Public Disclosure Authorized

INFRASTRUCTURE NOTES

36008

TRANSPORTATION, WATER AND URBAN DEVELOPMENT DEPARTMENT
THE WORLD BANK

December 1994
Transport No. RW-9

PURCHASING POWER PARITY ADJUSTED RAILWAY PERFORMANCE

Julie M. Fraser and Louis S. Thompson

It is often difficult to compare freight tariffs and passenger fares among the world's railways. Using purchasing power parity adjustments, this note attempts an initial cross-country comparison of Tariff levels.

In an earlier Infrastructure Note (RW-6, October 1993), we presented a series of statistical comparisons taken from the Bank's Railway Database. The latest revision is dated November 1994 (covering data through 1992 for many railways). Copies are available on request.

Bank staff. have often asked, "After making physical comparisons, how do a particular railway's tariffs compare to other railways?" or, "What can we say about a given policy of freight versus passenger tariffs in comparison with practice elsewhere in the world?' This note attempts to answer those questions.

The Database contains farebox receipts for freight and passenger services, and passenger-km (p-km) and freight tonne-km (t-km). We start therefore from estimates of national currency average passenger revenue (fare) per p-km and average freight revenue (tariff) per t-km. We emphasize "farebox" because subsidies paid by governments are sometimes left out of "revenues". We have "included Public Service Obligation (PSO) payments where possible, but this information is sometimes either not available or not sufficiently precise to be usable. Passenger revenues for some of the developed railways in the list may therefore be understated for this reason. In fact, few developing countries make PSO payments at all, so the potential distortion is not so large for them.

We have used the "overall GDP Price Deflator" taken from *World Tables* published by the Bank. All currency numbers in this note have been converted into constant 1992 values. We have used 1992 US dollars (S) as the uniform currency value for comparison; henceforth in this note "$" denotes 1992 US $. National currencies can be converted from their 1992 constant values into $ in two ways: by using the official rate of exchange, or by using a Purchasing Power Parity adjustor (PPP). Arguments can be made for using either.

The official exchange rate is largely related to the average value of the currency in international trade transactions, or on the exchange rate allowed by a government in official currency transactions. It has the advantage of being readily available (historically it was the only conversion value available) and, in some cases, reflects actual market transactions. We have used the "Conversion Factor (Annual Average)" from *World Tables.*

There are well known problems with official rates of exchange. One arises where countries set an "Official" value for the currency and do not allow its value to fluctuate with the need to balance trade flows: examples include the CFA Franc zone in francophone West Africa, or the Chinese Yuan before its value was allowed to be more closely market determined. Another problem arose in the planned economies where internal prices and external transactions were controlled for non-market reasons, leading to a highly distorted currency exchange value. A final problem is that international trade is often only a small part of the economic activity of a country so that the value

of a currency as reflected by "official" or trade-driven values (especially if the economy is protected by high tariffs and non-trade barriers) does not accurately reflect its relative purchasing power.

To address these distortions, a different approach was developed based on estimates of the relative purchasing power of a country's currency. In principle, this method would calculate the relative value of a currency based on the cost of a "standard" set of goods and services within the countries being compared, and would yield a more balanced estimate of the true cost of things purchased. The best available adjustment is generated by the IMF's International Comparison Project (ICP) and published in the Bank's World Development Report. The ICP version of Purchasing Power Parity conversion is based on a broad and carefully balanced set of goods and services. ICP PPP estimates ("international dollars") are now available for most of the world's economies and will be available for a few additional countries within the near future.

This is not merely a technical issue. As Table I shows, there can be a significant difference between official exchange rates and PPP values. In particular, there is a systematic distortion in official exchange rates: poorer countries almost always have official exchange rates well below their PPP value ("undervalued") while the wealthier countries tend to have "overvalued" currencies. In the case of India and China, for example, this suggests that the relative GNP of the country had been understated in official conversions by as much as a factor of four times.

Using this approach, Table I shows average rail passenger fares for a number of countries both in official $ and PPP $ per p-km. The impact of the PPP approach is significant: developing country fares that appear vanishingly small at official rates now look higher, and the apparent disparity between developing and developed, wealthier economies narrows. Table 1 also shows the comparable picture for average rail freight tariffs, but with different results: developing and developed countries look similar at official rates are quite different at PPP rates, with developing country tariffs looking much higher.

It is tempting to plunge into comparisons at this point, but some care is required. Fares and tariffs vary among countries for a large number of reasons. Average passenger fares are based on the overall mix of passenger classes (fourth class is cheaper than first class), multipleride suburban versus single-trip long haul, and average trip length (tariffs are higher per p-km for short trips than for long trips), among many other factors. In addition, of course, passenger fares are determined by railway efficiency, government subsidy policies, and the existence of artificially suppressed passenger tariffs compensated by unduly high freight tariffs. Average freight tariffs vary in accord with commodity mix (coal tariffs are usually lower than tariffs for auto part), size of shipment, and length of haul (rates per t-.km are lower for longer hauls). Railway efficiency also affects freight tariffs, along with government subsidy policy, although freight tariffs are rarely subsidized by government except through the financing of an overall railway deficit. In fact, far from being subsidized, freight service is often forced to subsidize passenger fares which are suppressed for public policy reasons and not adequately compensated by PSO payments.

The Database shows that railways vary enormously in these dimensions, and it would clearly be too complex to try to adjust for all of the differences. We *can* attempt to take one factor into account - the effect of length of haul for both passenger and freight. It is well known that, while the cost of a trip or a shipment increases with distance, it does not double when trip length doubles because some costs (e.g. the cost of ticketing,, billing, or station heating) are incurred independent of trip length. And, in fact, most costs tend to increase somewhat slower than the increase in the length of trip or shipment. Based on fare and tariff comparisons versus distance, Figure I illustrates the relative relationship between fare or tariff and trip or shipment length. This is a rough representation based on informal research, but the inter-country comparisons are surprisingly uniform.

In accord with the relationships shown in Figure 1, each country's average passenger fares and freight tariffs are adjusted to reflect what they would be if each country's average rail traffic moved the same, world "average" distance which, for passengers is 68 km (total world p-km, divided by total world passenger trips), and for freight is 682 km (total world ton-km divided by total world tons lifted). This adjustment attempts to make railway passenger fares and freight tariffs in smaller countries more comparable with those in larger countries. The effect of the adjustment is that fares and tariffs in countries where traffic moves less than the world average distance are somewhat lower (because costs per ton-km go down as haul length increases); fares and tariffs in countries with railways having a length of haul longer than the world average will be adjusted upward. While the passenger adjustment will, to some extent, reflect the effect of length of average passenger trips on fares, it will not

necessarily remove the influence of government policy toward multi-ride or seasonal ticketing discounts. Figure 2 shows the length of haul *adjusted* passenger fares and freight tariffs.

On the passenger side, of the 60 countries for which we have passenger data, Egypt appears to have the lowest passenger tariffs in the world, and only 7 (all developing countries) out of the 60 countries listed have adjusted passenger fares below PPP$.02 per p-km. On the upper end of the scale, the US and Canada have the highest passenger fares in the world (PPP$ 0.12 to PPP$ 0.16 per p-km) accompanied, generally, by the other developed economies (and by a few Latin American countries where there is not much competition for rail service). The CFA zone African countries appear quite high as well, but this may well be an artifact of the overvaluation of the CFA Franc at the time (it was devalued in January 1994).

The freight comparison has some surprises. Of the 64 countries included, Sweden (apparently as a result of large movements of iron ore at low tariffs and a Government policy which directly subsidizes part of the cost of infrastructure for freight) has the lowest adjusted freight rates, followed by the US and Canada: these are the only countries at or below the PPP$.02 level for freight tariffs. Nine other countries have tariffs below the PPP$.03 level, including China, The Republic of Korea, and those Baltic or CIS countries for which we have data. Interestingly, most of the West European and other developed economies fall in the lower half of the range (below PPP$.06 per t-km), which suggests that they are overcoming their relatively high costs with higher productivity (or they are pricing freight as the marginal user of their systems - or they are losing a lot of money on freight). A more surprising conclusion is that many developing countries appear to have quite high adjusted freight tariffs which suggests, inter alia, that their railways are likely to be exposed to very strong trucking competition, either now or in the near future.

Figure 3 shows the ratio of the country's adjusted passenger fare to its adjusted freight tariffs. Figure 3 underlines the observation that developing countries tend to charge less for passenger service than they do for freight, primarily because it is often government policy to attempt to subsidize passenger losses with freight income. Of the 20 countries having a ratio of adjusted average passenger fare to adjusted average freight tariff of 90 percent or greater, only four (Malaysia, Morocco, China and The Republic of Korea) are developing countries. Of the 40 countries having a ratio less than 90 percent, only two (Greece and Portugal) are considered developed.

Figures 4, 5 and 6 show another interesting conclusion that can be drawn from PPP$ comparisons -- the relative "financial" productivity of investments, as compared with the physical productivities shown in Infrastructure Note RW-6. Figure 4 compares the amount of PPP$ passenger revenue generated by each piece of passenger rolling stock, a comparison which is effectively the product of physical productivity (p-km/coach) and fare level ($/p-km). Assuming that the world price of a passenger coach is about $500,000 (a number which would be higher for new equipment or where the percentage of independently powered (Multiple Unit or "MU") equipment is high), then interest alone (at 10 percent) would consume a sizeable portion of the total revenue each coach generates. For some railways, the total passenger revenue per coach does not equal the financial charges on the coach alone, much less all other operating and financing expenses.

Figure 5 gives PPP$ freight revenue per freight wagon, a comparator which is again the product of physical productivity (t-km/wagon) and freight tariff levels. At an average cost of about $50,000 per wagon, most railways generate enough freight revenue per wagon to cover capital as well as operating costs. An interesting fact about this measure is how well several of the developing railways perform: India and China, in particular, significantly outperform most developed railways in their freight revenue generated per wagon.

Figure 6 illustrates PPP$ of total railway revenue per locomotive, a measure of each locomotive's financial output. As a rough approximation MUs are divided by three and then added to the locomotive fleet since MUs are part of the motive power fleet, and their cost is in the range of one-third that of a locomotive. The resulting revenue generation per "equivalent" locomotive again shows a wide range of performance:: some railways (China, India, and the CFA zone railways) generate large revenues per locomotive; others do not do as well. If a representative average international value of a locomotive is 32 million, most railways appear to generate far more in revenue from their locomotives than their locomotive financing cost alone (at 10 percent); but, some railways make their investment work far harder than others .

The next resource discussed is labor. Figure 7 shows the average wage of railway workers in PPP$ per worker. One

conclusion is that railway workers are, in general, quite well compensated. In most countries, especially the poorer ones, their average income is far above the average income per capita. Another option is to consider the portion of each $ of revenue earned which is spent on labor because low wages are not an advantage if the worker is not productive, and high wages can be money well spent if the worker is highly productive. Comparing Figure 7 with Table 1, it appears that China has made the best current tradeoff between staff costs and physical productivity: only $.13 of every $1.00 in revenue goes to labor. A few other railways, notably the US railways and Japan, have managed to keep their wage to revenue ratio below 40 percent. By comparison, a number of developed countries spend more, often far more, than $1.00 in wages alone for each $1.00 collected in revenues, definitely not a recipe for financial success.

The final asset to compare is track -- the physical infrastructure that most people think of as the "railway". The vast majority of the physical economies of scale railways are thought to come from density of track usage, and the financial economies would come therefore from revenue density. Figure 8 shows PPP$ of total revenue per line-km.. By far the world's leaders in measure are Japan (because of the very high density of Shinkansen operations) and China (which now has the highest rail traffic density in the world). They are followed at a distance by The Republic of Korea and India, and would also probably be accompanied by the CIS economies if data were available. It is surprising to note that the US falls quite far down the list by this measure, probably because average traffic density is low as a result of the existence of competitive main lines lightly used branch trackage (which is only economic on a sunk-cost basis).

CONCLUSIONS

The potential questions raised by these comparisons are far too numerous to discuss in one note. However, several tentative conclusions can be reached:

1. Using official exchange rate or PPP$ comparisons, there are a number of developing countries whose passenger fares are, by themselves, too low, even taking GNP per capita into account. If, for reasons of public policy, these fares are supported by a fully compensatory PSO payment system, the railway may be able to manage. If there is not a proper PSO system, railway is going to suffer financially, especially over longer term. Many railways already have suffered lack of adequate compensation. Earlier analyses have shown that, if anything, it costs more to produce a p-km than a t-km, so it is difficult, on economic grounds, to justify policies of charging far less for passenger than for freight services.

2. Some developing railways are almost certainly charging too much for their freight services. Allowing for the fact that commodity mixes vary considerably over different railways and that tariffs usually are higher for high value goods than for bulks, it is also true that (in truckload lots) begin to be directly price (as well as service) competitive with railways when railway tariffs rise much above roughly $.07 to $.10 per t-km -- no matter what the commodity. The railways in the US, Canada and China fully cover their costs at freight rates of PPP$.02 to .03 per t-km under high volume and high technical efficiency. Nevertheless, trucks have made considerable inroads into "rail" traffic in these countries, even though average truck tariffs (in the US) range from $.07 per t-km for full truckload shipments to $.17 per t-km for less-than-truckload (LTL) shipments. Clearly, developing railways operating under less favorable conditions of density or technical capability might need to charge somewhat more than US or Chinese levels if they are to break even, but it is very likely that , governments which are forcing their railway's freight tariffs upwards in order to avoid or reduce explicit passenger PSO payments are putting an undue, and literally unbearable, competitive burden on their railways. By the same token, Governments which allow their rail freight tariffs to rise well above reasonably efficient levels are unnecessarily penalizing their economies.

3. The vast majority of railway costs are determined by the productivity of physical assets and labor, and most of the Bank's borrowing railways are already or will be operating in competitive, market-driven economies in the future. Improved productivity will be the key to survival, along with improved quality of service. Railways will have to put great emphasis on reducing costs and improving productivity. Railways in the US and Canada, and now Japan, New Zealand, Argentina and Sweden, have shown that they can change rapidly and favorably if they are allowed (or forced) to work within the right policy and organizational environment. The job of restructuring will ultimately be for the railways to do, but they cannot succeed without government support in the form of adequate PSO schemes, a level regulatory playing field, and the legal ability to organize and operate as competitive enterprises. Bank lending should make every effort to support these changes.

To Learn More:

1. Contact Lou Thompson (202-473-3785) or Julie Fraser (202-473-3973) for copies of earlier articles or copies of the Railway Database which is available on floppy disk summary statistical tables, available either in paper copy or floppy disk.

2. "The Economist," October 1-7, 1994, Global Economic Survey, page 5.

3. World Bank, World Development Report, 1994 Edition, Table 30, page 229.