MYANMAR TRANSPORT
SECTOR POLICY NOTE

HOW TO IMPROVE ROAD USER CHARGES

ASIAN DEVELOPMENT BANK

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Foreword

Myanmar is at a historic milestone in its transition into a market economy and democracy. After decades of isolation and stagnation, the country has, since 2011, been undergoing a fundamental political, economic, and social transformation at unprecedented speed and scope. Achieving the country's high growth potential will require continued reforms and structural transformation, especially in advancing major investments in infrastructure, developing relevant capacities and skills, and enhancing the business environment. This will enable Myanmar to reach the ranks of upper middle income economies by 2030.

Due to massive underinvestment and neglect in recent history, Myanmar's infrastructure lags behind its Association of Southeast Asian Nations neighbors, and hinders access to markets and social services. High transport costs and associated limited access to markets and services are among the main causes of poverty and regional inequality. Twenty million people still live in villages without access to all- season roads. The questions then are: how can basic transport services be provided to all? What does it take to improve the quality of the transport infrastructure and services for the private sector? How can Myanmar reduce the economic and social costs of transport?

The Government of the Republic of the Union of Myanmar is committed to addressing these questions, and the underlying issues. Toward this end, the Government has commissioned from the Asian Development Bank (ADB) the preparation of a *Transport Sector Policy Note*. The Transport Sector Policy Note takes stock of the transport sector challenges, provides a strategic framework for reforms that could assist Myanmar's policymaking, and identifies the areas where international financial and technical assistance could make the highest contribution to the development of Myanmar's transport sector.

The *Transport Sector Policy Note* is composed of nine reports, including this one, and a summary for decision-makers. The first two—*How to Reform Transport Institutions*, and *How to Reduce Transport Costs*—provide an overview and framework for policy reform, institutional restructuring, and investments. These are accompanied by separate reviews of key subsectors of transport: *Railways*, *River Transport*, *Rural Roads and Access*, *Trunk Roads*, and *Urban Transport*. These reports summarize and interpret trends on each transport sector to propose new initiatives to develop them. The thematic report *Road Safety* builds a first assessment of road safety in Myanmar. The thematic report *How to Improve Road User Charges* is a stand-alone study of cost-recovery in the road sector.

The research was organized by ADB and the then Ministry of Transport, with the active participation of the Ministry of Construction and the then Ministry of Railway Transportation. A working group comprising senior staff from these government ministries guided preparation. The work stretched over the period of 24 months, and was timed such that the final results could be presented to the new government that assumed office in April 2016, as a contribution to its policy making in the transport sector.

As the *Transport Sector Policy Note* demonstrates, Myanmar can, and should, develop a modern transport system that provides low-cost and safe services, is accessible to all including in rural areas and lagging regions, and connects Myanmar with its neighbors by 2030. The Government has the determination to doing so, and can tap the support from development partners, the private sector and other stakeholders. It can take inspiration from good practices in the region and globally.

The *Transport Sector Policy Note* provides a rich set of sector data, is meant to be thought-provoking, presents strategic directions, and makes concrete reform recommendations. It stresses the need to strengthen the role of planning and policy-making to make the best use of scarce resources in the transport sector. It highlights the need to reexamine the roles of the state—and particularly state enterprises—and the private sector in terms of regulation, management, and delivery of services in the sector. It identifies private sector investment, based on principles of cost-recovery and competitive bidding, as a driver for accelerated change. Finally, it aims at a safe, accessible, and environmentally friendly transport system, in which all modes of transport play the role for which they are the most suited.

We are confident that the *Transport Sector Policy Note* will provide value and a meaningful contribution to Myanmar's policymakers and other key stakeholders in the transport sector.

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Union Minister
Ministry of Transport
and Communications

Acknowledgments

The Transport Sector Policy Note was prepared at the initiative of Hideaki Iwasaki, director of the Transport and Communications Division of the Southeast Asia Department of the Asian Development Bank (ADB). It was prepared by ADB staff and consultants. Adrien Véron-Okamoto (ADB) coordinated the study, prepared the notes *How to Reduce Transport Costs, How to Improve Road User Charges* and the overall *Summary for Decision-Makers*, drafted the executive summaries, and contributed substantially to the notes *How to Reform Transport Institutions*, *River Transport*, *Trunk Roads*, and *Urban Transport*. Gregory Wood prepared the note *How to Reform Transport Institutions*. The *Railways* note was prepared by Paul Power. It also benefited from analytical research and suggestions by Richard Bullock. Eric Howard prepared the Road Safety note. Kek Chung Choo prepared the *River Transport* note. Paul Starkey and Serge Cartier van Dissel prepared the *Rural Roads and Access* note. Serge Cartier van Dissel also prepared the *Trunk Roads* note. Colin Brader (of Integrated Transport Planning) prepared the *Urban Transport* note.

The notes benefited from advice and suggestions from ADB peer reviewers and colleagues including James Leather, Steve Lewis-Workman, Masahiro Nishimura, Markus Roesner, David Salter, Nana Soetantri, and Fergal Trace. Angelica Luz Fernando coordinated the publication of the reports. The editing and typesetting team, comprising Hammed Bolotaolo, Corazon Desuasido, Joanne Gerber, Joseph Manglicmot, Larson Moth, Principe Nicdao, Kate Tighe-Pigott, Maricris Tobias, and Alvin Tubio greatly enhanced the reports.

Assistance from the Government of Myanmar, especially of the Ministry of Transport and Communications, the Ministry of Construction, and the Ministry of Agriculture, Livestock and Irrigation, is gratefully acknowledged. A first draft of these notes was presented and reviewed by government's study counterparts in 2015. This final version benefited from the comments and suggestions received.

Abbreviations

AADT	annual average daily traffic
ADB	Asian Development Bank
BOT	build–operate–transfer
ESAL	equivalent standard axle load
GDP	growth domestic product
HDM	Highway Design and Management
IRI	International Roughness Index
km	kilometer
MOC	Ministry of Construction
MK	Myanmar kyat
MOTC	Ministry of Transport and Communications
PM	particulate matters
RUC	Road User Charge
RTAD	Road Transport Administration Department
TA	technical assistance
veh-km	vehicle-kilometer

Currency Equivalents

(as of December 2014)

$ 1 = MK 1,000

Executive Summary

A Review of Road User Charges in Myanmar

This note presents a preliminary economic analysis of road user costs and fees, partly drawing from the World Bank's Road User Charge (RUC) model and analysis framework, and a review of the tolling system. In this note, we:

- determine levels of financing required to maintain and develop Myanmar's road network on a sustainable basis;
- give orders of magnitude of road sector externalities;
- identify current fees and taxes paid by road sector users cover their costs;
- analyze the economic and financial efficiency of the Ministry of Construction's (MOC) tolled road program; and
- propose financial instruments and levels that would improve cost recovery and enable a higher level of investments.

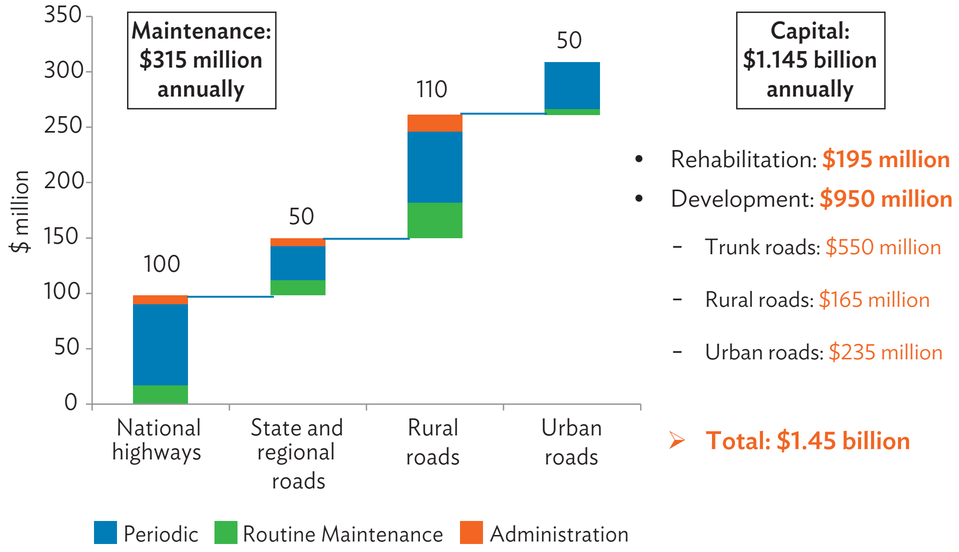
The Costs Associated with Road Use

Myanmar's road sector investment needs—and costs—reach about $1.45 billion annually. We estimate it would cost $315 million annually (Figure 1) to maintain the entire road network—trunk roads, urban roads and rural roads—on a sustainable basis. Capital works represent an additional annual effort of $195 million for rehabilitation and $0.95 billion for capacity upgrades and other improvements. Necessary road sector spending stands at about $1.45 billion a year (2.3% of Myanmar's gross domestic product [GDP]). This amount should grow in line with GDP.

Road externalities in Myanmar, particularly accidents, represent a cost similar in magnitude. Road externalities represent an annual burden to Myanmar estimated to also be about $1.4 billion. The costs per externality are: (i) road crashes: $800 million, (ii) air pollution: $75 million, (iii) congestion: $350 million, and (iv) CO_2 emissions $200 million. The main user categories responsible are motorcycles for road crashes, buses and trucks for pollution, and cars for congestion.

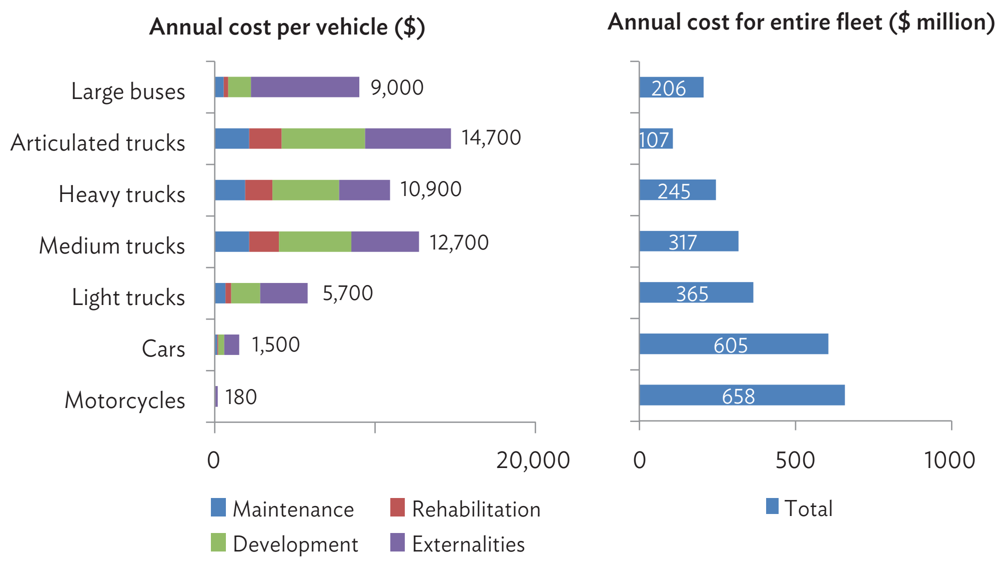
The infrastructure and external costs associated with each vehicle are high, justifying a potentially high level of taxation. Road user fees amount only to an annual revenue of $455 million, not counting import dues. The main fees are: (i) road registration tax ($260 million), paid mainly by cars, and (ii) tolls ($150 million), paid mainly by heavy trucks. Total costs per vehicle range from $166 each year for a motorcycle to $15,000 each year for an articulated truck (Figure 2).

Figure 1: **Long-Term Road Network Costs**



Source: Asian Development Bank estimates.

Figure 2: **Social Costs Associated with Road Use**



Source: Asian Development Bank estimates.

User Charging System and Cost Recovery

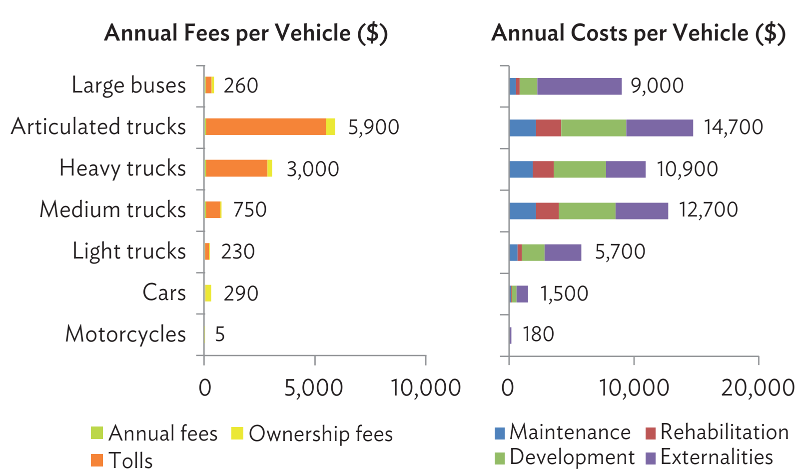
The amount that Myanmar levies on road users is significant, but still below the costs associated with road usage and network development. Total revenues ($450 million) would need to increase by about $300 million to cover a minimal share of infrastructure costs, and by up to $1 billion to cover all road externalities.

The distribution of road charges among users does not reflect the costs associated with their usage. Cars and the largest trucks are disproportionately charged, while small trucks, motorbikes and buses are only covering a fraction of their costs (Figure 3). This particularly discourages using large trucks, even though they are more cost-efficient and damage less pavements. There is also a risk that revenues from the registration tax, which bears mainly on imported cars, could dwindle in case Myanmar starts locally producing cars. Overall, charges on cars could still increase, but those on articulated trucks should not. Charges on other vehicles should rise disproportionately. Road charges on vehicle ownership should not depend on whether the vehicle is produced locally or not (this is the role of customs duties and taxes).

The structure of charges is also inefficient from an economic standpoint. The system puts a premium on personal vehicle ownership, but does not charge for the damage vehicles actually cause, or how much they will actually use the roads that are being rehabilitated or upgraded. This unbalance suggests that variable user fees should increase more than fixed fees.

Finally, the structure of charges is inefficient at channeling resources to where needs are. Users pay only a small share of their variable or investment costs on rural, urban and state and/or regional road networks. There is no explicit mechanism for channelling fixed revenues (collected centrally) to local networks.

Figure 3: **Coverage of Social Costs, by Vehicle Type**



Maint. (%)	Infra (%)	Total (%)
74	18	5
>100	63	40
>100	39	28
35	9	6
34	8	4
>100	49	19
21	12	3

Maint. = maintenance, Infra = infrastructure.
Source: Asian Development Bank estimates.

Review of the Ministry of Construction's Tolled Road Program

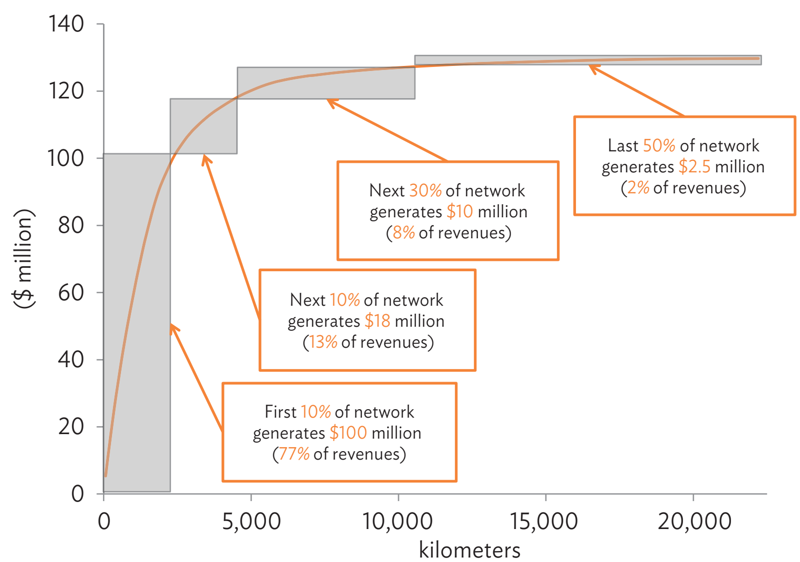
The Ministry of Construction's road and bridge tolling programs generate large revenues in the aggregate, but these are concentrated in a small share of the network. The MOC charges tolls along 22,000 kilometers (km) of roads and about 170 bridges, which generated about $150 million in revenues in 2013. However, 80% of the tolled roads have very limited traffic and revenues, only generating 10% of revenues (Figure 4). The "auction" road program seems a particularly inefficient revenue collection mechanism.

The tolling structure is very detailed and skewed, so that tolls are excessively borne by large trucks and not enough by cars. The MOC uses 24 vehicle categories, while most countries use five to nine. The rates for cars are well below levels in other countries, but large truck tolls are comparable. This large gap between truck and car toll rates is unseen in other countries, and not justified by the costs associated with each type of vehicle.

In this report, we provide two examples of more optimal toll rate structures that correspond to minor and major road improvements.

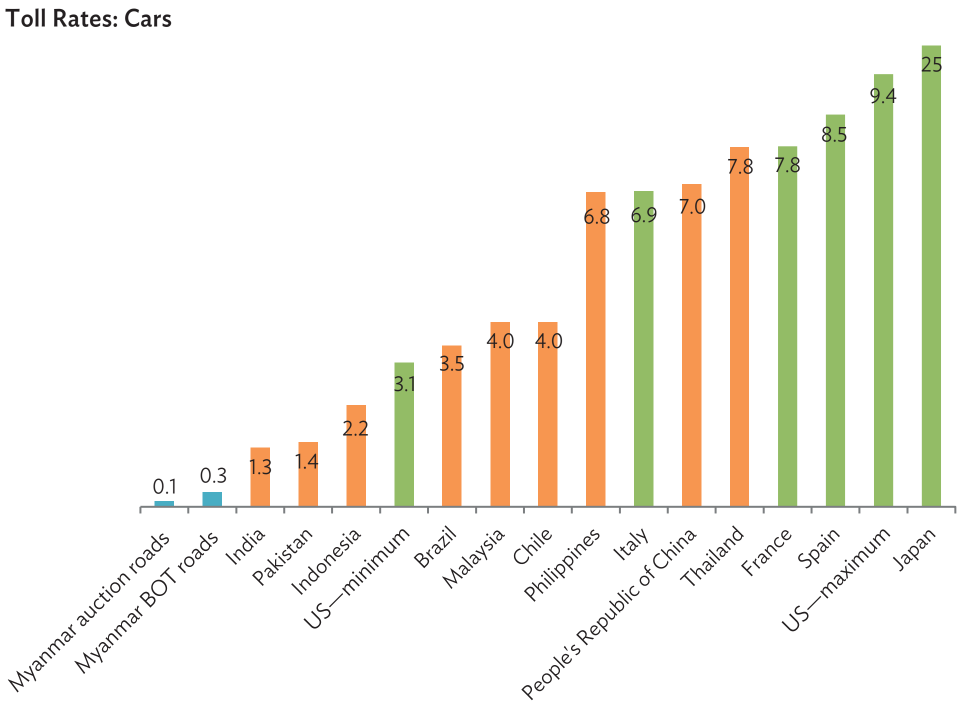
Current build–operate–transfer (BOT) road contracts cannot be implemented in a financially viable manner. The contracts include provisions for overly systematic road widening and for too-low toll rates and on roads having too little traffic. Very long tolling schedules are again uncommon by any standard, but still only marginally improve the financial equilibrium of contracts.

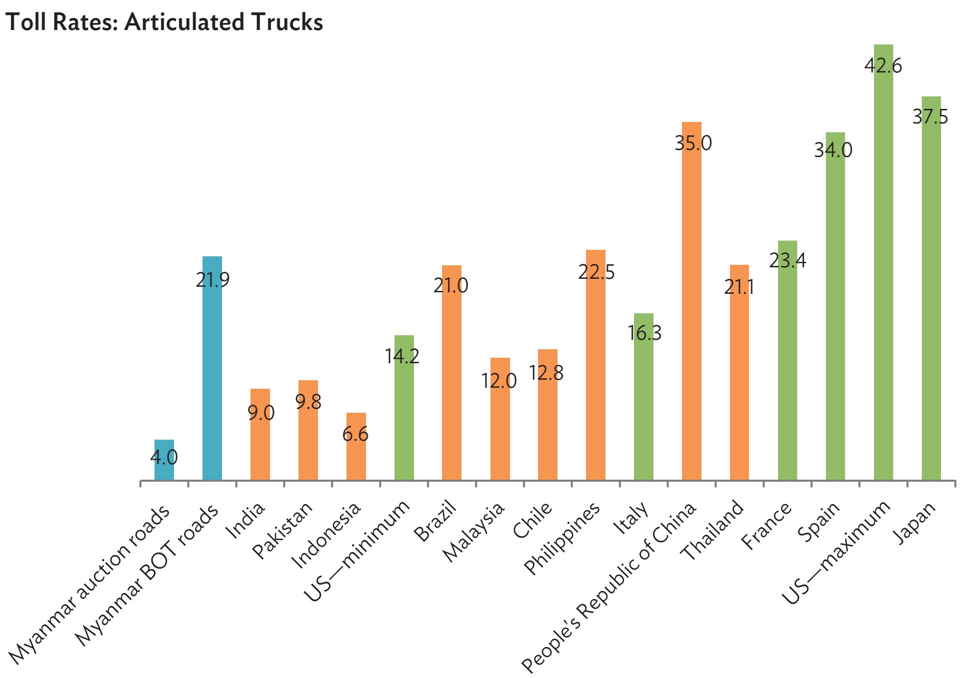
Figure 4: **Tolls Collected According to Network Length, 2013**



Source: Data from the Government of the Union of Myanmar, Ministry of Construction; and Asian Development Bank estimates.

Figure 5: **Toll Rates—International Benchmarks**
(US cents per km)





BOT = build–operate–transfer, km = kilometer, US = United States.
Source: Asian Development Bank estimates.

With higher toll rates, and more reasonable contract provisions, the BOT program could be used much more systematically to finance network improvements. However, the study finds little justification for charging tolls on roads with an Annual Average Daily Traffic (AADT) of fewer than 1,000 vehicles; at that rate, only about 4,500 km roads should be tolled.

The MOC's auction toll model does not share the same flaws, but brings moderate revenues to the MOC at a rather high 20% collection cost, and without applying a clear user-pays principle.

Possible Improvements in the Road User Charging Framework

Proposed principles for cost-recovery. To maximize the economic efficiency of the transport system, road user fees should be set equal to the costs of the resources consumed when using the road network. The proposed principles are:

(i) the road fees should never be set below the long-term variable costs of maintaining the road network;
(ii) variable road fees should preferentially be used to cover variable costs to align perceived incentives and costs;
(iii) where major investments are carried out, road fees should enable adequate cost recovery;
(iv) in urban areas particularly, fees should include congestion and other externality costs; and
(v) the instruments used for road charging should themselves be simple in design, correspond closely to their destination, and have the lowest administrative cost possible.

Measure 1: Create a new heavy vehicle license fee. This fee should be designed to make heavy vehicles pay for the actual damage they cause to pavement due to their weight and axle configuration. It would bring about $80 million each year, ranging from $120 a year for an unmodified medium truck to $2,000–$3,000 for the largest articulated trucks.

Measure 2: Create a fuel levy. This fee would make user contribute to road network maintenance and rehabilitation costs. At an initial rate of MK100 per liter (MK380 per gallon), it would bring $325 million in revenues annually (Figure 6).

Measure 3: Restructure the road tolling program. We propose to:

- **Restructure the toll rate schedule**. Two schedules of rates are proposed. The lowest rates would bring similar revenues as on current road BOTs, and the highest ones would bring about twice as much. The structure would be revised to reduce the number of vehicle categories from 26 to seven and reduce the ratio between the toll paid by the heaviest truck to that paid by a car from 70 to 5.6. This new structure shown in Table 1, would raise tolls on cars, and leave them as they are or reduce them for large trucks.
- **Cancel road tolls on roads with low traffic**. Potentially, tolls could be cancelled on up to 18,000 km, and kept only on the 4,000 km highways with an AADT above 1,000.
- **Restructure the contracts to align contractual specifications with actual road needs and financial capacity**, and better enforce them.

Figure 6: **Fuel Levy Revenue and Financing Potential**

Revenue potential:

– 65 Kyat/liter $220 million
– 100 Kyat/liter $325 million
– 200 Kyat/liter $640 million

Financing potential:

Maintenance costs (non-improved roads)
Also rehabilitation (non-improved roads)
Also 50% development costs

Source: Asian Development Bank estimates, based on Myanmar's 2014 vehicle fleet.

Table 1: **Alternative Toll Structures**

Vehicle Type		Current BOT Rates (MK per mile)	Alternative Toll Schedules		
			New Toll Structure[a]	Low Rates (MK per mile)	High Rates (MK per mile)
1.	Motorcycles	0		0	0
2.	Car	5–10	1.0	30	70
3.	Light truck/medium bus	20–30	1.4	45	100
4.	Medium truck	75–100	3.9	120	260
5.	Heavy truck	150–200	4.1	130	280
6.	Articulated truck	300–350	5.6	180	380
7.	Large bus	50–55	2.5	75	175

BOT = build–operate–transfer, MK = Myanmar kyat.

[a] This is the ratio of the toll paid by a vehicle to the toll paid by a car.

Source: Asian Development Bank estimates.

We also propose that the Ministry of Transport and Communications (MOTC) temporarily retain the initial road registration tax, which affects cars, at its current level, but that it consider moderately differentiating it by city and by the level of congestion in the medium-term. The MOTC's annual road registration tax could gradually be phased out as other fees are introduced.

These measures would raise road sector revenues from $450 million annually to $850 million. This would finance a much larger share of needs, and align far more closely to what users pay and to the actual cost to society (Figure 8). Despite the cancellation of tolls, the measures we propose would raise toll revenues to $210 million (Figure 7).

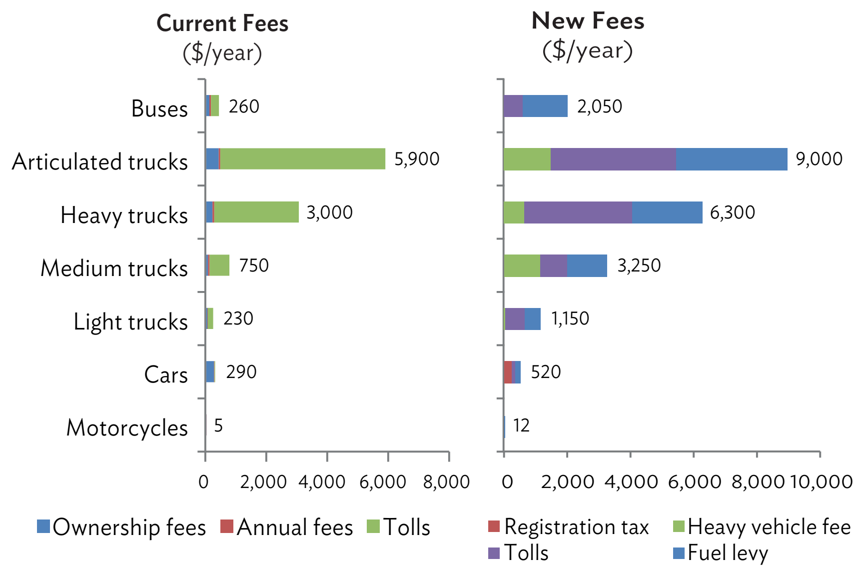
The reform would not lead to inflation in bus fares and freight rates if the resources raised are used to improve the road network. Higher resources for road maintenance and rehabilitation would help improve the road network, eventually reducing the costs of operating buses and trucks. This would counterbalance the impact of higher fees on end users. Bus user fares are expected to remain similar, or possibly be slightly reduced. Car user out-of-pocket fees would rise on trunk roads, but not on the rest of the network. Shipping in large trucks should become cheaper by 10%–25%, which would strengthen their competitive advantage over medium-sized trucks. Altogether, the changes brought by higher fees and better roads would be progressive, favoring bus users and rural road users over the more well-off car users and urban dwellers.

Figure 7: Annual Revenues after Reform
($ million)

	Current Fees FY2013	After Reform
• Initial registration taxes:	$274	$245
• Inspection fees:	$8	tbd
• Registration fees:	$22	tbd
• License fees:	$1	$75
• Tolls:	$150	$210
• Fuel levies ($10 c/l)	$0	$320
Total:	**$455**	**$850**

tbd = to be determined.
Source: Asian Development Bank estimates.

Figure 8: Coverage of Social Costs after Reform



Maint. (%)	Infra (%)	Total (%)
>100	89	22
>100	96	61
>100	81	57
>100	38	26
>100	40	20
>100	88	34
50	29	6

Maint. = maintenance, Infra = infrastructure.
Source: Asian Development Bank estimates.

Introduction

This note presents a preliminary economic analysis of road user costs and fees, partly drawing from the World Bank's Road User Charge (RUC) model and analysis framework, and a review of the tolling system. In this note, we:

- determine levels of financing required to maintain and develop Myanmar's road network on a sustainable basis;
- give orders of magnitude of road sector externalities;
- identify current fees and taxes paid by road sector users to cover their costs;
- analyze the economic and financial efficiency of the toll-road program under the Ministry of Construction (MOC); and
- propose financial instruments and levels that would improve cost recovery and enable a higher level of investments.

The steps for the analysis are as follows:

- **Step 1: road costs.** Estimate the annual costs of maintaining the entire road network on a sustainable basis. This amount is based on how much should be optimally spent by all agencies managing Myanmar's roads. Estimate the long-term budgets needed to bring the road network up to an acceptable condition that can be sustainably maintained, and to upgrade and increase its capacity. Estimate the externalities associated with road usage: traffic accidents, pollution and congestion. Based on these costs, prepare an outline showing the fixed and variable costs that should be met by road users, depending on the cost-recovery principles followed.
- **Step 2: user fees.** Identify the annual levels of user fees and taxes paid by road users. Determine overall revenues, revenues associated with vehicle ownership and usage by user category, as well as revenues earmarked for the road agencies.
- **Step 3: cost coverage analysis.** Determine the current usage levels of the network to identify the users among whom costs should be shared. Compare the fixed and variable fees paid by users with their fixed and variable costs related to each type of network.
- **Step 4: new user fees.** Propose user charging principles applicable to Myanmar. Determine the instruments and levels of fees needed to reasonably adhere to these principles.

This note has been prepared by Asian Development Bank (ADB) staff. It builds on available data sources, consisting of mainly: road network consistency data from the MOC, 2013 toll revenues for all toll and bridge gates (MOC), standard build–operate–transfer (BOT) contracts, and an account by the Ministry of Rail Transportation (MRT) of its 2013 revenues and levels for all fees managed by the MRT. Estimates of road investment needs are from the National Transport Development Plan (2014) and from early findings of ADB's technical assistance for Preparing an Asset Management Program for Myanmar Roads (2013). The analysis relies on the RUC model, which includes a number of built-in assumptions about vehicle damage factors, emission factors and maintenance costs, which were calibrated to fit Myanmar's situation.

Despite our efforts, data inconsistency or limitations may limit the validity of some of the results, but we believe not of the general findings and recommendations. Nevertheless, before implementing the recommendations, it may be useful to update the calculations and use more extensive data.

1 The Costs Associated with Road Use

Key Findings

Myanmar's road sector investment needs and costs reach about $1.4 billion annually. We estimate that it would cost $315 million annually to maintain the entire road network—trunk roads, urban roads, and rural roads—on a sustainable basis. Capital works represent an additional annual investment of $145 million for rehabilitation and $1 billion for capacity upgrades and other improvements. Necessary road sector spending thus stands at about $1.4 billion a year (2.3% of Myanmar's GDP). This amount should grow in line with the GDP.

Road externalities, particularly accidents, cost Myanmar about the same amount as its annual road-related investments. An annual burden estimated at about $1.4 billion. These externalities are made up of: (i) road crashes, $800 million; (ii) air pollution, $75 million; (iii) congestion, $350 million; and (iv) CO_2 emissions, $200 million. The main user categories responsible for these costs are motorcycles for road crashes, buses and trucks for pollution, and cars for congestion.

The infrastructure and external costs associated with each vehicle are high, justifying a potentially high level of taxation. Road user fees amount to an annual revenue of only $455 million, not counting import dues. The main fees are the road registration tax ($260 million), paid mainly by cars, and tolls ($150 million), paid mainly by heavy trucks. Total costs per vehicle range from $180 each year for a motorcycle to $14,500 for an articulated truck.

1.1 Cost of Providing and Maintaining the Roads

Myanmar has a large road network to maintain, most of which is earthen or gravel. Myanmar's registered road network was 143,246 kilometers (km) in 2013. Paved roads represent 22% of the total. These are mostly of bituminous penetration macadam surfacing. Gravel and macadam roads account for 27% of the total. Half of the registered network is earthen. The national, state, and regional network is managed by the MOC. Authority for the national road network is with the central government, while that for state and regional road networks is with the provincial government. Rural roads are managed by the Department of Rural Development, again under the local government authority. Urban streets are managed by city development committee (Table 2).

The network is generally lightly trafficked, with motorcycles responsible for a large share of the fleet and traffic. We estimate that Myanmar's 4.6 million vehicles generate a total 31.5 billion vehicle-kilometers per year, requiring 3.2 billion liters of fuel (2.7 million tons) (Table 3).

Table 2: Road Network Composition, as of 2013

Road Category	Concrete/ Bituminous	Gravel/ Macadam ("metalled")	Earth	Total
National road network	12,345	5,141	2,017	19,503
State and regional road network	5,502	6,241	7,837	19,580
Rural roads	9,617	26,445	60,848	96,910
Urban streets and avenues	4,531	723	1,999	7,253
Total	**31,995**	**38,550**	**72,701**	**143,246**

Note: The breakdown for half of the rural road network is missing. The composition was assumed to be similar to that of the other half of the rural road network.

Source: Government of the Union of Myanmar, Ministry of Construction.

Table 3: Vehicle Fleet and Use Assumptions

Vehicle Type	Number of Vehicles	Annual Distance Driven (km)	Annual Vehicle Utilization (million vehicle km)	Annual Fuel Consumption (million liter)	Annual Loading Impact (million ESAL km)
Motorcycles	3,975,824	4,300	15,394	419	0
Cars	457,501	22,000	8,696	1066	0
Light trucks	84,977	45,000	2,834	316	932
Medium trucks	14,615	65,000	1,625	315	12,289
Heavy trucks	26,345	65,000	1,463	498	5,574
Articulated trucks	12,307	70,000	510	257	2,308
Buses	23,134	45,000	1,026	323	1,748
Total	**4,594,703**		**31,546**	**3,193**	**22,850**

ESAL = equivalent standard axle load, km = kilometer.

Note: Detailed data on traffic is available from toll gates for most of the national roads. It indicates that 71% of the national paved network is lightly trafficked at fewer than 500 vehicles per day (not including motorcycles), 15% has traffic between 500 and 2,000 vehicles per day, 12% between 2,000 and 5,000 per day, and only a few short sections have traffic above 5,000 vehicles per day. The average share of heavy vehicles is 22%. Vehicle usage on the rest of the network was assumed based on casual observations, and manually calibrated to tally with usage figures computed based on the total vehicle fleet (data available from the government) and on annual vehicle mileage (surveys on usage available for trunk roads). These assumptions do not impact total maintenance needs, and only marginally affect figures by category of network. The assumptions regarding vehicles were based on the typical vehicles in use in Myanmar. Totals may not add up due to rounding.

Source: Asian Development Bank estimates based on data from the Government of the Union of Myanmar, Road Transport Administration Department.

Overloading is common but it is mainly an issue for medium sized trucks. Based on the stated loads by truck drivers responding to surveys, we estimate that about 21% of trucks are overloaded. The average axle load of a truck is 4.4 times the standard axle load of 18 kips, which is high. Of the medium-sized trucks, 25% are overloaded, and their overloading is severe: for overloaded medium-sized trucks, the overloading ratio is 58%. Larger trucks are less frequently overloaded, and their overloading is less severe. Actually, using a higher axle load of 11.5 tons, medium-sized trucks would still be considered overloaded, but most large trucks would not. Only 6% of trucks actually carry more than 30 tons of goods. Medium-sized trucks (two-axle) account for 22.4% of movements of goods, but cause 60% of the damage to road pavement (Tables 4, 5, and 6). Only 9% of trucks travel empty, and the average loading ratio is 91%, which is very high by international standards. The ratio is less on international corridors (e.g., 62% on the Greater Mekong Subregion East–West Corridor connecting to Thailand).

Table 4: Actual Truck Traffic Composition, 2013

Vehicle Type	Percentage of Truck Movements	Percentage of Tons Movements	Average Truck Capacity (tons)	Average Load (tons)	Gross Vehicle Weight (tons)	Legal Maximum Load (tons)	Loading Ratio (%)	Empty Trips (%)
Two-axle truck (less than 2 tons)	5	1	1.5	1.3	3.3	4	87	18
Two-axle truck (more than 2 tons)	43	22	7.1	6.4	11.4	15	90	12
Three-axle truck	16	16	14.0	12.7	19.7	19–21	91	6
Four-axle truck	23	31	17.6	16.5	26.5	25	94	5
Trailer truck	13	30	29.8	27.7	39.7	33–48	93	5
Fleet average			13.3	12.3			91	9

Note: The computations reflect a sample of 5,500 roadside truck surveys carried out on trunk roads as part of the preparation of the National Transport Development Plan.

Source: Asian Development Bank estimates based on data from Japan International Cooperation Agency (JICA). 2014. *The Survey Program for The National Transport Development Plan In The Republic of The Union of Myanmar*. Naypyidaw.

Table 5: Actual Truck Payloads, 2013

Vehicle Type	<4 Tons (%)	4–10 Tons (%)	10–20 Tons (%)	20–30 Tons (%)	>30 Tons (%)	Average Payload (%)
Two-axle truck (less than 2 tons)	95	5	0	0	0	1.3
Two-axle truck (more than 2 tons)	31	44	25	0	0	6.4
Three-axle truck	9	14	69	8	0	12.7
Four-axle truck	5	2	72	20	1	16.5
Trailer truck	5	2	11	34	47	27.7
Fleet average	21	22	40	11	6	12.3

Source: Asian Development Bank estimates based on data from Japan International Cooperation Agency (JICA). 2014. *The Survey Program for The National Transport Development Plan In The Republic of The Union of Myanmar*. Naypyidaw.

Table 6: Calculated Truck-Axle Damage Factors

Vehicle Type	Gross Vehicle Weight (tons)	Share Overloaded on 10-Ton Axle (%)	Average Overload (%)	Average ESAL	Share of Total ESALS (%)	ESAL for Legal Loads	Share Overloaded on 11.5-Ton Axle (%)
Two-axle truck (less than 2 tons)	3.3	0	0	0.2	0.2	0.01	0.2
Two-axle truck (more than 2 tons)	11.4	25	58	6.7	60	2.6	18
Three-axle truck	19.7	40	15	3.6	12	1.0	8
Four-axle truck	26.5	13	7	3.5	17	0.6	5
Trailer truck	39.7	6	12	4.1	11	2.7–5.3	1
Fleet average		21	31	4.8	100		10

ESAL = equivalent standard axle load.

Note: The overloaded share was computed based on the legal 10 tons per axle and, as an alternative, 11.5 tons per axle. The ESAL computations were carried out using the methodology of the American Association of State Highway and Transportation Officials for typical truck and trailer configurations, assuming the use of tandem or tridem axles.

Source: Asian Development Bank estimates based on data from Japan International Cooperation Agency (JICA). 2014. *The Survey Program for The National Transport Development Plan In The Republic of The Union of Myanmar*. Naypyidaw.

Long-term road network maintenance costs reach $315 million annually. We estimate this is the cost to maintain Myanmar's road network, not counting the costs of bring the network to a maintainable condition. Of the total, $150 million is for the network managed by the MOC, $110 million for rural roads, and $50 million for urban roads (Table 7). Also, 30% of the costs ($94 million) would be variable, while other costs are fixed. Again, the total costs does not include the rehabilitation the costs of necessary rehabilitation. And actual routine maintenance needs are higher, because of the degraded condition of the road network.

Road network rehabilitation and development costs are about $1.15 billion annually. Road network rehabilitation needs were estimated to be $195 million, and upgrade needs require $950 million on an annualized basis. Overall, the total road rehabilitation and development needs are estimated at $1.15 billion on an annualized basis (Table 8)—about 2.3% of Myanmar's GDP. This amount is an annuity corresponding to the 2013 situation: it was calculated based on needs, assuming that resources would rise in line with GDP.

Table 7: **Road Network Maintenance Costs, 2013**
($ million per year)

Road Network	Road Type	Routine Maintenance			Periodic Maintenance			Administration and Other	Total Costs
		Fixed	Variable	Total	Fixed	Variable	Total		
National roads	Paved	10.5	0.4	10.8	39.0	27.4	66.4	5.1	82.3
	Gravel	2.6	2.6	5.2	4.7	1.9	6.6	2.1	13.9
	Earth	0.5	0.7	1.2	0.0	0.0	0.0	0.8	2.0
	Total	13.6	3.7	17.2	43.7	29.3	73.0	8.0	98.2
State and regional roads	Paved	4.7	0.1	4.8	12.3	10.7	23.0	2.0	29.7
	Gravel	3.1	3.3	6.4	5.7	2.4	8.1	2.2	16.8
	Earth	1.0	1.4	2.4	0.0	0.0	0.0	2.8	5.2
	Total	8.8	4.7	13.5	18.0	13.1	31.1	7.0	51.6
Rural roads	Paved	8.2	0.1	8.3	20.4	17.7	38.0	1.5	47.9
	Gravel	6.6	4.0	10.6	24.0	2.4	26.4	4.1	41.1
	Earth	7.6	5.3	12.9	0.0	0.0	0.0	9.4	22.3
	Total	22.4	9.4	31.8	44.4	20.1	64.5	15.0	111.3
Urban streets and avenues	Paved	4.3	0.4	4.7	28.7	12.5	41.2	3.2	49.1
	Gravel	0.2	0.1	0.3	0.7	0.1	0.7	0.5	1.5
	Earth	0.2	0.2	0.5	0.0	0.0	0.0	1.3	1.8
	Total	4.7	0.7	5.4	29.4	12.5	41.9	5.0	52.3
All roads	Paved	27.6	1.0	28.6	100.4	68.2	168.6	11.8	208.9
	Gravel	12.5	10.0	22.5	35.0	6.8	41.9	8.9	73.3
	Earth	9.3	7.6	16.9	0.0	0.0	0.0	14.3	31.2
	Total	**49.4**	**18.6**	**68.0**	**135.5**	**75.0**	**210.5**	**35.0**	**313.4**

Notes: Fixed routine maintenance costs were assumed to be $850 per kilometer (km) for paved roads, $250 to $500 per km for macadam or gravel roads, and $125 to $250 for earth roads. Variable routine maintenance costs were assumed to be mainly for patching paved roads and grading unpaved roads. Periodic maintenance costs (overlays, seals, regraveling) were determined based on the optimal strategy for maintaining each road category in the network in good condition. (This is predefined in the model, and draws from an HDM-IV analysis.) Totals may not add up due to rounding.

Source: Asian Development Bank estimates using a road user cost model developed for this study, based on data provided by the Government of the Union of Myanmar, Ministry of Construction.

Table 8: **Road Network Rehabilitation and Development Needs, 2015–2025**

Road Network	Length (km)	Annualized Investment Needs: Rehabilitation ($ million per year)	Upgrade and Construction ($ million per year)	Total ($ million per year)
National roads	19,500	150	450	600
State and regional roads	19,580	45	100	145
Rural roads	96,910		165	165
Urban streets and avenues	8,010		235	235
All roads	**144,001**	**195**	**950**	**1,145**

km = kilometer.

Notes: The rehabilitation of a large share of the paved road network or, rather, its upgrading to asphalt concrete surfacing, is necessary for raising the network to a maintainable level. Urban road investments draw from the Yangon Urban Transport Master Plan ($230 million per year annualized), and we assume an additional 50% budget for other cities. The total cost of upgrading the rural roads was calculated to be $12 billion, which can only be met in the long run. The budgets for 2014 were used as a baseline. There was no base for determining the cost of upgrading the state and regional road network. Because traffic is lower there than on the national network, a $100 million annual requirement was considered.

Source: Asian Development Bank estimates.

1.2 Cost of Road Externalities

The cost of road externalities appears to be comparable to that of road maintenance and investment needs. Road usage generates negative externalities in all countries, including Myanmar. These are costs imposed by road users on other users (e.g., congestion) and on the rest of society (e.g., pollution, accidents involving pedestrians) without being compensated by monetary payments. This study develops rough estimates of these costs. The total cost of all road-generated externalities is estimated to be **$1.5 billion**.

- **Road Crashes.** The total cost to society of road crashes is estimated to be about **$800 million.** Road crashes impose long-term costs to society in the form of direct material damage, medical care and loss of future production. Based on trends observed in the first half of 2014, road users were involved in 13,400 accidents, which caused 23,400 injuries and 3,900 fatalities. The international benchmarks used in this study are the cost to society of 70 times GDP per capita for fatalities ($80,500), 17 times GDP per capita for injuries ($19,550), and $1,500 for accidents.
- **Air Pollution.** The total health costs associated with air pollution are estimated to be **$75 million**. Vehicle emissions are a major cause of respiratory diseases in urban areas. We estimate that in 2014, vehicles emitted 93,000 tons of NO2 and 4,200 tons of PM10, which are leading factors contributing to air pollution. A unit cost of $970 per ton of NO2 and $23,260 per ton of PM10 was generated in urban areas. These unit costs were estimated based on standard impact values for developing countries adjusted for the density of Yangon and Mandalay, and for the cities' levels of GDP per capita. Standard emission factors corresponding to a moderately old vehicle fleet were considered, and combined with the estimates of vehicle usage in urban areas to derive total emissions.
- **Congestion.** Urban road congestion costs are estimated to be about **$350 million** a year. This is likely an underestimate, and should thus be considered valid only with regard to its magnitude.
- **CO_2 Emissions.** Myanmar's vehicles are estimated to burn 3.2 million tons of fuel which emit 8 million of tons of CO_2 a year. Assuming a cost of $25 per ton, the associated cost to global society would be **$200 million**.

Table 9: **Crash Rates in Myanmar, 2012 and 2014**

Vehicle Type	Number of Crashes in 2012	Number of Fatalities in 2012	Number of Injuries in 2012	Crash Rates (per 100 Million veh-km)	Fatality Rates (per 100 Million veh-km)	Injury Rates (per 100 million veh-km)
Motorcycles	5,562	1,393	8,987	57	15	94
Cars	1,452	349	2,602	20	5	36
Light trucks	605	254	1,051	21	9	36
Medium trucks	238	100	438	21	9	38
Heavy trucks	202	85	105	21	9	11
Articulated trucks	72	30	70	21	9	20
Buses	699	234	1,909	106	37	295
Total 2012	**8,830**	**2,445**	**15,162**	**38**	**11**	**66**
Total 2014	**13,413**	**3,917**	**23,429**	**90**	**8**	**51**

Veh-km = vehicle-kilometer.

Notes:

1. The figures for 2012, including the breakdown by vehicle, are derived from government data.
2. The figures for 2014, also derived from government data, are based on trends during the first 8 months of that year.

Source: Asian Development Bank analysis of data from the Government of the Union of Myanmar, Road Transport Administration Department.

1.3 Overall Road Costs

Altogether, the annual cost to society associated with road usage reached $2.9 billion in 2013. We estimate that the total cost to the government (infrastructure costs) and to society (externalities) associated with the road sector was $2.9 billion in 2013. Of this total, $1.5 billion covered short-term variable costs—costs that were directly caused by road users when they traveled on the roads. This represents 2.5% of Myanmar's GDP (Table 10). Only a fraction of these costs were due to road damage. Most were due to externalities. Road crashes were the largest external cost of road use in Myanmar. The remainder ($1.36 billion) was either fixed (e.g., fixed network costs) or corresponded to investments that would benefit future road users.

Table 10: **Annual Variable Social Costs of Road Use**
($ million)

Costs	Total Costs	Short-Term Variable Costs	Fixed and Infrastructure Costs
Maintenance costs	315	95	220
Rehabilitation costs	195	...	195
Upgrade and construction costs	950	...	950
Road crashes	800	800	...
Air pollution	75	75	...
Congestion	350	350	...
CO_2 emissions	200	200	...
Total	**2,885**	**1,520**	**1,365**

... = data not available.

Source: Asian Development Bank estimates based on a road user cost model developed for this study.

Costs by vehicle. It is useful to consider how much these road costs represent for each vehicle on a yearly basis to measure the potential amount that should be recovered from road users. Variable maintenance costs and externalities are directly related to the use of the vehicles. Allocation rules concerning users are needed for fixed costs and investments, as there is no direct link between road usage and these costs. Also, only part of the fixed costs should be financed by current road users. The current rules are:

- **Fixed maintenance costs** are allocated 100% to current road users, with half based on utilization (in vehicle-kilometers), and half on the road space used (drawing from standard passenger-car-equivalent factors).
- **Rehabilitation costs** are allocated for 80% to current road users, on the assumption that part of them can be financed by debt. Costs are split equally according to the loading impact and road space used.
- **Upgrade and construction costs** are allocated for 65% to current road users, on the assumption that some have different requirements and because of this should not be financed by road users (poverty alleviation, urban development) and because debt and equity instruments are available. Costs are split between 20% for loading impact (representing incremental pavement costs) and 80% for road space use.

Total road infrastructure and externality costs per vehicle range from $183 a year for a motorcycle to $14,700 for an articulated truck. Based on this methodology, we estimate that road costs represent on an annual basis (Table 11):

- short-term variable maintenance costs only: $9 for a car and $1,020 for a heavy truck;
- all infrastructure costs: $600 for a car and $7,760 for a heavy truck; and
- all costs and externalities: $1,530 for a car and $10,930 for a heavy truck.

Table 11: Annual Costs per Vehicle
($ per vehicle per year)

Vehicle Type	Variable Maintenance Costs	Fixed Maintenance Costs	Rehabilitation Costs	Upgrading Costs	Externalities	Total
Motorcycles	3	21	3	14	144	183
Cars	9	150	50	380	930	1,530
Light trucks	80	590	350	1,820	2,950	5,790
Medium trucks	1,200	950	1,850	4,520	4,220	12,740
Heavy trucks	1,020	880	1,690	4,170	3,170	10,930
Articulated trucks	1,160	990	2,030	5,200	5,360	14,730
Large buses	230	330	280	1,420	6,760	9,020

Source: Asian Development Bank estimates based on the road user cost model developed for the study

2 User Charging System and Cost Recovery

Key Findings

The amount that Myanmar levies on road users is significant, but still below the costs associated with road usage and network development. Total revenues ($450 million) would need to increase by about $300 million to cover a minimal share of infrastructure costs, and by up to $1 billion to cover all road externalities.

The distribution of road charges among users does not reflect the costs associated with their use. Cars and the largest trucks are disproportionately charged, while small trucks, motorbikes, and buses are only covering a fraction of their costs. This discourages the use of large trucks, even though they are more cost-efficient and damage less pavement. There is also a risk that revenues from the registration tax, which affects mainly imported cars, could dwindle if Myanmar starts producing cars locally. Overall, charges on cars could still increase, but those on articulated trucks should not. Charges on other vehicles should rise proportionately. Road charges on vehicle ownership should not depend on whether the vehicle is produced locally or not (this is the role of customs duties and taxes).

The charging system is also inefficient from an economic standpoint. The system puts a premium on personal vehicle ownership, but does not charge for the damage vehicles actually cause, or how much drivers will actually use the roads that are being rehabilitated or upgraded. This unbalance suggests that variable user fees should increase more than fixed fees.

Finally, the charging system is inefficient at channeling resources to where the needs are. Users in particular pay only a small share of their variable or investment costs on rural, urban and state and regional road networks. There is no explicit mechanism for channelling fixed revenues (collected centrally) to local networks.

2.1 Road Use Fees

Myanmar's road user charging system involves a number of instruments managed by different actors. The fees imposed on road users are as follows:

- **Customs duties and taxes**. They are imposed on all vehicle imports based on standard cost, insurance, and freight (CIF) values. The average duty rate considered is 30% for cars (except taxis), and 3% for other vehicles. The average tax rate considered is 25% for cars and taxis, and 5% for other vehicles. Actual customs duty rates for cars can be much higher for large or luxury vehicles. The Ministry of Commerce collects these taxes.

- **Initial road registration tax.** This tax is imposed on all newly imported cars and taxis. It ranges from 30% to 80% of the CIF value, depending on the scheme under which it was imported. Our understanding is that this tax is collected by the Road Transport Administration Department (RTAD), which is under the Ministry of Rail Transportation (MRT), but we were unable to confirm this.
- **Registration fee.** This is an annual fee, ranging from $5 to $40 annually, depending on the type of vehicle and on whether it is the initial registration or a renewal. The RTAD collects this fee.
- **Inspection fee.** This is an annual fee, ranging from $0.5 to $10 annually, depending on the type of vehicle, and on whether it is the initial or renewal registration. The RTAD collects this fee.
- **Business license fee.** This is a $1 to $8 annual fee collected by the MRT's Transport Planning Department on all passenger and cargo vehicles.
- **Road tolls.** Most of the paved national roads and bridges are tolled by the Ministry of Construction (MOC), either under road concession schemes or through "auction" schemes. Section 3 analyzes the program in detail.

Altogether, the fees imposed on users are negligible for motorcycles, moderate for cars and buses, and significant for large trucks. The transport-related fees paid each year by a road vehicle owner is $5 for a motorcycle, about $290 for a car, $3,100 for a heavy truck, $5,930 for an articulated truck, and $420 for a large bus (Table 12).

Table 12: **Annual Average Road User Fees, by Vehicle Type**

(%)

Vehicle Type	Customs Duty	Customs Tax	Initial Registration Tax	Initial Inspection Fee	Renewal Inspection Fee	Initial Registration Fee
Motorcycles	0.0	0.0	0.0	0.5	0.5	1.0
Cars	150.0	125.0	250.0	0.5	5.2	1.0
Taxis	18.8	156.3	312.5	0.7	5.2	4.4
Light trucks	20.8	34.7	34.7	0.3	5.2	1.0
Medium trucks	33.0	55.0	55.0	0.4	10.3	1.5
Heavy trucks	120.0	200.0	200.0	0.6	10.3	3.4
Articulated trucks	240.0	400.0	400.0	0.6	10.3	4.6
Buses	60.0	100.0	100.0	0.5	10.3	1.5
Vehicle Type	**Registration Renewal Fee**	**Initial License Fee**	**License Renewal Fee**	**Tolls**	**Total**	**Total Transport**
Motorcycles	2.3	0.0	0.0	0.0	5.0	5.0
Cars	14.4	0.0	0.0	17.0	563.0	288.0
Taxis	30.9	0.3	2.1	0.0	531.0	356.0
Light trucks	5.2	0.3	4.1	188.0	294.0	239.0
Medium trucks	38.1	0.4	6.2	672.0	872.0	784.0
Heavy trucks	38.1	0.9	8.2	2,847.0	3,429.0	3,109.0
Articulated trucks	38.1	0.9	8.2	5,472.0	6,575.0	5,935.0
Buses	30.9	0.9	8.2	275.0	587.0	427.0

Note: Initial fees are annualized based on the assumed remaining life of vehicles after importation.

Source: Asian Development Bank estimates utilizing a road user cost model developed for the study. The road user fee statistics were derived from the Ministry of Construction toll revenue data, as well as Road Transport Administration Department and Planning Department data.

2.2 Revenues

We estimate that total revenues generated by road users reached $455 million in 2013. Total government revenues associated with the road sector was higher, at $742 million a year. However, the customs duties and taxes are not road user fees, per se. The rates are similar to rates for other luxury item imports, and can be considered as general taxation. Only $455 million can be considered as road user fees, divided as follows: $274 million for the initial road registration tax (90% paid by cars), $31 million for various fees, and $150 million for tolls (91% paid by trucks [Table 13]).

The charging system mainly affects cars and large trucks. For the most part, it charges cars for accessing the road network, and trucks for using it. The system is useful to the analysis, as one can differentiate between "access" fees, which are fixed based on ownership, and usage fees, which vary with actual use (only tolls in the case of Myanmar). One-time "access" fees on car and taxi purchases generate 55% of total road revenues. User fees on trucks generate 29.5% of total road revenues (Table 14).

Table 13: **Annualized Road User Fees**
($ million per year)

Vehicle Type	Customs Duty	Customs Tax	Initial Registration Tax	Initial Inspection Fee	Renewal Inspection Fee	Initial Registration Fee
Motorcycles	0.0	0.0	0.0	3.6	1.6	7.2
Cars	118.2	98.5	197.0	0.4	1.2	0.7
Taxis	3.0	25.0	50.0	0.1	0.3	0.6
Light trucks	6.6	11.0	11.0	0.1	0.3	0.3
Medium trucks	2.5	4.1	4.1	0.0	0.2	0.1
Heavy trucks	4.0	6.7	6.7	0.0	0.2	0.1
Articulated trucks	1.7	2.9	2.9	0.0	0.1	0.0
Buses	1.4	2.3	2.3	0.0	0.2	0.0
Total	**137.4**	**150.5**	**274.0**	**4.2**	**4.1**	**9.0**
Vehicle Type	**Registration Renewal Fee**	**Initial License Fee**	**License Renewal Fee**	**Tolls**	**Total ($ per year)**	**Total Transport ($ per year)**
Motorcycles	5.2	0.0	0.0	0.8	18.3	18.3
Cars	3.3	0.0	0.0	5.3	424.6	207.9
Taxis	1.8	0.0	0.1	0.0	81.0	53.0
Light trucks	0.3	0.1	0.3	16.0	46.0	28.4
Medium trucks	0.7	0.0	0.1	16.7	28.6	22.1
Heavy trucks	0.7	0.0	0.2	63.8	82.5	71.8
Articulated trucks	0.2	0.0	0.1	39.9	47.8	43.2
Buses	0.6	0.0	0.2	6.4	13.4	9.7
Total	**12.8**	**0.1**	**1.0**	**148.9**	**742.2**	**454.4**

Notes:
1. Initial fees apply only on new vehicles.
2. The assumptions underlying this table reflect the current state of the fleet, which is being quickly being renewed and expanded.
3. Toll data are actuals, based on traffic volumes recorded at each toll gate. These totals correspond to the total receipts at the toll gates.
4. The toll roads considered here do not include expressways because of the lack of accurate revenue data.

Source: Asian Development Bank estimates.

Table 14: Annual Revenues, by Vehicle Type ($)

Vehicle Type	Road Fees ($ per vehicle per year)			Share of Total Revenues (%)		
	Vehicle Ownership Fees	Annual Fees	Variable Fees	Vehicle Ownership Fees	Annual Fees	Variable Fees
Motorcycles	2	3	0	2.4	1.5	0.2
Cars	252	20	16	44.0	1.0	1.1
Taxis	318	38	0	11.3	0.5	0.0
Light trucks	36	14	177	2.6	0.2	3.3
Medium trucks	57	55	644	0.9	0.2	3.6
Heavy trucks	205	57	2,773	1.5	0.2	13.8
Articulated trucks	406	57	5,412	0.7	0.1	8.8
Buses	103	49	265	0.5	0.2	1.4
Total				**67.3**	**4.2**	**28.5**

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

2.3 Cost Coverage Analysis

We propose to analyze user charge cost coverage from a financial and economic standpoint. Our analysis starts with aggregate numbers. It then analyzes coverage ratios by vehicle category and by the parts of the road network. Two separate benchmarks are proposed to analyze whether users pay for the costs they cause:

- **Financial efficiency:** comparing total road user fees with part or all of the infrastructure costs. This tells the extent to which users are financing a minimum share of network maintenance and development.
- **Economic efficiency:** comparing variable road user fees with road users' social short-term variable costs (variable maintenance costs and externalities). This tells whether road use is correctly priced from an economic efficiency viewpoint, i.e., whether it gives incentives that maximize economic benefits to society.

Financial efficiency viewpoint. From a financial viewpoint, road-related fees ($450 million) cover road network maintenance and rehabilitation ($520 million). Altogether, road users cover 45% of their fair share of infrastructure costs ($1 billion). Cars and large trucks are close to covering their fair share of costs, while smaller trucks, motorcycles, and buses are undercharged (Table 15).

Economic efficiency viewpoint. From an economic standpoint, variable user charges adequately cover the damage vehicles cause to the roads, but only a small fraction of road externalities (Table 16). Articulated trucks are the only vehicles that cover close to all their costs, and they appear disproportionately charged in comparison with other vehicles. Medium trucks do not even cover their variable maintenance costs, which are high because of overloading. Motorcycles, buses, and, to a lesser extent, cars are the least charged for the damage they cause. The efficiency of the system in providing incentives to use the network is limited by the fact that tolls apply only to the national network. This implies that articulated trucks are charged higher for the use of the national road network, but lower for the use of the other road networks. The charging system insufficiently charges other types of vehicles.

Table 15: Cost Coverage—Financial Efficiency Viewpoint

Vehicle Type	Total Annual User Fees ($ per vehicle)	Share Covered by Total User Fees (%)		
		Maintenance Costs	Maintenance and Rehabilitation Costs	All Allocated Infrastructure Costs
Motorcycles	5	19	18	12
Cars	287	182	139	49
Light trucks	228	45	30	11
Medium trucks	756	37	20	9
Heavy trucks	3,035	163	86	40
Articulated trucks	5,875	277	142	63
Buses	418	76	51	19
Road user fleet		**143**	**86**	**45**

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

Table 16: Cost Coverage—Economic Efficiency Viewpoint

Vehicle Type	Annual Variable User Fees ($ per vehicle)	Shares Covered by Variable User Fees (%)	
		Variable Maintenance Costs	All Variable Costs
Motorcycles	0	7	0
Cars	17	179	2
Light trucks	253	313	8
Medium trucks	672	56	12
Heavy trucks	2,847	279	68
Articulated trucks	5,472	474	84
Buses	279	123	4
Road user fleet		**57**	**10**

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

Analysis by network and vehicle categories. Aggregate ratios hide disparities among network categories. This is because variable fees are incurred on tolled roads, while a large share of the costs are incurred on other parts of the road network (particularly externalities). Table 17 presents the analysis by network and vehicle category, and reveals the following:

- On tolled roads, the largest trucks cover their complete infrastructure costs. Cars only cover two-thirds. The small and medium-sized trucks, as well as the buses, cover 10%–20% of their infrastructure costs. A change in the charging system should ensure that the largest trucks do not get charged more on tolled roads, but the smaller trucks do.
- The actual use of state or regional and urban or rural road networks is not charged. A change in the charging system should enable charging for the use of these networks.
- Most vehicles, except cars, pay only a fraction of their infrastructure costs on rural and regional/state road networks. This is particularly an issue for the largest trucks, which do not even cover the maintenance costs.
- In urban areas, vehicles cover the costs of maintenance and rehabilitation well, and even cars cover the infrastructure costs they generate. However, vehicles in urban areas generate far more externalities, potentially justifying higher fees.

Table 17: Cost Coverage Ratios, by Vehicle Category on Each Network

Vehicle Type	Fixed User Fees[a] ($ per veh-km)	Variable User Fees ($ per veh-km)	Total User Fees ($ per veh-km)	Economic Viewpoint (%)		Financial Viewpoint (%)		
				Variable Maintenance Costs	Variable Social Costs	Complete Maintenance Costs	Maintenance and Rehabilitation Costs	All Allocated Infrastructure Costs
Motorcycles								
National roads (tolled)	0.12	0.02	0.13.	48	31	25	11	0
State and regional roads	0.12	0.00	0.12	0	12	10	9	0
Rural roads	0.12	0.00	0.12	0	9	9	8	0
Urban streets and avenues	0.12	0.00	0.12	0	61	61	23	0
Cars								
National roads (tolled)	1.23	0.20	1.43	619	241	150	44	12
State and regional roads	1.23	0.00	1.23	0	93	63	32	0
Rural roads	1.23	0.00	1.23	0	63	63	30	0
Urban streets and avenues	1.23	0.00	1.23	0	460	460	110	0
Small trucks								
National roads (tolled)	0.11	0.90	1.02	962	123	69	19	40
State and regional roads	0.11	0.00	0.11	0	7	4	2	0
Rural roads	0.11	0.00	0.11	0	4	4	2	0
Urban streets and avenues	0.11	0.00	0.11	0	30	30	7	0
Medium trucks								
National roads (tolled)	0.17	2.46	2.63	119	91	42	17	51
State and regional roads	0.17	0.00	0.17	0	3	2	1	0
Rural roads	0.17	0.00	0.17	0	2	2	1	0
Urban streets and avenues	0.17	0.00	0.17	0	12	12	3	0
Heavy trucks								
National roads (tolled)	0.40	7.42	7.82	652	381	181	67	148
State and regional roads	0.40	0.00	0.40	0	11	5	3	0
Rural roads	0.40	0.00	0.40	0	7	7	3	0
Urban streets and avenues	0.40	0.00	0.40	0	41	41	10	0
Articulated trucks								
National roads (tolled)	0.66	14.49	15.15	1092	628	294	106	225
State and regional roads	0.66	0.00	0.66	0	15	7	4	0
Rural roads	0.66	0.00	0.66	0	9	9	4	0
Urban streets and avenues	0.66	0.00	0.66	0	58	58	14	0
Buses								
National roads (tolled)	0.34	2.68	3.02	469	217	108	37	22
State and regional roads	0.34	0.00	0.34	0	13	7	4	0
Rural roads	0.34	0.00	0.34	0	8	8	4	0
Urban streets and avenues	0.34	0.00	0.34	0	52	52	12	0

veh-km = vehicle-kilometer.

[a] The fixed user fees refer to all transport-related user fees minus the tolls by user category and then divided by annual mileage.

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

3 Review the Ministry of Construction's Tolled Road Program

Key Findings

The Ministry of Construction's road and bridge tolling programs generate in the aggregate large revenues, but these are concentrated in a small share of the network. MOC tolls 22,000 kilometers (km) of roads and about 170 bridges, which generated about $155 million in revenues in 2013. However, 80% of the tolled roads have very limited traffic and revenues, only generating 10% of total revenues. The auction road program seems to be a particularly inefficient revenue-collection mechanism.

The tolling structure is very detailed and skewed, so that the tolls are too high for trucks and too low for cars. The MOC uses 24 vehicle categories, while most countries use 5 to 9. The rates for cars are well below the levels in other countries, but large truck tolls are comparable. This large gap between truck and car toll rates is unseen in other countries, and not justified by the costs associated with each type of vehicle. We provide two examples of more optimal toll-rate structures corresponding to minor and major road improvements.

Current build–operate–transfer (BOT) road contracts cannot be implemented in a financially viable manner. The contracts include provisions for too systematic road widening, for too low toll rates, on roads having too little traffic. Very long BOT durations are uncommon by any standards, and only marginally improve the financial equilibrium of contracts.

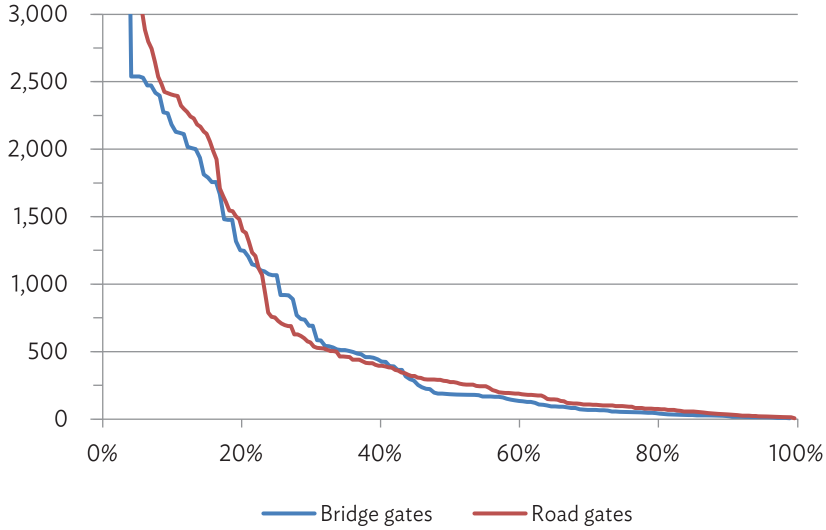
With higher toll rates, and more reasonable contract provisions, the BOT program could be used much more systematically to finance network improvements. However, we find little justification for tolling roads with less than 1,000 Annual Average Daily Traffic (AADT), implying that only about 4,500 km worth of roads in Myanmar should be tolled.

The MOC's auction toll model does not share the same flaws, but brings only moderate revenues to the MOC at a rather high 20% collection cost, and without applying a clear user-pays principle.

3.1 Overview

The MOC's tolling program covers most of the trunk road network, and generates large revenues. The tolling program covers about 22,000 kilometers (km) of trunk roads under the MOC's supervision, and generated about $155 million revenues in 2013. Based on available data, we estimate that the trunk road tolling program generates $125.5 million ($121.2 million collected under build–operate–transfer [BOT] schemes and $4.4 million under auction schemes). The bridge tolling program is estimated to generate $19.1 million ($2.8 million under an auction scheme and $16.3 million under a BOT scheme). The revenues associated with the Yangon-to-Mandalay expressway are about $10 million.

Figure 9: **Distribution of Traffic at Toll Gates**
(% of toll gates at various AADT levels)



AADT = Annual Average Daily Traffic.

Source: Asian Development Bank estimates based on data from the Government of the Union of Myanmar, Ministry of Construction.

However, revenues are highly concentrated on a small fraction of the road network with significant traffic. Only 20%–25% of toll gates register significant traffic, using a threshold of 1,000 Annual Average Daily Traffic (AADT), or 1,000 vehicles per day, not including motorcycles and bicycles, which do not pay tolls. Half of toll gates have traffic levels above 2,500 AADT, and 30% have even less than 100 AADT. Only 4% of bridge toll gates and 8% of road toll gates have a traffic level above 2,500 AADT (Figure 9). We received information on average traffic by vehicle category in 2013 at 213 toll gates located on roads (128 managed under auction schemes, and 85 managed under BOT schemes), and 170 toll gates located on bridges (154 auction and 16 BOT). The road BOT program covers 5,575 km, with an average length per toll gate of 66 km (41 miles). The auction road program covers 16,500 km, with an average length per toll gate of 130 km (80 miles). This corresponds to a tolled network of 22,000 km.

Road tolls are set according to the distance, and bridge tolls according to the length of the bridge. Computations assume that each road toll gate covers the same distance of 66 km for BOT gates and 128 km for auction gates. Large bridges (above 1,000 feet) receive much higher tolls than medium-sized bridges (between 180–1,000 feet). These bridges were individually identified to produce accurate estimates of revenues.

Road Toll Revenue Analysis

Most of the network is covered by auction road toll gates, which generate negligible revenues. The average revenue of an 'auction' road toll gate is $34,000 a year. The AADT is 215 (not including motorcycles). Almost all (96%) 'auction' road toll gates have less than 1,000 AADT, and 65% have revenues below $100,000 a year. The 10 'auction' toll gates with the most traffic generate annual revenues of $175,000 to $500,000 a year. Auction gates account for 60% of all road gates (Table 18).

Table 18: Analysis of Road Toll Gate Data, as of FY2013

Item	Auction	BOT	Total
Number of toll gates considered	128	85	213
Revenues estimates ($ million per year)	8.4	121.2	129.6
20% of gates with highest revenues generate (% of revenues)	...	...	84%
50% of gates with lowest revenues generate (% of revenues)	...	...	1.5%
Toll gates generating less than $100,000 annually, % (number)	94% (83)	1% (1)	39% (84)
Revenues generated ($ million per year)	3.8	0.1	3.9
Toll gates with traffic less than 1,000 AADT, % (number)	96% (123)	42% (36)	75% (159)
Revenues generated ($ million per year)	6.8	14.0	20.8

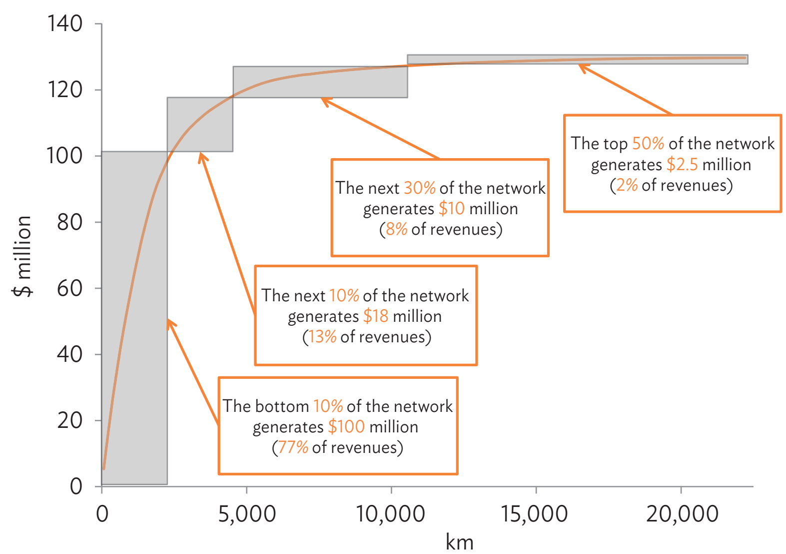
... = data not available, AADT = Annual Average Daily Traffic, BOT = build–operate–transfer.

Source: Asian Development Bank estimates based on data from the Government of the Union of Myanmar, Ministry of Construction.

In contrast, BOT road toll gates usually generate higher revenues. The average revenue of a BOT road toll gate is $1.4 million a year, and the AADT is 1,600. Only 1% of BOT road toll gates generate less than $100,000 a year. Still, 42% of BOT road toll gates have an AADT of less than 1,000. BOT gates account for 40% of all road gates.

Thus, a large share of toll gates generate minimal revenues. Of the total tolled network, 75% have less than 1,000 AADT. While the top 10% of the network generates 77% of revenues, the bottom 50% generates only 2% (Figure 10).

Figure 10: Toll Road Revenues, by Network Segment



km = kilometer.

Source: Asian Development Bank estimates based on data from the Government of the Union of Myanmar, Ministry of Construction

Bridge Toll Revenue Analysis

Auction bridge gates have generally have little traffic, but their individual revenues are higher than those for road gates. The average revenue of an auction bridge toll gate is $106,000 and the average AADT is 750. Only 20% of gates have traffic over 1,000 AADT with revenues above $100,000. Few have very high traffic (up to 16,000 AADT) and only four bridges generate annual revenues above $1 million, while the highest-revenue bridge gate generates only $2.6 million annually. All but one bridge with a large span are auction bridges. Auction gates account for 90% of all bridge gates (Table 19).

A few medium-sized bridges are managed under build–operate–transfer agreements. The average revenue of a BOT bridge gate is $170,000. The average AADT is 2,000. Most BOT gates have traffic between 1,800 and 2,500 AADT, and annual revenues between $200,000–250,000. BOT gates account for 10% of all bridge gates.

Altogether, the distribution of bridge toll revenues appears to be as skewed as the distribution of road toll revenues. Large bridge gates contribute even more disproportionately to overall revenues: the seven largest 50%.

Table 19: **Analysis of Bridge Toll Gate Data**

Item	Auction	BOT	Total
Number of toll gates considered	154	16	170
Revenues estimates ($ million per year)	16.3	2.7	19.1
20% of gates with highest revenues generate... % of revenues	...	...	85%
50% of gates with lowest revenues generate... % of revenues	...	...	2%
Toll gates generating less than $100,000 annually in % (number)	82% (126)	25% (4)	76% (130)
Revenues associated ($ million per year)	2.2	0.05	2.2
Toll gates with traffic less than 1,000 AADT in % (number)	80% (123)	25% (4)	75% (127)
Revenues associated ($ million per year)	3.5	0.05	2.5

... = data not available, AADT = Annual Average Daily Traffic.

Source: Asian Development Bank estimates based on data from the Government of the Union of Myanmar, Ministry of Construction.

Tolling Structure

The MOC's toll rate structure is very detailed, affects the largest trucks more than other vehicles, and lacks apparent coherence (Table 20). The toll rate structure includes 24 categories. There are 16 categories only for trucks only that depend on the number of wheels; the number of the axles; and the truck's length, function, and even brand. Categories for buses differentiate by seating capacity.

The ratio of the toll rate for the largest trucks (six-axle) to the toll rate for a standard passenger car is 18:1 on medium-sized bridges (180–1,000 feet), 33:1 on auction roads, and up to 70:1 on BOT roads and on bridges longer than 1,000 feet.

Table 20: **Ratios of the Toll Rates for Various Types of Vehicles to the Toll Rate for Cars**

		Road Toll Gates		Bridge Toll Gates	
Vehicle Type		Auction	BOT	< 1,000 feet	> 1,000 feet
1	Bicycles	...	...	...	0.1
2	Motorcycles, carts	...	...	0.2	0.3
3	Tricycles	1	1	0.4	0.7
4	Two-wheel tractor and trailers, saloon cars, station wagon (under 2 tons)	1	1	1	1
5	Farm trucks (2-stroke), double cabs, microbuses	3	3	2	2
6	Pickups (passenger transports)	3	4	2	2
7	Light trucks (4 wheels)	3	4	3	2
8	Farm trucks (4-stroke)	5	6	4	3
9	Light trucks (6 wheels, 2 axles, under 15 feet), minibuses (up to 25-seats)	5	6	4	4
10	Light trucks (6 wheels, 2 axles, over 15 feet)	8	15	5	7
11	Buses (26 to 35 seats)	5	6	4	5
12	Trucks (6 wheels, 2 axles)	10	20	5	10
13	Trucks (6 wheels, 2 axles) - TE 11, TE 21, UD Counter	10	20	5	10
14	Buses (36 to 45 seats)	5	10	4	5
15	Buses (over 46 seats)	6	11	4	5
16	Trucks (6 wheels, 2 axles)	10	20	5	10
17	Trucks (8 wheels, 3 axles)	13	23	6	12
18	Trucks (10 wheels, 3 axles)	15	25	6	13
19	Trucks (12 wheels, 4 axles)	18	30	7	23
20	Trucks (14 wheels, 5 axles, all wheels must drop on the road while driving)	20	35	9	27
21	Trucks (14 wheels, 4 axles, container with trailer)	23	40	11	40
22	Trucks (18 wheels, 5 axles, container with trailer)	30	60	16	67
23	Trucks (22 wheels, 6 axles, container with trailer)	33	70	18	73
24	Trucks or express bus without cargo or passengers	10	20	5	10

... = data not available, BOT = build–operate–transfer.

Note: The types of vehicles listed in this table are based on the 24 categories laid out by the Ministry of Construction.

Source: Asian Development Bank estimates based on data from the Government of the Union of Myanmar, Ministry of Construction.

The rates grow with the maximum loading weight or passenger capacity, but we could not find a direct relationship between rates and vehicle characteristics (weight, number of axles, or axle loads valid for all types of roads). Tolls for heavy vehicles are roughly proportional to their weight, except on large bridges, where the ratio increases. There is some degree of inconsistency among the scales. For example, the ratio of one vehicle category to another can sometimes differ significantly based on the type of tolling program, with no apparent logic.

Generally, it seems that tolls are based more on the users' ability to pay (taking into account the weight of the cargo and the number and wealth of the passengers) than on the benefit to the users, the purpose of the use of the road or bridge, and the damage caused to the road or bridge (user pay principle). The scale does not differentiate significantly among buses, except on BOT roads, where there is a large gap between the 26- to 35-seaters and the 36- to 45-seaters. The structure of BOT road tolls also singles out six-wheel, two-axle light trucks that are over 15 feet in length. Table 20 illustrates the ratios of the toll rates for various types of vehicles to the toll rates for passenger cars, based on the MOC's vehicle categories.

International Benchmarks

Myanmar's toll levels and structure stand out as an exception among developing and developed countries. The main lessons from the benchmarks of toll structures and rates as provided in Table 21 and Figures 11 and 12 are as follows:

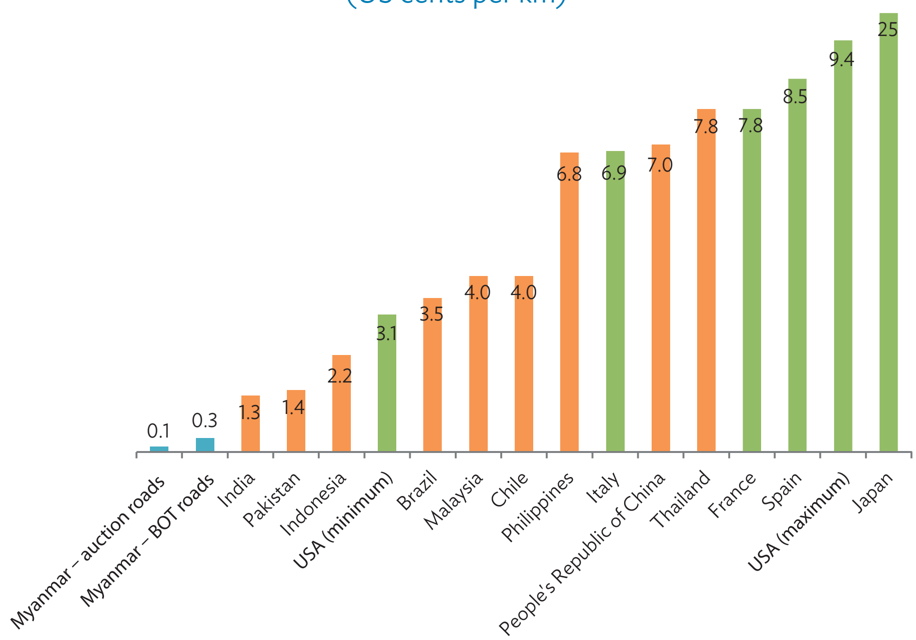
- Countries generally have fewer categories than the MOC, the norm being between five and nine.
- The ratios of the highest tolls to those paid for a single car is generally fall from 3:1 to 7:1.
- The MOC's toll rates for a car are 10 times lower than those in any other country for auction roads (current rate: $0.12 per km), and four times lower for BOT roads (current rate: $0.31 per km).
- The MOC's toll rates for the largest trucks are very low on auction roads (current rate: $0.04 per km), but on BOT roads they are comparable with, or are even higher than, the norm for developing Asian countries (current rate: $0.22 per km).

Table 21: **International Benchmarks for Toll Rates and Structures**

	Car Rate ($ per km)	Articulated Truck Rate ($ per km)	Articulated Truck:Car Ratio	Number of Categories
Myanmar auction roads	0.1	4	33.0	24
Myanmar BOT roads	0.3	22	70.0	24
India	1.3	9	7.0	7
Pakistan	1.4	10	7.0	7
Indonesia	2.2	7	3.0	6
USA (minimum)	3.1	14	4.5	9
Brazil	3.5	21	6.0	...
Malaysia	4.0	12	3.0	6
Chile	4.0	13	3.2	...
Philippines	6.8	23	3.3	...
Italy	6.9	16	2.4	5
People's Republic of China	7.0	35	5.0	
Thailand	7.8	21	2.7	5
France	7.8	23	3.0	5
Spain	8.5	34	4.0	...
USA (maximum)	9.4	43	4.5	9
Japan	25.0	38	1.5	5

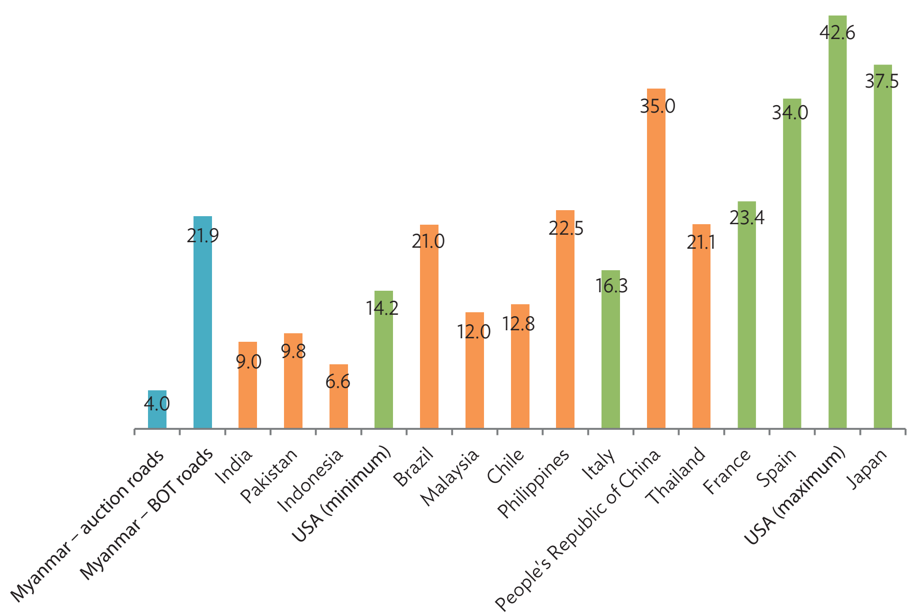
... = no data available, BOT = build–operate–transfer, km = kilometer.
Sources: Asian Development Bank estimates based on various sources.

Figure 11: **Toll Rates—Cars**
(US cents per km)



BOT = build–operate–transfer, km = kilometer.
Sources: Various sources.

Figure 12: **Toll Rates—Articulated Trucks**
(US cents per km)



BOT = build–operate–transfer, km = kilometer.
Sources: Various sources.

Comparison of Toll Structure with Costs and Benefits

Toll structures are generally based on any one or combination of the following: the damage caused by each type of vehicle, the road space used by each type of vehicle, and/or the benefits of road improvements for each vehicle type that are recovered through tolls. It has been admitted, however, that tolls should not exceed more than 30%–50% of user benefits.

There is scope for increasing the rates for cars, but not for large trucks. In the case of typical roads in Myanmar, user benefits would justify toll levels between $0.06 and $2.00 per km for a car and between $0.14 and $0.38 per km for a bus (Table 22). This suggests that there is much scope for increasing toll rates on cars, and that toll rates for the largest trucks on BOT roads are within the maximum range possible. We also find that the current BOT rate is, on average, approximately set so that it collects 30% of user benefits for a minor road upgrade, obviously with much variation among users. Setting the toll rate at 30% of user benefits for a major road upgrade would raise the average revenue tolls revenues by 150%.

Aligning toll rates with the costs caused by users would imply a flatter toll structure. The analysis of the alternative scales applicable in the case of Myanmar also suggests that the current difference between the tolls for the smallest vehicles and the largest ones is not justified economically (Table 23). Various options for sharing costs among users can be considered. For instance, one could allocate the pavement costs based on the actual load-damage factors and legal ones, the increasing costs due to road space use, and other costs, against the benefits obtained by the users. Table 17 shows that if these factors were weighted the same, the toll structure would have a range of 1 for a car to 5.6 for an articulated truck.

Table 22: **Benefits per User at Maximum Toll Rates**
(US cents per km)

	Minor Road Upgrade			Major Road Upgrade		
		Maximum Tolls			Maximum Tolls	
Vehicle Type	User Benefit	At 30%	At 50%	User Benefit	At 30%	At 50%
Motorcycles	1.3	0.4	0.7	1.7	0.6	0.9
Cars	6.1	2.0	3.1	12.8	4.3	6.4
Light trucks	7.5	2.5	3.8	15.1	5.0	7.6
Medium trucks	9.9	3.3	5.0	19.2	6.4	9.6
Heavy trucks	18.6	6.2	9.3	35.3	11.8	17.7
Articulated trucks	27.9	9.3	14.0	53.8	17.9	26.9
Large buses	41.8	13.9	20.9	76.7	25.6	38.4

Notes:
1. The user benefits include the vehicle operating costs and the value of time as computed based on the Highway Development and Management (HDM-4) model for Myanmar's vehicle fleet and typical time costs.
2. "Major Road Upgrade" refers to an upgrade of a 6.5-meter-wide road with an international roughness index (IRI) rating of 10 to a 9-meter-wide road with an IRI 3, and with the speed the road can accommodate rising from 30 kilometers per hour (kph) to 60 kph.
3. "Minor Road Upgrade" refers to an upgrade of a 6.5-meter-wide road with IRI 8 to an 8-meter-wide road with IRI 4, and with the speed the road can accommodate rising from 30 kph to 40 kph.
4. "At 30%" refers to a situation in which the tolls are equivalent to 30% of the amount the user benefits (in US cents per km) from using the road. "At 50%" refers to a situation in which the tolls are equivalent to 50% of the user benefits.

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

Table 23: **Theoretical Toll Structures**

Vehicle Type	Max. Legal Weight (tons)	Cost/Benefit Structure, Myanmar Parameters: Road Space (PCUs)	ESAL Actual Load	ESAL if Legal Load	Benefits per vehicle (Car = 1.0)	Toll Structure with Equal Factors (Car = 1.0)
Motorcycles	0.1	0.25	0.0	0.00	0.2	0.2
Cars	2.0	1.00	0.0	0.00	1.0	1.0
Light trucks	5.5	1.50	0.2	0.04	1.2	1.4
Medium trucks	16.0	1.75	6.7	2.00	1.6	3.9
Heavy trucks	25.0	2.00	3.5	3.00	2.9	4.1
Articulated trucks	40.0	2.50	4.1	4.50	4.4	5.6
Large buses	16.0	1.75	1.7	1.70	6.4	4.9

ESAL = equivalent standard axle load, PCU = passenger car unit equivalent.

Note: The legal load is 10 tons per axle.

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

Table 24: **Potential Alternative Toll Structures**

(MK per mile)

Vehicle Type		Current BOT Rates	Alternative Toll Schedules: New Toll Structure	Low Rates: Minor Improvement	High rates: Major Improvement
1.	Motorcyles	0		0	0
2.	Cars	5–10	1.0	30	70
3.	Light truck/medium buses	20–30	1.4	45	100
4.	Medium truck	75–100	3.9	120	260
5.	Heavy truck	150–200	4.1	130	280
6.	Articulated truck	300–350	5.6	180	380
7.	Large bus	50–55	2.5	75	175
Average gate revenue for 1,000 AADT		**840,000**		**1,000,000**	**1,940,000**

AADT = Annual Average Daily Traffic, BOT = build–operate–transfer, MK = kyat (the currency of Myanmar).

Note: The car rate is based on 30% of user benefit. The structure is applied to determine other rates. Gate assumed to control a road segment of 40 miles.

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

We provide illustrations of two potential rate structures that could be used in Myanmar, one for minor and the other for major road improvements. We build two alternative toll rate structures for BOT roads, drawing from our findings on optimum toll structures. To maintain some of the policy principles currently in use, we believe that motorbikes could remain exempt from tolls, and that buses should have a preferred rate, equal to half of the theoretical rate. A toll schedule for minor improvement works would produce revenues similar to those of the BOT structure, would shift the burden to car users, light trucks, and buses. The second-rate structure would generate 125% more revenues, in effect keeping rates constant for the largest trucks, but increasing them for all other vehicles (Table 24). The lower rates would put Myanmar within the norm of developing countries for both cars and trucks. The higher rates would be comparable with those of the People's Republic of China, the Philippines, and Thailand.

3.2 Financial Analysis of the BOT Road Model

We analyzed the existing BOT road contracts to determine whether they are financially balanced, on what type of roads and for what type of improvements they can be used, and what improvements could be made to the model.

The MOC's standard BOT contracts include long durations and costly provisions for major road widening. Specific features of BOT road contracts in Myanmar include:

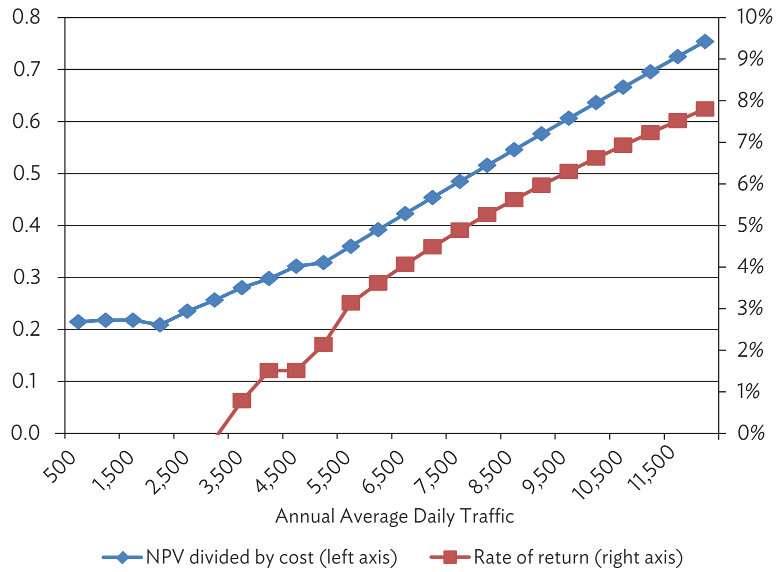
- long contract durations, specifically, 40 years plus three possible extensions of 5 years each thereafter;
- revenue-sharing agreements with the MOC after 5 years of operations, rising from 5% of revenues in the first 5 years to 20% of revenues after 34 years;
- inclusion in the contract of pavement improvements and major road widening once preestablished thresholds are passed: for instance, 2,500 Annual Average Daily Traffic (AADT) for four lanes and 5,000 AADT for six lanes (such threasholds appear very low, given that, according to the engineering standards of the PRC, the minimum level of traffic justifying a four-lane road is 15,000 AADT and for an eight-lane road, 60,000 AADT);
- no specifications or mechanisms to ensure the quality of maintenance;
- a provision that tolls may only start after 3 years and the completion of initial upgrade works; and
- a provision that all traffic and costs risks must be borne by the concessionaires.

No BOT road contract in Myanmar can currently meet the proper technical standards, and at the same be time financially viable. This is because BOT contracts for roads with low traffic do not generate enough revenues to cover maintenance costs. Additionally, BOT contracts for roads with moderate to high traffic would generate sufficient revenues to cover maintenance and rehabilitation costs, but are also contractually required to upgrade the roads to four or even six lanes, which makes them unprofitable. We built a simple financial model based on: (i) the standard costs of maintaining and upgrading roads in Myanmar, (ii) current BOT contract rules and toll rates, and (iii) the average traffic distribution by vehicle category. The model shows that a BOT contract could reach a financial rate of return of 10% only for a daily traffic rate of 16,500 vehicles, even taking into account future traffic growth over 40 years. For all BOT contracts, the ratio of total revenues to costs is likely to be between 0.2:1 and 0.3:1 (Figure 13). And this will only be realized if concessionaires carry out the maintenance and improvements necessary to maintain the proper levels of quality.

Given the prevailing toll and traffic levels, only periodic maintenance and, at best, rehabilitation could be financed by tolls. We then seek to assess what scale of investments the current BOT toll levels could enable, based on traffic levels and concession duration. In the model used, we consider contractors to be responsible for the maintenance of the road, and compare the present value of future net revenues over the concession duration, with the typical costs of an initial investment, which may include a periodic maintenance (e.g., an overlay), pavement rehabilitation works, reconstruction and limited widening, and major upgrades. Considering the revenue potential of BOTs, we find that the minimum AADTs for given types of concessions, depending on their duration, to be:

- maintenance concession: AADT of 750 (40 years) to 1,000 (10 years);
- rehabilitation and maintenance BOT: AADT of 1,750 (40 years) to 2,300 (15 years); and
- reconstruction and limited widening BOT: AADT of 3,500 (40 years) to 5,000 (20 years).

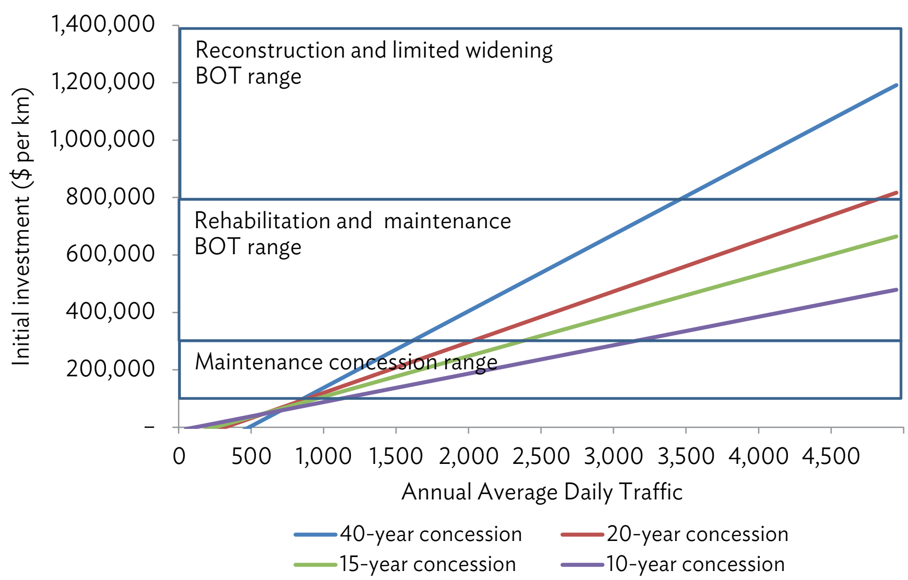
Figure 13: **Estimated Financial Returns of Build–Operate–Transfer Contracts as a Function of Traffic**



NPV = net present value.

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

Figure 14: **Initial Investments Financeable at 2016 Build–Operate–Transfer Rates, by Traffic**

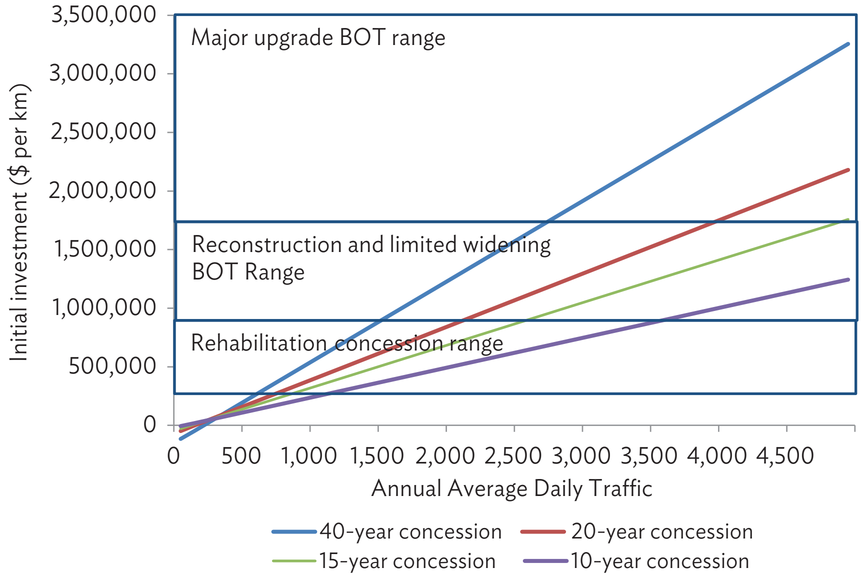


BOT = build–operate–transfer, km = kilometer.

Note: Initial investment thresholds are considered to be $100,000 per km for periodic maintenance, $300,000 per km for rehabilitation, $800,000 per km for reconstruction, and $1,500,000 for major upgrades.

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

Figure 15: **Initial Investments Financeable at Alternative Toll Rates, by Traffic**



BOT = build–operate–transfer, km = kilometer.

Note: Initial investment thresholds are considered to be $100,000 per km for periodic maintenance, $300,000 per km for rehabilitation, $800,000 per km for reconstruction, and $1,500,000 for major upgrades.

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

With the higher toll rates described in Section 3.1, road tolls could be used more systematically to finance rehabilitation and improvements. Using the proposed alternative toll structure based on the 20-year concession, depending on their duration, to be:

- rehabilitation and maintenance BOT: AADT of 750 (40 years) to 1,500 (10 years);
- reconstruction and limited widening BOT: AADT of 1,700 (40 years) to 2,800 (15 years); and
- major upgrade BOT: AADT of 3,000 (40 Years) to 4,200 (20 years).

Combining these findings, we find that a 1,000 AADT appears to be a meaningful threshold for any tolling to happen. However, at this traffic level, only long-term maintenance could be financed. Rehabilitation starts to be possible for 1500 to 2,300 AADT, and reconstruction with limited widening between 2,200 and 2,800 AADT. Major improvements are only likely viable (and necessary) at AADT of 4,200 to 5,000. These thresholds take into account the alternative toll rate structures defined above. They also try to align concession duration with the life of the assets created, a principle usually followed internationally. This principle limits concession life to 10–15 years for maintenance and rehabilitation, and to 20–25 years for larger works (Table 25). These considerations would, however, not apply to greenfield expressways. Because revenues depend on vehicle composition, finer thresholds could also be worked out using equivalent vehicle factors.

Table 25: **Minimum Traffic Thresholds, by Type of Concession**

Types of Build–Operate–Transfer Contracts	Minimum Traffic (vehicles)[a]	Duration (years)	Toll Rate Structure
Maintenance concession (including periodic maintenance)	1,000	10	Low Rates
Rehabilitation concession (including maintenance)	2,300	15	Low Rates
	1,500	10	High Rates
Reconstruction with limited widening	2,800	20	High Rates
	2,200	25	High Rates
Major upgrade	5,000	20	High Rates
	4,200	25	High Rates

[a] The figures in this column signify the Annual Average Daily Traffic (AADT).

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

3.3 Financial Analysis of the Auction Road Model

Principles Followed by the MOC. The auction model rests on very different principles from those of the BOT model. In principle, the MOC first carries out some improvement of the road (in practice, almost all paved MOC roads are tolled). The MOC then carries out a so-called auction for the management of the road. The MOC determines the revenue potential of the gate, based on the road's AADT in the previous year and on the toll rates. The MOC then selects a toll gate manager from among a number of candidates, first by preparing a short list of candidates based on technical and financial grounds, and then selecting them randomly from the short list. The toll gate manager is then required to make a payment to the MOC corresponding to 80% of the revenue potential of the gate for the next year. The toll gate manager is allowed to collect tolls for one year, before the next auction. Meanwhile, the MOC maintains the road.

This model generates only moderate resources to the MOC, at a high cost, and without the benefits of competition. It ensures the MOC a steady flow of revenues without the need to manage the toll booths directly. The MOC's collection costs thus amount to 20% of total revenues, whichever toll gate manager is chosen (in practice, being chosen for big toll gates may be a great opportunity, but that is much less the case for small ones). There is no role for competition, as the MOC reasons that the random selection makes the process more transparent and less corruption-prone than a real auction.

The auction toll model lacks a clear link between the size of user payments and the costs incurred by the MOC on these roads. While the model is apparently designed to make users pay for services provided, there is no direct link between what users pay and the works carried out. We compared annual net MOC revenues with typical maintenance and improvement costs. Altogether, the road toll program covers about all of the MOC's routine maintenance operational expenditures. The program generates $8.4 million a year, of which 80% ($6.7 million) goes to the MOC. This is approximately what the MOC allocates each year for operational expenditures (materials, hired labor) involved in the routine maintenance of these roads from the central government budget. This equivalence is valid only in the aggregate. Only 30% of the road toll gates generate revenues sufficient to finance the operational expenditures for routine maintenance by the MOC (materials, hired labor, estimated at $500 per km). Only 12% would have sufficient revenues to also finance staff salaries and equipment, estimated at $850 per km).

4 Possible Improvements in the Road User Charging Framework

Key Findings

Measure 1: Create a new heavy vehicle license fee. This fee would make heavy vehicles pay for the damage they cause to pavements. It would bring revenues of about $80 million each year, ranging from $120 a year for a medium-sized truck to $2,000–$3,000 for the largest articulated trucks. When this is being calculated, a review of the scope for increasing the legal maximum vehicle and axle loads is needed.

Measure 2: Create a fuel levy. This fee would make users contribute to road network maintenance and rehabilitation costs. At an initial rate of **$0.10 per litre (MMK375 per gallon)**, this would bring in $320 million in revenues annually.

Measure 3: Restructure the road tolling program. We propose to:

- **Create new toll rate schedules.** The lowest rate would bring similar revenues to those from current road BOTs, and the highest would bring about twice as much. The structure would be revised to reduce the number of vehicle categories from 26 to 7 and reduce the ratio between the toll paid by the heaviest truck to that of by a car from 70:1 to 5.6:1. The changes under this new structure would depend on the type of vehicle, raising them for cars, reducing them for large trucks, and leaving them the same for other vehicles.
- **Cancel road tolls on roads with low traffic**, potentially cancelling tolls on up to 18,000 km of roads and keeping them only on the 4,000 km of highways with traffic above 1,000 AADT.
- **Restructure the contracts to align their specifications with actual road needs and financial capacity, and then enforce them better.**

We also propose that the Ministry of Transport and Communications (MOTC) keep, for the time being, the initial road registration tax, which affects cars, at its current level, but that it consider differentiating the tax rates by city based on their levels of congestion in the medium term. The annual road registration tax could also be gradually phased out.

Altogether, these measures would raise road sector revenues from $450 million annually to $850 million. This would finance a much larger share of needs, and align much more what users pay and what they cost to society. Despite the cancellation of tolls, the measures we propose would increase toll revenues by 40% to $210 million.

Proposed principles for cost recovery. To maximize the economic efficiency of the transport system, road user fees should be set equal to the costs of the resources consumed when the road network is used. General principles to follow when restructuring a road user charging system are: (i) the road fees should never be set below the long-term variable costs of maintaining the road network; (ii) variable road fees should preferably be used to cover variable costs to align perceived incentives and costs; (iii) where major investments are carried

Table 26: **Characteristics of Different Road User Charging Instruments**

Charge	Potential Role	Related to Road Use	Recognizable as a Road User Charge	Collection Cost (%)	Evasion Corruption Risk	Suitability for Myanmar
Toll	User fee	Yes	Excellent	10–20	Moderate	Good
Registration tax	Control fleet size	No	Moderate	5	High	Good
Annual license fee	Vehicle access fee	No	Good	10	Unknown	Good
Heavy vehicle license fee	Vehicle access fee	No	Good	5	Unknown	Good
Fuel levy	User fee	Yes	Good	Negligible	Low	Excellent
Truck distance fee or weight–distance fee	User fee	Yes	Excellent	5	High	Low
Various types of congestion fees	Urban congestion charging	Can be	Moderate	10	Unknown	Low

Source: I. G. Heggie. 1995. Management and Financing of Roads: an Agenda for Reform. World Bank technical paper. *Africa Technical Series*. No. WTP 275. Washington, DC: World Bank.

out, road fees should enable adequate cost recovery; (iv) in urban areas particularly, fees should include congestion and other externality costs; and (v) instruments used for road charging should themselves be simple in design, correspond closely to their location, and have the lowest administrative cost.

Table 26 indicates the advantages and levels of suitability for Myanmar of possible road user charging instruments.

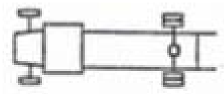
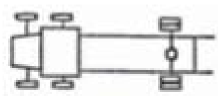
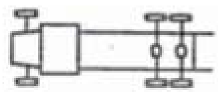
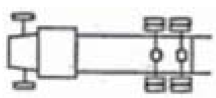
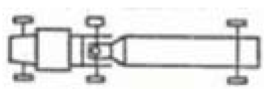
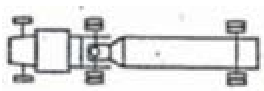
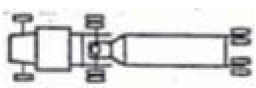
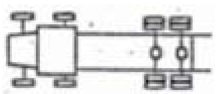
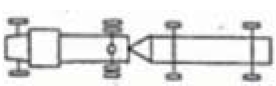
4.1 New Charging Instruments

Myanmar should consider introducing two new charging instruments, shown in Table 26.

The first is a heavy vehicle license fee, designed to pay for the damage trucks cause to pavements. In a simple version, this would be a fixed fee collected every year from all trucks and buses. It should preferably be structured to match the actual damage caused by trucks, based on their axle configurations, to provide an incentive for selecting the most efficient trucks. The costs resulting from damage due to loading are all variable periodic and variable routine maintenance costs on paved roads (variable maintenance costs on gravel roads depend more on utilization).

This fee should be designed to collect about $80 million annually (drawing from estimates of variable costs in Table 5). This amount should be allocated among heavy vehicles (trucks and large buses) based on the total axle load impact of a vehcle's equivalent standard axle load (ESAL). The scale should be proportional to the average number of annual ESALs for each category of vehicle (Table 4). It should include many categories because of the need to differentiate among axle configurations. Table 28 illustrates the range of rates, based on the standard axle configurations. The fees should be carefully set according to the actual axle configurations in Myanmar. At a later time, the fee could be made variable, depending on the actual annual mileage of each vehicle (truck weight–distance tax). A direct effect of the fee would be to give truck owners an incentive to shift to more efficient axle configurations. Introducing this fee would also be a precondition for raising the allowed axle load by 15%, as discussed in the 2016 Asian Development Bank (ADB) publication *Myanmar Transport Sector Policy Note: How to Reduce Transport Costs*. Manila.

Table 27: **Conventional Method for Denoting Axle Configurations**

	1.2	Single tires on the front axle Twin tires on the rear axle
	11.2	Single tires on the front pair of axles Twin tires on the rear axle
	1.11	Single tires on the front axle Single tires on the rear axles Two rear axles
	1.22	Single tires on the front axle Twin tires on the rear axles Two rear axles
	1.1-1	Single tires on all axles Articulated chassis
	1.2-2	Single tires on the front axle Twin tires on the rear axles Articulated chassis
	1.2-2s	Single tires on the front axle Twin tires on the rear axle 1 Separated tires on the rear axle 2
	11.22	Single tires on the front pair of axles Twin tires on the rear pair of axles
	1.2+1.1	Single tires on the front and both trailer axles Twin tires on the rear axle

Source: ND Lea International and Haskoning Koninklijk Ingenieurs-en Architectenbureau. 1991. Annex 1 in *Myanmar Comprehensive Transport Study*. UNDP Project MYA/86/012 Draft Inception Report. Yangon: United Nations Development Programme (UNDP).

A fuel levy would make it possible to charge all users on a pay-as-you-go basis. Fuel taxes affect all vehicles and movements. Their main benefit is to apply the user-pays principle to all road networks. In the case of Myanmar, its amount could be set to cover all road network maintenance costs (except those covered by the heavy vehicle license fee), and potentially rehabilitation costs. To cover all maintenance costs except on tolled roads, it would have to be set at a rate of $0.065 per liter (about MK65 per liter). To also cover all rehabilitation costs except on national tolled roads, a rate of $0.10 per liter (about MK100 per liter) is needed. If the purpose is to compensate for all social variable costs on nonurban networks, then the rate should be set at about $0.20 per liter (about MK200 per liter). In all cases, it should be acknowledge that coverage ratios involve much averaging. Table 29 presents the revenues per vehicle and the total to be expected from each option. The central value of $0.10 per liter is used in further discussions.

Such heavy vehicle license fees and fuel levies are common internationally.

Table 28: **Potential Heavy Vehicle License Fee Rates**

Truck Type and Configuration[a]	ULW (tons)	Payload (tons)	GVW (tons)	Axle Weight (tons)				ESAL	Annual License Fee ($)
				Front	Axle One	Axle Two	Axle Three		
Two-axle trucks									
1.2	2.0	4.0	6.0	3.0	3.0	...	...	0.0	10
1.2	4.5	6.0	10.5	5.3	5.2	...	...	0.3	120
1.2	4.8	8.0	12.8	5.4	7.4	...	...	0.9	400
1.2	5.5	10.0	15.5	5.4	10.1	...	...	2.8	1,260
1.2[b]	5.5	11.5	17.0	5.4	11.6	...	...	4.9	2,230
1.2[c]	5.8	15.0	20.8	5.4	15.0	...	...	15.0	6,810
Three-axle trucks									
1.22	5.8	12.0	17.8	5.4	12.4	...	...	0.6	290
1.22	7.0	14.4	21.4	5.4	16.0	...	...	1.5	680
1.2-2	9.3	16.0	25.3	5.4	10.0	10.0	...	5.0	2,280
1.2-2[b]	9.3	19.0	28.3	5.4	11.5	11.5	...	9.1	3,420
Four-axle trucks									
1.2-22	11.0	15.0	26.0	5.4	7.9	12.7	...	1.6	730
1.2-22	11.0	20.0	31.0	5.4	9.8	15.8	...	3.7	1,690
1.22-2	11.0	15.0	26.0	5.4	12.7	7.9	...	1.6	730
1.22-2	11.0	20.0	31.0	5.4	15.8	9.8	...	3.7	1,690
1.22-2	11.0	24.0	35.0	5.4	18.2	11.4	...	6.8	2,830
Five-axle trucks									
1.2-222	12.0	15.0	27.0	5.4	7.2	14.4	...	1.0	450
1.2-222	12.0	20.0	32.0	5.4	8.9	17.7	...	2.1	960
1.22-22[b]	12.0	25.0	37.0	5.4	15.8	15.8	...	2.7	1,215
1.22-22[b]	12.0	30.0	42.0	5.4	18.3	18.3	...	4.8	2,160
Trucks with trailers									
1.2+2.2	11.0	22.0	33.0	5.4	9.2	9.2	9.2	5.4	2,450
1.2+2.2	11.0	25.0	36.0	5.4	10.2	10.2	10.2	8.3	3,780
1.2+22.2	12.0	25.0	37.0	5.4	8.8	14.0	8.8	3.8	1,730
1.2+22.2	12.0	30.0	42.0	5.4	10.2	16.3	10.2	6.9	3,150
1.2+22.22	13.0	35.0	48.0	5.4	10.1	16.2	16.2	5.6	2,550
1.2+22.22	13.0	40.0	53.0	5.4	11.3	18.1	18.1	8.9	4,060
1.22+222	13.0	35.0	48.0	5.4	18.9	23.7	...	4.3	1,970
1.22+222[b]	13.0	40.0	53.0	5.4	21.2	26.4	...	6.9	3,130

... = not applicable, ESAL = equivalent standard axle load, GVW = gross vehicle weight.

[a] The first column of this table uses the conventional method for denoting axle configurations.

[b] The current permissible loads would not be allowed, but they would be authorized with a 15% higher axle load allowance.

[c] Thus is a typical observed case of overloading, and not for actual application.

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

Table 29: **Potential Fuel Levy Rates and Revenues**

Vehicle Type	At $0.065 per Liter		At $0.10 per Liter		At $0.20 per Liter	
	Annual Fees per Vehicle ($)	Total Annual Revenues ($ million)	Annual Fees per Vehicle ($)	Total Annual Revenues ($ million)	Annual Fees per Vehicle ($)	Total Annual Revenues ($ million)
Motorcycles	7	26.3	12	41.9	20	80.8
Cars	110	44.7	174	68.7	350	137.4
Taxis	310	24.6	474	37.9	950	75.8
Light trucks	330	27.7	501	31.6	1,000	85.2
Medium trucks	820	20.5	1,265	31.5	2,530	63.0
Heavy trucks	1,440	32.3	2,219	49.8	4,440	99.5
Articulated trucks	2,290	16.7	3,525	25.7	7,050	51.3
Buses	920	21.3	1,418	32.3	2,840	65.6
Total		**214.1**		**319.4**		**658.6**

Note: Revenue projections are based on Myanmar's 2014 vehicle fleet.
Source: Asian Development Bank estimates based on the road user cost model developed for this study.

4.2 Changes in Existing Instruments

The initial road registration tax should be maintained initially at its high level, but could be gradually differentiated by city. This tax acts primarily by controlling the size of the car fleet, which is mainly located in urban areas (60% of cars are registered in Yangon). Despite the high rate, and even after the introduction of a fuel tax, cars would still only cover 50% of their external costs in urban areas. This implicit subsidy to car travel would reduce the attractiveness of alternative transport modes (bus, rail), which in turn may require financial government support. However, the situation is very location-specific, and government policy in the last few years has been to facilitate access to car ownership. At this stage, it is recommended to maintain in the medium-term the tax rate at its current level. In the future, the efficiency and fairness of this instrument could be improved by differentiating the levels by city, and considering specific congestion-charging instruments, starting with Yangon. It could be complemented by a similar tax on motorcycles, which also congest urban roads and pollute. The levy would have to be city-specific specific. However, only limited variations could be possible because of the possibility of registering in a different area.

The annual vehicle registration fee would become redundant if other instruments described in this report are set up. There are no obvious economic reasons for maintaining an annual vehicle registration process and fee—after the instruments we have described are set up.

The tolling program should be fully rethought. The tolling program scope, and the toll level and structure, should be revised along the lines of the findings presented in Section 3. The current build–operate–transfer (BOT) toll levels are insufficient to finance the improvement works on most roads in Myanmar. The auction toll levels are usually insufficient for financing the maintenance of most roads in Myanmar by the MOC, and they come with a high collection cost of 20%—far more than the administration costs of a fuel tax. For economic fairness and efficiency, it would be preferable to ensure that when a road segment is tolled, the revenues are sufficient to finance the actual works that take place there. Auction road toll gates should be removed once the fuel tax is implemented. The discussion and international benchmarks described in Section 3 revealed that improvements would involve a combination of the following actions: (i) cancelling the tolls on the share of the network that has the least traffic; (ii) raising toll levels so that they can be enough to finance road maintenance, rehabilitation, and/or upgrade works; and (iii) revising the tolling structure to reduce the number of vehicle categories and share the tax burden more evenly, especially by raising the tolls on cars, light trucks, and buses.

The main recommendations for restructuring the tolling program are as follows:

- **Cancel all tolls on roads with traffic volumes of under 1,000 AADT**. This would bring the tolled road network from about 22,000 km to 4,000 km (3,250 km national highways and the Yangon–Mandalay expressway). A finer threshold should be worked out based on predicted revenues, rather than on AADT.
- **Apply the new low toll rate structure to roads with AADT from 1,000 to about 2,500, and convert the contracts into long-term maintenance concessions**. This would apply to about 2,100 km of roads initially.
- **Apply the new higher toll rate structure to roads with AADTs above 2,500, and enforce clear specifications about road-improvement works on these roads**. This would apply to about 1,000 km of roads initially.

Altogether, these proposals would increase the total revenues from tolls by 40%, from $145 million (not including the Yangon–Mandalay expressway) to $205 million annually. Possible implementation and transition arrangements are discussed in the 2016 ADB publication *Myanmar Transport Sector Policy Note: Trunk Roads*.

4.3 Revenues and Cost Recovery after the Proposed Changes

The changes proposed in the previous paragraphs would raise road sector revenues from $450 million to $850 million (Table 30). This would cover all maintenance and rehabilitation costs, pay 65% of total infrastructure costs, and cover 35% of social external costs. It would raise the fees on all vehicles, particularly on light and medium trucks and buses, and to a lesser extent on cars and motorcycles (Table 31). The logic for each instrument would be the following:

- **Financially**: Heavy vehicle license fee and fuel taxes would pay for the maintenance and rehabilitation of the road network. The road registration tax and the tolls would pay for part of the network upgrade and development works.
- **Economically**: About 75% of user charges would depend on actual level of network use, and only 25% would be fixed. The heavy vehicle license tax would cover the damage caused by heavy vehicles. The fuel tax would cover a fair share of road user externalities, applying user-pays principles to all road networks. The road registration tax would make car owners pay for their congestion and environmental costs in urban areas and would act to control the vehicle fleet.

The changes would also improve the extent to which all vehicles cover their costs (Table 32 and Table 33). The structure is imperfect in the sense that the heaviest trucks would remain more highly taxed than the smaller vehicles, and more than either their social variable costs or their fair share of infrastructure costs. This is because the fuel levy is a naturally imperfect tool for sharing fixed maintenance and rehabilitation costs among users based on how much they are on the road. However, the excessive taxation is partly artificial, as not all trucks use tolled roads. Improvements to this structure could seek to decrease the tolls further for heavy vehicles once the fuel tax is set up. Such improvements would also need to consider how to raise revenues from motorcycles, which contribute little under any scheme.

Table 30: Total Annual Road-Agency Revenues with Proposed Changes ($ million)

Vehicle Type	Fuel Levy	Initial Road Registration Tax	Heavy Vehicle License	Toll	Total	Structure as of 2014
Motorcycles	41.9	0.0	0.0	0.5	42.4	18.3
Cars	68.7	197.0	0.0	32.0	297.7	207.9
Taxis	37.9	50.0	0.0	0.0	87.9	53.0
Light trucks	31.6	0.0	3.1	37.9	72.5	28.4
Medium trucks	31.5	0.0	28.2	21.2	80.9	22.1
Heavy trucks	49.8	0.0	14.3	76.7	140.7	71.8
Articulated trucks	25.7	0.0	10.7	28.9	65.4	43.2
Buses	32.3	0.0	19.6	11.9	63.8	9.7
Total	**319.4**	**247.0**	**75.9**	**209.1**	**851.3**	**454.4**

Note: Revenue projections are based on Myanmar's 2014 vehicle fleet.
Source: Asian Development Bank estimates based on the road user cost model developed for this study.

Table 31: Average Annual Revenues with Proposed Changes ($ per vehicle)

Vehicle Type	Fuel Levy	Initial Road Registration Tax	Heavy Vehicle License	Toll	Total	Structure as of 2014
Motorcycles	12				12	5
Cars	170	250		100	520	290
Light trucks	500		50	600	1,150	240
Medium trucks	1,265		1,130	850	3,250	780
Heavy trucks	2,220		640	3,420	6,280	3,100
Articulated trucks	3,520		1,480	3,970	8,970	5,935
Buses	1,420		860	600	2,800	**427**

Notes: Heavy vehicle license fees are averages based on the assumption that license fees are set so that each vehicle covers its share of variable maintenance costs. Revenue projections are based on Myanmar's 2014 vehicle fleet.
Source: Asian Development Bank estimates based on the road user cost model developed for this study.

Table 32: Cost Coverage after Proposed Changes—Economic Efficiency Viewpoint

Vehicle Type	Annual Variable User Fees ($ per vehicle per year)	Variable User Fees as a Share of:	
		Variable Maintenance Costs (%)	All Variable Costs (%)
Motorcycles	9	414	8
Cars	240	2,945	29
Light trucks	1,000	1,364	36
Medium trucks	1,860	176	39
Heavy trucks	5,190	552	134
Articulated trucks	6,790	649	115
Buses	1,730	857	28
Road user fleet		**490**	**37**

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

Table 33: **Cost Coverage after Proposed Changes—Financial Efficiency Viewpoint**

Vehicle Type	Total Annual User Fees ($ per vehicle)	Total User Fees as a Share of:		
		Maintenance Costs	Maintenance and Rehabilitation Costs	All Allocated Infrastructure Costs
Motorcycles	12	50%	46%	36%
Cars	520	332%	253%	127%
Light trucks	1,150	171%	112%	57%
Medium trucks	3,250	151%	81%	50%
Heavy trucks	6,280	330%	175%	108%
Articulated trucks	8,970	418%	215%	129%
Buses	2,800	499%	333%	174%
Road user fleet		**270%**	**120%**	**85%**

Source: Asian Development Bank estimates based on the road user cost model developed for this study.

The new structure would not lead to inflation in bus fares or freight rates if the resources raised are used to improve the road network. Greater resources for road maintenance and rehabilitation would help improve the road network, which would eventually reduce the costs of operating buses and trucks. This would counterbalance the impacts of higher fees on end users. Bus fares are expected to remain sensibly similar, or possibly slightly reduced. Car user out-of-pocket fees would rise on trunk roads, but not on the rest of the network. Shipping via large trucks should become cheaper by 10%–25%, which would strengthen their competitive advantage against medium trucks. Altogether, the changes brought by higher fees and better roads would be progressive: they would favor rural bus user (actually, bus users in general) over the more well-off car users and urban dwellers.

Table 34: **Road User Benefits**
(MK per 100 km)

Item	Unit of Measure	Transport Costs Before		Transport Costs After		
		Trunk Road (BOT)	Secondary Road (Auction)	Trunk Road (High Toll Rates)	Secondary Road (Low Toll Rates)	Secondary Road (Not Tolled)
Bus user	psgr per100 km	2,000	2,300	2,000	2,300	2,250
Car user (out-of-pocket costs)	psgr per100 km	3,800	3,400	4,450	3,600	3,300
Freight—large truck	ton per 100 km	3,800	6,000	3,200	5,300	5,500
Freight—medium truck	ton per 100 km	5,400	10,000	5,900	10,000	9,700

BOT = build–operate–transfer, km = kilometer, psgr = passenger.

Sources: Asian Development Bank (ADB). 2016. *Myanmar Transport Sector Policy Note: Trunk Roads*. Manila (the assumptions in this table were drawn from the trunk road maintenance scenarios developed in this publication); ADB. 2016. *Myanmar Transport Sector Policy Note: How to Reduce Transport Costs*. Manila (the base line rates and vehicle cost models are developed in this publication).

Myanmar Transport Sector Policy Note

How to Improve Road User Charges

Better transport is essential to Myanmar's development. After decades of underinvestment, Myanmar's transport infrastructure lags behind other regional countries. Sixty percent of trunk highways and most of the railways need maintenance or rehabilitation. River infrastructure does not exist, while 20 million people lack basic road access. Can the transport sector deliver upon the master plan's objectives? What is needed to improve the quality of the infrastructure and services for the industry? How can basic transport services be provided to all? How can Myanmar reduce the economic and social cost of transport? This report is an attempt to answer these questions.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to the majority of the world's poor. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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