

# **AN ANALYSIS OF VERTICAL SEPARATION OF RAILWAYS**

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## **ABSTRACT**

A number of state railways over the world have experienced railway reform, and vertical separation has been frequently utilized during its process. This study investigated a variety of models of vertical separation, which the railway sector has experienced over the two decades. The result of the study leads to the conclusion that full costs and benefits should be considered upon introducing a form of vertical separation, and that the appropriate form of it depends on the circumstances as well as its objectives.

*Keywords: railway reform, coordination problems, open access, concession, competition*

## **1. INTRODUCTION**

Without subsidy from the government, nowadays, the number of profit-making integrated state-owned railways has become limited to a few. In addition to the deterioration of financial condition of railways caused by severe competition with other modes, many of the state-owned railways also face some problems such as lack of incentive to be cost-effective or to respond flexibly to the changes in user demand. They often had poorly defined goals and continued cross-subsidy between the social division and the commercial division.

In order to reform these stagnated state-owned railways, the railway sector has experienced various forms of vertical separation as a part of the restructuring process. Despite the abundant forms of vertical separation of railways, sufficient analysis has not been done partly because of the limited opportunities to share or obtain information due to scattered geographic locations in the world.

Based on the above background this study examines various types of vertical separation, which the railway sector has experienced over the world. This research investigates them focusing on the four key issues on vertical separation: 1) aims of railway reform; 2) forms and implementation; 3) advantageous effects; 4) disadvantageous effects.

As a number of further restructurings are about to be implemented and effects of vertical separation are crucial, this research intends to learn lessons from various models of vertical separation, which the railway sector has experienced over the twenty years.

## **2. BACKGROUND TO VERTICAL SEPARATION OF RAILWAYS**

### **2.1 Characteristics of the Railway Industry and Recent Status**

Railway infrastructure along with some type of networks such as pipelines, power transmission lines exhibit characteristics of natural monopolies, and because of the prominences of infrastructure costs in the railway industry, it has significant economies of scale. This means that generally average costs fall as output increases in the railway industry. Thus it is considered that competition, which may be unstable and destructive, is unsuitable in a natural monopoly. Under these circumstances, this kind of structure has been operated by a public firm, or heavily regulated in order to avoid the use of monopoly power (Nash and Trujillo, 2004). Another essential ground that network industries have traditionally been vertically integrated is their economies of scope arising from the needs for co-ordination, because the loss of economies of scope with vertical separation takes the form of higher transaction costs (Drew, 2006).

Though vertically integrated structure had been a traditional form, some network industries have been unbundled in several countries in these years. One of the backgrounds of this change is the problem that market power is greater when there are fewer firms, and monopolistic behaviour worsens allocative efficiency. Thus, the balance between allocative efficiency and scale economics is a principal issue to many problems in competition policy (Vickers and Yarrow, 1988).

### **2.2 Definition of Vertical Separation of Railways**

In this study the terms “separation of infrastructure and operation” and “vertical separation” refer to the situation where the owner of the infrastructure does not provide the given rail service over the given piece of infrastructure itself.

Although the historical model of railway operations is a monolithic organization, whereby single entity controls all facilities, train operation and administrative functions, the production of railway services can be divided into several factors:

- 1) investment and ownership of infrastructure;
- 2) maintenance of tracks and infrastructure;
- 3) capacity allocations and timetabling;
- 4) route setting (daily traffic controlling and signalling);
- 5) investment and ownership of rolling stock;
- 6) maintenance of rolling stock;
- 7) daily operation of trains (train service running and crew rostering);
- 8) service marketing and ticket sales;

9) administrative regulations on safety, technology, entry and retirement of services, fares, conflict settlement and so on.

In vertically separated railways the owner of the infrastructure is different from the provider of the rail service over the infrastructure. Therefore, the “above rail” functions, which indicate the factors 5), 6), 7) and 8), are performed by a different independent entity from the owner of the infrastructure. As the entity which carries out the other factors varies according to the railway, various models of vertical separation exist in the railway sector. As the author considers that, among the above nine factors, the factors 2), 3), 4), 6), 7) and 8) are especially essential for daily operation of trains, this study defines these factors as “essential factors of daily operation”.<sup>1</sup>

### **3. RESEARCH DESIGN AND METHODOLOGY**

This research is performed mainly based on: 1) data collection on literature; 2) investigation through interviews/questionnaires; and 3) comparative analysis.

The railways for the study are carefully selected based on the following conditions:

- The state-railways have already experienced a reform through vertical separation and the results have become clear to some extent;
- The railways cover different motives for introducing vertical separation;
- The railways cover different forms and implementation of vertical separation;
- The railways have different sorts of results through vertical separation;
- The state railways are large enough and have sufficient transport volume to investigate the transition;
- The cases of reform are confined to those within past decades of years since competition with other transport modes had become severe.

In the case study, various types of vertical separation are divided into four categories based on their characteristics. The railways selected and groups discussed are shown in Table 1.

In addition to close investigation into the literature, the research interviews are performed to a subject who is identified to have sufficient information and knowledge about vertical separation of the railway. In principle, the author made interviews/questionnaires with managers with enough working experience in the railways and an intimate knowledge about vertical separation of the railways.

As a first step of the study, each group of railways with a similar type of vertical separation has been investigated. Then in order to distinguish their characteristics they are compared analytically among different types of vertical separation especially in terms of operational responsibilities and financial responsibilities. Based on the investigation and comparison, the

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<sup>1</sup> The author considers that investment and ownership of infrastructure and rolling stock are not necessarily essential for “daily” operation because an operator can perform railway operation by leasing them from other entities. Thus author excluded the factors 1) and 5) from the “essential factors of daily operation”.

study also proposes an appropriate form of vertical separation in different market structures and policies.

**Table 1 – Group of Railways by the Type of Vertical Separation**

Group	Title of the Group
	Country (Railways)
Group 1	State-owned railways without within-rail competition
	Vietnam (VNR), Indonesia (PT.KA), Tunisia (SNCFT)
Group 2	Vertically separated railways with competition among operators
	Sweden, UK, Germany, France, Australia (ARTC)
Group 3	Railways with vertical separation for passenger or freight traffic
	Japan (JR Freight), USA (Amtrak)
Group 4	Private railways with long-run concessions
	Mexico

#### **4. STATE-OWNED RAILWAYS WITHOUT WITHIN-RAIL COMPETITION**

This section investigates vertically separated state-owned railways without within-rail competition focusing on the railways in Vietnam, Indonesia and Tunisia. In these three countries, the ownership and financial responsibility of rail infrastructure have been separated from railway operations.

Vietnam, Indonesia and Tunisia introduced vertical separation into the railway sector in 1995, in 1992 and in 1998 respectively. Since then, the government owns the infrastructure and finances its maintenance, renewal and development investments, which used to be covered by the state-owned railways. These three state-owned railways have common directions to improve the railways through the following policies:

- 1) Improving the efficiency of the railways allowing more freedom for the management;
- 2) Reducing the high degree of regulatory intervention and direct subsidies from the government.

In order to pursue the above policies, vertical separation in these railways aimed to discriminate the role of the government and that of the railways. Instead of covering the deficit of the state-owned railways as a whole, the financial responsibility of the government has been clearly stipulated. This clear definition of the government's ownership and financial responsibility for the railway infrastructure is the distinctive characteristic of this type of vertical separation.

In order to achieve more commercially-oriented rail services, along with the introduction of vertical separation, conversion of corporate status and the reform of organisation structure was also undertaken in the railways, and they have gained more freedom for management and more autonomy with self-responsibility. For example, in Vietnam and Tunisia, new

operators entered the passenger market under an agreement with the main operator.<sup>2</sup> These cases contributed toward introducing private investment into the railway sector as well.

Though the government is committed ownership and financial responsibility in investment and maintenance of the infrastructure, in these three railways, the main operator performs the essential factors of daily operation such as maintenance of the infrastructure and rolling stock, timetabling, route setting, daily operation of trains, and ticket sales. It also takes responsibility for the safety of train operation.

In the three countries, the government has its principle to pay much attention to the investment of the railway network, and long/medium-term plans are stipulated in each country. Based on these plans, the government and the state-owned railways make efforts to promote smooth negotiation for efficient construction and maintenance of the infrastructure. These railways try to reduce coordination problems raised by vertical separation through the negotiation with the government. These efforts contribute toward decreasing some expected coordination problems between the two parties such as difficulties in planning investment and maintenance of infrastructure. Owing to the efforts by the two parties, the study did not find any serious conflict between the government and the state-owned railways except the case in Indonesia, where the stipulated amount of compensation for the railways has not been paid by the government.

Different from European railways which are discussed in the next section, the government has no intention to introduce within-rail competition among operators. Instead, the government retains a will to revitalize the state-owned railways through commissioning more autonomous rights of the management, and it expects the incumbent state-owned railways to compete with other transport modes making the most of its engineering and operational abilities, and this is the background of introducing vertical separation in these countries.

In general, the recent reforms through vertical separation in these railways, reinforced by the change of the legal status and restructuring of the organization, have made them more active even though practically a sole state-owned railway performs the railway operation without within-rail competition. The management of the railway has become more market-oriented and active through stipulating more flexible tariffs and establishing a joint-venture with the private sector. Along with the government's positive financial contribution, these commercial efforts have, in general, resulted in the favourable traffic performance. For example, VNR has increased traffic with a 67 % in ton-kilometres and a 114 % in passenger-kilometres during the period from 1995 to 2005. These increases have been achieved in almost the same length of tracks without building new lines, and these figures are much higher than those of other railways in ASEAN countries, most of which are stable or steady increase. These figures show that VNR has been successful in improving railway performance since the reform through vertical separation in 1995.

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<sup>2</sup> In these cases the main operator dispatches its drivers, controls trains and makes a timetable taking almost all responsibilities of train operation within its networks. Different from the cases in Europe which will be discussed in the next section, they do not have competitive relationship each other, and there is no particular dispute between the main operator and the new entrant.

In summary, the principal advantage of the type of reform discussed in this section is to revitalize the stagnated state-owned railways by means of distinguishing the government's role and the railway's role mainly in terms of financial responsibilities. This kind of reform appears to be applicable to the state-owned railways, which can not cover the infrastructure cost by the revenue and lost sufficient incentive for attaining efficient operation despite its engineering and management capabilities.

## **5. VERTICALLY SEPARATED RAILWAYS WITH COMPETITION AMONG OPERATORS**

This section investigates the railway reform with vertical separation in European and Australian Railways. In their countries, several operators started competing each other without discrimination. Specifically, the author examines the cases in Sweden, UK, Germany, France, and ARTC in Australia.

### **5.1 The Background and Recent Transport Policy in EU and Australia**

As the background of introducing recent transport policies, the railways in the two regions, Europe and Australia, have following several similarities:

- Each railway has been developed as a state-owned integrated railway;
- Each railway has introduced its own technical systems within the state even if a railway line goes through different states. For example, a wide variety of signalling systems, electrification and safety rules exist around Europe;
- Because of the above background, it has not been easy for a specific railway operator to access smoothly to the track which is owned by a different organization;
- Because of the barrier for mutual access, railway transport has lost its competitiveness gradually, especially in the freight sector;
- Smooth cross-border transport in the railway sector has been required to compete with road transport in recent years.

The current transport policies in Europe and Australia aim to resolve the above similar problems. It can be expected that this background had resulted in adopting the transport policies, which have quite similar characteristics:

- ensuring the management independence of railway undertakings fostering competitive neutrality between rail operators;
- promoting third parties' access to essential rail facilities based on legislations;
- establishing regulatory pricing and rail access oversight institutions;
- promoting competition within railway market.

## **5.2 Outline of the Recent Reform**

Certainly, each of the railways in these countries is obliged to follow the similar transport policies described above. Nevertheless, the outline of the reform through vertical separation and the approaches to adapt to the policies vary so much.

In Sweden, UK and Australia (ARTC), legally and financially independent institutions have become responsible for the infrastructure and operation respectively. Except the case in UK, where the privatized company had become responsible for the infrastructure at first, the public sector became responsible for the infrastructure. Certainly, this structure is advantageous for facilitating public investment into the infrastructure fairly as all the investment can be channelled to the state-owned infrastructure rather than to a specific operator, and this has been the case especially in Sweden and Australia (ARTC).<sup>3</sup> This structure is also advantageous for promoting new entry into the railway services without discrimination.

In Germany, the main railway (DB AG) keeps a holding structure placing infrastructure and operation under the holding company. Certainly, it is useful to avoid coordination problems, but complete separation which infrastructure and operation are totally independent will increase according as competitive new entrants take the share of the rail market. This is also the case in France, where the main railway (SNCF) currently makes working timetable and performs maintenance and operation of the infrastructure (Nash, 2007).

In all the cases, in the process of timetabling, each operator applies for time-slots and the infrastructure manager allocates infrastructure capacity fairly and without discrimination. This is stipulated by the EC Directive and the Australian transport policy.

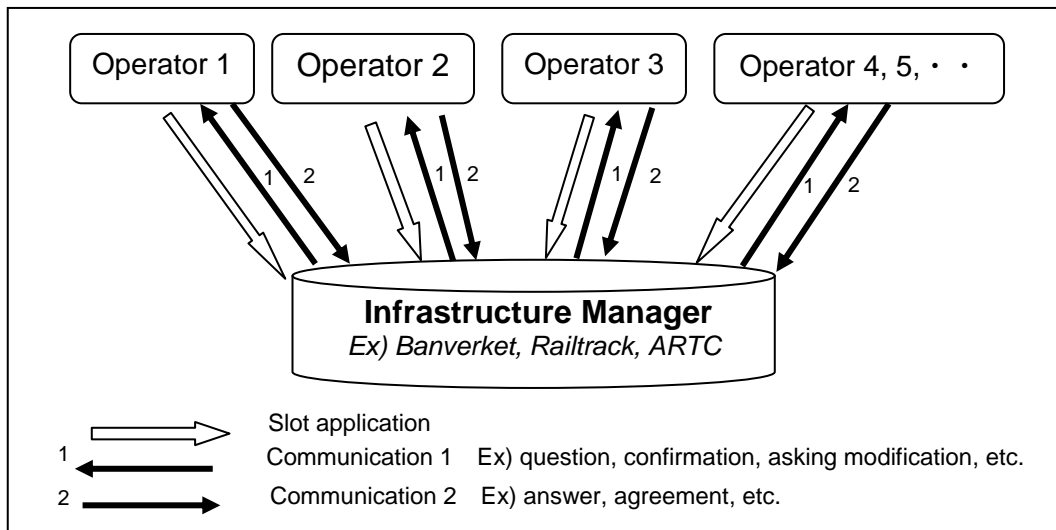
In the case of complete separation (Sweden, UK and Australia), based on the application for the time-slots, the infrastructure manager does slot allocation and also makes timetable. Nevertheless, the data must be exchanged between the infrastructure manager and a number of operators as shown in Figure 1. This procedure has become more complicated compared with an integrated railway, where those information exchanges and every operational decision can be performed within a sole organisation flexibly.

The study found that the infrastructure manager has difficulties to coordinate the operators' application especially in the following cases:

- 1) in a case infrastructure capacity is limited;
- 2) in a case several operators apply for the same time-slots;
- 3) in a case time schedule for maintenance works is difficult to be secured.

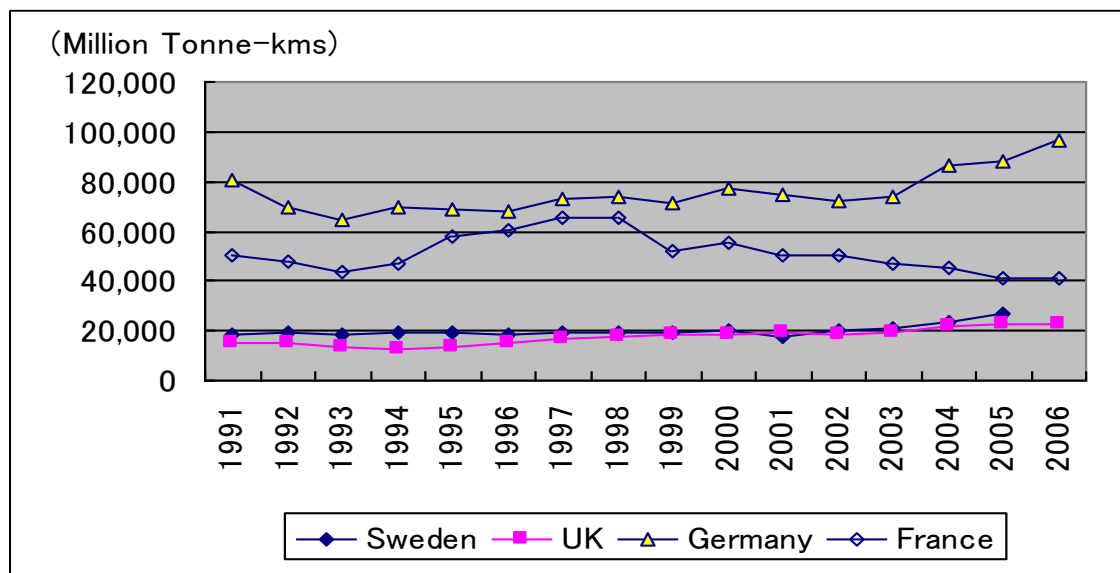
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<sup>3</sup> It is also the case in UK since Railtrack was replaced by Network Rail, which is committed to achieving a substantial improvement in rail infrastructure.



**Figure 1- Procedure for Making a Timetable in Complete Separation**  
 Source: Kurosaki (2008)

In European railways and ARTC, vertical separation was introduced mainly in order to promote competition among operators. In the freight sector of these countries competition 'in' the market has become common already. Compared with France, where progress of the liberalization is relatively slow, the rail freight traffic in the other further liberalized four railways increased more rapidly as shown in Figure 2. Some interviewees indicated that on-track competition among operators has resulted in the rapid increase in the freight sector. Although further research is required to prove it clearly, there are possibilities of validity that on-track competition is effective to improve the rail freight performance in certain circumstances.



**Figure 2- Trends of Rail Freight Transport in the four European Countries**  
 Source: Kurosaki (2008)



In the passenger sector, rail transport has improved after their liberalization and regionalization in these European railways. But, partly because the examples are so limited, the effectiveness of on-track competition has not been clarified. Behind this background, there is generally a need for subsidy for the passenger rail services. It should be possible that competitive entry into the rail passenger market, such as an entry to only peak hours, reduces a part of the subsidised operator's profit by 'cream skimming', and results in an increase of the amount of subsidy. Thus it appears that passenger franchising has more advantages to preserve an integrated network of rail services permitting tolerable cross-subsidy within the franchised network, whereby the operator avoids wasteful competition and makes the most of limited amount of subsidy.

The investigation showed that complete separation makes it possible to promote on-track competition in the freight sector, and it is suitable for promoting new entry into the passenger rail services through franchising. But it is also found that complete separation raises coordination problems between infrastructure and operation especially on condition that infrastructure capacity is limited. Thus, upon introducing the form for within-rail competition, full costs and benefits should be considered.

## **6. RAILWAYS WITH VERTICAL SEPARATION FOR PASSENGER OR FREIGHT TRAFFIC**

This section investigates the railway reform with vertical separation for passenger or freight traffic. Specifically, the author examines the railway reform in Japan (JR Freight) and the United States (Amtrak). In these countries, the railway in the prime market, either the passenger or the freight, keeps an integrated structure and another railway in the smaller/minor market had become a tenant on the main railway.

Table 2 shows passenger-km as a percentage of traffic units (combination of passenger-km and freight tonne-km). As the table shows both countries have particular characteristics that one of the sectors dominates in the rail transport market.

**Table 2 - Units of Traffic by Market Sector in the Two Countries**

<b>Country</b>	<b>Passenger-km (million)</b>	<b>Freight tonne-km (million)</b>	<b>Passenger-km / Traffic units</b>
<b>Japan</b>	241,980	22,264	92%
<b>USA</b>	8,800	2,427,268	0.4%

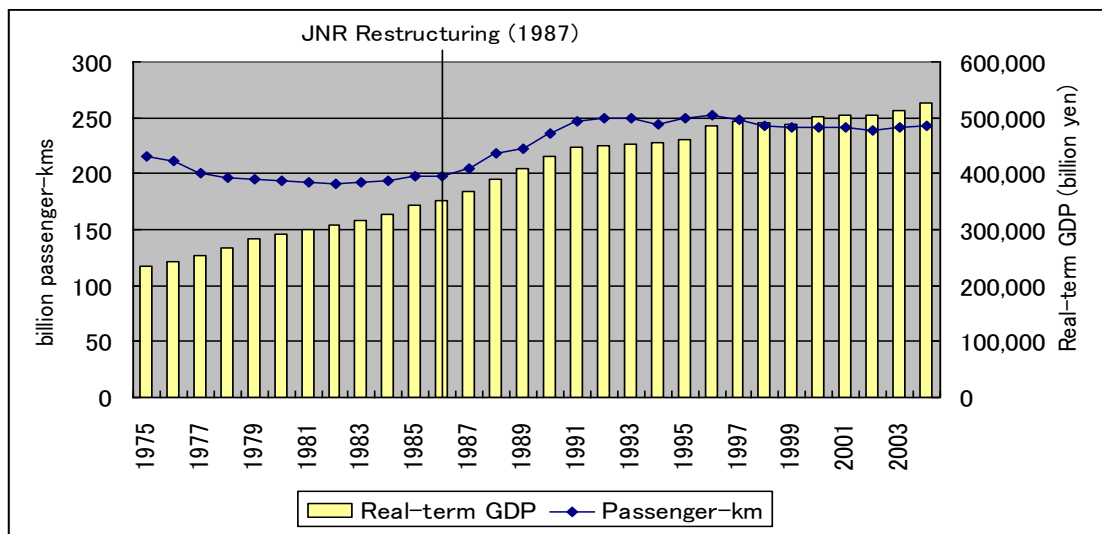
Source: Author's analysis of UIC statistics (2004)

As the background of railway reform in the US, similar to the cases in other countries, competition from automobiles and buses gradually eroded the rail market share in the US. Apparent losses on passenger service began to mount rapidly and, for many years, about half of the total net income from the private US freight railroad industry was being absorbed by losses on passenger services. Thus, the financial viability of many freight carriers and the entire railway industry was threatened (Thompson, 2003).

In 1970, Congress created the National Railroad Passenger Corporation (Amtrak) to relieve the freight railroads of the burden of money-losing passenger operations. Amtrak was established as a for-profit government corporation that was granted a monopoly to provide intercity rail transportation with Federal subsidies.

Similar to the above-mentioned case in the US, elimination of the excess cross-subsidies between the passenger and freight sectors was the primary reason for introducing vertical separation in Japan. Improving the focus on services in each transport market was also an important objective/advantage for the reform through this type of vertical separation. For example, in Japan, in spite of its status as a tenant, management efforts as an independent company focusing on its own market have changed the traffic output, which had been in serious down-turn trend since 1970's, and increased the freight rail transport (ton-kilometres base) as well after the reform in 1987.

Since the reform through separation, the integrated railway has been improved at a higher rate than before. For example, transport volume of the six JR passenger railway companies, which were established through the reform of Japanese National Railways (JNR), started to increase with much higher rate than before as shown in Figure 3. This growth rate is higher than that of other Japanese private railways, and it was attained while decreasing the number of employees at the same time.



**Figure 3- Trends of Rail Passenger Transport in Japan \***

Source: Kurosaki (2008)

\*: The figure includes the passenger transport of JNR and the six JR's.

In both countries, the reform has contributed to improve/retain the private participation into the railway industry. In Japan the reform has contributed to list the shares of the three large passenger companies. In the US it has also resulted in clearer definition of the government's financial role for the tenant, and revitalized the private freight railroads.

In this type of railways, the integrated dominant railway principally continues to perform the essential factors of daily operation such as timetabling, train control, signalling, investment and maintenance of infrastructure. In practice, the tenant faces some difficulties to get its time slots in both countries. But this is expected to be derived from the background of introduction of the vertical separation to rescue the railway in the prime market.

In these cases, vertical separation does not aim to introduce within-rail competition, and the laws concerned permit those operators to retain relatively exclusive track-access rights in general. Based on this regulation, the incumbent/reformed operator continues its railway operation even after the reform.

Generally, this type of vertical separation appears to be a successful approach in case one of the sectors is dominant and profitable enough to sustain the infrastructure, and another sector takes the only small rail market. As the dominant railway keeps an integrated structure, in principle, coordination problems raised by vertical separation, such as difficulties to get time-slots fairly, can be confined only into the small rail market.

## **7. PRIVATE RAILWAYS WITH LONG-RUN CONCESSIONS**

This section investigates railways with long-run concessions focusing on the railway reform in Mexico. Long-run concessions have been widely adopted in railways in Latin America and some countries in Africa as well. In these countries the state-owned railways were privatized, and a railway operator as a private concessionaire manages the infrastructure whose ownership is retained by the government. In addition to the freight concessionaires, this section investigates the Mexico City Terminal Railway, which the freight concessionaires access the marshalling yard and terminal facilities in Mexico City.

Ferrocarriles Nacionales de Mexico (FNM) was an integrated monopolistic railroad controlled by the Transport Ministry. Nevertheless, despite the necessity to promote investment into the railway sector economic conditions of the country were not good enough to continue spending a large amount of public expenditure into the sector. This was the impetus to seek private financing even into the rail infrastructure, and this background was different from that of some European countries, of which the government had an intention to promote public investment into the sector actively for revitalizing railways.

In February 1995, the Mexican Congress approved to open opportunities for private sector investment within the railway system. In the reform the primary lines were divided into three geographical divisions, North-east (TFM), North-Pacific (Ferromex) and South-east. The study made investigations into the former two concessionaires through the questionnaire.

In the two Mexican freight concessionaires, the operation is assigned through the competitive bidding. The concession contract is granted for a maximum of 50 years and renewable for another similar period. Thus, despite the initial open auctioning process that is essential for the success of privatization, the main aim of the long-run concessions should be regarded as utilization of commercial mechanism by the private sector. Once the operation is assigned

through the competitive bidding, these freight concessionaires (TFM, Ferromex) perform the essential factors of daily operation including *below-rail* functions with the operator's own financial responsibilities and they do not receive any subsidies from the government. The operator itself makes financial planning and investment in operations and infrastructure over the concession period.

Since the restructurings, the freight concessionaires had stronger incentives to increase the traffic with liberalized railway management such as setting market-oriented tariffs. These changes resulted in several advantageous effects. For example, in addition to the improvement of safety performance, revenue and traffic have been improved remarkably. According to the World Bank Railway Database, the traffic output (tonne-kms) had increased 55.3% during the period between 1997 and 2005. Since the growth of the real-term GDP during the same period is 27.2%, the rail freight traffic has improved more rapidly than that of national economy. This growth has been attained while the number of employee is decreased, and the productive efficiency of the concessionaires has improved remarkably since the concession is awarded.<sup>4</sup>

As the three primary freight concessionaires access Mexico City, its rail terminal was formed into a separate company. The following discusses that the case of vertical separation in this terminal, of which characteristics are different from the afore-mentioned freight concessions. The Mexican Government founded a neutral terminal access area for the Mexico City area, thus marshalling yard and terminal facilities in this area are operated by an independent organisation, the Mexico City Terminal Railway (TFVM). TFVM has four owners: 25 percent each for the three main freight concessionaires and 25 percent for the government. This type of vertical separation appears to be appropriate for attaining neutral access by certain operators exclusively. As TFVM has no reason to open the tracks to the operators other than share-holders, the share-holding relationship with limited number of operators was realizable, and this relationship contributes towards managerial cooperation between infrastructure and operation. Due to relatively sufficient infrastructure capacity, TFVM has been successfully coordinating the timetabling so far, and the access charges paid by the freight operators also can cover the maintenance costs of the Terminal.

In summary, as the main mechanism of the reform, the concession system was adopted and private operators have participated in the railway transport service in Mexico. Fundamentally, only one freight concessionaire operates on a specific line with commercial basis over the period. It can be noted that the concession worked as a mechanism for rail privatization, and utilization of private sector's ability for efficient control over both operation and infrastructure. On the other hand, the Mexico City Terminal is operated by an independent joint-venture in order to avoid monopolistic access to the country's most densely used network. Apparently, it is not practical approach for each freight concessionaire to have its own marshalling yard and terminal facilities in Mexico City. Thus, vertical separation in the case of TFVM has worked for economy of enhanced density.

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<sup>4</sup> During the period between 1997 and 2005, productivity of TFM and Ferromex has improved 487% and 632% respectively.

## **8. COMPARATIVE ANALYSIS PART 1: FORMS, OPERATION AND FINANCE**

In the former sections several kinds of vertical separation have been examined. Based on the study into each case, this section performs analytical comparison among them in terms of the following viewpoints: 1) forms and separation of operational responsibilities; 2) separation of financial responsibilities. The comparison and analysis aims to draw out the characteristics of each type of vertical separation.

### **8.1 Forms and Separation and Operational Responsibilities**

The author examines the forms of vertical separation mainly in terms of the entity that performs the essential factors of daily operation, and the degree of operational separation is investigated comparing among the railways discussed in the cases. Firstly, this section focuses on how the six essential factors of daily operation are performed within the industry.

Among the six factors, the author calls the former three factors following as the “below rail” functions:

1. Maintenance of track and infrastructure;
2. Capacity allocations and timetabling;
3. Route setting (daily traffic controlling and signalling).

Similarly, the latter three factors listed below are called as the “above rail” functions:

4. Maintenance of rolling stock;
5. Daily operations of trains (train service running and crew rostering);
6. Service marketing and ticket sales.

The study found that, in general, these “above rail” functions are performed: 1) by the main operator; or 2) by the tenant (Group 3: Japan; USA.). Then, the investigation also clarified the entity that performs each factor of “below rail” functions, and categorized the type of vertical separation. They are summarized in Table 3 according to the degree of operational separation between infrastructure and operation.

The table shows that a variety of forms of vertical separation exist in the railway sector, and the degree of operational separation varies to a large extent from the type of “integral” to “complete separation”.

**Table 3 - Degree of Operational Separation between Infrastructure and Operation**

Below Rail Functions  Type of Separation*	1. Maintenance of track and infrastructure	2. Capacity allocations and timetabling	3. Route setting	Examples of the Country / Railway
1. Integral (Both Markets)	O	O	O	
2. Integral (Only in the Primary Market)	O	O	O	Japan (Passenger Co.) USA (Freight Co.)
3. Separation of Ownership Only	O	O	O	Mexico (TFM, Ferromex)
4. Separation of Financial Support for Track Maintenance	O'	O	O	Vietnam (VNR) Indonesia (PT.KA) Tunisia (SNCF)
5. Separation with Common Ownership	(O)	(O)	(O)	Germany (DB AG)
6. Separation as a Shareholder of Infrastructure Manager	(O')	(O')	(O')	Mexico (TFVM)
7. Separation of Slot-Allocation	O'	O I*1	O	France
8. Separation as a Tenant	I	I	I	Japan (JR Freight) USA (Amtrak)
9. Complete Separation (Both Markets)	I	I	I	Sweden UK Australia (ARTC)

Degree of Operational Separation

Notes:

\*: The below rail functions marked in the table are those for the railway in the examples.

O: The main operator performs the factor with its finance.

O': The main state-owned railway performs the factor operationally, and the infrastructure owner is responsible for the factor financially.

(O): The infrastructure manager, which is the common ownership with the operator, is responsible for the factor operationally and financially.

(O'): The infrastructure manager, which has a share-holding relationship with the operator, is responsible for the factor operationally and financially.

I : The infrastructure manager (Group 2: France, Sweden, UK, Australia) or the dominant integrated railway (Group 3: Japan, USA), both of which are independent from the operator (Group 2) or the tenant (Group 3), is responsible for the factor operationally and financially.

\*1: The infrastructure manager (RFF) is responsible for capacity allocation, and the main operator (SNCF) makes working timetable.

Source: Kurosaki (2008)

The comparison revealed that the degree of operational separation between infrastructure and operation varies to a large extent, and identified that the railway industry has experienced various types of vertical separation.

The study also identified that in case it is not aimed to introduce within-rail competition through promoting new entry into the market, they have endeavoured to keep an integrated operation in order to decrease the coordination problems by certain measures such as:

*1) Assigning the below rail functions to the main operator:*

When the railway can afford the maintenance of the infrastructure, it can be operated performing both *above-rail* and *below-rail* functions such as the case in concessionaires in Mexico (TFM, Ferromex). On the other hand, even though the government has become responsible for the infrastructure maintenance cost financially, in some railways such as those in Vietnam, Indonesia and Tunisia, the main railways keep performing the essential factors of daily operation with integration;

*2) Close share-holding link between infrastructure and operation to attain managerial cooperation:*

Infrastructure and operation keep close share-holding relationship in some cases such as DB AG in Germany and TFVM in Mexico. In these cases operation of, at least, some of the essential factors of daily operation are separated. Nevertheless, the different entities, infrastructure and operation, retain share-holding link and this relationship contributes to managerial cooperation between the different organizations;

*3) Confining operational separation only into the smaller/minor rail market:*

In case one of the sectors is dominant and profitable enough to sustain the infrastructure, separation of the essential factors of daily operation can be confined only into the smaller sector. As a result, the main railway in the dominant sector can perform integrated railway operation without coordination problems through vertical separation. This is the case in Japan (JR-Freight) and USA (Amtrak).

Different from the above cases, it was also disclosed that, instead of a unique aim to introduce new entrants to the market competitively, the type of “complete separation” has separated *all* the “below rail” functions from the operator to the independent infrastructure manager which has no share-holding relationship with the operator even in the primary rail market. Thus obviously this is a distinct characteristic of “complete separation”, which is significantly different from other types of vertical separation.

The investigation in this section clearly revealed the large difference in the form of vertical separation in terms of the operational responsibility for each essential factor of daily operation. The study also disclosed that the above large difference between the type of complete separation and other types mainly comes from whether they have an intention to introduce within-rail competition into the railway sector through vertical separation or not.

## **8.2 Separation of Financial Responsibilities**

Traditional utility industries such as railways have a structure in which a non-competitive component of the industry is vertically integrated with a potentially competitive component or activity (OECD, 2001). Regarding a reform of the railway industry, which is one of the traditional utility industries, Thompson (2005) stresses that it is essential to separate the operational and commercial functions from social and policy aspects of the government's role. This is because cross-subsidy between them weakens the commercial division, which has to compete with other private sector transport such as buses and trucks. It is also important to revitalize the commercial division through an appropriate manner such as public listing of shares (privatization), deregulation, private sector participation, and so on.

Based on the above background, this section investigates how each type of vertical separation clarified the role of the government and that of the railway. The author identified which entity, either the government or the railway, bears financial responsibility for each function of the railway operation.

As most of the "above rail" functions, such as maintenance of rolling stock, daily operation of trains, service marketing and ticket sales, are financially borne by the railway, the study mainly focuses on the financial responsibility for "below rail" functions. Table 4 summarizes the result of investigation, and shows which entity bears the financial responsibility.

The table shows that separation of financial responsibilities can be varied according to the expectation of the government for the railway sector. For example, the Swedish government, which has an intention to support the railway sector putting railways on an equal footing with roads, actively continues to support to the social division of the railway sector financially, whereas the Mexican government released most of the financial responsibilities in the railway sector and the private concessionaires operate railways without subsidies from the public. Thus, in the process of separating the railway into the social and commercial divisions financially, the government can clarify the boundary between the two divisions through defining their scope.



**Table 4 - Financial Bearing for the Factor of Railway Operation**

Degree of Financial Separation ↓	Factors of Railway Operation *		Type of Financial Bearing				Examples of the Country (Railway)
	a) Upgrading	b) Maintenance	c) Below-rail operation	d) Above-rail functions			
1. Self-financed Railway with Infrastructure	R	R	R	R	R	Japan (Passenger Co.) USA (Freight Co.) Mexico (TFM, Ferromex) Mexico (TFVM) *1	
2. Tenant Accessing the Self-financed Dominant Railway	R'	R'	R'	R	R	Japan (JR Freight) USA (Amtrak) *2	
3. Railways with Government's Financial Support for Infrastructure Works	G	G	R	R	R	Vietnam (VNR) *3 Tunisia (SNCFT) Indonesia (PT.KA) *3	
4. Railways with Government's Large Financial Responsibilities for Below-rail Functions	G	G	G	R*4	R	France Sweden Australia (ARTC) (UK*5)	

\* (Factors of Railway Operation)

a) *Upgrading*: Investment for upgrading the infrastructure. It does not include investment for construction of new lines as it is not ordinary rail operation.

b) *Maintenance*: Maintenance of tracks, electrical and signalling facilities.

c) *Below-rail operation*: Timetabling and route setting.

R : The railway is mainly responsible for the factor financially.

R' : The integrated dominant railway is mainly responsible for the factor financially.

G : The government or a state entity is largely responsible for the factor financially.

\*1: Three concessionaires are responsible for the *above-rail* functions financially.

\*2: The government largely supports Amtrak financially.

\*3: The regulation stipulates that the railway can receive PSO (subsidy) in a certain case.

\*4: In some cases the (regional) government contributes to the (regional) passenger services financially.

\*5: In UK, firstly the private sector, Railtrack, was principally responsible for the *below-rail* functions. Since it is replaced by Network Rail, the government has been actively supporting the functions financially.

Source: Kurosaki (2008)

## **9. COMPARATIVE ANALYSIS PART 2: ADVANTAGES, DISADVANTAGES AND RELATIONSHIP WITH THE FORM**

This section examines various advantages and disadvantages of vertical separation of railways, and an appropriate form is also discussed and investigated based on the different market structures.

### **9.1 Advantages and Disadvantages of Vertical Separation**

#### *9.1.1. Advantages of Vertical Separation*

The study clarified various advantages of vertical separation of railways, and the author summarized them into five kinds:

*1) to facilitate public investment into infrastructure*

Compared with subsidizing the railway without separation to cover its deficit, in case the public sector owns the infrastructure, vertical separation increases transparency in terms of identifying how the public money is used in the railway sector. Vertical separation of railways is also beneficial for putting different transport modes on an equal footing.

*2) to permit private sector involvement*

Vertical separation can facilitate a private entry into a part of railway system separating sunk costs of the infrastructure. Utilization of ability of the private sector can be achieved through franchising/concession, as investigated in the cases in Europe and Mexico.

*3) to introduce competition*

The European rail policy has an intention to introduce within-rail competition into the rail transport sector by means of vertical separation. In European countries, on-track competition has become common in the freight sector and competitive tendering is widely introduced for passenger rail services. It is also the case with ARTC in Australia.

*4) to promote specialization*

Under certain types of vertical separation, such as those in Europe, the rail operators started to concentrate on providing *above-rail* functions, and the infrastructure manager also put greater focus on *below-rail* functions. In some railways such as those in Group 3, since the passenger and freight sectors have been separated into independent entities, they have started to improve the services focusing on their own market.

*5) financial arrangement among different entities*

In the case of Mexico City Terminal Railway (TFVM), where the freight concessionaires and the government are the shareholder of TFVM, all the three freight concessionaires attained mutual access to the dense rail infrastructure by means of vertical separation.

### *9.1.2. Disadvantages of Vertical Separation*

The study also clarified various kinds of the disadvantages of vertical separation of railways, and the author summarized them into three types:

*1) coordination problems due to vertical separation of entities performing railway operation*

In case the entities performing railway operation are separated, in addition to increase of the transaction cost between infrastructure and operation, the study also found that it would become difficult to make coordinated technical decisions. The interviewees also indicated that, once operational entities are separated, it would be also hard to acquire broad knowledge for operation, which might result in difficulties to harmonize the technologies for optimal train operation.

*2) coordination problems due to separation of finance*

When financially separated entities try to make optimized investment for the improvement of railways, they have more difficulties than integrated railways as railway traffic is the result of interlinked production. In addition, the separated entity tends to focus only on the separated entity itself instead of making efforts for improvement of the railways as a whole.

*3) coordination problems due to multiple operators*

Within the railways of Group 3, the study through interviews revealed that the infrastructure manager has difficulties to coordinate the multiple operators' slot-application especially in the following cases: 1) in a case infrastructure capacity is limited; 2) in a case several operators apply the same slots of timetable; 3) in a case time schedule for maintenance works is difficult to be secured. In addition, the increase of new entrant operators might result in some sub-optimization and loss of flexibility of controlling trains/crews.

### *9.1.3. Results of the Comparative Analysis*

Results of the comparative analysis are summarized in the following.

Firstly, advantages and disadvantages of each type of vertical separation vary to a large extent depending on the type of vertical separation. This means that the appropriate form of vertical separation is widely different according to the specific aim to achieve.

Though most of the advantages can be achieved even under integrated operation by the main railway, it was identified that only railways in Group 3 have the advantage to introduce within-rail competition. In particular, among various forms of vertical separation, "complete separation" has a unique form in which all the *below rail* functions are separated into the completely independent institution operationally and financially. This form is worthwhile to introduce within-rail competition fostering neutrality among operators in both sectors. On the other hand, the study also revealed that "complete separation" generally faces larger degree of coordination problems even in the primary market compared with other types of vertical separation. As a result of open access policy, this type faces the disadvantages due to multiple operators as well.

The investigation found that the derived costs of operational separation are also expected to largely depend on individual conditions such as traffic density. In addition to the coordination problems through vertical separation, the costs for the necessary regulation and those for the franchising/concession contract should also be taken account of. As the outcome of the reform through vertical separation should be evaluated including its advantages as well as disadvantages, the benefits of within-rail competition need to compensate for the derived costs in order for there to be a case for introducing it.

## **9.2 Appropriate Form depending on Market Structure**

Based on the study performed, this section discusses and proposes an appropriate form of vertical separation depending on different kinds of market structures. The study clarified that whether it is aimed to introduce within-rail competition or not outlines the structure of vertical separation, thus an appropriate form is investigated in each of the two directions.

### *9.2.1. Forms utilizing the Capabilities of the Incumbent/Reformed Operator*

This type of reform aims to improve efficiency of the railway through revitalizing the incumbent/reformed operator. This type does not aim to introduce within-rail competition through the reform, and the way of reform tends to be moderate compared with other forms, which accompany within-rail competition. Nevertheless, as studied in the cases of Vietnam, USA and Japan, it is also possible to revitalize the stagnated railway through utilizing this type of reform.

An appropriate form is investigated depending on the different market structures in the following.

#### *1) Passenger/Freight dominated market*

In case the dominant sector can afford the cost of infrastructure, as investigated in the cases of Japan and USA, the study found vertical separation for passenger/freight traffic can be an appropriate structure. In this type of separation, coordination problems through vertical separation are confined into the minor/smaller market. On the other hand, in case the dominant operator can not afford the cost of infrastructure the public sector is obliged to take a certain financial responsibility for the railways.

#### *2) Railways where neither passenger nor freight is dominant*

In this kind of market where the railway is required to reform, in general it is difficult that only one of the sectors, the passenger or the freight, bears the infrastructure costs. When the railway becomes deficit as a whole and is still required to operate for some reasons, the third party such as the public sector should bear a certain financial responsibility. The study examined this kind of railways in the cases of Vietnam and Tunisia.

### *9.2.2. Forms utilizing Competition / Capability of a New Participant*

Different from the above type, in order to improve efficiency of the railway transport services this type promotes within-rail competition or utilizes capability of other professional operators to a large extent. In some cases, such as the cases in UK and Mexico, the former state-owned railway is disbanded and new operators commenced their operation through competitive bidding or open access. From this viewpoint, the way of reform appears to be more radical than the former type. An appropriate vertical structure of railways is investigated depending on the three types of railway transport market in the following.

#### *1) Passenger dominated market*

It is prospected that competitive entry into the passenger market through open access would occur cream skimming of the incumbent operator's profit and results in an increase of the amount of subsidy. Thus competitive tendering has particular advantages as a way of introducing competitive pressures into the rail passenger services preserving an integrated network of rail services.

#### *2) Freight dominated market*

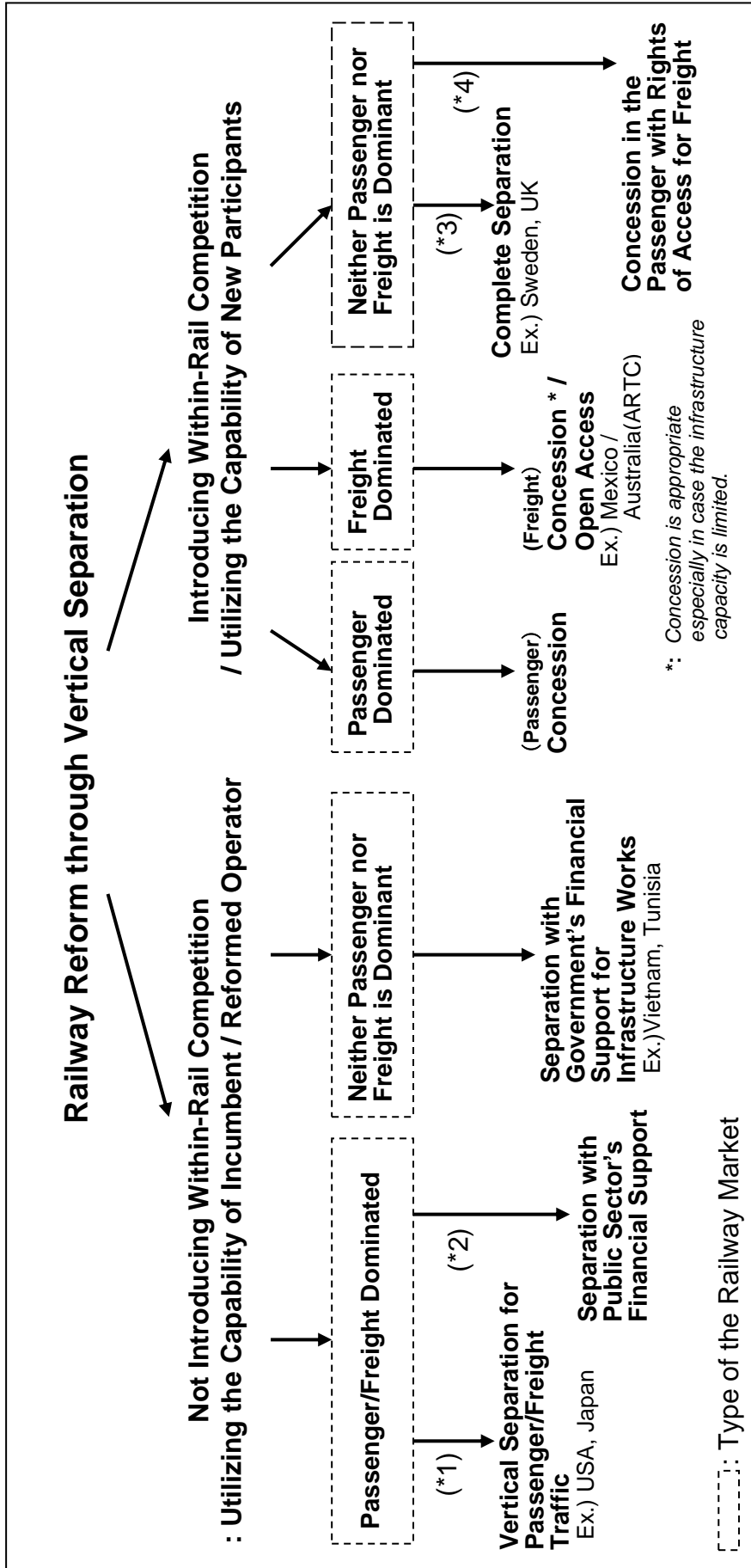
The study identified that there are two typical ways for professional operators to enter into the rail freight market: 1) open access; 2) concession. The study showed that freight transport in Australia (ARTC) has been increased based on open access, and transport in Mexico has been increased through concession. As the concessionaire operates both *below rail* and *above rail* functions, this form does not raise coordination problems through vertical separation. Thus concession is especially adaptable to the network where infrastructure capacity is limited.

#### *3) Market where neither passenger nor freight is dominant*

The study investigated this type of market in Europe, where the regulation stipulates that the body which is independent of any transport operator should be responsible for path allocation. In addition, to secure non-discrimination among operators, this type also ensures the account for transport service and the one for railway infrastructure kept separate. The study revealed that this type of separation raises coordination problems, and these problems would be greatly enlarged when infrastructure capacity is limited.

Instead of European model, concession with integrated passenger operation along with rights of access for freight operators is expected to be another candidate model for this kind of market structure where the railways do not need to follow the EU regulations. Even if stronger regulation is demanded for stipulating access neutrality between the two sectors, this type should reduce coordination problems within the passenger sector, which requires more coordination than the freight sector.

The investigation in this section is summarized in Figure 4.



(\*1) The dominant railway can afford the cost of infrastructure.  
 (\*2) The dominant railway can not afford the cost of infrastructure.  
 (\*3) The below rail functions are ensured to be independent to foster neutrality between the two sectors.  
 (\*4) The below rail functions are integrated with the passenger operation.

**Figure 4 - Appropriate Forms depending on Different Market Structures**  
 Source: Kurosaki (2008)

## 10. CONCLUSIONS

A number of state railways over the world have experienced railway reform, and vertical separation has been frequently utilized during its process. This study has investigated a variety of models of vertical separation, which the railway sector has experienced over the two decades.

This study clarified the key issues on vertical separation: aims of the reform; forms and implementation; advantages; disadvantageous effects. In addition, based on the examination into the selected cases, this study comparatively analyzed them in terms of: 1) separation of operational factors; and 2) separation of financial responsibilities. The study also tried to examine an appropriate form of railways depending on the market structure.

There are a number of different forms of vertical separation in the railway sector, and the study clarified the characteristics of them and showed that their degree of separation varies to a large extent. The study also showed that the public sector bears a different scope of financial responsibilities depending on the type of vertical separation, and identified that it can play a role to abolish cross-subsidy between the commercial and the social divisions.

The comparative study also demonstrated that whether it intends to introduce within-rail competition through vertical separation or not largely outlines the form of railways. In case it is intended to introduce within-rail competition promoting new entry into the market, it leads to separate operational (at least slot-allocation) and financial responsibilities between infrastructure and operation, whereas without an intention to introduce it, coordination problems through vertical separation are endeavoured to be lessened through at least one of the three measures: 1) integrated operation; 2) share-holding relationship; 3) confining the separation into the smaller market.

The study showed that vertical separation has a number of advantages, and that only European Countries and Australia aimed to introduce within-rail competition into the railway sector by way of separating the *below rail* functions (at least slot allocation) and the account for them. In order to attain this unique exclusive aim, among various types of vertical separation, complete separation should be regarded as the most appropriate structure fostering neutrality even between the passenger and the freight. Nevertheless, without adopting above mentioned three measures to lessen the coordination problems, complete separation tends to increase coordination problems because of its high degree of operational and financial separation even in the prime market. The research through the interviews also revealed that these coordination problems are greatly enlarged especially on condition infrastructure capacity is limited.

The effectiveness of within-rail competition through vertical separation has not been clarified yet sufficiently in the rail markets except Europe and Australia, and it is expected that the results vary to a large extent depending on the local circumstances of the railway industry.

The research showed that the appropriate structure of the rail industry varies depending on certain conditions such as: 1) whether within-rail competition is aimed or not; 2) market structure of the rail transport. In summary, full costs and benefits should be considered upon introducing a form of vertical separation, and the appropriate form of it depends on the circumstances as well as its objectives.

## **ACKNOWLEDGEMENTS**

This study was originally conducted in Ph.D. course in Institute for Transport Studies in the University of Leeds. I have received the guidance throughout the whole project from the supervisors, Professor Chris Nash and Dr. Jeremy Toner. In addition, a vast amount of information was offered from UIC Member Railways and other experts during the process of interviews. My companies, JR East and JR East Consultants Company, also gave me their support. I hereby express my sincere appreciation to any concerned person who has contributed to this research project.

## **REFERENCES**

- Drew, J. (2006). The Costs and Benefits of Different Railway Structures, *MSc Dissertation in Dept. of Economics*, City University, London
- Kurosaki, F. (2008) *An Analysis of Vertical Separation of Railways*, Ph.D. thesis, Institute for Transport Studies, The University of Leeds
- Nash C. (2007) "Results and Perspective of the Japan National Railway Reform from a European Point of View", *Transportation & Economy*, Vol.67 No.4, pp74-76
- Nash, C. and Trujillo, C. (2004) Rail Regulatory Reform in Europe-Principles and Practice, *Paper for the STELLA Focus Group 5 Synthesis Meeting*, Athens, June 2004
- OECD (2001) *Restructuring Public Utilities for Competition: Competition and Regulatory Reform*, OECD Publications
- The World Bank Group (2001) *Railways Database*, Available from World Wide Web:  
<http://www.worldbank.org/transport/rail/rdb.htm>
- Thompson, L. (2003) New Rail Passenger Structures in the United States: Using Experience from the E.U., Japan and Latin America, *First Conference on Rail Industry Structure, Competition and Investment*, Toulouse, France, Nov.,7-8,2003
- Thompson, L. (2005) REFORM is Imperative, but Solution Must Be Flexible, *Railway Gazette International*, July, 2005
- UIC (2004) *International Railway Statistics*, UIC
- Vickers, J. and Yarrow, G. (1988) *Privatization: An Economic Analysis*, The MIT Press