題目：

アジア大都市における地下鉄

運営事業の経営分析

(A COMPARATIVE STUDY ON FINANCIAL PERFORMANCE

OF ASIAN METRO OPERATORS)

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Contents

Figures:

Tables:

A COMPARATIVE STUDY ON FINANCIAL PERFORMANCE

OF ASIAN METRO OPERATORS

Abstract

Rapid population growth and urbanization speed has become the major causes of transportation problem in Asian megacities. In many cities, metro system has emerged as a prior option for solving this problem. Although metro system has proved to be beneficial in many ways, the cost of constructing and operating the system is not affordable to many cities in developing countries. So far, there have been many researches and surveys on methods to secure funds for construction of city metro, however, there has been little attention on operational and financial performance of metro operators.

This study investigates the financial performance of metro operators in Asian megacities and evaluates the best metro operators in the region. The study also attempts to find the relationship between financial performance with various variables such as city characteristics and business scheme. With constraint of information availability, the target of the study consists of ten metro operators in Japan, Hong Kong MTR, Seoul SMRT, Singapore SMRT, Delhi DMRC and Bangkok BMCL. The data for analysis were collected from annual report of each operator, Annual Japanese Railway statistics and each city transportation authority.

Keywords: *metro operator, financial analysis, Asia megacities*

1 Introduction

Rapid population growth and speedy rate of urbanization have become challenging problems for sustainable development of Asian megacities. In almost developing countries, the megacities are characteristics by the high density in cities center and the unordered development of suburban area. Along with the increases in personal income, there is sharp increase of automobiles, which in turn, become the major causes of traffic congestion. The result is that the transportation infrastructure cannot accommodate such rapid increase in traffic demand.

Learning experience from Japan and other developed country, a public transit-oriented transportation has become a choice of many Asian megacities. In order to increase the percentage of public transportation, bus transit system, light rail (LRT) and heavy rail (metro) has been introduced in many cities. So far there are various studies on the methods to secure funds for the construction of metro system (OECF Research Paper, 1998), however, only small number of studies focus on the issue of metro operation, particularly Asian metro. In Asia there can be observed three types of metro operator. The first type, which is the most common form of

metro operator, is a public corporation or a division belonging to transportation department of municipal government. The second type is a quasi-public company of which capital was funded by both governmental sector and private sector. The last one is the privately incorporated entity. The financial performance of metro operators varies across cities and type of ownership.

This study investigates the financial performance of metro operators in Asian megacities and evaluates the best metro operators in the region. The study also attempts to find the relationship between financial performance with various variables such as city characteristics and business scheme. With constraint of information availability, the target of the study consists of ten metro operators in Japan, Hong Kong MTR, Seoul SMRT, Singapore SMRT, Delhi DMRC and Bangkok BMCL. The data for analysis were collected from annual report of each operator, Annual Japanese Railway statistics and each city transportation authority.

In the first part, operation status and financial performance analysis of each metro operator will be conducted. Then a comparative analysis will be performed to compare performance of those metro operators in term scales, profitability, efficiency, and financial leverages.

2   Operation status of major Asian metro systems

2.1   Existing metro systems in Asia

The urban railway system can be classified into Tram and Rapid Transit railway. Rapid transit differs from street tram in the sense that it has separated right of way. In big city, in order to acquire land for station and rail track without intersection with other transportation route, either underground or elevated tracks can be options. However, due to issue of noise pollution and scenery effects, in highly density city, underground railway is preferable.

There are several ways to call a metro system. In America, the metro system is classified as heavy rail, which is contrary to light rail transit. According to the definition of American Public Transportation Association (APTA) (2009), "Heavy Rail is a mode of transit service (also called metro, subway, rapid transit, or rapid rail) operating on an electric railway with the capacity for a heavy volume of traffic. It is characterized by high speed and rapid acceleration passenger rail cars operating singly or in multi-car trains on fixed rails; separate rights-of-way from which all other vehicular and foot traffic are excluded; sophisticated signaling, and high platform loading". In Asia the general way to call the system is Metro. This name was derived from the short way to call Paris Metropolis urban railway. In Japan, in China and Japan, the system is called with the meaning of "underground railway". However, even with this meaning, the system is not necessarily totally being underground.

About Asian metro history, the first metro was built in Tokyo in 1927 and then the second in Osaka in 1933. In Japan, due to the World War II, the new construction of metro systems did not restart until 1954. Currently, there are nine cities with metro systems (**See** Appendix 1). In other

Asian countries, the acceleration of metro construction started from late 1980s and rapid growth is expected as many cities, particularly almost megacities have plans to build or extend the mass rapid transit railway. The Appendix 2 illustrates the current situation of metro construction and operation in Asia cities. The below Table-1 depicts the distribution of metro around the world. European, where metro started, is still the continent with highest number of 55 cities with metro system, which comprises 43% of total length of metro system in the world. There are 36 cities in Asia with total length of 1926 km, making up 22% of total system.

Table 1: Metro distribution by region (2005)

Area	Number of country	Number of city	Length(km)	Percentage
Asia	12	36	1926	22
European	20	55	3817	43
NIS	7	17	682	8
Africa	1	1	65	1
North America	4	22	1964	22
South America	4	11	344	4
Oceania	0	0	0	0
Total	48	142	8798	100

(Source: Basic of railway technology-2008)

2.2 Organizational structure of metro operators

In Asia, metro system operators can be classified into three broad categories. The first type of operator is a state-owned public corporation, or a branch of transportation department under administration of municipal government. This type of operators is the most popular throughout Asia. There are both advantages and disadvantages of this type. The biggest advantage is that the city can have integrated policy toward all public transportation modes. The competition among public transportation mode can be avoided. However, there is lack of innovation and financial soundness of the system. The second type is an incorporated entity where the government holds over half of shares. It is called "quasi-public" company. The last one is a totally private corporation.

Due to the requirement of huge financial funding for construction of metro system (including infrastructure, rolling cars, signal and informational equipments), from the beginning it is difficult to attract private capital into the project. The quasi-public entities appear only after several or many years of operation. At the time, the depreciation expense costs less and the uncertainty of business is also less significant. The case of Tokyo Metro and Hong Kong Mass Transit Rail (MTS) illustrate this observation.

For the totally private corporation, the business exists under the concession agreement with governmental authority to operate the system in exchange for paying lease fee. The business scheme can be observed in Singapore and Bangkok metro system.

3 Business overviews of metro operators
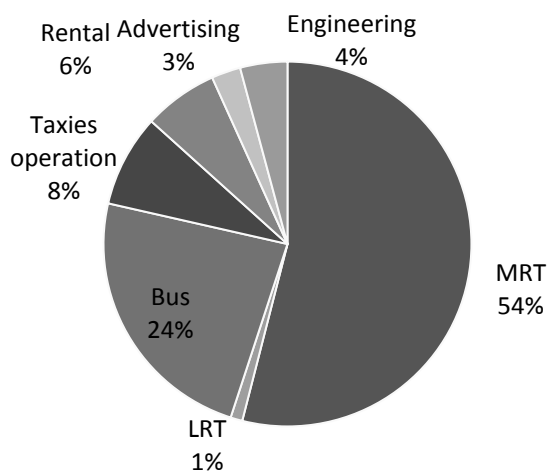
3.1 Singapore SMRT

3.1.1 Overview of business

Singapore is a country with area of 710.2 sq. km. According the 2008 statistics, the population of the country is 4.84 million and the average population density is at level of 6,814 person/sq. km.

The construction of metro in Singapore started from 1982 and the first line was opened for revenue in 1987. The construction of the network was continuing and current network is 110 kilometres. About metro lines, the East-West line (44 km) and East-South line (49.2 km) is under operation of Singapore Mass Rapid Transit (SMRT); the North –East line (20 km) is operated by SBS Transit. In 2009, the Circle Line (37.5 km) opened its first section (5.7 km), which is also operated by SMRT. The construction of total lines was done by Singapore Mass Rapid Transit Corporation (from 1995, MRTC was under control of Land Transport Authority(LTA)).

SMRT was incorporated in 1987 and financed by Singapore government. In 2000, the company was listed on Singapore Stock Exchange and became a total private corporation. Fare revenue comes from metro, LRT, bus business. The non-fare businesses include taxies, advertising and engineering consultancy. The segmentation information is illustrated in the following Figure-1

Figure 1: Singapore SMRT's sales by segment (FY 2008)

Source: Singapore SMRT's Annual report (FY 2008)

Currently, SMRT operates total railway network of 93.2 kilometres with 53 stations, 3 depots and 106 cars. SMRT also binds a contract with LTA to operates the Circle Line which is 35.7 kilometres in length with 31 stations. As explaining above, the characteristic of Singapore metro is the separation of construction and operation. The Singaporean government was in charge of constructing the infrastructure and preparing the whole systems (rolling cars, signal and safety systems,..). SMRT, which is a totally private company, has responsibility to operate the metro and pay lease revenue to LTA. After 10 years of operation, the ownership of operating assets was tranferred to SMRT.

3.1.2 Operational performance

The ridership has been growing steadily and in 2009 the annual ridership is 510.2 million passengers, which is equivalent to daily average ridership of 1.5 million. The financial performance of SMRT is in healthy condition as net operating profit has been growing up year by year. From financial year 2005 to 2009, total revenues has increased from S$ 673.5 million to 879 million and in the same time, operating profit went up from S$92.8 billion to S$188.7 billion.

Table 2 : Operational and financial performance of Singapore BCML

Items	2005	2006	2007	2008	2009
Ridership (million)	402.6	413.8	434.9	469.3	510.2
Growth rate of ridership (%)	2.8	2.8	5.1	7.9	8.7
Car-vehicle kilometer(million)	75.11	75.5	77.1	78	85.2
Growth rate of car-vehicle kilometer (%)	-3	0.6	2	1.2	9.2
Passenger kilometer (million)	4,928	5,058	5,288	5,714	6,223
Total revenue(S$ million)	673.5	711.7	743.1	802.1	879
EBITDA (S$ million)	230	247.2	255	284.1	299
Net Operating Profit(S$ million)	92.8	138.8	145.3	178	188.7
Profit before taxes(S$ million)	83.9	124.1	142.3	176.2	185.8
Net profit(S$ million)	126.6	103.6	135.8	149.9	162.7

Source: Singapore BMCL financial highlights

3.2 Bangkok BCML

3.2.1 Overview of business

Bangkok, the capital city of Thailand, occupies an area of 1568.7 km^2 with the population of 6,355,144 persons in 2000. Along with the increase of personal income, the number of automobiles was rapidly growing, which causes the traffic congestion become more and more problematic. Thailand government had the plan to introduce urban railway (both underground

and elevated rails) since 1998. However, due to the financial crisis, most of the project was postponed. The first metro line was opened in July 2004 with total length of 20 km and 18 stations. This metro line, or Blue Line, was financed by Japanese ODA loans and government subsidiaries. Bangkok Metro Public Company Limited (BMCL) is the operator of this metro line.

BMCL was established in 1998 as a special subsidiary of CH.KarnChang group, one of leading construction group, to operate the Blue Line. In August, 2000, BMCL and Thailand Mass Rapid Transit Authority (MRTA) signed the concession contract for Operating and Maintenance. The business scheme is illustrated in the figure below.

Figure 2: Bangkok metro Blue Line O&M scheme
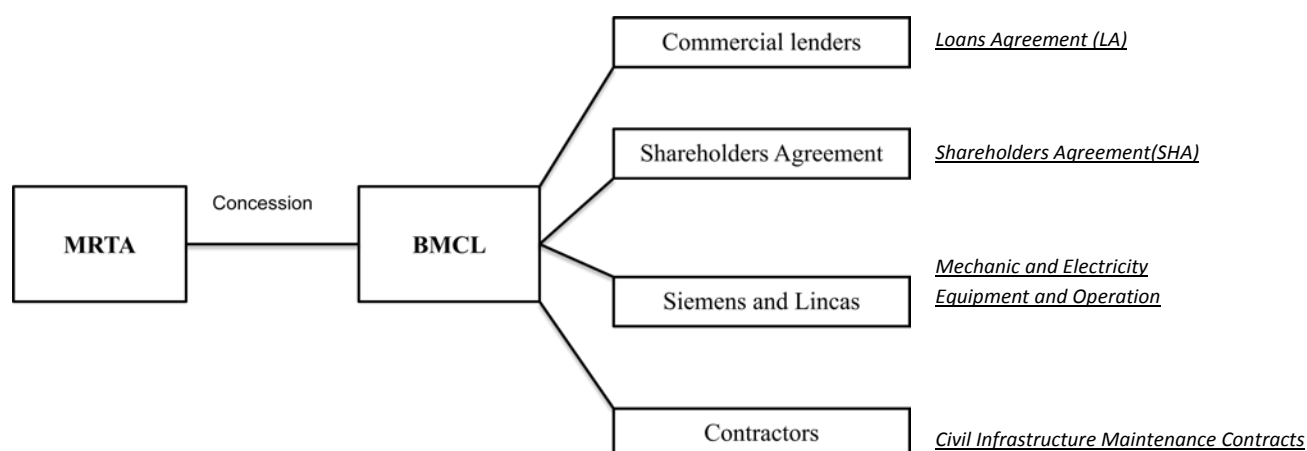
Source: BMCL 2008 Annual Report
　　　　JICA Bangkok Metro construction evaluation

The MRTA adopted the vertical separation for the Blue Line. Unlike the case of Singapore, MRTA owns and maintains the non-operating assets, which includes stations, tunnels, ventilation system and rail tracks while BMCL owns, operates and maintains operating assets (Rolling Stocks, Signal and Communication system, automatic fare system, power supply…). BMCL engaged the third party, Siemens and Lincas, to manufacture and procure the M&E equipment as turnkey contract. Moreover, Siemens and Lincas were also assigned as a contractor for maintaining the M&E equipment for period of 10 years, which ends in 2014. After this period, BMCL has intention to operate the system on its own without relying on contractors.

About source of finance, in 2008 financial report, about 30% of capital was paid up as shareholder's equity. Three largest shareholders [1] are under obligations of Shareholders Agreement, which requires those shareholders to provide financial support to maintain liquidity set by Loan Agreement with commercial lenders who supplies over 65% source of finance.

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[1] In 2008, the three major shareholders are CH. Karnchang Public Company Limited, Hicrete Products & Technology Company and Natural Park Public Company

3.2.2 Operational performance

Ridership of Blue Line has been growing steadily since the opening from July 2004. However, according to JICA evaluation report (2008), the ridership is still far below the estimated numbers in the feasible study. Moreover, the growth rate of annual ridership is lower than expectation. The revenue of train operations occupies 88% of total revenue; the other portion of 8% was contributed by advertising service. Revenue from retail space leases and ATM service was not significant. The bottom line was minus for consecutive years and interest expense was significant due to large portion of liabilities financing. The following table illustrates the past performance of BMCL[2] since 2005.

Table 3: Operational and financial performance of Bangkok BCML

Items	2005	2006	2007	2008
Annual ridership	59,642,095	57,814,540	60,045,055	61,981,745
Growth rate in annual ridership (%)	-	(3.1%)	3.9%	3.2%
Daily Average ridership	163,403	158,396	164,507	169,813
Fare revenue	969,908,851	1,229,498,758	1,270,412,785	1,374,587,917
Total revenue	1,046,003,476	1,398,940,573	1,445,834,060	1,578,724,476
EBITDA	(742,937,800)	(456,830,507)	(341,189,665)	(281,353,189)
Interest Expense	(810,999,573)	(1,060,962,637)	(946,605,445)	(953,578,079)
Net loss for the year	(1,715,994,866)	(1,669,383,725)	(1,485,030,455)	(1,456,952,969)

Source: BMCL annual report (FY2005-FY2008)

3.3 Hong Kong MTR

3.3.1 Business overview

Hong Kong occupies an area of 1104 km^2 with population of 6,909,500 persons in 2008. The density on average is 6,259 persons per km^2. The first metro line in Hong Kong was opened in 1979. The current MRT network is 211.6 km, in which includes the light rail.

The network was operated by the Mass Transit Railway Corporation (MTRC), which was established in 1975 as a wholly state-owned corporation by Hong Kong government. Hong Kong MTRC had function of building, owning and operating the metro system. In 2000, it became a private company when it was listed on Hong Kong Stock Exchange. However, the government of Hong Kong still holds 50% of total shares. Thus, Hong Kong MRTC is a "quasi-public" corporation.

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[2] The financial data for the consolidated of BMCL (including Metro Mall development, BMCL network Limited and Triads networks Limited)

At time of first metro construction, though being a wholly state-owned corporation, the company did not receive the guarantee for commercial loans from the government of Hong Kong[3] and neither did the subsidies in case of operating loss. However, it was granted rights on real estate development and this business became the main source of profit. In 1991, the company's profit after depreciation became positive, and then in 1996, there was no cumulative loss. Apart domestic business, the company also involves in many oversea metro projects.

3.3.2 Operation status

Ridership in Hong Kong is extremely high with 1,205 million passengers annually which is equivalent to over 3.3 million per day. Railway operation, advertising business, retail space lease and profit on property development counts for 51%, 15%, 12% and 51% consequently of total business revenue. In railway operation, revenue from MRT system occupies 95% of total revenue[4]. Currently, there are 14,076 employees totally, among which 8540 employees belong to railway operation.

Table 4 : Financial performance of Hong Kong MRTC (FY 2008)

Items	Railway Operation	Advertising	Property ownership, and other business	Property development	Total
Revenue	11,467	3,449	2,712	4,670	22,298
Operating expenses before depreciation and	5,969	822	785	-	7,576
Depreciation and amortization	2,722	76	71	-	2,869
Operating profit after depreciation expense	2,776	2,551	1,856	-	11,853
Operating profit before interest and finance charges					11,012
Interest and finance charges					1,998
Net profit					8,280

Source: Hong Kong MRTC Annual Report 2008

3.4 Delhi DMRC

Delhi occupies an area of 1202.4 km^2 with population of 13,782,796 residents[5]. It is one the most populated cities with density of 11,463 persons per km^2. The first section of the metro was

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[3] OECF Research Paper No.25, p.41

[4] Hong Kong MRTC provides MRT, Light Rail and Intercity service. However, because there are no segmental data for each service and revenue from MRT is relatively high (95%), data for analysis are referred as data for railway operation.

[5] Office of Registra General & Census Commissioner, India, Census 2001 data

opened in December 2002. The Phase I of the network was completed with 65.11 kilometers and the first section of Phase II was finished in 2008. Currently the total network is 96 kilometers.

Delhi Metro Rail Corporation was established by Government of India and Government of national Capital Territory of Delhi to implement and operate the metro system in India. The model of Delhi DMRC is, to some extent, similar to the Hong Kong's metro development model. The government grants the company right to develop real estate business. Moreover, the company itself has diversified into many fields such as project consultancy, office lease and commercial.

3.5 Seoul SMRT

Seoul city has a population of 9,762,546[6] residents covering an area of 601.8 km^2. It is the most populated city in East Asia with density of 16,221 persons per km^2.

Seoul Metropolitan Subway Corporation (Seoul SMRT) was established in 1994 for purpose of operating subway system lines 5, 6, 7 and line 8. Although it was incorporated as public corporation, the government owns all the shares.

The operational and financial status is summarized in the following table.
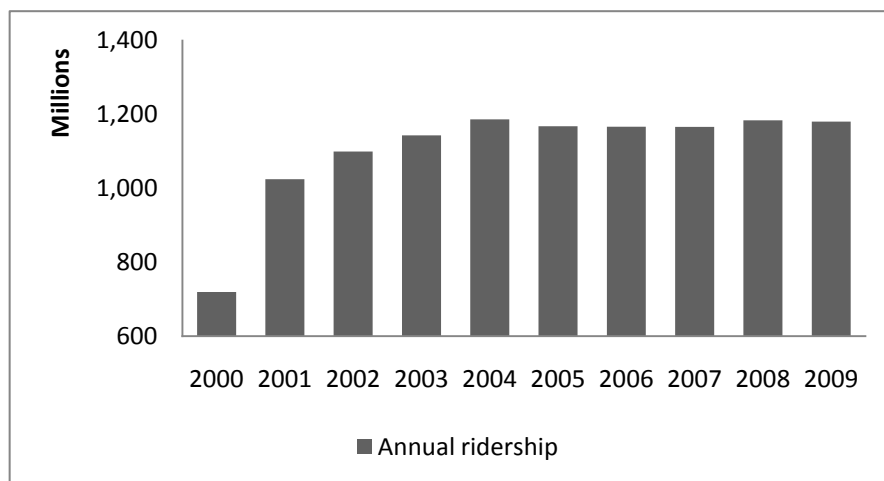
Figure 3: Seoul SMRT annual ridership

4   Financial performance in comparison

In this section, a comparative analysis of above metro operators will be conducted. The financial data for Japanese metros were extracted from the Yearly Handbook of Japanese Railway (2007). For other companies, the data was collected from each company annual report (2008) and financial statements. For the scale and cost comparison, other currencies were converted into

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[6] Statistics Korea, Population census 2005

Japanese yen using the 2009 annual average exchange rate published by Mitsubishi UFJ Research and Consulting group.

4.1 Analytical framework

The framework for business analysis is presented by Palepu *et al*. (2008). According the author, a company is able to gain growth and profitability through both Product market strategies and financial market strategies. In the product market, managers practice operating management (revenue and expense) and investment management (working capital and Fixed Assets). In the financial market, firms' growth and profitability rely on financing decision (liabilities and equity) and dividend policy. This paper will focus mainly on operation and financing decision of the firm.

To compare the relative performance between firms in the same industry, ratio analysis, which is also referred as cross-sectional comparison, is the most common tools. In this paper, ratio analysis was utilized to compare profitability and productivity (evaluation of operation management), and financial leverages (financing decision).

4.2 Profitability

A firm's net profit margin shows the profitability of the company's operating activities. The further decomposition of profit margin can be gross profit margins ((Sales-Costs of sales)/ Sales). According to Palepu *et al.* (2008), gross margin is affected by two factors: the price premium that a firm's products or services command in the market and the efficiency of the firm in the production process. For fare revenue business, the most popular indicator is fare box ratio. The fare box ratio is the proportion of revenue generated from fare box divided by the total operating expense. The ratio implies how the operating expense can be covered by fare box revenue. It also can be interpreted as an indicator of financially independent level of railway business. In some documents, the fare box ratio is calculated as division of fare box revenue for direct operating expense (elimination of capital expenditure such as depreciation). However, the result can be misleading

There are another two ratios providing useful signals for a firm's profitability:

NOP margin = NOP/Sales

EBITDA margin = Earnings before interest, taxes, depreciation and amortization/Sales

The NOP is an important indicator for operating performance because it reflects all operating policies eliminates the affects of debts policy. For the case, there is much difference in debt policies between the public companies, quasi-public companies and private companies; thus, the NOP is a comprehensive ratio to evaluate the operating performance. EBITDA margin provides similar information but it excludes depreciation expense. For different company structures (whether infrastructure belongs to the firm or not), there are significant differences of

depreciation expense. Then elimination of depreciation and amortization of the company will give a more meaningful insight of net operating activities.

About the financial data, different companies have different financial statements format and accounting policies, for the uniformity of data, the financial data will be rearranged and recalculated according to Japanese-style income statement format

Table 5: Selected profitability indicators

Company	Fare box ratio	EBITDA	NOP	Net profit margin
Tokyo Metro	123%	47%	28%	13%
Sapporo	113%	54%	19%	3%
Sendai	107%	52%	21%	-4%
Tokyo	109%	49%	15%	7%
Yokohama	111%	54%	13%	-4%
Nagoya	114%	50%	19%	0.2%
Kyoto	73%	17%	-30%	-36%
Osaka	124%	50%	24%	12%
Kobe	91%	44%	-3%	-8%
Fukuoka	95%	48%	5%	-9%
Hong Kong MTR	151%	57%	41%	37%
Delhi DMRC	76%	3%	-54%	-10%
Singapore SMRT[7]	139%	41%	28%	19%
Bangkok BCML	68%	-85%	-100%	-92%
Seoul SMRT	61%	-9%	-49%	-52%
Average	**104%**	**31%**	**-2%**	**-8%**

Fare box ratio, (Fare box revenue/ Total operating revenue), EBITDA, NOP are calculated for railway segment
Net Profit margin is calculated for whole company
Fare box ratio = (Fare box revenue/ Operating cost)
EBITDA ratio = (Earnings before Interest expense, Tax, Depreciation and Amortization)/ Operating revenue
NOP ratio= (Net Operating Profit/ Operating revenue)
Net profit margin = Net profit/ Total revenue

4.2.1 Fare box ratio analysis

On average the fare box rate is 104% which is much higher than the ratio of American metro operators (See Appendix -4). According to Shoji (2004), the main reason is the characteristics of American cities, which are less populated as Asian ones. Moreover, only about 10% of Americans are commuters to business central district.

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[7] For Singapore SMRT, advertising and related railway business are separated from railway segment

The observation of data shows that Japanese companies, Hong Kong MTR and Singapore SMRT have higher fare box ratio than Delhi, Seoul SMRT and Bangkok BCML. There can be two explanations. The first is that the formers achieved relatively higher operating revenue. The second is that those companies operate more efficiently than the remains. Further decomposition of operating revenue into number of annual passenger and price of services can provide more comprehensive understanding.

The assumption in this analysis is that the price setting is performed by the government agency, thus metro price is competitive to other mode of transportation. By using correlation analysis (Appendix-4), it can be concluded that the number of annual passenger has strong correlation with network length and density. The following estimation can be made by using linear regression model with independent variable (network length * density) and dependent variable (annual ridership).

Table 6: Estimation on ridership

City	Estimated Yearly ridership('000)	Real ridership ('000)
Bangkok	92,515	61,982
Delhi	707,827	328,500

The estimated yearly ridership was calculated basing on the regression model.

$y = 0.5083x + 108225$

(whereas, Y= yearly ridership, X= (network length * density))

The estimation result implies that with the assumption of equal pricing, fare box ratio of Bangkok BCML and Delhi was lower than Japanese company because of lower annual passenger. However, the low ratio of Seoul cannot be explained by the low ridership.

The second explanation for different operating revenue can be different pricing. The following table shows the price of a single ticket for the public transport network for a journey of approximately 10 kilometers or at least 10 stops and revenue per passenger for each operator

Table 7: Comparative metro price and revenue per passenger of Asian metro operators

City	(1)Metro price (¥)	(2)Revenue per passenger
Bangkok	46.3	58.77
Delhi	18.5	16.91
Hong Kong	74.1	76.58
Seoul	74.1	27.4
Singapore	92.6	60.68
Japanese cities average	200.0	166.34

Source: (1) UBS AG **Price and Earning,** 2007. The metro price was quoted in US$, the number was calculated using average yearly exchange rate for the year 2009. This metro price is a single ticket price which does not reflect the public transportation policy. (2) Calculated by dividing fare box revenue by annual passengers

There is significant difference in the standard single ticket price and revenue per passenger. The fact shows the pricing policy is the main factor explaining low profitability of Seoul SMRT.

4.2.2 EBITDA analysis

Earnings before interest, taxes, depreciation and amortization imply the profitability of operation by eliminating the depreciation expense from the operating expense. EBITDA also shows the same tendency as the fare box ratio.

4.2.3 Net Operating Profit (NOP)

Net operating Profit is calculated as the difference between operating revenue and operating expense taking into account the significance of depreciation expense. The result implies that the entities which own both operating assets (rolling stocks, signal system…) and infrastructure (or non-operating assets) have low NOP ratio due to depreciation expense. The table below indicates the depreciation expense as percentage of operating expense.

Table 8: Comparative depreciation expense

Operator	Depreciation expense('000 Yen)	Percentage of operating expense[8]
Tokyo Metro	63,172,822	19%
Sapporo	13,812,890	35%
Sendai	3,722,291	31%
Tokyo	44,319,550	34%
Yokohama	13,585,204	41%
Nagoya	23,079,295	30%
Kyoto	10,485,410	46%
Osaka	41,306,406	27%
Kobe	8,500,160	47%
Fukuoka	10,016,455	43%
Hong Kong MTR	33,395,160	16%
Delhi DMRC	3,171,532	57%
Singapore SMRT	4,084,831	13%
Bangkok BCML	579,730	15%
Seoul SMRT	14,176,774	40%

Source: Calculated from financial data

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[8] The operating expense for railway operation only

4.2.4   Net margin ratio

The bottom line of income statement of metro operators, net income, is the profit (loss) after deducting all cost and expense from total revenue and income. The significance between NOP and net income can result from the high finance cost (See table -10) or operating profit from other businesses other than railway operation. Among Japanese operators, only two operators had minus railway operating net profit, however, there are five operators with minus net income. The cause is the high finance cost and loss from bus operation. On the other hand, Hong Kong MTR has both high NOP and net margin ratio. The reason is the high profit from real estate development which contribute to over half of net income. The following table illustrates the finance cost as percentage of total revenue.

Table 9: Comparative finance expense

Operator	Finance cost ('000 Yen)	Percentage of operating revenue[9]
Tokyo Metro	21,958,699	6.5%
Sapporo	14,474,449	35.9%
Sendai	4,833,522	24.6%
Tokyo	23,978,332	13.9%
Yokohama	14,107,180	25.9%
Nagoya	23,398,873	24.7%
Kyoto	12,415,119	29.9%
Osaka	29,944,942	17.0%
Kobe	7,541,010	23.6%
Fukuoka	9,632,282	41.6%
Hong Kong MTR	23,256,720	9.0%
Delhi DMRC	1,756,724	19.1%
Singapore SMRT	481,505	0.8%
Bangkok BCML	2,526,982	60.4%
Seoul SMRT	1,285,744	3.6%

Source: Calculated from financial data

Through profitability analysis, the following conclusions can be drawn:

- Metro operators in Asian cities are more profitable than American operators. The evidence is the high fare box ratio of which value is 104% on average for 15 operators in studies. The ratio in America is 57%.
- There is significant difference in term of profitability among Asian operators. Bangkok BCML, Delhi DMRC and Seoul SMRT are the least profitable companies in term of fare box ratio. In case of Bangkok BCML and Delhi DMRC, the main cause is the low ridership. In case of Seoul SMRT, the pricing policy is the main factor.

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[9] The operating revenue for the whole company

- The business scheme, or the type of ownership, has significant effects on profitability as the amount of depreciation expense varies among different type of ownership. Bangkok BCML and Singapore SMRT have less depreciation expense as a result of vertical separation business scheme.
- The net income is the most diversified variable among metro operators. The main causes, excluding operating efficiency and depreciation cost, are finance cost and business portfolio diversification. Most of Japanese operators also have unprofitable bus business. Hong Kong MTR, Delhi DMRC also conducts other profitable business, especially real estate development.

4.3 Efficiency

The efficiency, or productivity, of business can be evaluated by financial ratio and input/output ratio. The financial ratio such as assets turnover indicates how efficiently an operator utilizes their assets. The input/output ratios are more specific indicators for efficiency in metro operation. The following table shows range of both financial and input/output ratio.

Table 10 : Efficiency indicators

Operator	Fixed assets turnover	Ridership per employee ('000)	Number of employees per kilometer	Number of employee per station
Tokyo Metro	0.28	267.47	46.51	50.67
Sapporo	0.10	285.63	15.27	14.96
Sendai	0.13	123.65	29.19	25.41
Tokyo	0.09	223.42	34.43	35.41
Yokohama	0.07	182.44	18.41	30.72
Nagoya	0.11	157.19	30.39	28.21
Kyoto	0.08	192.08	19.46	19.58
Osaka	0.13	141.22	46.37	48.98
Kobe	0.09	176.48	19.77	23.27
Fukuoka	0.05	210.72	19.73	16.33
Hong Kong MTR	0.17	141.15	40.36	56.18
Delhi DMRC	0.03	71.41	47.92	58.97
Singapore SMRT	0.79	167.28	32.73	59.80
Bangkok BCML	0.08	56.86	53.17	60.56
Seoul SMRT	0.07	170.76	45.53	46.76
Average	**0.15**	**128.28**	**33.28**	**38.39**

Source: Calculated from financial data

　　　　Fixed assets turnover= total revenue/fixed assets

Several conclusions can be drawn from the above ratios:

- Singapore SMRT has highest fixed asset turnover because of vertical separation. Non-operating assets are off balance sheet.
- In term of ridership per employee, Seoul SMRT, and Japanese operators have more passengers per employee, which indicates high efficiency.
- In term of employees per station, Japanese operators are also proved to be more efficient.

To precisely evaluate the efficiency of a metro operator, the operational inputs such as electricity consumption, number of operational employees, labor hours and operational outputs such as capacity-km, car-km, are necessary. Due to the unavailability of those data, this paper is not able to have persuasive evidence to compare efficiency level of the target operators.

4.4 Financial leverages

Financial leverages analysis is a tool to evaluate the financial management of a firm. There are two big issues related to financial leverages. The first is the capital structure strategy which enables firms to pay least cost of capital. The second is the risk arising from a firm's financial leverage. This section will mainly deal with the issue of risk arising from financial leverage. One of financial leverage risk is short-term liquidity – the risk of inability to meet short-term obligations. The key indicator this liquidity risk is current ratio[10] . It evaluates the risk by comparing the current liabilities with short-term liability. Another financial leverage risk is the long-term debt solvency. The liabilities- to-equity ratio measures the capital structure. Interest coverage[11] is an indication of firm ability to cover its interest payment.

Regarding the fact that a public company can rely on municipal government to repay loans and other obligations when it is able to generate enough cash and profit, the analysis attempts to evaluate the financial risk of non-public operators.

The characteristic of private operators is high liabilities to equity ratio. It is a common business practice because debt financing is beneficial in several ways (Palepu *et al.,* 2008). Firstly, debt financing is cheaper than equity because the payment is predefined. Secondly, the debt financing is generally tax deductible. Thirdly, debt can motivate managers to operate business in more efficient manner. However, debt financing is beneficial only if the business generate sufficient income to reimburse interest payment. Bangkok BMCL, Singapore SMRT, Hong Kong MTR and Tokyo metro all have high liabilities ratio ranging from 1.5 to 3.82. However, Bangkok BMCL does not generate enough profit to cover the interest payment. If there is no improvement of profitability, the solvency is a problematic issue for Bangkok BMCL.

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[10] Current ratio = $\frac{Current\ assets}{Current\ liabilites}$

[11] Interest coverage = $\frac{Net\ income\ +Interest\ expense}{Interest\ expense}$

Table 11: Financial leverages indicators

Operator	Current ratio	Liability to equity	Interest coverage
Tokyo Metro	0.30	3.82	3.05
Sapporo	0.79	0.77	1.09
Sendai	0.25	0.54	0.84
Tokyo	1.82	0.71	1.50
Yokohama	0.85	0.33	0.83
Nagoya	0.46	0.73	1.01
Kyoto	0.13	0.42	-0.21
Osaka	1.47	0.08	1.70
Kobe	0.24	0.21	0.64
Fukuoka	0.02	0.27	0.79
Hong Kong MTR	3.30	1.50	5.14
Delhi DMRC	1.34	2.02	0.69
Singapore SMRT	0.94	4.82	23.06
Bangkok BCML	0.27	2.48	-0.53
Seoul SMRT	0.95	0.18	-13.21

Source: Calculated from financial data

5 Conclusion

Metro system plays an importance role in effort of Asian megacities to meet the increasing traffic demand. This paper deals with the operational and financial performance of various metro operators in Asia cities. The study shows that the performance of metro operators varies across cities, business schemes.In general, Asian metro operators are more financially independent than American operators. Among studied operator, Hong Kong MTR, Singapore SMRT and Tokyo Metro are best metro operators with high profitability, high efficiency and financial soundness. Their profitability was largely contributed by diversification in other profitable businesses such as space leasing and real estate development. Singapore SMRT is in good financial position as their depreciation expense is small. Delhi DMRC was unprofitable due to the low ridership; however, the company has the same development model as Hong Kong MTR. It is expected that they will able to receive enough income from real estate development to become a financially independent entity. Japanese operators are highly efficient in operation, which contributes to their operating profitability. Their low profitability in the bottom line can be explained by high depreciation expense and finance cost. The most problematic operator at the moment is Bangkok Metro. The main causes are low ridership and finance cost. Solvency is a big issue for this operator. Seoul SMRT illustrates a different case from other operators. Their pricing strategy implies the public transportation promotion policy of Seoul authority. The government is willing to grant huge amount of subsidies to public transportation operator in exchange for high public transportation ridership.

Appendix 1: Japanese cities with metro system

Cities	Operating km	No. of Stations	Rolling- stocks	Daily ridership	Construction year
Sapporo	48	46	396	572,041	1971
Sendai	14.8	17	84	157,619	1987
Tokyo	279.4	266	3,739	8,160,565	1927
Yokohama	53.4	40	282	489,999	1972
Nagoya	89.1	83	762	1,163,039	1957
Kyoto	31.2	31	222	318,565	1981
Osaka	129.9	100	1,280	2,305,083	1933
Kobe	30.6	26	208	291,721	1977
Fukuoka	29.8	35	212	338,541	1981

Source: Japanese big cities comparative statistics (2007)

Appendix 2: List of metro systems in Asia

Country	City	Project name	Length km	Operator	Status
Korean	Seoul	Line 1-4	134.9	Seoul Metro	1974
		Line 5-8	152	Seoul Metropolitan Rapid Transit Corporation	1994
		Line 9	25.5	SML9	2009
	Daejeon	Line 1	22.6	Daejeon Express Transit Corporation	2006
	Incheon	Line 1	29.4	Incheon Metro	1999
	Busan	Line 1.2	76.8	Busan Transportation Corporation	1985
	Daegu	Line 1	25.9	Daegu Metropolitan Transit Corporation	1997
		Line 2	28		2005
China	Beijing	Line 1.2	54	Beijing Mass Transit Railway Operation	1969
		Line 13	40.8		2003
		Line 八通線	18.9		2002
		Line 4.5.8.10	113.5		2007
	Guangzhou	Line 1	18.5	Guangzhou Metro Corporation	1997
		Line 2	23		2002
		Line 4	36.3		2006
		Line 4	38.96		2007
	Shanghai	Line1.2.3.4.8.9	213.8	Shanghai Metro Operation Co.Ltd	1993
	Shenzhen	Line 1	21.5	Shenzhen Metro Corporation	2008
	Nanjing	Line 1	17	Nanjing Metro Corporation	2005
	Tianjin	South-North	26.1	Tianjin China Metro General group	1984
	Hong Kong	Metro and LRT	211.6	Hong Kong Mass Transit Railway Corporation	1979
Taiwan	Taipei	Metro	84.7	Taipei Rapid transit Corporation	1997
	Kaohsiung	Line 1.2	42.7	Kaohsiung Rapid Transit Corporation(BOT)	2008
India	Delhi	Three lines	96	Delhi Metro Railway	2002
	Mumbai	Metro (PhaseI)	62.68	Mumbai Metro One Private Limited	Constructing （2011~）
	Kolkata	Metro	16.5	Metro Railway Kolkata	1984
Vietnam	Ho Chi Minh city	Line 1	20.5	N.A	Planning
Thailand	Bangkok	Blue line	47.9	Bangkok Metro Company Limited	Partly operation(2004~20km)
		Purple line	39.5	N.A	Planning
		Orange line	23.8	N.A	Planning
Singapore		MRT 3 lines	93.2	Singapore Mass Rapid Transit Ltd.	1987
		MRT East-North line	20	SBS Transit	2003
Indonesia	Jakarta	Metro	20.8	N.A	Planning

Source: Data from each metro operator's website, transportation authority and Japanese metro association

Appendix -3: Fare box ratio of American metro operators

Operator	Fare box revenue (US$)	Operating expense (US$)	Annual ridership	Fare box ratio (%)
Los Angeles County Metropolitan Transportation Authority	23,738,928	87,368,181	40,883,369	27.2
San Francisco Bay Area Rapid Transit District	281,494,352	458,909,745	109,019,696	61.3
Washington Metropolitan Area Transit Authority	404,837,785	696,335,404	276,440,693	58.1
Miami-Dade Transit	13,435,411	80,628,996	17,504,736	16.7
Metropolitan Atlanta Rapid Transit Authority	50,462,915	171,626,175	77,685,887	29.4
Chicago Transit Authority	198,020,403	536,049,010	190,272,996	36.9
Massachusetts Bay Transportation Authority	125,471,260	261,148,955	143,666,785	48.0
Maryland Transit Administration	12,429,257	50,550,360	13,158,501	24.6
Port Authority Trans-Hudson Corporation	92,554,583	223,567,490	80,595,845	41.4
Port Authority Transit Corporation	19,016,861	39,201,940	9,406,473	48.5
MTA New York City Transit	2,030,025,155	3,028,507,897	2,390,402,930	67.0
Staten Island Rapid Transit Operating Authority	5,409,739	32,906,212	7,422,568	16.4
The Greater Cleveland Regional Transit Authority	5,361,001	24,408,221	7,450,341	22.0
Southeastern Pennsylvania Transportation Authority	73,447,447	143,738,619	88,461,397	51.1
Puerto Rico Highway and Transportation Authority	9,874,375	53,399,250	7,822,790	18.5
Total	**3,345,579,472**	**5,888,346,455**	**3,460,195,007**	**56.8**

Source: American Public Transportation Association (APTA), Resource Library, Public Transportation Database, 2007

Appendix -4: Correlation matrix between metro ridership and cities' characteristics

	Area	Population	Density	Network (km)	Density*network	Annual passengers
Area	1					
Population	.377	1				
Density	-.274	.732(**)	1			
Network (km)	-.097	.569(*)	.708(**)	1		
Density*network	-.207	.671(**)	.916(**)	.874(**)	1	
Annual passengers	-.161	.494	.707(**)	.886(**)	.906(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

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