"Investment Efficiency" of High-Speed Rail Extensions in Japan

Details of the "investment efficiency" of the Hachinohe – Aomori extension are presented by the Japan Railway Construction, Transport and Technology Agency (JRTT, 2007). The "overall business efficiency" of the investment was calculated by comparison of the "net present values" of benefits and expenses (see "terminology," below). NPVs were calculated for a 50-year interval, and the "base year" was 2006.

1.) Overall business efficiency of investment, Tōhoku Shinkansen extension

Benefits (B)	Expenses (C)	NPV of investment (B-C)	Benefit / Expense Ratio (B/C)	Economic Internal Rate of Return
JPY 891.7 * 10^9	JPY 481.4 * 10^9	JPY 410.3 * 10^9	1.9	7.5 percent

Notes: JPY = *en* ("yen," ¥), the unit of Japanese currency.

10^9 = thousand million (billion).

"Benefits:" Major benefits, e.g. to users (passengers) and the service provider (railway operating company).

"Expenses:" Major expenses, e.g. construction and related expenses, improvements to land, maintenance expense.

"NPV of investment" may be described as the net present value of the (economic) profits generated by the project during the 50-year interval.

2.) Business efficiency of remaining investment, Tōhoku Shinkansen extension

Benefits (B)	Expenses (C)	NPV of investment (B-C)	Benefit / Expense Ratio (B/C)	Economic Internal Rate of Return
JPY 891.4 * 10^9	JPY 250.2 * 10^9	JPY 641.2 * 10^9	3.6	14.8 percent

Notes: JPY = *en* ("yen," ¥), the unit of Japanese currency.

10^9 = thousand million (billion).

"Benefits:" Major benefits, e.g. to users (passengers) and the service provider (railway operating company) if project were completed, adjusted by subtracting the value of benefits provided by the uncompleted project.

"Expenses:" Major expenditures, e.g. construction and related expenses, improvements to land, maintenance expense, that had *not* been made up to date of analysis (2006 fiscal year).

Table 2 (above) provides an interesting exercise in benefit-cost analysis (and might draw criticism from readers not fully acquainted with the concept of "sunk cost").

Two important figures do not appear in the table above:

Benefits provided by uncompleted project during 50-year interval, JPY 300 million.

Expenses to date of analysis, JPY 231.2 thousand million.

The benefits provided by the uncompleted project would amount to a tiny fraction (0.03 percent) of those provided by the completed project.

"NPV of investment" may be described as the net present value of the (economic) profits generated as the result of completing the project - in other words, as the result of investing the unspent amount, JPY 250.2 thousand million.

The "Benefit / Expense Ratio" compares the value of benefits delivered by the completed project (adjusted as explained above) with the investment required to complete the project. The "Economic internal rate of return" pertains to this investment. Result: given sufficient resources, successive annual construction budgets should be increased.

The economic term "sunk cost" refers to a past (retrospective) expenditure **that cannot be recovered**. We have added the emphasis for a reason that should become apparent below.

According to classical economics, a sunk cost is not relevant to current decisions, which should be assessed rationally - that is, exclusively on their own merits. Table 2 (above) stands apparently as affront to this principle - but this is so only if one ignores Table 1.

As established in Table 1, funds expended to date are not "sunk costs" (... although certain loyal and disloyal opponents might attempt to argue otherwise ...). The project did "pass muster" from the perspective of economic benefits provided. Thus, expenditures to date **can** be recovered if the project is completed.

The fact that "investment to date" provides virtually no benefits does not mean that such investment is a "sunk cost." Instead, as established in Table 2, successive annual construction budgets should be increased if adequate resources are available, because the remaining investment is relatively more productive. This is not always the case, because some lines and extensions can be opened in stages. However, it would be very difficult to open only part of this project. If the line were not completed, significant expenditures

would be required to insure that uncompleted structures did not become hazards, and were properly maintained to permit eventual completion.

Terminology:

"***Present value***" calculations are used to provide a uniform basis to compare cash flows (e.g. income, expenses) which occur at different times.

"Present value" may be explained as follows: if one invests USD 10 today and earns interest at an annual rate of 10 percent, then one's investment is worth USD 11 after one year has passed.

Thus, if one assumes a 10 percent annual interest rate, then USD 11, paid one year from today, has exactly the same value as USD 10 paid today. In other words, USD 11, paid one year from today, has a ***present value*** of USD 10.

"***Net present value***" (NPV), with reference to the "overall business efficiency" calculations described above, is defined as the sum of the ***present values*** all benefits (or expenses) which occur during a specified interval. As noted above, NPVs of benefits and expenses were calculated for a 50-year interval. The "base year" was established as 2006.

"***Internal rate of return***" (IRR) is the annual rate of interest at which the NPRs of benefits and expenses are equal. IRR does not incorporate "external" factors (cost of capital, inflation).

The private sector ignores "externalities," which are costs and benefits which do not affect private investors (and are therefore irrelevant to investment decisions). Examples include environmental damage, pollution, and impacts to others which do not affect market prices. When these are accounted for among other benefits and costs, the term "***Economic Internal rate of return***" (EIRR) is used to avoid confusion.

It should be noted that the cost of capital in Japan was very low during 2010 compared to that in other developed economies. At 2010 August, Japanese ten-year treasury bonds yielded 1.3 percent, compared to US bonds which yielded 3.5 percent (Smith, Charles Hugh. 2010. Japan's Cheap Debt Could Cost the World Dearly. Daily Finance, 2010 August 4.)

It should also be noted that, at 2010 October, the inflation rate in Japan was barely above zero (0.2 percent annual rate; Japan Inflation Rate, Trading Economics).

References:

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Budgeted TS Ex project cst, Y459 bn, FY 2003.