent, 10 percent, and 15 percent respectively from the base case, and the results are shown in Table 4.9. In these analyses, the operating costs are not changed from the base case. It has been found

that the adjusted net present values are positive when the decrease in the revenue is less than 5 percent, and they are negative when the decrease is more than 15 percent. The break-even point lies in a decrease of between 5 percent and 15 percent in revenues from those of the base case.

Table 4.9 VC Analysis, in Case of Changes in Revenues

(Unit: £ million)

Change in Revenues	0%	-5%	-10%	-15%
ANPV 1)	413	246	79	(88)
ANPV 2)	326	159	(8)	(176)
PV 3)	2,703	2,536	2,369	2,202
(1-T) Net Revenues				
1993	257	241	226	210
1994	396	371	347	322
1995	440	413	386	359
1996	486	456	426	396
1997	529	496	464	431
1998	572	536	501	465
1999	623	585	547	508
2000	672	631	590	548
2001	724	679	635	590
2002	783	735	687	638
2003	840	788	736	684
2004	900	845	789	733
2005	962	902	843	783
2006	1,026	963	899	836
2007	1,094	1,027	959	891
2008	1,175	1,102	1,029	956
2009	1,261	1,183	1,105	1,027
2010	1,353	1,269	1,186	1,102
2011	1,452	1,362	1,272	1,182
2012	1,558	1,461	1,365	1,268
2013	1,672	1,568	1,464	1,360
2014	1,784	1,673	1,562	1,451
2015	1,903	1,785	1,667	1,549
2016	2,031	1,905	1,778	1,652
2017	2,167	2,032	1,897	1,763
2018	2,312	2,168	2,024	1,881
2019	2,466	2,313	2,160	2,007
2020	2,631	2,467	2,304	2,141
2021	2,807	2,632	2,458	2,284
2022	2,994	2,808	2,622	2,436
2023	3,194	2,995	2,797	2,598
2024	3,393	3,182	2,971	2,760
2025	3,604	3,380	3,156	2,932
2026	3,829	3,591	3,353	3,114

2027	4,067	3,814	3,561	3,308
2028	4,321	4,052	3,783	3,514
2029	4,590	4,304	4,019	3,733
2030	4,876	4,573	4,269	3,965
2031	5,180	4,857	4,535	4,212
2032	5,503	5,160	4,817	4,474
2033	5,845	5,481	5,117	4,752
2034	6,180	5,795	5,409	5,024
2035	6,534	6,126	5,718	5,311
2036	6,908	6,477	6,045	5,614
2037	7,304	6,847	6,391	5,934
2038	7,722	7,239	6,756	6,273
2039	8,163	7,653	7,142	6,631
2040	8,631	8,090	7,549	7,009
2041	9,124	8,552	7,981	7,409
2042	5,494	5,150	4,805	4,461

Notes:
1) In the case that costs under the Construction Contract are discounted with discount rates of the Credit Facilities.
2) In the case that costs under the Construction Contract are discounted with Risk-Free Interest Rates.
3) The figures in this line represent present values of "(1-T) Net Revenues" in each column.
4) All items are in nominal terms.

4.6 Expected Values of Adjusted Net Present Values

The expected value of net present value depends on the distribution of the possibilities of occurrence of the cases. In this section, some assumptions on the distributions are made, then the expected values of adjusted net present values are calculated.

4.6.1 Construction Cost Overrun

The latest banking case as of June 30, 1987, assumed no construction cost overrun for Eurotunnel on the Construction Contract. The costs assumed were £75 million lower (in real terms) than Eurotunnel's estimation. The expected value of the construction cost should be between the level of the

contracted amount between Eurotunnel and the Contractor and the level lower by £75 million. Therefore, it can be said that the expected value of the cost overrun is at the point of no cost overrun (or some savings), for there seems to be the same amount of likelihood of decreasing costs as those of increasing ones. In addition, it has been found that the adjusted net present value is linear with respect to the amount of the cost overrun at the end of Section 4.3. In this case, the expected value of adjusted net present value occurs at the point where the expected cost overruns occurs. In short, the expected adjusted net present value with respect to cost overruns is £413 million at the maximum and £326 million at the minimum (or a little larger respectively).

4.6.2 Delay of Opening of the System

The banking case assumed a 6-month delay in the opening. Also, as of November 1987, the view of the Maître d'Oeuvre, which is an independent organization appointed by Eurotunnel to monitor the design, development and construction of the works and to advise on technical and other matters, indicated a maximum delay of not more than five months in the completion of the System. Therefore, the mode of the distribution of the possibilities of the delay lies around a delay of 6 months.

The distribution of the possibilities of delay was assumed arbitrarily as in Table 4.10, although it may be too

conservative, for the expected value of the delay will be 9.6 months (= 0 month x 0.1 + 6 months x 0.4 + 12 months x 0.3 + 18 months x 0.2), which is far larger than the expectations by the banks and the Maître d'Oeuvre. In Table 4.10, "Maximum ANPV" and "Minimum ANPV" are the values obtained in Section 4.4.

Table 4.10 Distribution of the Possibilities of Delays

(Unit: £ million)

Delay	0 month	6 months	12 months	18 months
Possibilities	10%	40%	30%	20%
Maximum ANPV	413	293	179	70
Minimum ANPV	326	206	92	(17)

The expected values have been calculated as follows:

$$E[\text{Max.ANPV}] = \sum_n [\text{possibility}_n \times \text{Max.ANPV}_n]$$

$$E[\text{Min.ANPV}] = \sum_n [\text{possibility}_n \times \text{Min.ANPV}_n]$$

(n = 0, 6, 12, and 18 months)

The expected values of £226.2 million as the maximum adjusted net present value and £139.2 million as the minimum net present values have been obtained. Therefore, it seems that the delay in the opening of the System is not the critical factor with respect to the financial viability of the project.

4.6.3 Decreases in Operating Revenues

The banking case assumed lower revenues than those of Eurotunnel's. For example, they are lower by 15.6 percent in 1994 and by 4.2 percent in 2000. The banks' assumption was based on lower air fares and a two-year delay in the

introduction of high-speed train services. These assumptions were made before the French Government's decision about the introduction of high-speed train services.[1]

The assumption regarding the distribution of the possibilities of a decrease in operating revenues is made arbitrarily as in Table 4.11, although this also may be too conservative as in the previous section, for far larger possibilities are given for the points between a decrease of 5 percent and 15 percent in operating revenues despite the fact that the banks' projection does not reflect the information of high-speed train service. In Table 4.11, "Maximum ANPV" and "Minimum ANPV" are the values obtained in Section 4.5.

Table 4.11 Distribution of the Possibilities of Decreases in Operating Revenues

(Unit: £ million)

Change in Revenues	0%	-5%	-10%	-15%
Possibilities	10%	30%	30%	30%
ANPV Max.	413	246	79	(88)
ANPV Min.	326	159	(8)	(176)

The expected values of £112.4 million as the maximum adjusted net present value and £25.1 million as the minimum net present values are calculated from Table 4.11 in a similar manner as that used in section 4.6.2. Positive

[1]The Prime Minister of France announced on October 9, 1987, that the French government had decided to proceed with the creation of a high-speed railway line north of Paris, which will be connected to the System by the commencement of the Eurotunnel's operation

expected values of ANPV are still obtained, although they are smaller than those in other cases.

Among the three cases, the decrease in operating revenues affects the ANPV the most, and the delay of the opening of the System is the next largest. All the expected adjusted net present values resulted in positive values, although some probabilities are assumed as being too conservative in that the expected value of the variables far exceeds the modes. Therefore, it can be said that the Eurotunnel project is profitable for the shareholders, and this project is a financially viable one.

4.7 Warrants

Eurotunnel intends to raise funds through the exercise of warrants, which consist of New Warrants, Founder Shareholder Warrants, and Bank Warrants, the schemes of which have been presented in Section 2.6.

Warrants represent the right, but not the obligation, to buy in the future a pre-determined number of shares at a pre-determined fixed price. Therefore, warrants are quite similar to call options on shares. The major difference between warrants and call options is that no issue of new shares is accompanied in the case of exercise of options, whereas on the exercise of warrants new shares are issued.

As for options, the Black-Scholes formula on European (and American) call options for no-dividend shares is as follows:[1]

$$\text{Present value of call option} = P \cdot N(d_1) - EX \cdot e^{-r_f t} \cdot N(d_2) \quad [4.1]$$

where,

$$d_1 = \frac{\log\frac{P}{EX} + r_f t + \frac{\sigma^2 t}{2}}{\sigma\sqrt{t}}$$

$$d_2 = \frac{\log\frac{P}{EX} + r_f t - \frac{\sigma^2 t}{2}}{\sigma\sqrt{t}}$$

$N(d)$ = cumulative normal probability density function

EX = exercise price of option

t = time to maturity date

P = price of stock now

σ^2 = variance per period of (continuously compounded) rate of return on the stock

r_f = (continuously compounded) risk-free rate of interest.

The general rule[2] on warrants for deciding whether to exercise at maturity is to exercise if:

$[\frac{N_w}{N+N_w}$(old equity value + exercise money)] exceeds [exercise money]

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[1]Richard Brealey and Stewart Myers, Principles of Corporate Finance, Second Edition, (New York: McGraw-Hill Book Company, 1984), p. 446.

[2]Ibid., pp. 527-528.

where, N_w is the number of shares warrant holders can purchase, N is the number of shares if the warrants are not exercised, and the "old equity value" consists of values of common stock and warrants.[1] This expression is rearranged: exercise if:

$$[\frac{N_w}{N+N_w} \text{ x old equity value}] \text{ exceeds } [\frac{N}{N+N_w} \text{ x exercise money}] \quad [4.2].$$

The expression $\frac{N_w}{N+N_w}$ is the proportion of outstanding shares held by (former) warrant holders if all of them exercise. $[\frac{N}{N+N_w}$ x exercise money] represents the cost for exercising the warrants if exercised.

The present value of the warrants is evaluated by the Black-Scholes option formula, for which $\frac{P}{EX}$ is as follows:

$$\frac{P}{EX} = \frac{\frac{N_w}{N+N_w} \text{ x old equity value}}{\frac{N}{N+N_w} \text{ x exercise money}} \quad [4.3].$$

Also, in evaluating warrants, the variance rate σ^2 used in the Black-Scholes formula should be the variance of

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[1]While the Eurotunnel warrants (Founders', Banks' and New) are American, that is they have a time period, any time during which they can be exercised, the value conditions we use in this section hold strictly only at maturity. We perform that evaluation of the warrant under this condition for purposes of simplification and tractability at this stage, thus our result is only an approximation to the value of an American warrant which has time left to maturity. Hence our resulting calculated value will be biased lower than true market value of the warrant, except at maturity when it will be exact.

returns to old equity (common stock plus warrants), not the variance of common stock alone.[1]

4.7.1 Application of Black-Scholes Option Formula to the Eurotunnel Project

Eurotunnel intends to pay the first dividend in 1995, by which time all the warrants expire, so no modification relating to dividends is necessary to be made for the application of the formula. In this section, the value of New Warrants is calculated. The origin of the time is assumed to be in November 1987, when New Units together with New Warrants were issued.

1) The value of old equity

In this section three cases with regard to the value of old equity are discussed.

a) As a value of old equity, the sum of an adjusted net present value of the Eurotunnel project (in Table 3.24) and present values of investments of the shareholders (in Table 2.3) is adopted. That is,

The value of old equity
= ANPV (of Eurotunnel) + PV of existing investments
= ANPV + PV of cash inflow through issue of Existing Units + PV of cash inflow through issue of New Units

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[1]Richard Brealey and Stewart Myers, Principles of Corporate Finance, Second Edition, (New York: McGraw-Hill Book Company, 1984), p.528.

= ANPV (£413 million) + £253 million + £770 million

= £1,436 million.

Where, although the re-calculated ANPV with its origin in November, 1987 and the present value of £253 million with discount rates for the Construction Contract should be adopted, the present values of these in July 1987 was adopted for simplicity. Therefore, the correct old value is a little more than £1,436 million.

The numbers of Units N and N_w are as follows (for further details see Section 2.6):

N = 112,376,780 Units + 220,000,000 Units

= 332,376,780 Units;

N_w = 22,000,000 Units.

Therefore, P is calculated as follows:

$$P = \frac{N_w}{N+N_w} \times \text{old equity value} = \frac{22}{332.38+22} \times 1,436$$

= 0.06208 x £1,436 million = £89.1 million.

b) Alternatively, Eurotunnel's offer price for a Unit (a share price including the price for ten warrants) in November, 1987 was £3.50 per Unit, and in this case the value of old equity and P are:

The value of old equity = £1,163 million

P = 0.06208 x £1,163 million = £72.1 million.

The differences of assumptions and method used between the author and Eurotunnel is the reason for the difference

between Case (a) and (b) as discussed previously in Sections 3.1, 3.2, 3.3, and 4.6.

c) Also, the market price for a Unit on December 10, 1987 was £2.50 per Unit, and the market price for ten warrants, which would be necessary to buy one Unit, was £1.25 (for ten warrants) - i.e., 12.5 pence per warrant on the same date. In this case, the value of old equity and P are:

The value of old equity = $N \times £2.5 + N_w \times £1.25$

$= 332,376,780 \times £2.5 + 22,000,000 \times 1.25$

= £858.4 million

P = 0.06208 x £858.4 million = £53.3 million.

2) Exercise prices

EX is calculated as follows (the exercise price is £2.30 plus FRF23 for one share and the number of the Units to be issued through the exercise is 22,000,000 Units, as shown in Section 2.6):

$$EX = \frac{N}{N + N_w} \times \text{exercise money}$$

$$= \frac{332.38}{332.38+22} \times (22 \text{ million} \times £4.6)$$

$$= 0.93792 \times £101.2 \text{ million} = £94.9 \text{ million}$$

3) Variance rate σ^2

We first estimate the annualized variance rate σ^2 of the returns to old equity of Eurotunnel (common stock plus warrant) by using the market data available as shown in the previous Section (c) of 1), where the Unit price is £2.5 and

the warrant price is 12.5 pence. Using these data and solving the option model for σ^2 yield an approximate value for the annualized standard deviation of 60.5 percent. This very high value illustrates the market's perception of high risk for this warrant. This high level standard deviation holds for several risky companies in the world, e.g., though not in the railroads industry, Tele Communications in the US.[1]

4) Continuously compounded risk-free rate of interest

Continuously compounded risk-free rate of interest for the Black-Scholes formula can be calculated from the rates which are simple annual rates based on the government bonds shown in Table 3.2, so as that the discount factors for a period of one year calculated by both rates are the same. That is,

r_f = log(1+Nominal risk-free simple annual interest rate)

If 9 percent is adopted as a nominal risk-free simple annual interest rate, then r_f is 8.618 percent.

5) Time to exercise date

The new warrants are exercisable between November 15, 1990 and November 15, 1992. It is assumed that investors will exercise the warrant on the latest date of the exercisable period, because exercising before maturity would effectively reduce t, the time until maturity, and therefore reduce the value of the warrant. With no dividends it always

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[1]Ibid., p. 124.

is more valuable to hold or sell a warrant rather than exercise it early. Hence, the time to exercise date is 5 years, from November 1987 to November 1992.

6) Value of warrants

The following values are substituted for variables in Formula 4.1:

Case (a) our VC analysis: P = £89.1 million;

Case (b) Eurotunnel's offer price in November 1987: P = £72.1 million;

Case (c) market price on December 10, 1987: P = £53.3 million;

EX = £94.9 million;

σ^2 = 0.366025 (standard deviation 60.5%)[1];

r_f = 8.618 %;

t = 5 years.

Then, a present value of New warrants of £52.6 million for case (a), £38.9 million for case (b), and £24.7 million for case (c) have resulted. Therefore, the value of one warrant for case (a) is $\frac{\text{£52.6 million}}{\text{22 million shares x 10 warrants/share}}$ = 23.9 pence per warrant for Case (a); 17.7 pence for Case (b); and 11.2 pence for Case (c). The results are summarized in Table 4.12 below.

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[1]Sensitivity analyses to this large value of σ are performed in Table 4.13 at the end of this section.

Table 4.12 Summary of Values of Units and New Warrants

	Case (a) Our Analysis in November 1987	Case (b) Eurotunnel's Offer Price in November 1987	Case (c) Market Price of Units and Warrants on December 10 1987
Total value of old equity	£1,436 m	£1,163 m	£858.4 m
Price per Unit	£4.32*	£3.5*	£2.5
Price of one warrant	-	-	12.5p
Value of one warrant from option model	23.9p	17.7p	11.2p
Exercise price per warrant	46p	46p	46p
P	£89.1 m	£72.1 m	£53.3 m
EX	£94.9 m	£94.9 m	£94.9 m

Note *: These figures include the portion of warrants.

As mentioned in Section 1), the difference in the total value of old equity between Case (a) and Case (b) is caused by the adoption of different assumptions. That is, the base case, which does not assume cost overruns, delay of the opening of the System, nor decrease in operating revenues, has been adopted for case (a), while Eurotunnel's offer price in Case (b) probably reflected such deviations from the base case.[1] This difference in total value of old equity between Case (a) and Case (b) is a primary cause of the difference in the value of warrants between these two cases. If one of the expected values of adjusted net present values calculated in

[1]As for the Unit price, the Prospectus notes: "The value per Unit in mid-1995 of all the projected dividends over the period of the Concession, if discounted to that date at an annual rate of 12 percent, would be . . . £17 . . . ." Therefore, the Unit price in November, 1987 would be about £6.87 ($=\frac{£17}{(1.12)^{(1995-1987)}}$), if the weighed-average-cost-of-capital method with a discount rate of 12 percent is adopted. The Eurotunnel's offer price of £3.5 is considerably lower than this Unit price of £6.87. Further details of the offer price are not given in the Prospectus.

Section 4.6, which is £139 million in the minimum-ANPV case of delay of the opening of the System, is adopted to Case (a), the value of the old equity will be almost the same as that in Case (b), and thus, almost the same value of warrants as that of Case (b) will resulted for Case (a).

As for Case (c), the value obtained from the Black-Scholes formula (11.2 pence) is calculated by assuming the value of σ so that the resulting warrant value and the market price of warrants on December 10, 1987 (12.5 pence) will be very near each other. Hence the value of the standard deviation of 60.5% on the price of the old equity is assumed, although it is too high for railroads industry. If this figure does not held, and if the resulting warrant value differs considerably from 12.5 pence, it can be said that there might be market imperfections, such as imperfect information. If all our data are correct, then one probable reason why the market value of 12.5 pence is higher than our model value of 11.2 pence is that our model strictly holds for an American option at maturity, whereas the market value reflects the value before maturity.

The considerable difference in the total value of old equity between Case (b) and Case (c), which was probably caused by the differences of the projections between Eurotunnel and investors, or by market imperfections, is a probable cause of the difference in the value of warrants between both cases.

The influence of the variability of the changes in value of old equity (σ) on the value of warrants is extremely large. In other words, the riskiness of the Eurotunnel project magnifies the price of warrants. Against σ, the sensitivity analyses are performed as shown in Table 4.13.

Table 4.13 Prices of New Warrants with Various σ's

σ	Case (a)	Case (b)	Case (c)
10.0%	12.6p	5.7p	0.9p
21.9% 1)	14.6p	8.5p	3.4p
40.0%	19.0p	13.0p	7.2p
60.5%	23.9p	17.7p	11.2p

Note 1) The percentage is the annual figure for the portfolio on common stocks of 500 large firms in the US over the 1926-1981 period. Source: Richard Brealey and Stewart Myers, Principles of Corporate Finance, Second Edition, (New York: McGraw-Hill Book Company, 1984), p. 123.

The prices of warrants increase along with the σ. As of November, 1987, the value of σ is large and assumed to be possibly as large as around 60 percent, because the tunnel boring was not started. Along with the progress of the project, the decrease in the uncertainty of the project will lower the value of σ, thus the price of the warrant will decrease. If Eurotunnel is of average risk of investments in economy (σ=21.9%), then the warrant value of 14.6 pence in our VC analysis case (a) is not far off the warrant market value of 12.5 pence on December 10, 1987.

The present value of EX as of November, 1987 is £61.7 million ($=\frac{94.9}{1.09^5}$), and this figure is less than the value of P (the present price of shares) of both Case (a) and Case (b) (£89.1 million and £72.1 million respectively). Therefore,

it can be said that the possibility that investors will exercise warrants is relatively high. Of course that depends on whether the market price of shares remains higher than the present value of EX, or if it falls, increases back up to EX by maturity. Since the actual market price of shares has been increasing to the level of the Eurotunnel's offer price since the commencement of listing of the shares, as will be shown in the next chapter, we can highly expect that the investors will exercise warrants.

CHAPTER 5. CONCLUSIONS

The long history of the English Channel link has shown that the privatization of the project is the only way to actualize the project, otherwise it seems it will never exist, as discussed in Chapter 1. Eurotunnel was introduced as a private sector Anglo-French group whose objectives are to construct, finance, and operate the Channel tunnel for a period of 55 years without any government financing. Also, it has been suggested that Eurotunnel's trial serves as a test for privatization of projects for which many candidates are prevailing throughout the world.

Then, in Chapter 2, Eurotunnel's financial scheme was presented. Eurotunnel's financial requirement up to the System opening, totaling £4,874 million in nominal terms, consists of costs under the construction contract, Eurotunnel's corporate and other costs, provisions for inflation, and net financing costs. To meet those requirements and contingencies, Eurotunnel has arranged financing up to £6,023 million, which includes equity financing (£1,023 million) and debt financing through the Credit Facilities (£5,000 million) In addition, Eurotunnel has arranged future potential equity financing through exercises of warrants totaling £178 million.

Next, in chapter 3, Eurotunnel's financial scheme was examined by employing the Valuation-by-Components method to analyze a simplified base case. The result was a positive net present value of £413 million, which means that the Eurotunnel project is financially viable as long as the assumptions made hold.

Finally, sensitivity analyses have been performed in Chapter 4 by changing the assumptions which have been made in the previous chapters: by increasing costs under the Construction Contract, by increasing the delay of the System opening, and by decreasing operating revenues separately.

From the results of these sensitivity analyses, expected adjusted net present values have been calculated by assuming rather conservative probability distributions of the occurrence of cost overruns, the delay of the opening, and the decrease in operating revenues respectively. That is, as for the construction cost overrun, although the expected value of the cost overrun is between £0 million and minus £75 million (that is, cost saving), the probability distribution which will result an expected cost overrun of £0 million is used for the calculation of the expected value of ANPV. Also, for the cases of the delay of the opening and the decrease in revenues, high probabilities are assumed at the points which exceed six-month delay and ten-percent decrease in revenues respectively for the calculation of the expected values of ANPV. Despite the conservative probability

distributions, all positive expected adjusted net present values have resulted as summarized in Table 5.1.

Table 5.1 Summary of Expected Adjusted Net Present Values

(Unit: £ million)

In case of:	Construction Cost Overruns	Delay of Opening of the System	Decreases in Operating Revenues
E[ANPV Max.]	413	226	112
E[ANPV Min.]	326	139	25

Here, E[ANPV Max.] and E[ANPV Min.] stand for expected values of adjusted net present values with the costs under the Construction contract discounted with interest rates of the Credit Facilities and the risk-free rates respectively, and between these two expected values is the correct expected value. Therefore, the expected ANPV is between £413 million and £326 million in the case of cost overrun, between £226 million and £139 million for the delay of the opening, and between £112 million and £25 million for the decrease in operating revenues respectively.

The result of this sensitivity indicates that the Eurotunnel project is profitable for shareholders under a wide range of assumptions, so this project is financially viable through completely private financing without any government financing.

Indeed, the placement of issue of equity 3 has been successful, (although there were some difficulties,) on which the further existence of the Eurotunnel project depended.

5.1 Placement of Issue of Equity 3

The Wall Street Journal reported on November 16, 1987, when the Prospectus for the issue was published, that Eurotunnel's £770 million share issue appeared to be assured of success because British institutional investors pledged to buy directly or underwrite the £350 million British portion of the Anglo-French project.[1] Actually, the share issue was fully underwritten including the portions of French and international issues.[2] Therefore, it can be said that the Eurotunnel's equity issue succeeded anyhow, owing to the British Bankers.

However, if there had not been such help from the bankers, Eurotunnel's trial might have been interrupted, for the Wall Street Journal said:

> Lukewarm interest by British investors in shares of Eurotunnel left the issue 20% under-scribed; but international issue did better. . . . Because the British portion of the Eurotunnel offering was fully underwritten, big British institutional investors are obliged to purchase the remaining unsold shares. Besides underwriting commitments, British insurers and pension funds had agreed to buy £147 million of the British portion.[3]

Also, the share issue in France was not fully subscribed, for the Financial Times in London reported on December 1st, 1987:

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[1]"Eurotunnel's Equity Issue Seems Certain to Succeed," The Wall Street Journal, November 16 1987, p. 26.

[2]"Eurotunnel Share Issue Is Fully Underwritten," ibid., November 17 1987, p. 34.

[3]"British Investors are Lukewarm on Eurotunnel," ibid., November 30 1987, p. 16.

> Sources in Paris estimate that . . . the remaining 20 percent will be left with the sub-underwriters.[1]

Losses are borne by the bankers, although they were not so large, as the same source continues:

> . . . The UK underwriters' losses will probably small compared with those they faced on the BP issue. Their take-up will be lower and most of the shares are likely to be held by long-term investors, suggesting that selling and consequent damage to the price will be limited.[2]

On December 10, 1987, Eurotunnel Units began trading in London and Paris. Both started at a sharp discount to their offer price of 350 pence: Eurotunnel Units traded in London at 250 pence down from 284 pence (the opening price on December 10, 1987) and in Paris Eurotunnel Units closed at 25.55 FRF down from 27 FRF (the opening price on December 10, 1987) to 35 FRF each (offer price in France).[3]

As of April 28, 1988, the Eurotunnel Unit price in London, which is separated from the price of warrants, was 327 pence (the highest quote was 339 pence and the lowest quote was 232 pence between December 10, 1987 and April 28, 1988).[4] Also, on the same day, the Eurotunnel Unit price (without the price of warrant) in Paris was 34.35 FRF.[5]

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[1]"Eurotunnel loses Paris hope," Financial Times (London), December 1st 1987, p. 44.

[2]Ibid.

[3]"International Corporate Report," The Wall Street Journal, December 11 1987, p. 20.

[4]"London Share Service," Financial Times (London), April 29 1988, p.42.

[5]"Bourse Du 28 Avril," Le Monde, April 29 1988, p. 43.

Therefore, it might be said that the share prices were approaching to or exceeding Eurotunnel's offer prices of 350 pence in the UK and 35 FRF in France in November, 1987, which include not only the price for a Unit but also the price for ten warrants.

According to the Prospectus, Eurotunnel intends to pay its first dividend in 1995, two years after the start of operation. That is, the investors can obtain the dividend only eight years after the subscription of the shares. Most individual investors in the UK were probably not able to tolerate this long period of eight years without no dividend (despite the fact that they can obtain the cash by selling the shares), thus the placement of the share issue was accompanied with considerable difficulties in the UK; while the international placement of shares was successful, and thereafter the price of the shares has been increasing, both of which are explained with the positive adjusted net present value of the project indicating that this project is profitable enough for them.

5.2 Exercise of Warrant

As described in Section 4.3, the amount of principal outstanding on the Credit Facilities reaches its maximum amount at the ends of both 1993 and 1994. In the case when considerable cost overrun occurs, and when its financing requirement exceeds the maximum provision of the Credit

Facilities, Eurotunnel intends to raise the funds through exercises of warrants (already issued): £101 million (New Warrants) in November 1992, £52 million (Founder Shareholder Warrants) in December 1994, and £25 million (Bank Warrants) in June 1995.

The price of Eurotunnel shares decreased considerably on the first day of the trading of the shares, which was on December 10, 1987, and the total market value of Eurotunnel decreased to £858.4 million on the same day from Eurotunnel's total offering price of £1,163 million as calculated in Section 4.7. However, there was stronger buying in Eurotunnel's warrants, 10 of which entitle the holder to subscribe for one Eurotunnel share for 460 pence between November 15, 1990 and November 15, 1992, and the trading closed at 12.5 pence a warrant on December 10, 1987.[1]

This means that investors expected a high possibility of a significant rise of the Eurotunnel share price for the years after 1990, by which the breakthrough of the service tunnel is planed to be finished, against the small amount of cost, whereas they were still not sure of the success of the breakthrough and buying the shares on December 10, 1987.

In Section 4.7, the value of New Warrants as of November (or approximately December) in 1987 are examined by using the Black-Scholes Option formula and adopting three cases to the

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[1]"Eurotunnel price falls to 250p on first day," Financial Times (London), December 11 1987, p. 48.

old equity value: our ANPV (Base) case; Eurotunnel's offer price case; and Market Price (on December 10,1987) case. Also, sensitivity analyses are performed to the variability of the changes in value of old equity as shown in Table 4.13.

In order to explain the market warrant price of 12.5 pence for December 10, 1987, an extraordinary high level of variability of 60 percent (which matches high-risky Tele Communication in the US) for "Market Price Case" with the resulting warrant value of 11.2 pence must be assumed, or our "ANPV (Base) Case" with an adequate variability between 10 percent and 20 percent (which matches the railroads industry) with the resulting warrant value between 12.6 pence and 14.6 pence must be taken.

As of April 28, 1988, the warrant price increased to 25.5 pence (the highest quote was 28.5 pence and the lowest quote was 10 pence between December 10, 1987 and April 28, 1988) from its price on the first trading day of 12.5 pence.[1] Therefore, it might be said that if Eurotunnel has finished the construction of the service tunnel without any serious problems, then the investors will be very sure about the profitability of the Eurotunnel project thereafter, and Eurotunnel will not find any difficulties in raising funds from exercises of warrants. That is due, as described in the previous section, that as the price of Units has been

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[1]"London Share Service," Financial Times (London), April 29 1988, p.42.

increasing to the level of the Eurotunnel's offer price, the general rule for exercising warrants will be satisfied by the maturity date when the investors will exercise the warrants.

5.3 Privatization of the Channel Tunnel

As one case of privatization, the Eurotunnel project can be characterized by two points: one is about the absence of a grant from the government; the other is about the strong backups from bankers in the form of large commitments to the project.

The Eurotunnel project has not been granted anything from governments (except for the acceptance of the autonomy about the Channel link and the grant of use of lands); that is, Eurotunnel has obligations to pay taxes in the same way as its competitors do, and no investment tax shield has been provided for the project. The total cost of the project would have been lower, at least, by the portion of the tax, if the project had been undertaken by both governments, whereas it has been the essential condition that governments not involve themselves in the project financially. Despite such an absence of grants from governments, the results of VC analysis have proved that the project is profitable enough for investors owing to the high leverage through debts. There is enough high profitability in the Eurotunnel project to offset the absence of grant from governments.

Throughout the history of Eurotunnel, banks' support has been distinctive in this project. As have been described in Chapter 1, since the early 1980's, when both British Railway and the European Economic Community pointed out the high viability of the privatization of the project, bankers had continued their own studies on the Channel link. These bankers and several major contractors formed a team in each country: one was Channel Tunnel Group Ltd. in the UK, and the other was France Manche SA in France. Furthermore, these two teams combined themselves into a consortium group, to offer its proposal to the governments. Its proposal won owing to the strong backing of the bankers. Then, the group renamed itself as Eurotunnel, and at the beginning of the construction, it was again bankers who supported the issue of the shares by underwriting, through which Eurotunnel could raise the funds.

As a conclusion, it must be pointed out that, at first, high profitability of the project is essential to actualize such projects which could not have been undertaken by public sectors; and, second, even if the actualization of the project through the privatization were both financially and technically possible, it would be very difficult to raise the funds at the early stage of the project, and the existence of supports from financial institutions will be critical for the project.

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