21st Australasian Transport Research Forum
Adelaide, September 1997

Economic Approaches to Road Congestion in Bangkok

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Abstract:

This paper examines policies for pricing roads in Asia's most traffic-congested city, Bangkok. First-best arguments for road pricing are bolstered by Bangkok's traffic hypercongestion suggesting motorists will derive gains from pricing even without income compensations. Second-best policies however are likely to be favoured because of the transactions costs of pricing in such a large city and because of non-auxiliary externalities such as transport subsides and second-best problems. Distributional arguments against pricing are weak. Alternative road supply, public transport and other complementary good pricing policies are analysed and the implications of continuing to rely on supply-oriented policies examined.

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Introduction

What economic policies exist for dealing with Bangkok's intractable traffic congestion? What are the limitations of conventional supply-oriented approaches to congestion control? This paper answers these questions but avoids concern with the very specific details of Bangkok's circumstances. The aim is to provide conceptual clarity. Too often desirable policy reforms for Bangkok's urban problems are avoided by appealing to a need for more data. More data is *not* needed with respect to Bangkok's transport problems - they are self-evidently severe and worsening: Congestion in central Bangkok is close to gridlock with traffic volume/capacity ratios from 0.85-1.00. Occasionally traffic comes to a complete stop for periods from 2-4 hours. Traffic growth has been slow in recent years simply because flows are close to capacity limitations. The increases which have occurred have been accommodated by a lengthening peak which lasts most of the day. Average travel times have worsened by 20-30 per cent over the last five years with problems spreading distantly from the city: see JICA (1996). Supply-oriented policies and traffic control tinkering have not reduced chronic congestion. This paper shows how arguments for using economic instruments to manage traffic need adaptation in congested developing country cities, with Bangkok the primary case.

First-best pricing arguments

Initially simplify problems of planning in Bangkok by initially assuming that: (A1) Further road supply options are limited there with the social marginal product of investment in improved road supply low without road use demand management. (A2) While public transport demands increase with effective private vehicle demand management the resulting demand increases are manageable with an efficient bus and the proposed mass transit system.

(A1) is accurate in Bangkok. This is controversial but easy to defend. There is a huge latent demand for travel with many people not making private vehicle journeys simply because of anticipated congestion. Unless future increases in road supply are impracticably large they will be swamped by such latent demands leaving congestion unchecked. (A1) will gain increasing community acceptance as successive supply-augmentation options, such as expressway expansions, fail to reduce chronic congestion and as traffic worsens. (A2) also requires justification. Improved public transport is self-financing if bus services run efficiently and recover costs through pricing. Also, if Bangkok's hypercongestion is reduced, buses can make more city journeys per day effectively increasing public transport provision. There are probably cost advantages in continuing to rely primarily on bus rather than more capital-intensive mass transportation services such as rail but the development of mass transit systems within and around Bangkok should help accommodate increased demands for public travel following congestion pricing. Without effective pricing however the expanded use of mass transit and buses, by diverting users away from private vehicle use, will result in

latent private vehicle demands becoming active, swamping initial reductions in private use demands and leaving congestion as before.

Provisionally make three further assumptions: (A3) There are no second-best constraints bearing on pricing so *all* traffic flows are *simultaneously* efficiently priced. (A4) Transactions costs of pricing are negligible with external costs associated with road use being instantaneously, exactly and costlessly measurable. (A5) Pricing maximises net social benefits (*efficiency gains*) with costs of all externalities internalised.

(A3) means no other external costs are left unpriced. This extreme assumption, if relaxed, mainly implies qualifications about the *types* of roads which should be priced and the scale of pricing, rather than the case for pricing. (A4) implies that road use costs can be accurately estimated with charges levied at negligible cost. Appropriate charges then depend on specific journeys and the time they are made. Label price policies which can isolate (presumably electronically) such specific costs as *continuous monitoring policies*. (A4) amounts to assuming that continuous monitoring is feasible. Actual policy might be less precise than this. Prices may be levied for entry to particular areas regardless of journey or when taken - this is *discrete monitoring*. Such discrete policies only approximately reflect social marginal costs (SMCs) but are important because they lower the transactions costs of pricing. Objections to (A4) can be accommodated via approximate policies which trade off transactions costs against efficiency gains. Finally (A5) is controversial since it ignores *distribution* issues. However we will argue distribution can be accommodated by revenue redistribution.

Given (A1)-(A5), the first-best policy for Bangkok is to price a vehicle journey at its instantaneous SMC (in terms of value of time lost by other users, road maintenance, accident costs, emission and noise pollution costs). This maximises efficiency gains from roads. This well-understood principle of 'first-best' welfare economics (see Walters (1961), Hau (1992)) is an efficiency conclusion since it only argues that the value of 'gains' to pricing exceeds value of losses induced - thus a *potential Pareto improvement* occurs with gainers being *potentially* able to compensate losers. However, if revenues from pricing compensate motorists by providing them with public goods they would otherwise pay through taxes or charges, there are *pure* Pareto gains to all.

Thus, while road users are disadvantaged in having to pay for use of roads that were previously free, they gain through shorter trip times and less congestion. The income lost through pricing exceeds the value of the time saved and reduced externalities so eliminating externalities *without compensation* implies losses to users. Charges need to be redistributed to users as public goods to achieve net gains for all.

This case for pricing has long been advanced and, at first sight, nothing seems new with respect to Bangkok. However Hau (1992) argues that road pricing in cities like Bangkok is particularly attractive because traffic there displays *hypercongestion*. Figure 1 below illustrates this. Here travel demand is high at DD*. The average cost curve AC has the normal non-negative slope over an initial phase but then has a backward-bending phase

reflecting that, at high traffic densities, there is a stable high-density-high cost traffic equilibrium A called a *hypercongestion equilibrium*. At such densities the cost of travel in terms of time and petrol costs is high at AA*. With efficient pricing there is a case for setting a user charge equal to the divergence between average and SMC (the distance EF) so the charge plus the private cost to the user is EE*. The point is that drivers *do not need* to be compensated when subject to this toll since their cost of travelling falls from AA* to EE*. Everyone is better-off with pricing. The government derives revenue and motorists experience reduced travel costs.

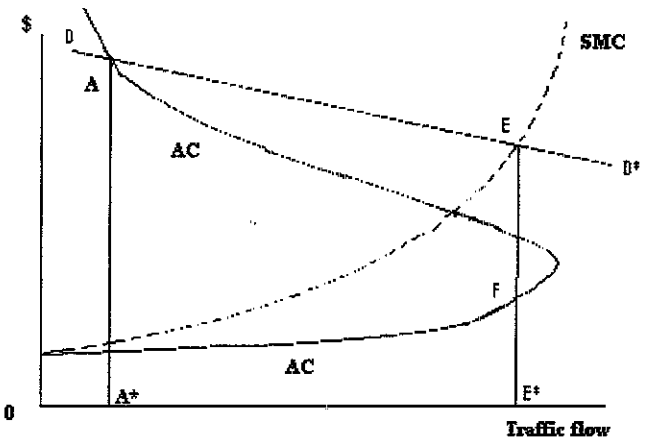

Figure 1: Traffic Equilibrium with Hypercongestion.

As will be discussed, even without hypercongestion, distribution is not a major constraint on the case for pricing in Bangkok because gains in time saved are likely to be vast. The main limitation lies in potential violations of assumptions (A1)-(A5). Then first-best policies may be sub-optimal. Accounting for these violations suggests alternative approaches to dealing with congestion using *second-best* (or other) policies.

Second-best policies: limitations to first-best pricing

How might first-best optimum conditions be violated? How serious are such violations?

Transactions costs

If transactions costs of pricing - costs of monitoring, collecting and enforcing road tolls - exceed the efficiency gains attributable to pricing, it is inappropriate to price road use even given (A1)-(A3) and (A5). At issue is the technical feasibility and cost-effectiveness of pricing. The technology of toll collection has advanced considerably with *electronic road collection* tested in Hong Kong and being an engineering and economic success: see Hau (1990). This technology is now commercially available and

operating on toll highways and bridges around the world. It handles road pricing transactions quickly and efficiently without appreciably slowing traffic.

In Bangkok the congestion and pollution costs of road use are large. People spend significant proportions of their lives in traffic jams: Midgley (1994, page 16) estimates vehicles spend 44 days per year on average stuck in traffic. However Bangkok is a large city so aggregate transactions costs of pricing are significant. Even if such aggregate transactions costs are lower than pollution, congestion and other costs, the latter do not have a market valuation and hence have less weight in public budgets than they should.

More economical methods of road pricing than continuous monitoring may yield lower gains in terms of reduced externalities but produce lower transactions costs. Such approximations to efficient pricing include (i) pricing at city gateways or boundaries, (ii) fixed per day charges, (iii) various parking charges and (iv) pricing of complementary goods sold with the use of private automobiles such as fuel, tyres and registration. These policies are discussed below. While transactions costs of pricing do not destroy the case for road pricing in Bangkok they may influence the technology used to bring about *approximate* efficient pricing.

Other externalities

In Bangkok there are many unpriced externalities. Apart from traffic congestion these can be associated with noise and waste pollution, road maintenance and road accidents. In some cases these costs are associated with vehicle use because use involves the emission of pollutants and the creation of noise - such costs are called *auxiliary externalities*. The existence of such costs does not constitute a problem for first-best policy-making with respect to traffic pricing since the SMCs applied to compute usage tolls can simply be augmented to include the auxiliary costs.

Public transport however is also underpriced in Bangkok and is not an auxiliary cost. The practical rationale for such pricing is a misguided attempt to improve the distribution of income to favour the poor: the *Second Theorem of Welfare Economics* shows a better policy is to price transport at marginal cost and then to provide compensating transfers to the poor. However an efficiency rationale for subsidies can be based on the support they provide to a second-best policy of inducing commuters away from unpriced and relatively-congesting private vehicle use toward less congesting public transport. This is socially suboptimal because subsidies to public transport help encourage *overall* socially excessive commuting demands - the better policy is to price *both* public and private travel at SMC. That public transport is underpriced is not an efficiency argument against efficient pricing of private vehicle use. Full pricing of private vehicle use removes second-best reasons for subsidising public transport whose prices can then be adjusted to their SMCs given efficient road pricing.

In Bangkok public bus travel is heavily government-subsidised. With efficient pricing of Bangkok's roads there will emerge socially-excessive demands for bus travel and increased inefficiency and financial losses associated with their utilisation. Since there are no substantial economies-of-scale advantages associated with increased demands for such services, such increased demands generate severe problems for public transport. From an efficiency perspective public fares should be increased to cope with increased demands to fully reflect SMCs. This reduces incentives to make a switch from private vehicles to public buses but such shifts tend to be self-financing for the public sector and results in socially-desired usage of each mode. Without such reform non-recouped costs of public transport remain an obstacle to reducing congestion via road pricing.

Boundary issues

Significant second-best constraints limiting efficient road pricing arises because not *all* private vehicle journeys can be feasibly priced. For transactions cost reasons it is impossible to price *all* trips. Pricing use of particular roads when others are unpriced leads to traffic diversion toward unpriced roads and concentrated congestion there. This is a *boundary problem*. In a large city like Bangkok, with severe traffic problems over a large area, diversion around tolled area is likely to be important.

Bangkok, unlike Singapore, has no clearly-defined CBD where pricing can be enforced. The traditional central areas of Bangkok (Silom, Suriwongse, Rama 4, Sukumwit) are all *very* congested. But so are areas fifteen kilometres from these areas such as Latprau. Even areas 40-50 kilometres from these areas such as Rangsit and Minburi suffer congestion. What city sectors should be priced?

Suppose for simplicity the only second-best constraints are of the boundary problem type. Then extreme answers to the question of where pricing should be enforced are of little interest. If only small areas are priced this will not improve traffic flow due to traffic congestion and parking problems on their boundary. Pricing all of Bangkok (or of Thailand!) is limited by transactions costs. If continuous monitoring of vehicle use in an extended area is not ruled out on transactions cost grounds - then pricing over this extended area is feasible and desirable. Otherwise pricing needs to cover only major alternative roads into and around Bangkok with perhaps quantitative restrictions on use of smaller roads. If continuous monitoring is impossible, so only fixed charges can be levied for vehicle use within the large area, then a practical difficulty is that many residents already live within the tolled area. A fixed toll on car use operates as a disincentive to own vehicles but not as a specific incentive to limit use within the area. A fixed toll on entry to the area would not capture vehicle use by those resident.

Experience suggests that fixed charges on vehicle ownership might not have a significant impact on car ownership - in the past when import duties on vehicles were high there was still a rapid expansion in Bangkok's traffic due to price-inelastic car demands. Also one suspects that scams would soon be developed whereby vehicles used

in Bangkok were registered outside city limits. Thus unless continuous monitoring is feasible, boundary problems impose constraints on feasible road pricing.

Boundary problem difficulties can be avoided by approaching road pricing iteratively. Roads where congestion is significant relative to transactions costs are then priced and resulting boundary problems observed. The roads in the boundary set (where congestion problems are severe) are then also priced and the search for boundary congestion problems replicated. This process continues until an iteration where all roads with significant congestion are priced and congestion in boundary areas is low relative to the transactions costs of pricing.

The current road pricing philosophy among Bangkok's planners is to introduce tollways as differentially-priced alternatives to congested networks: see Midgley (1994, page 51). Thus suppose there are two ways of proceeding from one destination to another - the most efficient unpriced (and congested) route costing $\$C_1$ in terms of petrol, time and other costs and the less-congested priced route costing $\$C_2+t$ where t is the toll. Assuming no intrinsic merit to taking either route (this is so if motorists *only* travel to reach a destination) then in equilibrium $C_1 = C_2+t$ and the imposition of a toll imposes a differential between the congestion costs of alternative routes. Thus tolling imposes a deadweight loss because shifting users from congested to uncongested routes increases aggregate welfare. Imposing a toll on a road for which there are unpriced perfect substitute routes reduces social welfare. If one route cannot be priced then the expressway should remain unpriced. Current Thai policy does *not* promote economic efficiency and so is not a 'second-best' optimum policy.

Efficiency gains and distribution

The economic analysis of road pricing is dominated by concern with efficiency. The reason for this concentration on aggregate welfare rather than its *distribution* is the *Second Theorem of Welfare Economics* implying that, under certain conditions, distribution and efficiency issues are *separate*. Society should price to determine efficiency but move toward socially desired distributions using tax/transfers: see Stiglitz (1988, Chapter 3). This implies roads should be priced at SMC and if this results in losses for some (the poor and those 'tolled-off' roads because their value of time is low) these should be compensated by gainers. Ideally taxes should be lump-sum but, if this is infeasible, *approximate* optimality is achieved by charging efficiency prices and compensating non-lump-sum by standard (and distorting) tax/transfers: see Ng (1984).

The main losers from pricing are those commuters who previously used roads without charge. If these people continue to use roads after charging they derive gains from reduced congestion and pollution which partially offset the effects of charging and, with hypercongestion, may reverse them. Other losers might include businesses in tolled areas facing reduced demands. Also, bus commuters may face increased bus congestion or increased fares from the increased demand for public transport. These costs, however,

are offset by gains such users derive from reduced travel times and improved trip frequencies made possible due to the reduced congestion.

The main gainers are Bangkok residents whose lives will be dramatically improved through reduced travel times. In a city starved of public facilities, funds yielded by road pricing can provide parks and facilities as well as improved public transport. Many individuals who currently spend 4-5 hours travelling to and from work daily 20 kilometres from the CBD can now accomplish their travels in 2-3 hours which saves about 2 hours per day or 10 hours per week. With a working week of 45 hours this represents substantial reduced unpaid-for work time and a gain in terms of reduced discomfit. Distribution arguments against road pricing in Bangkok are weak. Political difficulties need be counteracted with campaigns emphasising the benefits of pricing.

Alternative traffic policies for Bangkok

The economic arguments for road pricing in Bangkok are strong but in public bureaucracies, and among politicians, there is little support for pricing. Pricing proposals are seen as impractical. If we understand the unpopularity of pricing it may be possible to represent the case for such policies more successfully. It might also be possible to promote alternative policies achieving similar outcomes which have greater feasibility. If there are few attractive alternatives then arguments for pricing strengthen.

Significant losers from moves to pricing are those firms concerned with building *new* roads and with those sections of the public sector whose prestige and political power stems from road expansion. Substantial losers would be politicians/bureaucrats who continue to argue for supply policies now seen to be wasteful. With efficient pricing some preexisting road investments may be seen to be excessive so capital expenditures will switch from road construction to road maintenance: The World Bank (1994) argue developing countries spend too much on new roads rather than on maintenance - this seems particularly valid in Bangkok where many new roads are deteriorating rapidly.

Ignoring such interest groups, why have authorities been slow to price when benefits dominate costs? The implication one draws from observing the preference for supply solutions is that there must be *non-economic* costs of pricing. Charging is a vivid expense - environmental and congestion costs less vivid. Those constrained to take long journeys through heavy traffic may see charging as a tax without clear benefits. With proposals to charge, must go education emphasising the social costs of pollution/ congestion and the benefits derived from charges. We now survey alternative policies arguing that, unless they are close substitutes to pricing, they will be *poor* alternatives.

Road supply policies

The main policy focus among Bangkok public officials and politicians has been to promote the cause of wider, improved or new roads (especially radial tollways) as solutions to congestion. While vast sums have been invested, traffic problems have steadily worsened. One reason is that peak road use times in Bangkok are so long (in some cases there is congestion from early morning to late evening) that there is substantial *latent demand* for travel: This latent demand is accentuated by a latent demand for private vehicles. Bangkok's traffic congestion is severe but levels of car ownership are low. JICA (1996) estimate motor vehicle ownership at 280 vehicles per thousand residents compared to developed country cities where ownership is 500 per thousand. In Downs' (1992) terms, there are *triple convergence* implications of a supply-oriented approach to congestion: large latent demands respond to new supply options by actually travelling, users of other routes switch to new options and those making peak-hour journeys embark on trips later leaving congestion unchecked. Only policies increasing the cost of journeys can avoid triple convergence. Building more roads will not.

One difficulty is that Bangkok's planners have been assessing the need for new roads in an environment where roads are unpriced. Without pricing there is a propensity to overinvest in roads. If road demands are priced then additional investment is justified by revenue effects at the margin - supply should be increased if roads make profits until the marginal cost of increased supply equals marginal revenues: see Newbery (1988). If road pricing is used then investment in expansion should be redirected toward maintenance with new road investments being targeted to dealing with the implications of higher traffic speeds, with breaking down the predominantly radial character of major roads and in developing improved feeder roads to better utilise planned tollways.

An argument against current road investments - even ignoring pricing - is their primarily *radial* character. Many major tollways and new roads lead directly *into* central Bangkok where extreme congestion prevails. While vehicles can be shifted to the site of this extreme congestion more quickly, an inevitable bottleneck occurs unless central traffic moves more freely. Land in this central area is expensive and the building of much-improved roads there impractical. Some emphasis is being given to ring road development diverting traffic from the need to enter Bangkok and from using complex radial links to make cross city journeys. According to JICA (1996) this emphasis should be increased. Also there is the need to change philosophy from building radial highways which encourage linear city developments and *urban sprawl*. Radial roads provide most benefits to residents living on or near the roads and few to those living adjacently. One reason is that Bangkok's roads have little *hierarchical structure*. Major roads link up with small roads ('soi') which are not well equipped to handle traffic volume and which, by providing ongoing low traffic volumes, continually interrupt flows on major roads. More effort should be devoted to building feeder roads which efficiently enable those not living on major roads to utilise such roads.

A major advantage of utilising efficient pricing of road use in Bangkok would be to eliminate the waste of resources accompanying excessive road construction. The

overhead Don Muang carriageway running north from Bangkok, is now estimated to cost 160 billion baht (see Sherer (1995)) and seems likely to worsen city-based bottlenecks. Apart from design implementation problems it is subject to the difficulty of being wasteful for triple convergence reasons. It cannot alleviate congestion and is an aesthetic blight on the city landscape. The resources used in this construction represent a substantial cost - they could be much better used to provide urban facilities such as parks and recreational areas and for preserving greenbelt areas on Bangkok's periphery.

Public transport

The official policy focus in Thailand is to improve public transport to alleviate congestion. The idea is that if commuters could be induced to travel in buses (and perhaps on mass transit trains though the relevance of arguments favouring buses over mass transit have not been evaluated in Bangkok) then, since fewer vehicles would be on the road, congestion would be lower. It is clearly advantageous to commuters to have a comfortable, well-maintained bus and train service responsive to consumer needs. The difficulty with such policies is their triple convergence implications. With improved public transport there is encouragement of latent demands for travel by private vehicle. There is diversion from the more to less congested routes while those leaving for work early to cope with peak delays can move to leave. The effect of investing in improved transport infrastructure will be a marginal reduction in congestion.

Moreover, with unpriced roads a shift from private to public transport is difficult to achieve. There is low cross-price substitution between private and public transport: see Button (1993). This is likely in Bangkok since bus and train travel are significantly less convenient than private transport and, in terms of time, more expensive. Much travel is not radially directed towards a CBD - often it is cross-town requiring several changes of bus for a single journey - so a case for preferring private vehicle use remains strong.

If efficient pricing of roads *is* introduced then some passengers will avoid travelling ('the tolled out'), others will continue travelling but pay a toll ('the tolled in') and others will switch their mode of transport to less preferred options such as bus or will not travel at all boosting latent demands for travel. The important implications of road pricing for public transport policy are:

- First, as mentioned with pricing it is possible to eliminate subsidies as a second-best offset to road non-pricing. This saves resources by preventing overinvestment in loss-making buses and better cost-recovery because fares move toward costs.
- Second, with efficient pricing and consequent lower congestion, existing bus fleets can be run more efficiently. Provided congestion is absent, the frequency of service can be enhanced at low marginal cost. The only additional costs with such a more efficient operation of the bus fleet are the additional fuel demands (if any) from running buses continuously at speed rather than idling in the traffic jams. Without pricing, a 110 km return bus journey in Bangkok from Rangsit to Sukumwit might

take 5-6 hours. Thus at best 2.5 return journeys can be accomplished per day (6 am to 9 pm). If the return journey is reduced to 3 hours due to reduced congestion the bus can make 5 return journeys per day - effectively doubling route capacity.

An argument raised by Thai bureaucrats is that road pricing can only occur *after* public transport service improvement. The problem with such a philosophy is that bus services are being improved in a non-optimal environment where too many journeys are being taken. Correct pricing of roads involves pricing both private car use and bus travel at respective SMCs. In so far as both prices increase markedly it may be that optimal levels of bus provision do not need to increase much - particularly if improved operating efficiencies of bus fleets can be realised.

While this discussion has been phrased largely in terms of bus services, the options of promoting intercity rail or intra-city mass transit (policies currently being implemented in Greater Bangkok) can be interpreted similarly as can schemes for restricting certain types of travel. Such policies will not reduce congestion much given their triple convergence implications and low substitution possibilities from private vehicle use.

Complementary good pricing

Pricing of goods consumed with private car use seems an attractive way of deriving the advantages of road pricing without associated transactions costs. Transactions costs are not increased with such pricing because trade in such items *already* occurs - the only issue is the scale of charges. We consider two complementary policies - via fuel prices and via car registration fees/taxes.

Taxes on fuel. To the extent that fuel use is linearly related to congestion, road charging can be imposed indirectly by taxing fuels. This appears an attractive option for Thailand where fuel prices are among the lowest in the non-OPEC world and where there is concern over the scale of the national energy import bill. For clarity assume other externalities associated with the use of fuels *per se* have been internalised. Thus, if fuel use creates marginal pollution costs in terms of lead (or other emissions) emitted into the atmosphere of 5 baht per litre and if road maintenance externalities are 2 baht per litre, then suppose these have already been internalised via a tax on fuel. The only issue is whether, in addition to such internalised charges, extra charges can and should be levied to approximate congestion charges.

There are several difficulties. Fuel is only a small part of total private transport costs so the price elasticity of private travel with respect to fuel use is low: see Button (1993). Thus charges must be substantial if they are to significantly reduce private vehicle use. By itself this is not necessarily a criticism. However fuels are used where they are not creating congestion. They are used in industry and in agriculture for irrigation and farm equipment. Also fuels are used by private vehicles in rural areas where there is no congestion. Here pricing fuels above their SMC creates its own inefficiencies. Factories

and farms not experiencing external costs but subject to a levy will be inadequately mechanised and transport services in rural areas will be underprovided and expensive.

This is not a negligible issue in a country like Thailand where 80 per cent of the population live in rural areas and where government actively encourages use of fuel-intensive technologies to raise living standards. Also, imposing an unwarranted externality tax on this population would be distributionally unjust.

An apparent solution is to levy the congestion tax only on fuel supplies which add to congestion. This means charging a levy only on fuels purchased for travel within Bangkok. This policy however creates its own costs - fuel is sold at two prices depending on type of user and perhaps location. This leads to socially-wasteful (and possibly dangerous) 'fuel-fetching' with motorists or illegal suppliers travelling to uncongested areas to purchase fuel for resale. There is also the need to monitor fuel sales to non-congesting users to check that purchases are not being resold.

Another possibility is to subject all fuel supplies to the charge but then pay rebates to purchasers who demonstrate use outside congested areas. There remain substantial transactions costs of verifying such use and of monitoring use to ensure legality.

Thus charging more for fuels to effect congestion control is costly. There are advantages to a developing society in having access to cheap fuel. Setting high prices on fuel throughout the country to prevent congestion in part of the country seems inappropriate. The alternative of setting different prices for different types of user imposes high transactions costs of discriminating and of monitoring. The better option is to direct pricing at the point where congestion is occurring - on road use in Bangkok.

Car registration/car pricing. It can be argued that car registration fees and taxes on car purchases can be increased to offset congestion. Each measure is subject to the same difficulties as using complementary fuel taxes to proxy road user charges. A large pool of users lives outside Bangkok where congestion is a lesser issue. Charging discriminatory charges for Bangkok residents might create an industry in upcountry 'car registrations' - though one facing smaller costs of policing than 'fuel fetching'.

A difficulty is that such discriminatory taxing fails to distinguish socially-desirable vehicle use. It is undesirable to restrict private vehicle use *per se* - in the right circumstances vehicle use creates social benefits. The objective is only to restrict use where it generates substantial unpaid-for costs. Thus levying a high tax on vehicle purchases for those living in Bangkok (or subjecting such users to high registration costs) fails to distinguish between the car-owner who travels to work by bus each day and one who drives to work each day.

Finally, we mention an advantage of applying charges via registration fees rather than via new car prices. Levying hefty taxes on new cars reduces incentives to update vehicles as they are subject to depreciation. Charging via registration fees has no such

effect. An aged car fleet involves use of obsolete technology, extra fuel and maintenance costs. It may also imply extra risks of in the event of car accidents.

Final comments on complementary pricing: The difficulties of dealing with congestion through complementary pricing have been argued. These qualifications however, must be carefully put since if pricing is ruled out for transactions cost reasons these complementary policies may emerge as at least *feasible* options.

Discriminatory fuel, registration or car tax policies are impractical for reasons set out. However a package of high tax, high registration charge and high fuel charges *uniformly applied* throughout the Kingdom seems an attractive option on other grounds. Thai fuel and vehicle demands are price-inelastic and hence are good public revenue sources. Also, vehicle ownership is skewed in favour of the wealthy and there are serious income distribution and poverty problems. Whatever the inefficiencies of imposing unwarranted congestion taxes on communities outside Bangkok, such taxes do permit a substantial feasible redistribution of income to the rural poor. There are also gains to Bangkok's residents in reducing congestion. These redistributive and efficiency gains may be enough to offset losses consequent on using nondiscriminatory taxes for congestion.

This is not a weakening of the argument for pricing road use in Bangkok - it simply sets out an inferior alternative policy that is feasible and also increases welfare.

Parking policies: Parking in Bangkok is cheap compared to other Asian cities. Increasing parking costs and extending parking restrictions (and the intensity with which they are policed) increases the cost of travel to Bangkok when a city location is the destination. Such price increases and parking restrictions have few disincentive effects on *through* traffic - they may increase the demand for through traffic journeys given the reduction in other demands and reduced obstructions to travel when on-street parking is reduced. There will be triple convergence consequences of increasing the costs of parking by encouraging more through-journeys. In some cases this could be severe - for example if drivers are led to 'drop-off' people at sought-after destinations.

There would, however, seem to be some efficiency gains from pricing parking efficiently and from restricting opportunities for on-street (free or paid) parking because of the effect of such policies in increasing costs of in-town destination journeys. There are three policy design issues here (i) the *scale* of parking charges, (ii) the relation between parking charges and duration of stay (the *gradient* of charging) and (iii) the effects of privately-provided parking for employees. We discuss these in turn.

The *level* of parking charges needs to be set higher than at present but should not be treated as an instrument that *alone* can deal with congestion. Parking charges are a blunt charge since they are a function solely of journey-destination and disregard origin. Levying a high charge unreasonably penalises those making short, non-congesting trips. They reduce the agglomeration benefits from living in a city - the possibilities of being in close contact and of directly exchanging goods and information. Charging needs to be

high enough to induce care in using private vehicles but not so high that commercial and personal life deteriorates markedly.

Parking charge *gradients* likewise need to be designed to provide disincentives for short-duration trips which add considerably to congestion. Charges should decrease with duration of stay with short-term stays adjacent to peak periods being heavily charged. The intent is to reflect short-term marginal congestion costs.

Finally, correct incentives should be given to firms to provide private parking places to employees. The imputed market value of such parking facilities should be estimated in terms of corresponding costs of privately-provided parking inclusive of congestion charges. This would then be included as employee income and taxed as income. The employee would then have the option of retaining a company-paid car parking facility or of taking the corresponding benefit as income when again the benefit would be taxed.

Doing nothing: We last consider a most plausible policy. 'Doing nothing' means not pricing complementary goods and not making parking more expensive. Most importantly, it means *not* pricing road use directly. It might mean attempting to augment road supplies or promoting non-congesting public transport but, as we have argued, these policies will have little effect on congestion for triple convergence reasons.

Political-economy reasons for continuing with current ineffective policies are strong. Political leaders and government bureaucracies in Thailand have underwritten an extensive supply-oriented program that they would be reluctant to agree faces the prospect of offering little relief to congestion. Foreign aid schemes and local entrepreneurs gain substantial benefits from providing consultants and engineers to design and construct an expanded road supply and other transport supply options. Finally, one feels a bias in Thai society favouring technological solutions to intractable problems - even if such reforms do nothing to improve traffic congestion, overhead carriageways and monorails advance an image of modernity.

If such measures fail and Bangkok's traffic congestion problems continue what urban trends will emerge? Thailand still faces at least two decades of sustained extensive growth before its growth levels out at developed country 'intensive' rates of increase. During this phase per capita incomes will substantially increase and the demand by Thai citizens for an improved environment will grow substantially: see Clarke (1995). As part of this demand the value placed by Thais on travel time will substantially increase. In itself this will reduce demands for travel into cities like Bangkok and increase demands for residences, schools and businesses to locate on the city's periphery. The desire to avoid congestion as augmented by rising living standards would create a sprawling congested mega-city with a population of 15-25 million people in 25 years.

This response to congestion is already occurring with central Bangkok's population declining by 60,000 people annually. Businesses and housing are relocating on the periphery. There are costs of such developments. Allowing people to relocate away

from congestion problems rather than pricing them leaves most people exposed to miserable lifestyles dominated by traffic jams. It also means that the agglomeration economies providing the rationale for Bangkok's existence are lost as populations and businesses become diffuse. It also signifies socially inappropriate conversions of rural and forested land to urban development when, given income-elastic demands likely in the future, Bangkok should be doing all that it can to preserve such areas. It has few neighbouring wilderness areas and only very limited parklands close to its city centre.

Road use pricing limits longer-term costs to Thailand of an expanding economy. Failure to price means that costs borne by Thais, in terms of congestion, pollution and excessive demands for expanded roads will continue to increase as the economy grows.

Final remarks

There is a strong presumptive case for pricing road use in Bangkok at SMC. There are two main supporting arguments: (i) there are no satisfactory alternative policies and (ii) pricing provides welfare gains.

The reason there are no feasible alternative policies is the *triple convergence* argument of Downs (1992). Improvements in highways and improved public transport will not go far to improve welfare because congested conditions will reemerge as motorists switch to less congested routes, peak travellers make departures closer to desired arrival times and latent travel demands become realised.

Road supply policies should concentrate on improving the maintenance of existing city roads, on expanding the delivery of ring roads which reduce motorists needs to travel on radial roads when making non-radial journeys and finally on improving the hierarchical structure of roads linking residential areas to major arterial roads.

The gains from pricing take the form of reduced travel times and commuting costs, saved public resources through reduced private and public transport costs and, in the longer-term, through reduced pressure on city environments. According to the theory of hypercongested traffic flows, with prevailing conditions in Bangkok, gains will accrue to all, even without income compensations to motorists. More conventional theory suggests gains to all will occur with a move to pricing provided compensations are paid to those motorists who lose with charging.

While there are no strict alternative policies there are substitute policies which can approximate congestion charging. These include increased car registration fees, taxes on new vehicles, parking charges and restrictions. Also, while not all roads in Bangkok can be priced for transactions cost reasons, there are iterative procedures which price all roads subject to serious congestion and which simultaneously limit congestion problems on the boundary of areas priced.

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