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Managing Sustainable Mobility: The Economics of Transport Externalities and Policy

By Ravinder N. Batta

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I. Introduction

Efficient transportation systems are necessary for providing access to resources, markets, and services (e.ghealth and education) alongside other amenities. Availability of cost-effective mobility options or the lack of it has not only direct implications on the economic efficiency, but also affects the overall well-being of the people. It is estimated (Lakshmanan 2007) that transportation interventions in production and supply chain generate types and sequences of consequences (such as expansion of markets, higher efficiencies through scale economies, economic restructuring through entry and exit of firms exposed to new competition) that enhance overall economic benefits. Thus, the contributions of transport to the economy are both direct (arising out of active use of transportation systems) and indirect (aggregate economic activity benefits related to changes in output, productivity and employment). These types of economic impacts occur in three forms: system performance and cost effectiveness, regional economic development, and liveability.

However, like all other good things in the world, transport also does not come without a cost. One of the major limitations of the road transport is that it requires a huge infrastructure before its product (automobile) is of some use to the society. Then on use, automobiles are associated with a number of externalities major among them are energy- and emission-intensity, congestion and road fatalities. It is for these unintended side effects that the governments world over are re-evaluating their policies to see if they could handle these problems. Several recent developments (e.g. global warming, spurt in oil prices leaving many countries in serious balance of payments crisis, urban grid lock, and rising road fatalities) make a case for reinventing transport policies. Several studies provide discussions on such externalities like Litman (2006), Parry, Kenneth, and Small (2005), Parry, Walls and Harrington (2007), Schafer 2012; and Zivin and Neidell (2013). While most studies conclude that reducing carbon intensity of energy and energy intensity of transport is a must, but some of them (e.g.Litman 2006; and Schafer 2012) conclude that actions on modal structure and volume of mobility (clubbed as behavioural approach) are also required.

From the policy perspective, ultimate objective is to achieve sustainable transport. The concept of sustainable transportation systems is defined as the one in which fuel consumption, vehicle emissions, safety, congestion, and social and economic access are of such levels that they can be sustained into the indefinite future without causing great or irreparable harm to the future generations throughout the world (Zivin and Neidell 2013). For achieving sustainable transport, it is essential to study the detailed implications of each one of these externalities and the current policy scenario as well as the possible solutions in terms of policy instruments. It may be useful to understand as to how to handle policy instruments when these externalities are affected by diverse factors for example, emissions vary with fuel usage, vehicle technology, vintage, traffic flow, and driving behaviour. Likewise, congestion may be affected by vehicle miles travel (VMT), insurance regime, siting of residential and commercial facilities, and timing of travel. Road safety is also a result of many factors like vehicle technology, insurance regime, and enforcement of regulations. Further complications are introduced in the presence of asymmetric information among the various agents.The challenge before the policy makers therefore is to control the four components through policy interventions: the carbon intensity of fuels, the energy intensity of mobility, the modal structure of mobility and the volume of mobility. In terms of Schafer

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(2012), the first two are classified as technology oriented and the last two are behavior oriented (often called Travel Demand Management TDM).

Most studies focus on the technological aspects of mitigation (on the energy intensity of mobility and carbon intensity of fuels) but tend to ignore the behavioural aspects(Schafer 2012) of mobility (e.g. volume of mobility and adoption of low carbon modes). A typical approach from the standpoint of technological approach for addressing the problems of transport is to build more roads and fuel-efficient vehicles. However, two major effects arise affecting volume of mobility: induced demand effect (Goodwin 1996) and rebound effect (Greening et.al. 2000). The induced demand effect arises as a result of infrastructure building or improvement leading to increased mobility. In the long run, it also changes the economic value of land affecting the location of activities and hence mobility needs. The rebound effect arises consequent to reduction in marginal cost of travel due to fuel economy (for a detailed analysis please see Gillingham 2020). Thus, instead of solving the problem, we end up aggravating it. Hence, it is argued (Litman 2006) that behavioural approaches have to be explored to find a sustainable solution. This paper is an attempt to highlight the need and importance of behavioural approaches in solving transport problems. In order to practically understand the dynamics of it, it takes up a study of transport policy of Himachal Pradesh - a province in the Indian Himalayas.

This paper is organized as follows. Section 2 presents discussions on transport externalities in alternate forms and dimensions. It also includes a literature review on the issue of externalities and their management. Section 3 is devoted to the study of transport sector in Himachal Pradesh. It highlights the current scenario in the sector, situation on externalities and presents analysis of the policy challenges faced by the state. Section 4elaborates the behavioural policy options available to the state and finally section 5 draws conclusions of the study. The study finds the transport policy in Himachal Pradesh fails to provide transport infrastructure of high standards, promote non-discriminatory competition within and between modes, and ensure tackling externalities. It is argued that the traditional approach of providing more infrastructure should be supplemented by behavioural initiatives to reduce the travel demand.

II. Transport Externalities

Among the major externalities are environmental emissions, energy security, congestion and road accidents. All of these are examined in detail as under.

a) *Environmental Externalities*

Among the major emissions caused by automobiles are Carbon Dioxide (CO2), nitrogen oxides (NOx), and hydrocarbons (HC). Each one of these has a different effect on human lives. For example, CO2 reduces oxygen supply to the bloodstream causing breathing difficulties and cardiovascular problems. HC and NOx react with sunlight to form ozone leading to smog and hence breathing difficulties among children and visibility issues. Besides, NOx and HC react to form particulate matter. Studying the health impacts of air pollution is complicated due the fact that these pollutants interact with each other and other atmospheric factors. For instance, ozone pollution is not directly emitted but forms as a result of complex interaction between two other emitted pollutants namely nitrogen oxide (NOx) and volatile organic chemicals (Deryugina et. al. 2019). The actual impact is also dependent on exposure. Deschenes, Greenstone and Shapiro (2012) examine the impact of NOx on mortality, hospitalization, and medication expenditures. The study finds that reduction in NOx emissions led to a significant decrease in ozone pollution. It is estimated that the transport sector is responsible for about 25 percent of emissions of the gases contributing to global warming in industrialized countries, but only about one-half of this amount in developing country cities. While the proportion appears to have been stabilized in the Organisation for Economic Co-operation and Development (OECD) countries, it is still growing in the developing countries as motorized transport increases (OECD 2011).

There is often an observed synergy between Green House Gas (GHG) reduction and local environmental and economic interests. The GHGs that most contribute to global warming in the transport sector include carbon dioxide (CO2), methane, and nitrous oxide (NOx). Emissions of CO2 are directly proportional to the quantity of carboniferous fuel consumed. Fine particulate matter PM 2.5 (also associated with fuel consumption), is a mixture of various particulates with a diameter of 2.5 micrometres or less, including nitrates, sulphates, ammonium, and carbon (Kundu and Stone 2014). It could be both locally produced as well as transported from other locations through wind. Other things being equal, reduced fuel consumption will reduce economic costs and global pollution simultaneously (Heal 2017). Better traffic flow conditions typically reduce fuel consumption per kilometer. Thus, while diesel is a particularly in-efficient fuel from the point of view of reducing GHG emissions, only the new generation of clean diesels should have a role in GHG strategy (Parry, Walls, and Harrington 2007). Furthermore, mitigation measures for local pollution focus on emissions of vehicles in use, whereas the entire life cycle (from well to tailpipe) is relevant for analysis of GHG emissions (Greenstone and Jack 2015). Some emission reduction measures in fuel quality also lead to green-house gas emissions.

The generation of these pollutants can be curbed by reducing the vehicle miles travelled (VMT), improving average of vehicle, using technologies that reduce emissions per gallon of fuel, and retiring the obsolete fleet that is more polluting. It therefore makes a strong case for environmental regulation. Studies have concluded (e.gZivin and Neidell 2013; Deschenes, Greenstone, and Shapiro 2012; Dittrich et. al. 2012) that as environmental regulations contribute to productivity, they should be treated as an investment in economic growth. A large volume of literature explores mitigation options and policies in the transport sector at various levels.The most insightful among them are:IEA 2009; Parry, Walls, and Harrington 2007 (at the global level), Banister, 2000 for Europe (at the regional level), Bristow et.al. 2008, for UK; Greene and Plotkin 2011, for US; and Greenstone et.al. 2015, for India (at the national level), and Hickman et.al 2011 for London and Delhi (at city level).

b) Energy Security

Automobile use consumes a lot of fossil fuel. International Energy agency estimates that transport accounts for more than half of the primary oil demand and due to its limited substitution and short run price inelasticity (Dahl 2012), the sector will account for three quarters of the projected increase in oil demand (IEA 2009). Excessive dependence on imported oil exposes the countries to energy price volatility and price manipulation that could even compromise national security interests of the country (Parry, Walls, and Harrington 2007). While, the market shocks could be absorbed if the prices reflect the true cost of production and there are no hidden subsidies, the chances of macro- economic disruptions getting accentuated is enhanced in the wake of market failures (For instance, price and wage rigidities, underinvestment in fuel efficient technologies, inadequate investment in oil explorations).Oil dependency ultimately results in higher military and political costs (Delucchi and Murphy 2004).

c) Congestion Costs

Congestion is basically a by-product of a mismatch between road capacity and vehicle use. Owing to the land constraints and heavy investment in creation of road infrastructure, the road capacity enhancements are not able to keep pace with the vehicle use. Gridlocks are therefore the natural outcome of such a mismatch. Congestion imposes costs for vehicle users (direct costs) as well as non-users (indirect costs). While user costs are in terms of enhanced fuel consumption, pollution, and travel time, the non-users cost are manifold: additional costs are imposed in terms of reduced service areas for work force, suppliers and customer markets. The phenomenon has three different dimensions of variation: traffic congestion may vary area wise (spacial pattern), occurring at various points of time during the day (temporal patterns), and it could be predictable or a random event (stochastic element).

There are following five elements of factors that affect congestion and its economic impacts (Transportation Research Board 2001).

(i) Transportation related investments and pricing affecting the capacity of the facility;
(ii) Transportation systems performance measured in terms of network demand and congestion levels;
(iii) Business market accessibility and location costs measured in terms of operating costs related to accessibility of various locations;
(iv) Productivity effects considered in terms of output levels and cost economies of scheduling and market scale;
(v) Economic growth effects entailed in adjustments in response to changes in the cost competitiveness of business location in various urban areas.

The last three costs are indirect costs of congestion. These essentially arise due to the cost escalations of delivery of goods and services, limitations caused in accessing the markets and inability to expand businesses and derive benefits of economies of scale. This in turn affects economic growth. Correcting this external effect generated by urban density and making the best use of agglomeration economies is one of the main challenges in urban and transport economics (Proost, and Thisse 2019). NITI Ayog (2019) assesses the cost of congestion in 4 major metros in India as $ 20 Billion per annum across the four metros (figure 2).

Figure 1: Avoidable Social Cost of Congestion

Although the costs of travel delays are borne by drivers collectively, yet each individual driver neglects the external cost imposed on others and the consequence is excess travel at inefficiently low speeds. Consequent upon the pioneering work by Pigou (Pigou 1932), the often-recommended solution to the problem of congestion is road pricing (Parry, Walls and Harrington 2007; Proost and Thisse 2019). Subsequent models (e.g.Small, Winston, and Yan 2005; and Koster and Koster 2015) exploit the heterogeneity among drivers for their travel time values. This approach makes road pricing a dynamic tool that substitutes high value trips (e.g. business trips, and highly skilled commuters) for low value trips and thus generate additional benefit of increasing productivity. Likewise, drivers have varied preferences for schedule delays. Studies (e.g.van den Berg and Verhoef 2011) show how by imposing a time varying toll heterogeneity of preferences can be exploited. This aspect is considered important in the light of evidence (van Ommeren and Gutierrez-i-Puigarnau 2011) that workers who must travel more for work are prone to being absent, tend to arrive late, and are less productive.

d) Road Accidents

Safety of human life has also become a major concern in transportation especially in the developing countries. As per World Health Organization (WHO) Global Burden Disease study (IHME 2017), road traffic injuries in developing countries are the cause for one fourth of injury-related deaths. It was ranked ninth in the overall cause of death in 1990, which has risen to the sixth rank by 2020, with India bearing most of the burden. One of the most dangerous aspects of the road traffic injuries is the profile of the victims. As per IHME (2017) estimates, over 90 percent of deaths and injuries occurred in developing countries, with children accounting one in every five fatalities. It concludes that the road traffic injuries are now one of the leading causes of deaths among children in the age group of 15-19 years.

The accident costs are often measured in two types: ex ante and ex post costs. The ex-ante costs are basically assessed by undertaking willingness to pay surveys. The underlying assumption is that people do not value their lives for its utility to the society, but because of its intrinsic value to them and their families. This value, often referred to as Value of Statistical Life" (VSL), can be estimated by determining the amount that people are willing to pay to reduce the risk of being killed in an accident. However, a major limitation of the method is that it could lead to low estimates of VSL in developing countries where both average wages and life expectancy are low. Besides, additional factors (like assessing intangible losses such as pain grief and sufferings) add further difficulty in imputing the true cost levels. The ex-post costs, on the other hand, are costs in the form of medical bills, property damages, production loss, travel delays, insurance and legal costs.

Further, like other externalities, road safety also entails many vehicle and non-vehicle characteristics (White 2004; Gayer 2004). Vehicle characteristics comprise of type of vehicle, size/weight, vintage, and maintenance status. For instance, study by White (2004) concludes that the chances of death are 61% higher if the other vehicle is a light truck than if it is a car. Vehicle technology also has a direct impact on the road safety: technological choices range from driving assistance to autonomous vehicles. A similar situation exists with reference to maintenance of vehicles: the more the maintenance the lesser are the chances of accidents and injuries. As both technology and maintenance (including refitment) entail a cost for the vehicle owners making it a policy challenge as to what kind of policy regime should be put in place that encourages adoption of safer vehicles and their maintenance.

The non-vehicle characteristics are driver's age, gender, region, speed, negligence, weather and road conditions, insurance regime, and behavioural aspects (like risk averse or risk preference driving). Vehicle Insurance regime particularly affects the choices and behaviour of individuals (Tooth 2017). Through the vehicle insurance, the drivers are largely protected from the significant financial liability. This in itself poses a serious problem of moral hazard: there is no incentive to the drivers to adhere to safer road use. If the insurance premiums are not based on driving characteristics, the premium will be the same regardless of whether the insurance covers a heavy or a light vehicle and older (generally risk averse) or a younger driver (risk prone). Unless the premiums vary with the expected cost of claims, regulation has the effect of increasing premium of low risk drivers and reducing premium of high-risk drivers (in other words, taxing the safe drivers to subsidize the risk prone drivers). In India (as in the case of most countries in the world), the premium is the same regardless of age, driving skills and driving behaviour of drivers. It therefore subsidises high risk drivers and penalises the risk averse drivers (figure 2). The latest trend is towards usage-based insurance (UBI) where the premium value is directly related to the vehicle miles travelled.

Other externalities mostly relate to noise pollution caused by the vehicle use, infrastructure maintenance costs, parking requirements, and urban sprawl.

e) Information Asymmetries

A situation of information asymmetry is created when one of the parties involved in a strategic relationship has private information about some important element relevant to the relationship. While considering each of the above externality, it is presumed that there is no interaction among them and there is a

perfect flow of information. However, it is not a realistic assumption. There are many problems with information that arise in an economy: employers want to know the productivity of their employees, investors want to know the return on various investments, and insurers want to know the likelihood that various people that they might insure have an accident. All these problems ultimately lead to incentive problems also known as moral hazard (Stiglitz 2000; Bowles 2016). Lack of information also leads to *adverse selection*. In other words, when private information held by the agent is endogenous variable such as agents' discretionary actions (e.g.taking safeguards against risk), it is situation of moral hazard. However, if it related to some exogenous variable (like technology or cost of production), it is a case of adverse selection. Both moral hazard and adverse selection represent a market failure.

Typically, moral hazard arises when the actions of one person are unobservable to another and the adverse selection arises when one person cannot identify the type and character of another person. *Moral hazard* in the transport context arises where the damages caused by a vehicle to the society are insured by the insurance company so that the firm has no incentive to mitigate the damage. More complete the cover and the lower the psychic loss from the insured event, the less firms have to bear the consequences of their action and less therefore the incentive to behave as they would if they had to bear the loss themselves. Another form of moral hazard arises when the insured person can influence the expected loss at a cost lower than the expected gain. Despite the insurance cover requiring the firm to invest in preventive activities thereby reducing the probability of occurrence of the insured event, if the losses are fully insured and the insurance company cannot monitor individual preventive activities, the extra spending by a firm reduces its premium marginally. As a result of this type of externality, firms face private incentive to under invest in preventive activities.

Adverse selection in the transport context is manifestation of a situation where the service provider is aware of the external effects of the operation, but is able to conceal it from the users (for example, plying a vehicle without the same being mechanically fit for roads).

Information asymmetries play an important role in environmental policy making. There are two different hypotheses on the impact of asymmetric policies: pollution heaven hypothesis and Porter hypothesis. The pollution heavens hypothesis predicts that more stringent regulations increases costs and overtime tend to shift pollution intensive industries to low investment cost regions causing pollution heavens and policy induced pollution leakages (Levinson and Taylor 2008). In contrast Porter hypothesis argues (Porter and van der Linde 1995) that more stringent environmental policies can have positive impact as these policies promote innovation and cost cutting improvement. Dechezlepretre and Sato (2017) conclude that there is a strong evidence that environmental regulations induce innovation activities in cleaner technologies.

III. Transport Sector in Himachal Pradesh

a) *Current State*

Owing to its geo-political conditions (as most parts of the state are remote and inaccessible), road transport is, the only mode of communication and hence is of utmost importance for the state. Being so, the sector makes substantial contribution to the state economy both directly and indirectly. Directly, its contribution comes in the form of value of services generated by the sector and the employment opportunities generated in the sector. Its contribution in the form of value addition made in the goods and services produced by other sectors is its indirect contribution. The sector is growing at the rate of over 6% per annum and is expected to contribute more with increased transport demand led by the rising incomes.

The vehicle population in the state has shown a phenomenal growth over the past few decades. From an average growth rate of 2.7 % during 1980-85, growth rate of vehicle population in HP increased to 7.8% in 1995-2000.After 2007, the vehicle population has grown at an average rate of nearly 17%. The total registered motor vehicles in the state have been reported to be 1.6 million as on 31st March 2019 that is a 28.5 % increase over total vehicles registered in 2011.Out of the total vehicles, non-commercial vehicles accounted for nearly 80 % of the total vehicles in 2019. The commercial vehicles are nearly 20% of the total vehicles in the state. Two wheelers and cars dominate the vehicle composition, accounting for nearly 51% of the total vehicle population. An average growth rate of nearly 15.5% was observed in case of two wheelers from 2007-19; cars indicated a further higher average growth rate of nearly 20% over the same time period. Apart from the above, nearly 0.4 million vehicles registered elsewhere enter the state during the tourist season that lasts for 9 months a year.

This clearly indicates an exponential growth in traffic volumes particularly personal vehicles in HP. This in combination with slow growth in road infrastructure and services has led to the rising problems of congestion, pollution, and depleting air quality over the years. Easy availability of finance, rising affordability, and lack of adequate public transport systems; have all led to the increasing preference for personalized modes. It therefore, calls in for a need to promote measures that wean people away from personalized modes and help promote more sustainable modes especially the public transport.

While the growth of private vehicles has been phenomenal, the growth of public transport is negligible. In the absence of a maximum life span of vehicles under the statute, obsolete technology vehicles ply on the roads, leading to the problems of pollution and road safety. Petrol and diesel are the dominant sources of energy for the vehicles, as CNG and electrically propelled vehicles are yet to be introduced. For these reasons, the transport sector in the state was also chosen to be the focus area for the green growth initiative.

b) Infrastructure Development Trends

Road transport forms the backbone of the transportation sector in HP. The role of roads in movement of people and goods is therefore critical in the overall growth and development of the human settlements in Himachal Pradesh as they stand today. Contribution of roads has not only been in making the isolated regions accessible but has also improved the overall quality of life of the people by enabling and improving the overall movement of goods and services across the state. There has been a phenomenal growth in road network in the past few decades. The state had only 288 kilometres of motorable roads in 1948 which has now grown to 37,460 kilometres and nearly 90 %of these are single lane roads. While motorable single lane roads have grown at an average rate of 5 % per year; motorable double lane roads have grown at an extremely slow rate of less than 1%.Data indicates that the primary focus of the government has been on providing access to the inaccessible villages/habitations in the state followed by conversion of existing nonmotorable roads into motorable roads. The presence of Railways and Air transport in HP is negligible. At present there are three airports in HP, in Shimla, Kangra and Kullu. Apart from that, there are 68 operational helipads. To provide better connectivity and open up remote and tribal areas to the tourists, the state government has introducedheli-taxi services in the state.

One major limitation of the sector is a lack of institutional set up to coordinate the activities of all the stakeholders. Transport systems require several functions to be performed in a well-coordinated manner for seamless and comfortable travel experience for commuters, for instance, the road management, land use planning, development of industrial areas, and urban development. Transport planning has to be integrated with land use planning right from the beginning to ensure provision of services. Currently, there is no synergy between urban development and transport planning. Transport planning is undertaken independent of the development of commercial and residential areas. Such a scenario has led to a situation where many new residential and commercial areas are planned without transport network. This has resulted in crowding in of para transit vehicles like autos and increased trend towards private car ownership. There is no formal mechanism of sharing new developments including industrial areas with the transport department.

Non availability of land is another major bottleneck in expansion of transport infrastructure. A peculiar situation is created in Himachal Pradesh since 66% of land in the state has been classified As forest land which cannot be put to any other use. As regards private land, very high costs of land acquisition along with arduous and time-consuming processes are a major barrier for planning integrated transport infrastructure. About 70 per cent of delays in all infrastructure projects are due to problems related to land acquisition. One of the factors is the heavily distorted land market, caused by zoning and development control rules that limit the supply of land that can be devoted to commercial, industrial or residential use. Significant amount of public lands keep large portions of well-located land outside markets. Cumbersome and time-consuming forest to non-forest land conversion rules increase cost of land. The Floor Area Ratio (FAR) and Floor Space Index (FSI) regulations as espoused in the Development Control Regulations (DCR) are too low compared to international benchmarks. Exceptions to these rules are traded on a highly selective and non-transparent basis, offering little incentive for land owners to surrender their lands for infrastructure development.

Common standards for design, operation and maintenance of transport infrastructure and rolling stock are relatively absent in the state. Till recently, bus bodies were being built by the local vendors and this had serious limitations in terms of passenger comfort, safety and vehicle efficiency. In a study on the road accidents that had taken place in the past five years, it was concluded that the defective bus bodies were responsible for larger number of deaths in bus accidents as the bus bodies used to fall apart throwing passengers out of the bus. Thanks to the amendment in the Central Motor Vehicles Rules which had made it compulsory to build monocoque bus bodies. However, truck bodies are still being built by the local vendors. Similarly lack of uniform guidelines on terminal facilities has resulted in bus terminals with bare minimum facilities and completely absent IT related infrastructure for passenger information.

c) Public Transport Services

Public transport in Himachal Pradesh is mostly conducted through the Himachal Road Transport Corporation and is fully owned and managed by the state. Constituted in 1974, the Corporation has a fleet of 3100 buses and operates the same both within and outside the state. A study discovered that there were at least 294 new roads opened in the last few years, but no service has been provided by the HRTC so far (Batta 2016). Public transport is subject to a very high tax

regime. These vehicles pay taxes on a monthly basis compared to the one-time, nominal tax levied on private vehicles. Even the taxes levied on the interstate routes are very high—almost double the normal Special Road Tax (SRT). In addition, inter-state movement of public transport in India (both buses and trucks) is subject to a severe problem of "tax exporting". This arises when governments tax the non-resident population on arrival to its territory, as corridor states levy high rates of tax on a competitive basis on the entry of outside vehicles. Even though the Motor Vehicles Act (which is a federal legislation applicable to all states) has a provision for scrapping vehicles based on age, it does not specify any age limit. Because of this, there is a "free rider" problem with owners of antiquated vehicles plying highly polluting, unsafe vehicles with old technology having to pay less private marginal cost at very high social cost. The externalities in the form of pollution, road accidents and congestion enhance the marginal social costs. Data shows that buses up to 20 years of registration age are still in operation, while trucks of more than 30 years registration age are still on roads.

With increasing mobility needs, a phenomenal increase in the segment of private run contract carriage vehicles (tourist taxis) has been observed in the segment of contract carriage vehicles in the state. The total number of light motor vehicles carrying passengers in the state has increased by more than 61 % in the last ten years from 2009 to 2019. However, there are serious concerns in terms of quality of services and passenger security in these vehicles (GoHP 2014).In absence of adequate public transport services, the dependency on personalized modes has also increased over time in cities in HP bringing along problems of congestion, rising pollution levels, and others.

In this segment, an additional complication is introduced by its overlap with the stage carriage operation. There is a rather thin distinction between the operational parameters of stage carriage and contract carriage operation. Ideally, the contract carriage operation should be limited to taking passengers from one place to another with no stoppage for boarding and alighting the passengers en route. The stage carriage operation on the other hand is operation on affixed route, from stage to stage, and committed regardless of pre-booked passengers. In the absence of enough tourist business throughout the year and in all places, the contract carriage vehicles (both buses and taxis) start operating on a fixed route taking passengers from place to place en route. It often leads to violent conflicts with stage carriage operators and instance of legal action for violation of the Act.

With market being supply driven dominated by small operators, there is a cutthroat competition in busy places and instances of over charging in remote localities. It has seriously affected the vehicle maintenance leading to problems of pollution and road accidents. Frequent problems of mixing kerosene with diesel are also reported. Transportation is a complex system as it constitutes several activities, stakeholders and processes. Unfortunately, the capability for undertaking a coordinated approach along with a holistic understanding of transport issues and their causes involved is generally lacking at the state government and city level. This is attributed to a lack of transport management skills amongst city and state officials. In most cases, state and city level agencies dealing with transport planning and provision have typically suffered from overstaffing with people with homogeneous skills consisting of largely untrained and unskilled manpower on the one hand and shortage of qualified technical staff and managerial supervisors on the other (Batta 2016). It is a major reason that they have not been in a position to deliver the current demand for transport services, let alone plan for the growing needs of cities and peri urban areas. The staff and management at these agencies are typically not accustomed to innovation and taking up new tasks, and are more comfortable opting for traditional methods of procurement and working with government grants and loans.

d) Freight Transport

The state has had a huge and ever-growing demand for movement of goods ever since its formation. With opening of new areas with development of roads, industrial and tourism development; need for movement of goods has increased phenomenally. The goods transport is also dependent on road transport in HP further adding onto extreme pressures faced by the road network. The number of goods carriage vehicles (including trucks, lorries and light motor vehicles carrying goods) in the state have doubled up since 2007. The total number of goods carriage vehicles registered in HP in 2019is 1,62, 849. The number has grown at an average rate of growth of 26% per year since 2010.

The state's transport policy clearly states that the freight segment in Himachal Pradesh is characterized by proliferation of small operators with high operating costs in the absence of economies of scale, dominance of old and polluting fleet, cartelization of operators to enforce rates and terms as per their choice, and problems of overloading associated with ill effects in the form of accidents and damage to the roads. In the absence of ample employment opportunities in other sectors, the transport sector has by default absorbed a large chunk of manpower which is now totally dependent on it for livelihood. It therefore presents a delicate politico-economic policy problem and the challenge to find an easy solution is difficult to the extent of being infeasible. Further, it is realized that the goods transport has not seen any new innovation in technology and operation in the past many years due to

which the transportation of farm produce and industrial products at competitive fares remains an area of serious concern (GoHP 2014).

e) Externalities

i. *Road Accidents*

Road safety is a major concern in the state. In 2018, the total number of road accidents reported in the state were 3017 and fatalities reported were 1168 and it showed an increase of nearly 30% over 2005. The total number of accidents per 100,000 population reported in HP in 2013 were 42.4, which is higher than the national average of 38.9 accidents. Similarly, the total number of road fatalities 100,000 population in HP in 2013 were 15, which was also higher than the national value of 11 fatalities (MoRTH 2013). The above statistics indicate that though the growth in accidents and fatalities over the years has been slow, but still the number is higher than the national average and needs immediate attention.

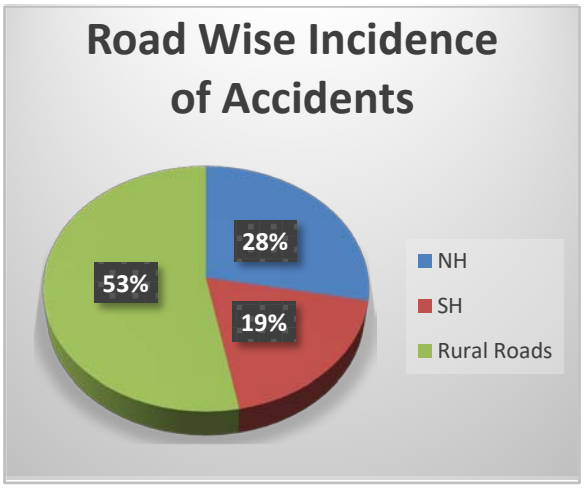

Figure 3: Road wise incidence of Accidents

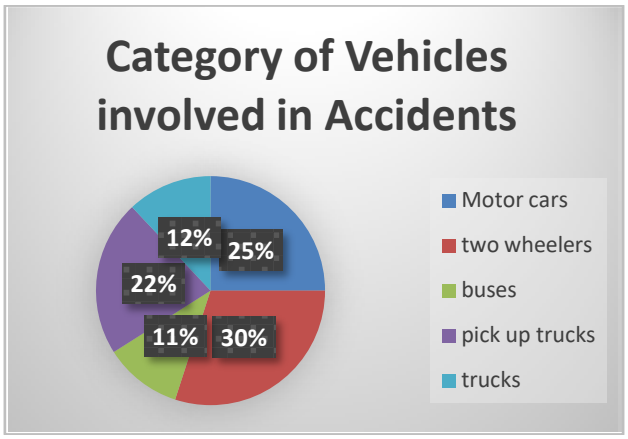

Figure 4: Type of vehicles involved in accidents

As per the road accident statistics maintained by the Department of Transport Government of Himachal Pradesh, on an average, around 3000 accidents take place every year in which 1100 deaths are reported. Most of the victims are in the age group of 21-35 years of age and 81 percent of them are males. Over 40 % of vehicles involved in accidents are motor cars and two wheelers, with over 50% accidents occurring in the rural roads. There are four main actors involved in the traffic operation: vehicle, driver, road, and passenger (Batta 2008). There are different concerns in each of them which are discussed as under.

a. *Vehicle Related Concerns*

Vehicle related concerns are often divided in three parts. First, relate to the machinery itself. The technology used, the road safety devices provided and the maintenance regime for vehicles. The older the model of the vehicle, the more it is likely to be polluting, unsafe and breakdown prone causing traffic hazards. Second, concerns the operational aspects of vehicle. These mostly relate to route planning, putting in use intelligent transport systems to regulate traffic, and policies of the government relating to vehicle use and technology. For instance, with government policies

encouraging safe vehicles by reducing taxation and promoting non- polluting vehicles like the electrical vehicles, the pollution and road safety are both attended to. Third, relates to the vehicle density and carrying capacity of roads. It is here that the role of two and four laned roads gets important.

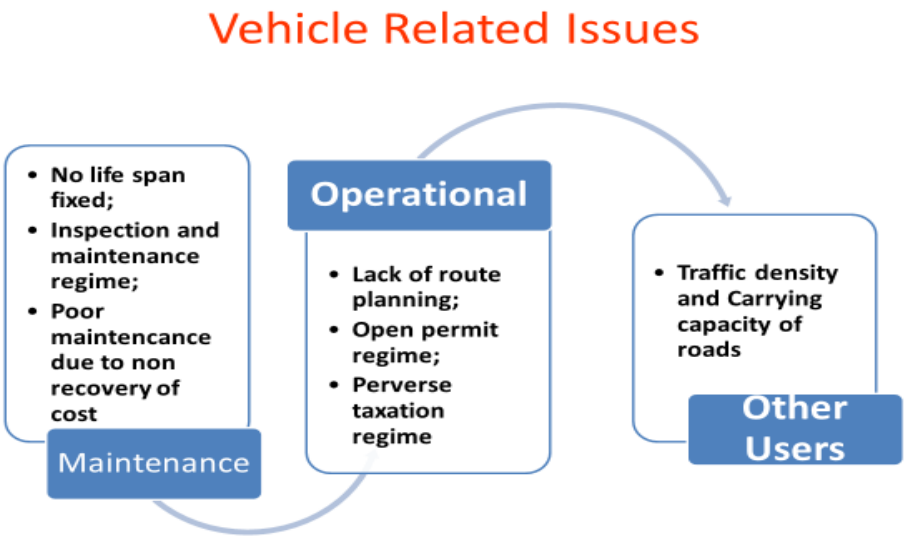

Figure 5: Vehicle Related Issues

When seen with reference to the state, there is no life span prescribed under the law for scrapping of vehicles. As a result, vehicles aged over 30 years are still plying on the roads. With their capital cost being zero and minimal insurance premiums, the owners are able to free ride by operating on nominal variable costs and with high marginal social costs loaded on to the society. Even the inspection and maintenance regime is also faulty as all inspections are carried out visually (without the help of machines). Further, there are serious issues of spurious parts being sold in the markets at low prices incentivizing the operators to get repairs done from the open market rather than the authorized dealers. All this put together results in highly polluting and unsafe vehicles being plied on roads. Further complications are introduced in the absence of appropriate route planning and perverse taxation regime favoring old vehicles. Even the roads being narrow with high vehicle density (especially in major district roads), the congestion and accidents are a common phenomenon.

b. *Driver Related Concerns*

Driver related concerns relate to level of education and training of the drivers, the licensing regime, their mental and physical condition, their driving behavior, insurance regime, traffic management practices in vogue, and policies relating to these aspects. The more stringent is driving licensing regime, educational and training requirements, driving behavior related insurance premiums, and intelligent transport systems keeping an eye on the driving practices by each driver; the safer the roads are likely to be.

The current licensing regime and the extant laws do not repose much confidence on the driver's capability to offer safe driving. Licensing applicants are subject to a routine test for a short while and with large number of applicants in a day and the inspector being under pressure to pass vehicles and conduct driving tests of a large number, the driving skills of the licensed drivers is always in doubt especially during the odd situations like fog, heavy rains, snow, and in the presence of heavy traffic. The insurance system is administered premium based and not linked to the driver's behavior which encourages risky behavior (one of the reasons of high death rate among the young drivers is this faulty insurance regime).

c. *Road Related Concerns*

Road related concerns pose another serious challenge. Major road related concerns are size, quality and technology in use (bitumen or cement concrete roads), traffic density on roads, maintenance of roads, and regulatory regime to enforce road quality and standards. The problem emanates from the very construction and passing of roads. Being a hilly area, most roads are constructed by cutting on the hillside and filling on the valley side. Most of these roads are prone to landslides and collapsing of retaining walls (Bayan 2013). In its endeavor to connect more and more villages, there is always a possibility of negotiating the quality standards to save costs. Even the road fitness regime is also not accurate as the committee responsible for this does not have any technical member (Batta 2016). There are serious issues in terms of road management and quality maintenance as several agencies are responsible for road construction (e.g. Public Works Department, Forest Department, and Rural Development Department) and none has

adequate resources for maintenance of roads. All user charges collected are deposited in the government receipts and the money is not available for the agencies charged with the responsibility of maintenance. Even the crash barriers are not installed on all roads as there is no law for enforcing of road standards.

d. *Passengers Related Concerns*

Passenger related concerns basically relate to the availability of passenger information systems, willingness on the part of the passenger to pay cost-based fares, road safety improvements, and adherence to traffic regulations.

Overall, the major factors contributing to road accidents could be divided in two parts (figure 6): policy related and legal. Policy related factors are further divided in two parts namely legal and institutional. Major legal factors emanate from the provisions of the Motor Vehicles Act, insurance regime encouraging free riding, open permit regime, lack of data and scientific investigation of accidents. The institutional factors are lack of road management and certification systems, and absence of an effective mechanism for cost recovery. Unemployment is the major social factor leading to over-crowding of commercial vehicles.

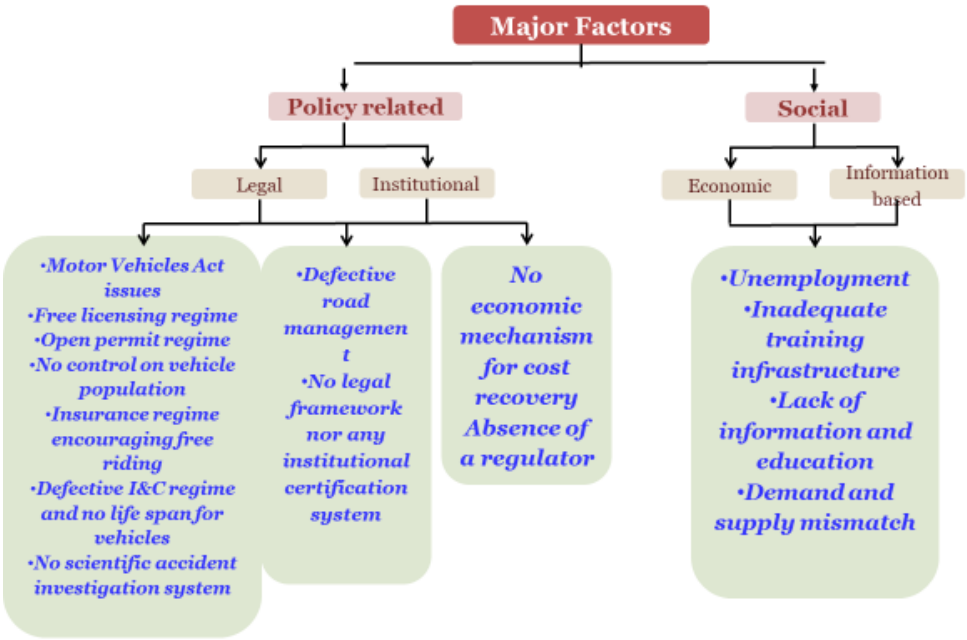

Figure 6: Major Factors Affecting Road safety

ii. *Pollution*

The major concern in terms of air pollution is unsafe levels of PM2.5. HPPCB (2014) notes that increases in the values of PM2.5 is a matter of concern. As there is no exclusive study on air pollution in the state as such studies considering the country as a whole have to be relied upon. Greenstone et al. (2015) estimates for India (including Himachal Pradesh) find that 660 million people in India (54.5% population) live in regions that do not meet the 40 µg/m3 National Ambient Air quality standard (NAAQS), and 262 million people live in regions with levels twice this standard. They further observe, "Nearly every Indian (99.5% population) lives in an area with PM2.5 pollution above WHO's 10 µg/m3 guideline (Greenstone et al., 2015: 42). All major towns of the state fall within the category of 40-60 µg/m3. HPPCB (2014) attributes this increase in the values of PM2.5 to the increased vehicular pollution. The loss of quality of life due to the increase in air pollution is estimated to be an average 3.2 years (Greenstone et al. 2015).

As ecosystems in the state harbor a wide range of natural resources, they are particularly sensitive to change. Regional changes in climate have already affected many physical and biological systems in the mountains. Analysis of temperature trends in the Himalayas and vicinity shows that temperature increases are greater in the uplands than the lowlands. Climate change impacts include movement of apple orchards to higher altitudes, loss of various tree species, drying of traditional water sources, change in bird types and population, reduction in crop yields, and increased vulnerability of winter cropping due to changes in rainfall patterns and planting dates (MOEF 2009). Projections by the Government of India (MOEF 2009) are even scarier: the annual temperature in the state is projected to increase up to 2.6±0.7℃by the 2030s and the annual rainfall upto 1604±175.2 mm. The projected

precipitation is likely to increase by 5% to 13% by 2030s as against 1970s levels (GFN and CII 2008). For a state like Himachal Pradesh heavily dependent on agriculture for livelihoods and GDP, the impacts of Climate Change on water resources are of critical significance.

iii. *Congestion*

The state has experienced a rapid urbanization and income growth led vehicle population explosion. Most of the cities have seen adjoining villages getting converted into dense localities. The trade-off between urban agglomerations and urban mobility is quite apparent as most urban areas face acute congestion during the peak hours and during the peak tourist seasons. Peak hour traffic delays and huge demand for services poses serious challenge to the service providers to meet the demand for services. As the supply gets further constrained due to congestion led delays (buses make lesser number of trips), there is often a problem of overloading of buses. Besides, being a tourist state, the traffic flows during the tourist seasons increase manifold due to large scale influx of outside vehicles. Hence, the urban transportation offers a major challenge to the transport planners and policy makers.

Apart from the rising vehicle fleet and increased mobility, roadside parking and encroachments have further reduced the capacity of the existing roads to take traffic as per design. On several occasions, this reduced capacity has led to serious accidents. Congestion has affected pollution levels as well as road safety in the state. The normal response has been to build bypass roads (the state has built bypasses in all the cities), however, these bypasses have also been taken over by the ribbon developments along the road causing traffic delays. The issue of congestion has been a hotly debated topic which has even attracted the intervention of the High Court of Himachal Pradesh. On several occasions the High Court has passed directions to the civil administration to ensure free flow of traffic.

f) Information Asymmetries and the Transport Externalities

i. *Road Accidents*

We have noted the concerns with respect to all the stakeholders in the transport management. In the situation where there is no life span prescribed for vehicles, perverse taxation regime encouraging old vehicles, imperfect licensing systems, untrained drivers with gross mismatch of skills with the vehicle technology requirements, no age limit for drivers, roads neither support the latest technology nor are well maintained, and passengers not willing to afford cost of operation; the likelihood of accidents is much more. When the element of information asymmetry is introduced, the driver does not know the road as well as the bus condition, the owner does not know the driver's skills, the passenger does not know the road, bus and driver's status and is also unaware of the next bus timings, there is every likelihood of accident which results in a death trap' (figure 7).

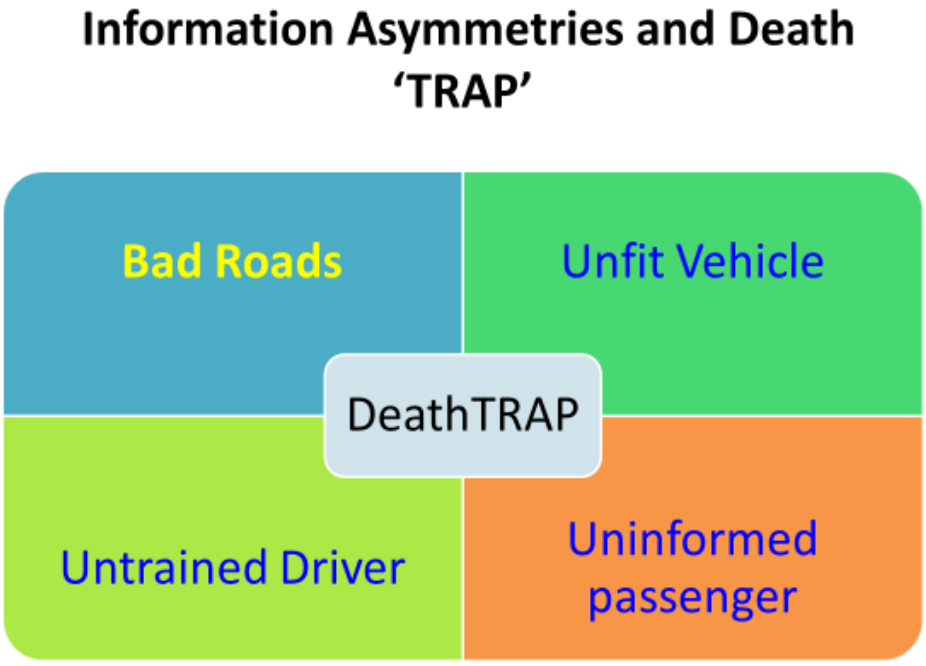

Figure 7: Information Asymmetries and Road Safety

With a view to actually find out the effect of asymmetries in the road accidents, accident inquiry reports maintained by the transport department were examined and the following facts came out.

Table 1: Information Asymmetries and Road Accident

Vehicle Details	Date of Accident	Driver	Bus	Road	Passenger	Fatalities
H.P. 65 7065	20-06-2019	Driver not fit to drive	Mechanically Defective bus	Steep curve, no crash barriers	Overloaded with 87 passengers	45 dead 17 injured
H.P. 03B 6205	01-06-2018	Over speeding	Defective bus Being Illegally plied	Steep un-mattled road	nil	09 dead 21 injured
H.P. 47 2477	20-05-16	Not fit to drive	Defective bus	Defective road	Overloaded	10 dead 30 injured
H.P 14A 4256	25-02-2016	Driver no holding license	Defective bus	No crash barriers	nil	8 died 22 injured
H.P. 86 0957	21-06-2018	Minor and without license	Unfit vehicle	No crash barriers	Overloaded	1 dead 11 injured

Almost all the inquiry reports have pointed out the road shortcomings and defective vehicle inspection regime declaring vehicles fit without any mechanical inspection.

ii. *Congestion*

Information asymmetries result in two-fold effects. First, it is difficult to know the marginal cost of congestion and the marginal benefit to the drivers. It is therefore often difficult to levy an appropriate congestion toll. This is especially true for the tourists visiting the state during the summer season. Second, while the congestion is highly variable over time and space, it may not be only due to the inadequate capacity of the road (it may even be due to some bottleneck occurring elsewhere). Therefore, estimation in such a dynamic scenario is all the more difficult when there is no system of collection and release of information.

The asymmetry of information also plays a serious role in public transport infrastructure management like roads, parking, and the rolling stock. The problem is that it is difficult to know the marginal benefit derived by each consumer using the infrastructure hence, either the transport infrastructure would be undersupplied (if it is left to the market mechanism with private capital to take the investment initiative), or the cost would not be recovered even if the state intervenes by augmenting the capacities to facilitate deriving benefits from forward and backward linkage effects. The social distributive consideration often leads to under pricing of such services vis-à-vis normative costs. In the context of the state, subsidized or free use of road and transport services have resulted in under pricing, poor maintenance and delayed augmentation of capacities. That is why not only the Himachal Road Transport Corporation is running in losses but it is true for all state PSUs in the road transport. It is for this reason that public transport services are subsidized by governments world over (Chandler 2014). Challenge therefore is to put a system in place that while protecting the interests of the poor also supports the public transport operation to fund the gap.

iii. *Environmental Management*

Information asymmetries plays an important role here. First, one major limitation is that often consumers undervalue new vehicle fuel economy because of the short planning horizons and have greater appreciation for other attributes (like sports utility functions and horse power, especially in the hilly terrain), and do not expect savings to be reflected in used vehicle prices. Therefore, the policy tools may not bring the desired results. Second, it is difficult to assess damage caused to the environment especially as there are other factors also contributing to the pollution.

IV. Travel Demand Management

Travel demand management (TDM) seeks to reduce externalities by reducing single occupant vehicle trips as well as shifting the travel to non-peak hours of the day. The TDM strategies mainly aim at: moving more people in fewer vehicles by using transportation that does not contribute to congestion and pollution (public transport/mass transit), reducing the number of people travelling during the rush hours (congestion pricing), and eliminate the need to commute to work (transport efficient land uses and Information technology).

a) Public Transport Management

The model structure of mobility breaks down between carbon intensive (e.g passenger cars, trucks) and low carbon intensive options (e.g. public transport and non-motorized transport). The expansion of the latter requires huge investment in infrastructure to ensure efficiency, reliability and coverage. One of the major limitations in the state is neglect of the public transport. The services are neither reliable and nor comfortable. The data maintained by the Corporation shows that on an average 30% of services face

problems of breakdowns and non-completion of trips for various reasons (Batta 2016). Even when road transport is the only mode of transport, there are no luxury services connected the state headquarters with districts and inter district traffic. One of the reasons of morning jams is school traffic which again due to the inability of the Corporation to provide services connecting all places, people are forced to bring their wards on personal vehicles. The recent success of Volvo services to Delhi shows the public preference for comfort and their ability to pay more if quality services are provided.

Promotion of public transport is also essential from the equity considerations. Transport having more of the character of a necessity in the basket of a poor man's consumption, the utility function of the poor will involve inelasticity of substitution between a transport and a non-transport goods. Since variation in prices facing the poor would have both an income and a substitution effect, a higher price of transport would have an adverse effect on real income as also on social welfare level. This leads often to the argument that ideally society should resolve such distribution problem by income transfers through lump-sum taxes and subsidies independent of the regime of the relative prices, as this would not cause any distortion in the allocation of resources. However, often the political-economic transaction cost of implementing such policies of income transfer becomes too high, reliance by default, has to be placed on the use of prices as instrument of resolving the distributive problems through subsidy in consumption of the necessities.

For promoting public transit services, appropriate pricing strategies are essential so that transport business is kept sustainable. It is also important for promoting pollution abatement technologies and road safety. The growth of the transport sector and the consideration of allocative efficiency would require the pricing of any mode of transport to follow the long run marginal cost pricing principle (Sengupta 2001). Unfortunately, it is not a practical solution for two reasons: market failure and distributive considerations which create problems. First, the ground-fixed infrastructural items (like roads and bus terminals, etc.) have 'public good' character so that it is not possible to apply the pricing principles as applicable for private goods. Second, on the operation side, the transport operation exhibits tendencies of vertical integration and large-scale economies leading to a natural monopoly situation. Simultaneously, there are both negative and positive externalities generated by transport again leading to market failure. Besides, income inequalities make a case for government intervention to provide access to the poor.

The state needs to correct its taxation system, review the current fare fixation system to enable the operators to recover the costs, and promote technology centric replacement of fleet. Adequate services of budget travel as well as luxury travel need to be promoted to provide substitute to the personal vehicle use. The recent initiative of adding electric buses using a national program funding should be further expanded to cover the entire state. Private sector participation should be earmarked for certain sections and be encouraged by tax concessions and appropriate pricing regime.

b) Emerging Pricing Policies

Over the years, with the introduction of electronics and telecommunications, many developments have led to development instruments for addressing congestion and accidents that complement the fuel taxes. Using pricing as a tool, behavioral change among the users is sought to be made. Discussions hereinafter examine the ways how pricing could resolve some of the congestion and accidents related problems.

i. *Congestion Pricing*

The basic premise of the congestion tolls is to charge motorists the difference between their marginal cost to all drivers and average travel cost to the individual drivers. Even though, there is ample scope of controlling congestion and mobilizing resource by using this tool, but the main limitation is that the current collections of state entry tax (a kind of toll tax charged for entering the state. It is a fixed charge that does not vary with the time of the day.), are all credited to the state exchequer with not a single penny used for the maintenance of roads. It therefore creates political as well as public opposition against any increase in toll. One important, and probably effective way of making this tool useful in managing congestion is by judicious use of revenues from congestion tolls to create a broader coalition of winners from the policy change (Parry, Wall and Harrington 2007). A review of literature shows (e.g. Small 1992; Goodwin 1995; Harrington, Krupnick, and Alberini 2001; and Transportation Research Board 2006)that mixed spending on road improvements, transportation alternatives, and road safety bring good results. Studies like Harrington, Krupnick, and Alberini (2001) finds discernible increase in support for congestion tolls when the revenues are recycled for reduction in local taxes or benefits from the toll collection are visible.

Congestion pricing often results in timing adjustments and car pool. It is often seen that as all offices and business establishments open at the same time, there is a peak time travel rush causing congestion. Flexi working hours, working from home, and compressed working weeks are some of the options to reduce travel demand during the peak hours. However, it requires employer employee adjustments and all places and establishments may not be amenable to such adjustments. Though staggering the opening timings of educational institutions, shopping malls, and

entry of goods vehicles could be easily done. Likewise, encouraging car pools and park and ride also reduce number of SOV (single occupancy vehicles) on roads. These car pools could be informal or even under some formal arrangements. Under the dynamic ride sharing prevalent in some countries, an independent organization matches the passengers and drivers for individual trips. Park and ride is basically used to provide last mile connectivity and connecting people with HOVs.

ii. *Parking Fees*

Parking management is an equally important element in the TDM strategies. Parking practices and prices have a substantial impact on the car use. For instance, free or inexpensive parking encourages car users to undertake long trips by car rather than use bus or rail link. Such parking facilities incentivize long time parkers at the expense of those undertaking short trips for shopping or other short-term users (like for healthcare and medical services).Most effective parking strategies apply cost-based pricing measures that fix demand-based parking rates with incentives to car pools and short term parkers. It has an effect of reducing total parking demand and tends to shift travel to other modes. One of the serious limitations in Himachal Pradesh, is that the entire road space is used for parking. It not only reduces the available road space for plying of vehicles, but has rendered the commercial parking non-viable. The state has tried to mobilize resources for parking and bus stands under public private partnerships (PPP), however, all these are running in losses due to this factor. While PPPs have inherent advantages of providing private finance, expertise, and management; but the economic characteristics of transport infrastructure is exogenous demand risk (Engel and Galetovic 2014) whereby predicting initial use and growth rates is very difficult. Both macro-economic cycles and demand uncertaintiespose a serious threat to such projects and if the demand is further curtailed by open free parking policies like this, then the very purpose of having PPP is defeated.

c) *Planning for Low Traffic Neighborhood*

Transport efficient developments are characterized by higher density and mixed and uses. Reorientation of investments towards public transport is possible if density of settlements is enough and for doing so land-use policies and fiscal policies handling control of land markets become important. Similar is the case with policies aimed at reduction of demand for travel as it entails some degree of reorganization of firm's production and distribution processes and households' pattern of consumption. Studies supporting this hypothesis have highlighted by concluding that energy consumption from transport and CO2 emissions are dependent on population density (Grazi et.al 2008), compact cities as sustainable urban forms (Holden and Norland 2005), and association between land use planning and automobile dependence (Glaeser and Kahn 2010).

It is a known fact in the state that in most of the urban areas, expansion of settlements has taken place horizontally rather than vertically. It has posed serious issues not only in terms of provision of public transit services but also in terms of provision of other civic amenities like water supply, solid waste management and public health facilities. It has also resulted in escalating the prices of scarce land and is often held culprit for visual pollution (Batta 2000). Thus, there is a strong case for integrating complimentary policies on the demand side such as infrastructure policies, land-use policies, building regulations, and in addition to these physical policies, the soft policies (telecommunication) that reduce the need for travel.

d) *Using Emerging Technologies in TDM*

Our analysis so far has revealed that the transport sector faces information asymmetries in both the forms: one party lacks the information about quality of other party (e.g. the standard of bus, quality of road and skill level of the driver) and behavioral aspects of a driver (principle agent problem between bus owner and the driver and driver and insurance company leading to moral hazard). Use of information technology is critical in maintaining and dissemination of vital information. The current impacts of intersecting physical and digital technologies are unprecedented: with convergence of developments such as machine learning, real time data, and artificial intelligence has increased automation in multiple areas from traffic and network management to autonomous vehicles. This will provide ways to not only improve infrastructure, but will also have a substantial impact on transport demand and information dissemination.

V. Conclusion

Externalities caused by transport are very significant and could potentially be very costly if not contained by appropriate policy interventions. It needs to be appreciated that transport sector reforms have co-benefit features in the form of increased incomes and leisure time, cost savings, and enhanced competitiveness all of which have bearing on the quality of life. Similarly, investments in public transportation, besides expanding service and mobility, help boosting the economy as a whole in many ways. These could occur in the form of saving in the cost of travel as well as vehicle ownership cost avoided by those travelling by public transport or shifting to public transport from the private modes. It also results in reduced traffic congestion, caused due to decreased personal vehicle use, often leads to travel cost savings for businesses and households through operating cost savings

associated with worker's wage (i.e. less time spent by a worker on travel during a business trip).In addition, business productivity improvements due to access to broader labour markets with more diverse skills is enabled by reduced traffic congestion and expanded transit service areas.

However, the sustainability considerations require that the pricing of transport services is pursued in a scientific and professional manner. It needs to be appreciated that transport input costs (e.g. wage rate, interest rates, and exchange rates) have all moved from the administered price regime to the market determined prices, but the fare fixation has still remained in the administered price regime in the garb of equity. The fare rates are often revised by the governments after long intervals while the input costs increase almost on weekly basis. It is therefore difficult to match the costs with fares leading to implicit subsidy being transferred to the users of services. It initially affects quality of services and ultimately the quantity of the service supplied. It therefore makes a case for public funding of transport services. It is a known fact that governments world over fund public transit services through subsidies and tax credits (Chandler 2014). This public intervention is warranted to discourage negative externalities caused by cars (Parry, Walls, and Harrington 2007; Erutku 2020). Studies (Anderson 2014;Andler and Ommeren 2016; Bauernschuster, Hener, and Rainer 2017) have found increased pollution and congestion during the strike by public transit operators.

Seen from the perspective of TDM, it needs to be appreciated that two distinct changes are taking place in the current evolution of traditional TDM programs. First, the changes in technology are affecting both supply (road pricing, intelligent corridor management, dynamic ride sharing) and the demand (changing travel behavior relating to telecommunications and improved information on travel choices) for transportation. Second, is the demographic transition taking place in Himachal Pradesh that is likely to affect demand for travel. Therefore, any successful TDM program has to focus on understanding the changes in demographic characteristics like income, age and place of residence and develop tools for projection of travel demand.

The state faces serious issues on the road safety front: the current policy regime views the problem of road safety in isolation from the broader context. There has been increased recognition that combinations of interventions demonstrate greater cost effectiveness. This requires focus on systemic issues and simultaneous interventions at multiple levels. For effectively controlling traffic injuries and deaths, the state needs to put in place a strict licensing regime where by no unfit person could obtain a license, maintain data to keep track of the driving behavior of the licensee, thoroughly revamp the inspection and maintenance regime by putting up fitness centers across the state, enforcing permit conditions effectively and cancel permits in case of major violations, introduce tax reforms for disincentivizing unsafe vehicles, reconsider road inspection committees by putting independent professionals therein, and have effective accident enquiry systems that contribute to identifying appropriate changes in policies and procedures across the sectors. Besides, other interventions like improvements in land use and built environment (land zoning, traffic calming measures), improved quality of public transport, improvements in information dissemination, legislation and enforcement of traffic regulations, and improved quality of roads with a well-designed enforcement mechanism for ensuring quality; would also help. It is often seen (Wales 2017) that lack of accurate data on accident causes, damages, and costs to humanity has led to low political saliency and failure to fully implement reforms.

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