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Railway access charges in China: a comparison with Europe and Japan

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Although Chinese Railways remains largely a government owned vertically integrated system, track access charges were implemented for passenger trains in 2005 and freight trains in 2017. In recent years, many joint venture railway companies and local railway companies have been set up to bring in funding from provincial governments, state-owned enterprises and private enterprises for the construction of new lines. The coexistence of different railway enterprises and the interconnected characteristic of the railway network make the proportion of inter-rail company traffic for both passenger and freight high in China. Therefore, Chinese railways have adopted a series of revenue / cost settlement regimes reforms, including new rail access charges regimes. This paper examines these reforms, finding that the current Chinese access charges are still mainly a way to balance the accounts of rail companies. Given the revenue model of joint venture railway companies in China, the level of rail access charges is crucial for their financial performance. Moreover, the Chinese government has announced its intention of permitting open access competition, so the level and structure of track access charges will become much more important in future. Finally, this paper produces recommendations about how to reform the Chinese rail access charges regime for better adapting to the market needs in the future, in the light of European and Japanese experience.

Keywords: rail access charges; revenue settlement; high speed railway; joint venture railway company; railway costs

1. Introduction

In the last thirty years, European railways have been transformed from government owned vertically integrated monopolies into vertically separated (at least in organisational terms) companies facing competition in freight and passenger markets. In this context, track access charges have become an important issue and much research has been done on the subject (see for example Nash et. al., 2018). Given that Chinese Railways remains largely a government owned, vertically integrated system, it may

seem that track access charges have little relevance for China. However, the situation is more complex. In recent years, there has been a major growth of Joint Venture companies (JVs[1]) between China State Railway Group Co., Ltd. (CR) and regional governments; at the same time, leveraging increased reliance on finance from banks and other institutions. Due to the coexistence of different rail enterprises in China – that is, CR and the new JVs – as well as the interconnected characteristic of the rail network, the proportion of inter-rail company traffic (traffic that runs on the infrastructure of at least two railway companies) for both passenger and freight is high (Wu et al., 2020). Therefore, the Chinese railway system has introduced a series of revenue / cost allocation regimes, including new rail access charges regimes. Track access charges play an important role in determining the profitability of different companies within the system, and also in the incentives they give to the various parties to improve efficiency and attract traffic to the network.

Despite the reforms noted, CR continues to dominate train operations under a centralised 'command and control' structure, and as such the importance of such incentives remains limited at present. However, track access charges are set to play a more important role. The Chinese government has declared its intention of opening the railway to competition by allowing new entry into both freight and passenger services (State Council, 2020). In this case, track access charges will become much more important in giving the correct incentives to new entrants as to what level of service to provide, at what time of day, over what route and using what rolling stock; and also to future non-CR's investors who are interested in investing in the railway sector. The reforms made to date in respect of track access charges can therefore be seen as a

[1] List of abbreviations are summarized in appendix.

necessary first step in order to drive appropriate incentives in the new structures that may emerge following further reforms.

This paper examines the current situation regarding track access charges in China, and considers – in the light of European and Japanese experience – the direction of necessary reform. The importance of Europe as a source of information on approaches to track access charges has already been noted. We add Japan to the comparison because although there is no need for track access charges for most passenger services, the national freight company accesses the tracks of vertically-integrated passenger companies by paying an access fee. In addition, charges are payable for access to the separate high-speed infrastructure. A key challenge is the lack of publicly-available, stated information on the principles on which the Chinese charges are based, and the evidence base on which the levels are set. Chinese railway specialists generally agree that full cost recovery (thought only including investment costs in the case of more profitable high-speed lines) is the underlying principle. However, on the exact reasoning behind the structure of charges and the relative levels of the different elements of those charges, there exists no published information. We can, though, examine whether the overall level and structure of charges looks reasonable in terms of alignment with the principles underpinning track access charges in the EU (and also Japan).

The contributions of this paper are: firstly, to examine the Chinese rail access charges regime reforms. The Chinese railway system is the largest in terms of gross tonne km in the world and it is important to understand the motivations behind the reforms in the context of a largely state-owned and monopolistic industry, but where traffic has to move between the networks of different companies, and where the involvement of JVs (with some private sector participation) and local railway

companies is increasing. Secondly, given the objectives to reform Chinese railways more widely, and to introduce competition in the future, to produce recommendations on how to reform the rail access charges regime in the future in the light of European and Japanese experience, as a guide to railway managers and regulators.

The next section reviews the literature on the theory, principle and motivation of track access charges regimes in Europe and Japan. Section 3 introduces the rail industry structure in China. Section 4 examines the reforms of rail access charges in China, both for passenger and freight. Section 5 presents case studies covering passenger and freight separately. Finally, we conclude with some remarks and policy recommendations in Section 6.

2. Literature review

There is little published research on Chinese track access charges. What there is concentrates on cost allocation between passenger and freight traffic on mixed traffic lines, (for example, Li et al. 2002) and the choice between average cost pricing and marginal cost pricing (Li, 2006a, b).

By contrast there is a great deal of literature on track access charges in Europe (e.g. Nash et al, 2018). Mostly this advocates charges based on the principle of short run marginal social cost and this appears to be the approach required by the European Commission (e.g. European Commission Regulation (EU) 2015/909.) although there is some dissent from the view, (eg Rothengatter, 2003 and response from Nash, 2003). The EC refers to this as Direct Cost, and specifies that this should include wear and tear on the track, any elements of operating costs such as signalling that vary with traffic volumes and charges for congestion and scarcity where relevant, as well as environmental costs such as noise and pollution (but these must only raise the overall

level of rail track access charges if they are also charged on other modes) (Sánchez-Borrás et al., 2010).

Research on wear and tear costs focuses on incremental maintenance and renewal costs and uses a mix of econometric and engineering models (Wheat et al, 2009). In general, it finds 30-40% of maintenance and renewal costs to be variable with use. The most accurate single variable representing the impact of different types of train on the infrastructure is gross tonne kilometres, but many other features of rolling stock (such as speed and unsprung mass) also have an impact, so an accurate reflection of these costs will require a more detailed categorisation of trains. But given that Chinese Railways operate many long and heavy trains, some way of reflecting this impact would surely be needed.

What little evidence does exist on the variability of operating costs suggests that this is small. On the other hand, on an increasingly congested rail system, we would expect congestion and scarcity to play a more important role. Since track capacity utilisation is determined by the type of train and number of train km run, any charge for congestion and scarcity is expected to be a charge per train km and varying by route and time of day in accordance with variations in track capacity utilisation.

Thus we would expect a structure of charges involving at least two parts – a charge per gross tonne kilometre and a charge per train km – but probably with differentiation according to the type of train, and in the case of the charge per train km, the route and time of day. Environmental surcharges might be applied to trains using diesel traction (although in China, where a lot of electricity is generated from coal, electricity also involves pollution), and to noisy trains, where the type of brakes on freight trains is a particular issue.

But the European Commission recognised that track access charges based on these principles would not cover anything like total cost. If member states were unwilling to meet the remaining costs from public funds, then higher track access charges would be needed. Thus member states are permitted to charge mark-ups on direct cost. These mark-ups must not discriminate between train operators but may vary between types of traffic according to ability to pay, using Ramsey pricing (whereby the mark-ups are inversely proportional to the price elasticity of demand).

There is a further important issue. Marginal social cost pricing is only efficient if it is also applied to all competing modes. To the extent that other modes are not efficiently priced, second best principles take over. There is some provision for this in the European legislation in that subsidies to rail track access charges are permitted if other modes are undercharged. However, Quinet and Meunier (2009) raise another issue. If train operations are not fully competitive then it may be desirable to reduce track access charges below marginal social cost to counter the impact of monopoly pricing by train operators.

Despite the fact that member states of the EU are all subject to the same legislation on track access charges, different countries have taken very different approaches (Nash et al, 2018). In particular some – such as Britain and Sweden – have seen giving the correct incentives to use the network efficiently as the primary purpose of track access charges, which others -notably Germany and now France – have concentrated on full cost recovery (usually excluding investment costs). But the legislation requires charges to be based on marginal social cost plus economically efficient mark-ups where necessary to achieve the degree of cost coverage the member state requires. In general, the countries that base their pricing system on marginal costs recover at least the marginal maintenance and renewal costs, whereas those with a full cost approach aim to

recover at least maintenance and renewal costs in full, according to their higher cost recovery target (ECMT, 2005; Calvo and Ona, 2012).

Concerning the mark-ups, they may be differentiated according to various market segments. Thus, it is important to segment the market and calculate their ability to pay. In accordance with the recent European and national legislations, many countries, like Italy, have proposed new charging schemes with deeper market segmentation based on the ability to pay (Rotoli et al, 2018; Malavasi et al, 2019). Sánchez-Borrás et al. (2010) considers that substantial mark ups of 100–200% for high-speed rail service may be justified. In France, the mark-ups for the most profitable high-speed trains approach 1000% (Nash et al, 2018).

Japan has no need for access charges for much of its traffic, which is carried by vertically integrated passenger companies (JRPs). Where through passenger trains run between companies, each company is responsible for the costs and revenue of the service for the part of the route on its tracks (Kurosaki, 2017). The JR-Freight company (JRF) could use JRPs' tracks by paying an access charge under the avoidable cost rule, regulated by the national government. Mizutani and Fukuda (2020) consider that avoidable cost equals marginal cost. Ozawa (2004) gives more detail on these charges, which include a 1% mark-up designed to incentivise the passenger operators to provide more capacity for freight. After 1997, the JR conventional lines parallel to new HSR, were separated from the JR companies, and owned and operated by the newly established railway companies. JRF pays an access charge to the new railway companies when it accesses these routes. The access charge includes the avoidable cost and a subsidy paid by the new HSR to compensate for the difference between the access charges under the avoidable cost rule and the maintenance costs (Mizutani & Fukuda, 2020).

In order to promote quicker HSR network extension, the new HSR opened after 1997 was built and owned by the national agency, Japan Railway Construction, Transport and Technology Agency (JRTT). The JRPs use the new HSR tracks by paying track access charges to JRTT, and maintain the tracks by themselves (Mizutani & Fukuda, 2020). The amount of track access charges is based on the difference between the expected profit of the railway company with the new railway line, and the expected profit without it (Figure 1). The amount is fixed over a 30-year period after opening (Kurosaki, 2018). This seems an appropriate way of the state paying for the costs of lines which cannot be recovered from traffic, rather than forcing the operator to do so at the cost of its financial stability.

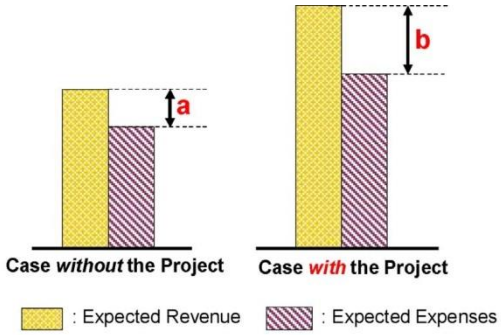

Figure 1 Track access charge for new HSR

Source: Kurosaki, F., 2018. A study of vertical separation in Japanese passenger railways. Case Studies on Transport Policy. 6, 391-399.

Thus the literature gives us a fairly clear but not universally accepted picture of what efficient track access charges would look like. The interesting issue for this paper is how far those in China follow this approach. But first we examine the structure of the rail industry in China to see why track access charges are necessary even in advance of the introduction of competition.

3 Rail industry structure in China

At present, there are more than 200 railway companies in the Chinese railway market, including the dominant CR with its 18 Regional Railway Group companies (RRCs)[2], together with over 200 JVs and 56 local railway companies (Wu et al., 2020), of which state railways account for the largest absolute proportion in terms of traffic. Figure 2 and Figure 3 show the market structure change of Chinese Railways from 2000 to 2018. The data shows that CR no longer has a complete monopoly of rail transport in China, and its share decreased from 97.40% and 95.93% in 2000 to 45.28% and 76.80% in 2018 for passenger and freight transport separately. But taking account of the market share of JVs controlled by CR, CR's market dominance is still very strong.

Although China now has a multiplicity of railway companies, these are mostly publicly owned and many are subsidiaries of or operated by CR. Most of them have been set up in order to bring in provincial and bank funding for new lines, rather than to compete with each other. But there is some parallel or source[3] competition in some places or some market segments.

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[2] A kind of mixture of regional administrative branch and subsidiary company of CR.

[3] For example, if a coal-fired power plant at location A can buy coal from a mine at point B served by railway B, but can also buy coal from a mine at point C served by railway C, then it can take advantage of competition between railway B and C (if they and the coal mines want to compete).

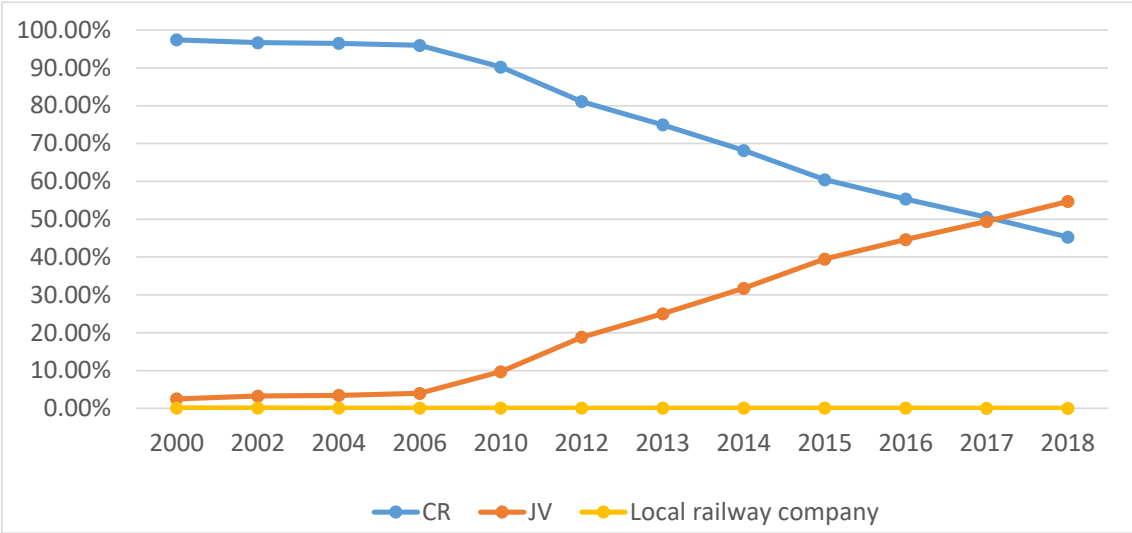

Figure 2 Market Structure of railway passenger transport in passenger-km

Source: Authors' study based on National Bureau of Statistics (2001-2019), China Statistical Yearbook.

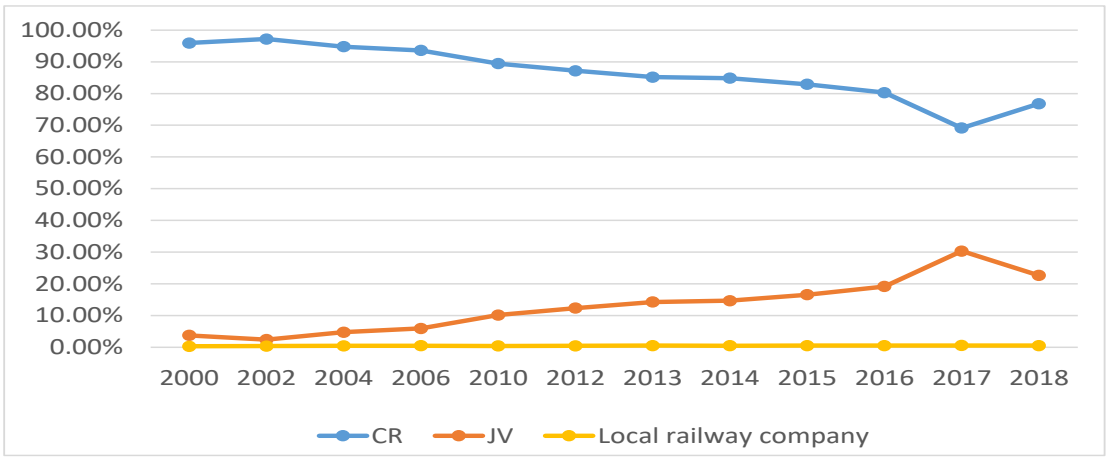

Figure 3 Market Structure of railway freight transport in tonne-km

Source: Author's study based on National Bureau of Statistics (2001-2019), China Statistical Yearbook.

Before 2013 almost all public railways in China were operated and regulated by the Ministry of Railways (MOR). However, this model combining commercial activities with sector administration became increasingly incompatible with the development of the Chinese railways. Consequently, MOR was abolished in 2013 and its duties were split into three parts (Figure 4). The government function in railway planning and policy

formation were taken up by the Ministry of Transport (MOT). The newly-established National Railway Administration (NRA), a bureau within the MOT, took over other government functions. The enterprise function was undertaken by the newly-established China Railways Corporation (CRC) - known as CR after 2019 (State Council, 2013).

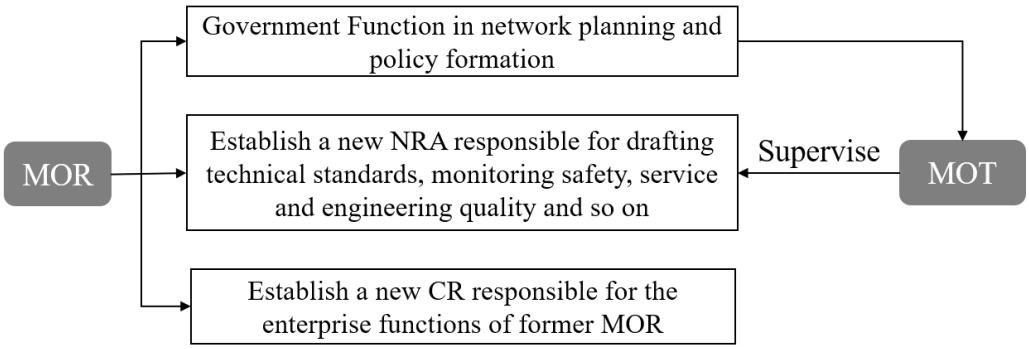

Figure 4 The reform of Chinese railways in 2013

Source: Wu, J. H., Liu, Y. Q., Kang, Z. X., & Wang, Y. X. (2020) 'Railway Reform in China'. In C. L. Chen, H. X. Pan, Q. Shen, & J. J. Wang (Eds.), Handbook on Transport and Urban Transformation in China (pp. 334–354). Edward Elgar.

CR is a solely state-owned enterprise with its shares held by the Ministry of Finance (MOF) (Figure 5). CR focuses on railway passenger and freight transport services and carries out diversified business operation. It is responsible for: unified dispatching and control of railway transport; unified allocation of transport capacity of the network; railway revenue settlement and management; public service obligations (PSO); railway construction and investment plans in conjunction with the National Development and Reform Commission (NDRC) (China Railway, n.d.).

CR has several subsidiary companies, of which the most important are the 18 RRCs- known as Regional Railway Administrations (RRAs) before 2017. CR and the 18 RRCs have a two-level enterprise relationship; the former exercising unified vertical management over the RRC. The RRCs are responsible for maintaining the rail network and providing train services within their jurisdictions.

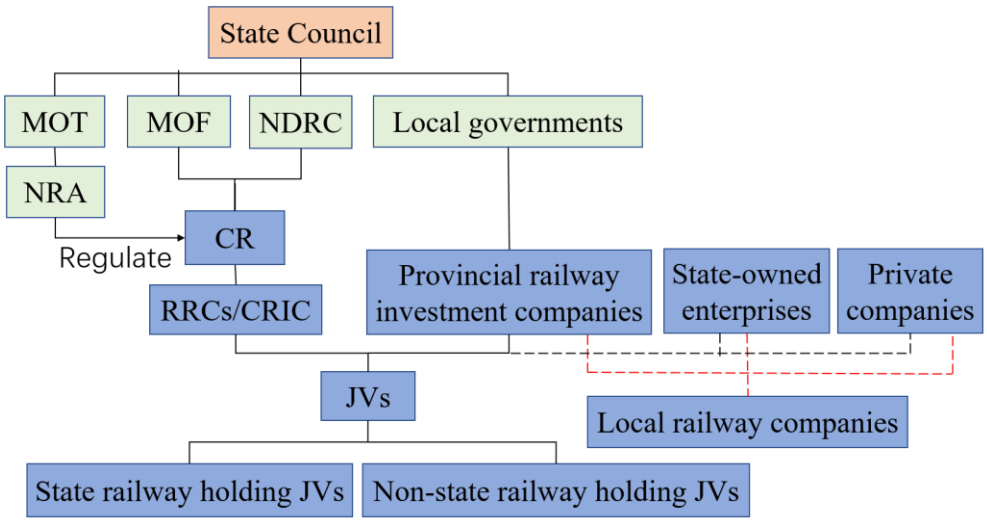

Figure 5 Structure of Chinese rail sector

Turning to the JVs, they have played a particularly important role in the development of new rail lines, especially HSR. JVs act as a kind of financing platform to bring capital from the central government, provincial governments, other state-owned enterprises (SOEs) and/or private companies, and borrow loans from the bank (Wu & Nash, 2000). The central government is represented by CR, who provided funding for the investment through its subsidiaries, such as the RRC or China Railway Investment Corporation (CRIC). Whereas many provincial governments hold their ownership interests by establishing railway investment companies. These JVs are typically financed with 50% equity and 50% debt. Each JV partner contributes equity, with the provincial government often contributing in the form of paying land acquisition and demolition cost. The JV raises the rest of the financing by borrowing loans from banks, such as China Industrial and Commercial Bank, China State Development Bank and so on (Lawrence et al., 2019).

Although the infrastructure is the property of the JV, most JVs do not operate the rail services by themselves. Instead, they contract with the local RRC completely or partially for: train operation; infrastructure maintenance and management; safety management; and management of railway land, including maintenance and patrolling of

boundaries. These JVs are essentially infrastructure financing and asset management companies responsible for supervising construction, use, and maintenance of the asset and for debt service (Lawrence et al., 2019).

Finally, local railways are feeders and stubs to the state railway network, and mainly for freight, such as dedicated coal transport lines. These lines are mainly invested in and owned by local governments, SOEs and/or private companies. Most of the local railways are operated and managed by setting up local railway companies, while a small number are contracted out to the RRC.

4. Rail access charges reforms in China

Since 1949, reforms to the system of the revenue/cost allocation regimes including rail access regimes have been initiated. Prior to 2005, most railways were owned and operated by MOR and its subsidiaries (RRAs), and there were no track access charges in China for passenger or freight traffic. Instead, the revenue / cost allocation regimes were concerned with the internal share of revenues and cross-subsidies[4] between MOR and RRAs – and were the same for passenger and freight traffic. Taking the revenue/cost settlement regime in 1995 as an example, when an RRA operated the train on its own track (the origin-destination (OD) is within this RRA's boundary), 82% of the transport revenue was retained by this RRA and 18% was retained by MOR. For through train services operated by an RRA (origin (O) was within the RRA's boundary

[4] In China, railway transport has historically been subject to government guidance under the Price Law. Although the government is deregulating railway prices, Chinese railways adopted a national unified price for a long time. But the actual cost of each railway company is different. Thus, Chinese railways adopted a series of revenue/cost settlement regimes to balance the revenue of these rail companies.

and destination (D) was outside the RRA's boundary), the transport revenue of this RRA was equal to the passenger-km / tonne-km completed by this RRA multiplied by a set unit price for passenger / freight services. The unit price was a kind of internal revenue clearing price set by MOR and was different for each RRA. The MOR could adjust the revenue of each RRA and the revenue retained by itself through the unit price. For a more detailed review of the revenue/cost allocation regimes from 1949 to 2005, see Zhu, 2011.

However, the development of JVs in China, in particular the participation of private investors, and the competition from other transport modes meant that a cost reflective and fair revenue allocation system became much more important (Chen et al., 2020). Meanwhile, the large volume of inter-rail company traffic (traffic running on the network of at least two railway companies) also means that there is a need to share the revenue between the rail companies involved.

Therefore, in 2005, MOR adopted "Measures for Settlement of Railway Transport Revenue" (MOR Finance [2005] 16), which applied to all rail transport enterprises within China. This regime adopted the experience of the separation of operation and infrastructure in Europe to separate accounts of operation and infrastructure for passenger services, and introduced access charges for the use of the infrastructure[5]. The purpose of this regime was to achieve a fair sharing of costs and revenues for JVs with independent accounts. In 2017, freight also separated accounts of

[5] It should be noted that in Europe various forms of vertical separation exist, including accounting separation, institutional separation and complete vertical separation in which transport operation and infrastructure management are provided by distinct companies. Chinese Railways now is in the stage of accounting separation.

operation and infrastructure, and adopted the same access charges regime as passenger trains. Since the reforms, the access charges level and structure have been adjusted several times, but the settlement approach has not changed.

The new regimes are set by MOR/CR and operated by the Transport Revenue Settlement Center which is a subsidiary of CR. However, due to information asymmetries and lack of technical expertise, it has proved difficult for the regulatory bodies - NDRC and the newly-established railway administrative organisation, NRA - to supervise the access charges set by CR. Here it should be noted that the NRA is not fully independent from CR and does not have political power to regulate track access charges.

The new regimes of track access charges for passenger traffic (from 2005) and freight traffic (from 2017) are set out in sections 4.1 and 4.2 for passenger and freight traffic respectively below; and then illustrated via case studies in section 5. Our focus is on track access charges. Charges for the use of other facilities are not considered in this section.

4.1 Track access charges for passenger trains (2005 to date)

As discussed above, prior to 2005, there were no access charges for passenger traffic. In 2005 a new regime was introduced whereby the passenger carrier collects and retains all ticket revenue, and pays various fees to the rail companies who provide services. These fees include track access charges paid by the carrier to the rail companies who provide track services. As noted above, whilst the access charges level and structure have been adjusted several times and published by MOR/CR, the settlement approach has not changed.

The rail track access charges for passenger services in 2019 are shown in Table 1. The track access charges at night (10:00pm-6:00am) are calculated at 40% of the

standard. 18 route categories are grouped by infrastructure performance standard and utilization level. 8 train categories are grouped by train type and service on a route.

Table 1 Track access charges for passenger trains (values in CNY/train-km)

Train type / Route category	HSR train		New air-conditioned train			Conventional train		
	8 cars	16 cars	General train	Short train	Short-distance slow train	General train	Short train	Short-distance slow train
Super 1st class busy line A	101.7	152.7						
Super 1st class busy line B	105.5	158.4						
Super 1st class busy line C	109.3	164.0						
Super 1st class	94.2	141.4	70.4			49.8		
Super 2nd class busy line A	84.6	126.9						
Super 2nd class busy line B	87.7	131.6						
Super 2nd class busy line C	90.8	136.3						
Super 2nd class	78.3	117.5	67.2			47.6		
1st class up busy line	76.0	106.5	69.1			48.9		
1st class busy line			64.0	51.2	38.4	45.3	36.3	27.2
1st class up	70.4	98.6	64.0			45.3		
1st class			59.3	47.4	35.6	42.0	33.6	25.2
2nd class up busy line	38.0	53.2	34.6			24.5		
2nd class busy line			32.0	25.6	19.2	22.7	18.1	13.6
2nd class up	35.2	49.3	32.0			22.7		
2nd class			29.6	23.7	17.8	21.0	16.8	12.6
3rd class	26.1	36.5	23.7	19.0	14.2	16.8	13.4	10.1
3rd class down			19.0			13.4		

Note: 1. Up means a higher charge based on the basic price. Down means a lower charge based on the basic price. 2. The unit price includes tax.

Source: Materials provided by CR.

It is clear that the structure of track access charges in China incorporates many of the features we would expect. It differentiates by type of route and by type and length of train, although not by gross tonne km and not by time of day. It is clearly not just a wear and tear charge, but presumably also incorporates some element of a congestion and scarcity charge and/or charging by demand elasticity. As noted earlier, there is no published information giving further details of the basis for the charges.

4.2 Track access charges for freight trains

4.2.1 Previous regime (2005 to 2017)

As noted earlier, the reforms implemented for passenger track access charges in 2005 did not impact freight services until 2017. Freight traffic from 2005 therefore continued to operate on the principles of the revenue / cost settlement approach outlined earlier in this section. Here we provide more detail on those arrangements to set the scene for understanding the changes that were made subsequently in 2017.

There were two types of freight revenue settlement method according to the types of rail companies involved. Where there was a need to consider revenue sharing between different types of rail companies (e.g. RRAs and JVs), freight revenue was shared based on the length of haul of each rail company. For example, as Figure 6 shows, if JV_1 carried traffic from origin A to destination D, it must use an RRA's track from B to C and JV_2's track from C to D. In this case, JV_1 obtained the transport revenue, and then shared it with the RRA and JV_2 based on the proportion of their share of line length utilised (100:200:300). The carrier could also be an RRA, who uses a JV's track to complete the journey for its freight consignment. This regime for sharing revenue between different types of rail companies had, however, two significant problems: (1) it lacked incentives for carriers to attract traffic from the market, e.g. the JV_1 attracting the traffic will only retain1/6 (sometimes even smaller) share of the revenue, which is not conducive to shifting the traffic from the road; (2) it has not considered the actual cost of the rail companies.

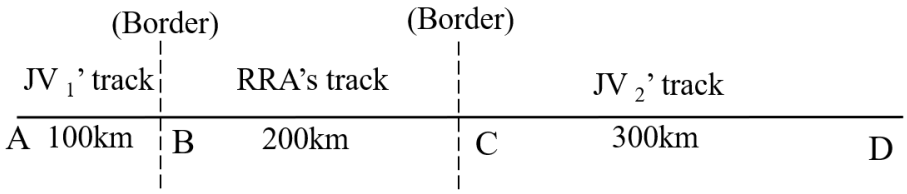

Figure 6 Previous track access charges regime

The second method concerned a situation where only RRAs were involved in the transaction. Where an RRA operated services solely on its own track (the OD was within this RRA's boundary), all freight revenue was retained by the RRA. For through train services operated by an RRA (O was within this RRA's boundary and D was outside this RRA's boundary), the freight revenue was settled according to origination, operation and arrival steps separately. Specifically, the freight revenue was settled based on the following formulas:

RRA's freight origination settlement revenue = freight revenue × the origination settlement ratio (Eq1)

RRA's freight operation settlement revenue = Tonne-km completed by this RRA × the operation settlement price (Eq2)

RRA's freight arrival settlement revenue = Tonne completed by this RRA × the arrival settlement price (Eq3)

The origination settlement ratio, operation settlement price and arrival settlement price were 5.26%, 545 CNY/ 10000 Tonne-km and 0.08 CNY/ Tonne separately in 2005. These are changed and published by MOR from time to time.

4.2.2 New regime (2017 to date)

Given the problems of the previous regime, CR adopted a new "Revenue settlement method for railway freight transport (Trial)" (CR Finance [2017] 333) in 2017. It came into force on January 1, 2018 and applies to all railway transport enterprises within China. The purpose of the new regime is to achieve a fair share of revenues and create incentives for rail companies to attract traffic, increase rail mode share, and operate efficiently. Under this policy the freight carrier obtains the transport

revenue and pays fees to the rail companies who provide services. Track access charges are paid by the carrier to compensate for infrastructure services related costs such as labour, electricity, communications, etc. Specifically, the freight revenue is settled based on the following formula:

$$\text{Track access charges} = \sum(\text{Loaded wagon-km} \times \text{unit track access charge} \times \text{adjustment coefficient}) \quad \text{(Eq4)}$$

The freight lines are classified into three categories according to the location, train density, and traffic density of the freight lines. The unit track access charge (including tax) for second-class freight lines is 1.64 CNY per wagon-km, first-class freight lines and third-class freight lines rise and drop 8% respectively compared to the second-class freight lines. Adjustment coefficients are set by CR to reduce the track access charges for carrier companies, and encourage them to attract traffic, according to transport costs and market conditions. They range from 0 to 1 according to the season, freight commodity, train type and transport direction, etc. But there is no published information about how these factors are taken into account quantitatively. In principle, after the adjustment, the track access charges should be able to cover the variable cost of infrastructure such as labour, electricity, and communications, etc.

In 2019, CR adopted "Notice on Amending the Partial Contents of the ‘Revenue settlement method for railway freight transport (Trial)’" (CR Finance [2019] 19), which is a recast of the "Revenue settlement method for railway freight transport (Trial)" (CR Finance [2017] 333). The unit track access charge (including tax) for second-class freight lines was adjusted to 1.80 CNY per wagon-km. The differentiation of track access charges for first-class and third-class freight lines remained at plus and minus 8% as above, but a new category, “super first-class freight lines”, was introduced (8%

higher than the charge for first-class freight lines). At the same time, the "Railway Freight Line Classification Method" and "Railway Freight Line Classification Table" also were revised and published by CR.

As with passenger charges, there is differentiation by type of route, which may reflect congestion and scarcity costs. The adjustment coefficient may reflect some sort of demand elasticity. But in terms of basic reflection of wear and tear costs, to have charges per wagon km, and not to allow for the gross weight of the wagon or any other of its characteristics will not give incentives to develop and use more track friendly wagons, and will not reflect the impact of the weight of the particular consignment on the track. Similarly to have no charge related to train km will not incentivise efficient use of track capacity by the running of long trains.

5. Case Studies

In this section, we discuss case studies for passenger and freight separately. The case studies enable us to explain the access charging system discussed in the previous section in more detail. We choose three highly important rail lines for which data is available, two high-speed passenger railways: Beijing-Shanghai and Xinmin (in Liaoning Province)-Tongliao (in Inner Mongolia), and one freight railway between Baotou in Inner Mongolia and Shenmu in Shanxi Province.

5.1 Passenger: Beijing-Shanghai and Xinmin-Tongliao High Speed Railway

The Beijing-Shanghai high speed railway opened in 2011, and runs through 7 provinces with a design speed of 350km/h, connecting the two biggest metropolitan areas of Beijing-Tianjin-Hebei and the Yangtze River Delta. The infrastructure of this HSR is owned, operated and developed by Beijing-Shanghai High Speed Railway Co., Ltd. This JV was jointly funded by MOR/CR (through its subsidiary, China Railway

Investment Corporation (CRIC), with 49.76% of the shares), local governments along the Beijing-Shanghai HSR (through their provincial railway investment companies, with 27.91% of the shares) and 3 SOEs (not related with CR, with 22.32% of the shares). CRIC is the controlling shareholder and MOR/CR is the actual controller.

There are two types of revenue allocation model according to OD on the Beijing-Shanghai HSR (Figure 7). One is the access charge model for through train services (at least one passenger O or D is outside this HSR's boundary). In this model, the Beijing-Shanghai HSR Co., Ltd. collects access charges for use of its lines, railway catenary and stations by train operators (RRCs) and contracts with the 3 related RRCs along this HSR for infrastructure maintenance. The RRC organizes the train service and retains the passenger ticket revenue. The other model is the ticket revenue model in which all the passenger ODs are within this HSR's boundary. In this model, Beijing-Shanghai HSR Co., Ltd. leases electric multiple units (EMUs) from CR (from RRCs before 2019), and contracts with the RRCs along this HSR for train operations and infrastructure maintenance. The Beijing-Shanghai HSR Co., Ltd. collects the revenue from passenger tickets and pays the RRCs for their services. We can understand the access charges regime for passenger traffic more clearly through the access charge model of Beijing-Shanghai HSR.

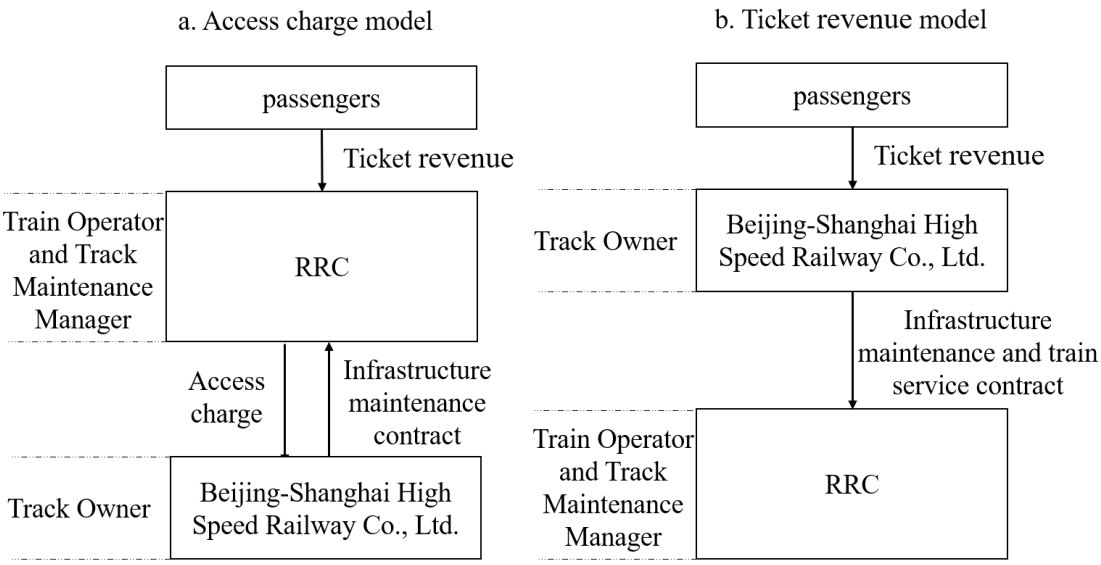

Figure 7 The revenue allocation model of Beijing-Shanghai HSR

In accordance with section 4.1, the revenue allocation approach for passenger traffic has not changed since the access charges regime was adopted in 2005. Thus, the Beijing-Shanghai HSR has always adopted the current revenue allocation model/ access charging system since the opening of 2011. But there have been several changes for its route category and charge level. For example, in 2016, in order to increase the revenue of RRCs (train operator), CR reduced the track access charges of Beijing-Shanghai HSR for 8 and 16 cars from 104.7 and 157.1 CNY/train-km to 94.2 and 141.4 CNY/train-km respectively. However, there is no published information about the basis for the changes in the charges. We can see therefore that the new access charges regime for passenger functions as a way for CR to balance the net revenue of each rail company, although the original idea was to create a fair revenue reallocation regime more closely reflecting the costs borne by the different parties.

According to the revenue allocation model of Beijing-Shanghai HSR, we can see that there are a multitude of transactions between JV and RRCs, CR. This means that rail access charges are crucial for the financial stability of JVs. The board of directors of the JV can choose whether to adopt the revenue model. In order to reduce

the connected transactions with CR and RRC, many HSR JVs in China, like Xinmin-Tongliao HSR, now choose to operate under the access charge model. These JVs operate only as track access providers in the Chinese railway system (Lawrence et al., 2019). Moreover, it is more profitable to choose the access charge model than the ticket revenue model when the passenger load factor is low. The passenger load factor for many HSRs is very low since there is not a sufficiently large passenger flow to support the high service frequency required by the local governments to provide greater service. In the access charge model, revenue and expenditure of JV are primarily related to the number of trains operated rather than passenger volume.

We can see from Table 2 that, excluding train operating costs, the ticket revenue of Beijing-Shanghai and Xinmin-Tongliao HSR cannot cover the access charges. The current track access charges for Beijing-Shanghai (100.5 CNY/train-km for 8 cars and 150.8 CNY/train-km for 16 cars on average) and Xinmin-Tongliao HSR (70.4 CNY/train-km for 8 cars and 98.6 CNY/train-km for 16 cars) are higher than most high-speed lines in Europe which ranged from 25.41 CNY (3.13€) to 248.62 CNY (30.63 €) per train-km[6] (UIC, 2017). But the construction costs for HSR lines in China are at least 40% cheaper than in Europe (European Court of Auditors 2018, 35). On average, train operators in Europe pay anywhere between 15% and 30% of their ticket revenues towards infrastructure charges, while Beijing-Shanghai and Xinmin-Tongliao HSR can reach 55.8% and 320% respectively. After taking into consideration maintenance costs, net revenue per year for most infrastructure managers in Europe was anywhere between 1.0% and 2.5% of construction costs, while Beijing-Shanghai HSR can reach 5.7%.

[6] The train is based on a TGV Duplex (200 meters, 10 cars, 500 seats, 430 tonnes), with a 65% average load.

Thus the access charge of Beijing-Shanghai and Xinmin-Tongliao HSR is relatively high compared with the case in many European countries.

Table 2 Revenue, access charge and cost of Chinese HSR (values in Billion CNY)

	Beijing-Shanghai HSR (in 2018)	Xinmin-Tongliao HSR (in 2019)
Ticket revenue	26.57	0.05
Train operating cost	13.01	0.03
Access charge	14.82	0.16
Infrastructure maintenance cost	3.63	0.15
Infrastructure total cost	6.12	0.43
Infrastructure investment cost	196.53	18.07

Source: Authors' estimation based on Beijing-Shanghai High Speed Railway Co., Ltd. (2019) and materials provided by Xinmin-Tongliao HSR.

Moreover, the access charges of Beijing-Shanghai HSR can not only recover the infrastructure maintenance cost, but also the total cost. But the Xinmin-Tongliao HSR just can recover the maintenance cost of infrastructure not total cost. This seems to be inconsistent with the full cost recovery principle generally agreed by Chinese railway specialists. But this implies that the access charge of Beijing-Shanghai and Xinmin-Tongliao all are well above marginal cost and make a contribution towards fixed costs. Thus the circumstances on these two lines are precisely those for which the system of charging marginal cost plus mark-ups differentiated by demand elasticities was designed in Europe. Differentiating track access charges by train speed and train length is obviously in line with what would be expected by mark-ups based on demand elasticities, although there may be further opportunities for differentiation, for instance by time of day/day of the week. But we are aware of no research into measurement of marginal cost and demand elasticities designed to ensure that charges on routes such as this are optimal in China.

5.2 Freight: New Baotou-Shenmu railway

The New Baotou-Shenmu railway opened in 2010 and mainly used for coal transport. The infrastructure of this line is owned, operated and developed by New Baotou-Shenmu Railway Co., Ltd. This JV was jointly funded by CR (through its subsidiary China Railway Hohhot Group Co.,Ltd. (RRC)) (with 38.55% of the shares) with a SOE (18.99%) and 8 private companies (42.46%). China Railway Hohhot Group Co.,Ltd. is the controlling shareholder and CR is the actual controller.

In accordance with section 4.2, New Baotou-Shenmu railway shared revenue with other rail companies based on length of haul on each rail company before 2018. In order to encourage rail companies to attract traffic and increase railway mode share, CR adopted the new approach in 2018. According to the new access charges regime, now there are two types of revenue allocation model for New Baotou-Shenmu Railway Co., Ltd. (Figure 8). One is the access charge model in which the freight cargo is transported by other rail companies. In this model, the New Baotou-Shenmu Railway Co., Ltd. collects access charges for use of lines and railway catenary, and contracts with the RRC for infrastructure maintenance. Another rail company organizes the train service and retains the transport revenue, taking revenue risk. The other model is the transport revenue model in which the New Baotou-Shenmu Railway Co., Ltd. takes revenue risk. In this model, New Baotou-Shenmu Railway Co., Ltd. leases locomotives from the RRC and wagons from CR, and contracts with the RRC for train operation and infrastructure maintenance. New Baotou-Shenmu Railway Co., Ltd. collects the revenue from freight shippers and pays the RRC for its services.

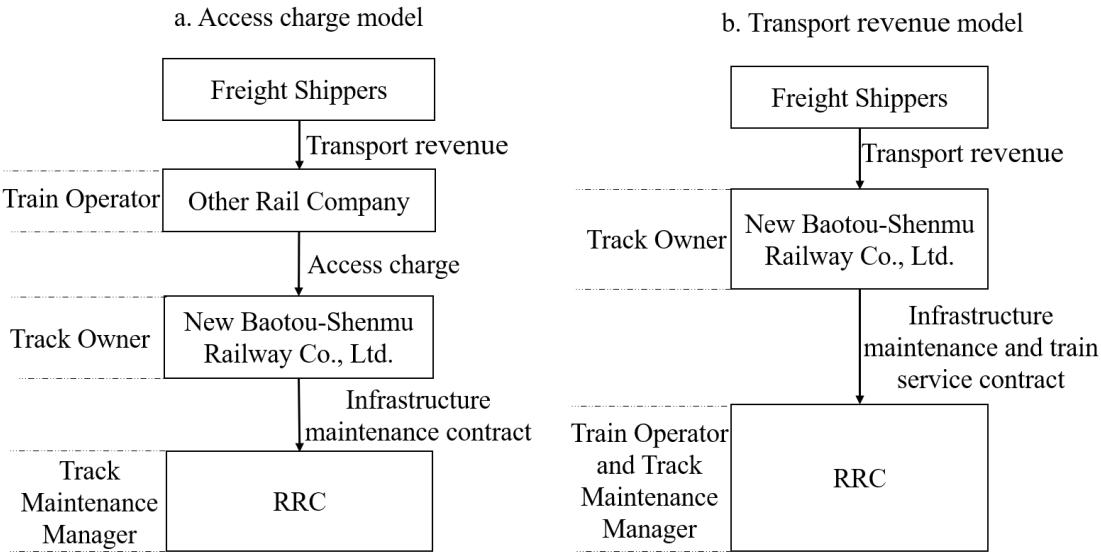

Figure 8 The revenue allocation model of New Baotou-Shenmu Railway Co., Ltd.

Due to the implementation of the new regime, the net profit of New Baotou-Shenmu Railway Co., Ltd. increased by 4.82 times in 2018. At the same time, the freight revenue of the Huhe-Zhangjiakou company, which is responsible for the final rail section of the whole OD – and which is more reliant on access charge revenue - declined up to 50%. CR realised that the revenue reallocation had therefore been pushed too far, and therefore raised the level of track access charge in 2019 to increase the revenue of the rail companies which rely heavily on access charge revenue. As a result, the net profit of the New Baotou-Shenmu railway decreased by 36% in 2019. We can see therefore that the new access charges regime for freight mainly functioned as a game for CR to balance the revenue of each rail company, although the original idea was to create a kind of market-oriented revenue reallocation regime based on the full costs incurred by different companies. Since the new access charging system for freight has just begun to be implemented and still in the adjustment stage, and data is relatively scarce and confidential, thus we cannot judge the charging principle. Again, the problem is to ensure that the right incentives are given to encourage the winning of traffic and provision of services, whilst protecting the financial results of the

infrastructure managers, exactly the situation that the European system of charging track access at marginal cost plus mark-ups is designed to handle.

6. Conclusion

This is the first paper in the literature to undertake a comprehensive study of track access charges as they have evolved in China over the last twenty years, and draw comparisons with other countries – most notably, the EU, which has developed a clear set of principles for track access charges as part of wider reforms. Historically the focus of inter-company payments in China has been to balance revenue between largely state-owned companies owned and operated by MOR and its subsidiaries. However, as China has seen increased prevalence of JV railway companies, supported to an extent by private finance, alongside increased inter-railway traffic, there has been a need to make charges more cost reflective, and also to incentivise companies to attract traffic.

Though there have been changes to the level and structure of charges as a result of the reforms, track access charges in China are still set by CR with no independent regulation, and can still be seen mainly as a way to balance the accounts of rail companies in the system. Given the revenue model of JVs, the level of rail access charges is hugely important for their profitability. At the same time, most decisions concerning timetables, fares and choice of rolling stock are taken by CR centrally. Thus the level and structure of track access charges are of limited importance from the point of view of these decisions, although they do affect the incentives to attract traffic. However, given the declared intention of China to move towards open access for competitors to enter the market, track access charges would become very much more important in this context.

Despite the very different setting, it seems that the appropriate approach to track access charges in China should be to adopt the same principles as in Europe of charging

marginal cost plus a mark-up according to ability to pay. This will ensure that infrastructure managers are at least compensated for the additional costs traffic imposes on them and receive a contribution towards fixed costs in accordance with what can be afforded. Marginal cost based pricing will give incentives for railway undertakings to attract new traffic whenever this is worthwhile from the point of view of the system as a whole, and to use rolling stock, routes and times of day which optimise the system as a whole.

However, because CR receives no explicit subsidy and has to borrow to fund investment, track access charges in China generally have to cover a higher percentage of costs than is the case in many European countries where infrastructure managers receive a substantial proportion of their funds from the government. Thus the need for substantial mark-ups is greater than in Europe, and it becomes even more important to differentiate these mark-ups according to the ability to pay of the customers. But there are also some PSO or seriously loss making lines, like Qinghai-Tibet Railway and Lanzhou-Urumqi HSL, whose traffic density is very low. If these were given explicit subsidy, the subsidy may even permit mark-ups lower than in Europe or charges below marginal cost where this is seen as desirable in terms of regional development or environmental protection.

Because the basis for calculation of the current charges is not published, it is not known to what extent the current charges follow these principles. More research is therefore needed to identify marginal cost and ability to pay in China, though this would require access to data.

The lack of subsidy is a major problem in China, particularly in the case of new high-speed lines. It is policy to build these to all parts of the country, including low population density and relatively undeveloped parts as well as the more economically

successful East Coast. The Japanese model for planning, constructing and subsidising such new lines by creating the Japan Railway Construction Corporation to build and lease them to operators - on the basis that their profitability should be no better and no worse than without the line - appears a highly relevant model for China to adopt.

Of course, the ability to pay of different types of traffic depends crucially on the end user price. If regulation of these is eased, and railway prices are set more according to market conditions as part of broader reforms proposed, so the ability to pay higher access charges would in turn be influenced. Further, in Europe, independent regulation is seen as important to ensure non-discriminatory charges (and in some countries to ensure the efficiency of the infrastructure manager). If it desired to attract competitive new entry, then given the dominance of CR, introduction of an independent regulator to oversee track access charges also appears to be necessary in China in future reforms.

Overall, the setting of rail access charges is a complicated issue worldwide, and a process of continuous improvement. China has made some steps in developing the regimes, but these are likely to need to go further, and other methods of competitive access and intramodal rail competition may need to be explored. There are clear lessons from other countries to guide future reforms to China’s track access regimes, but these need to take account of China's national conditions and also be closely aligned with the objectives of wider railway reforms that are planned for the country’s rail system.

Appendix. List of abbreviations in this paper

CR	China State Railway Group Co.,Ltd.
JV	Joint venture railway company
HSR	High Speed Railway
SOE	State-owned Enterprise
RRC	Regional Railway Group Co.,Ltd.
RRA	Regional Railway Administration
MOT	Ministry of Transport
NRA	National Railway Administration
MOF	Ministry of Finance

CRC	China Railways Corporation
PSO	Public Service Obligations
NDRC	National Development and Reform Commission
CRIC	China Railway Investment Corporation
JRP	JR Passenger company
JRF	JR-Freight company
JRTT	Japan Railway Construction, Transport and Technology Agency

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