TOO MANY CARS + NOT ENOUGH ROAD =

The Economic Prescription for Too Many Cars
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PREFACE

Occasionally, the opportunity presents itself to pursue a project that has relevance to self and the community in which one resides and works; as a consequence, these projects take on a life and personality all their own. Thus the knowledge and lives of the project team are enriched, and potential benefits – a set of positive externalities - are identified for those outside the project itself. This is such a project.

"***TOO MANY CARS + NOT ENOUGH ROAD"*** is a project that began its life as a venue for expressing the frustration and stress that most Southern California drivers deal with each time they "hit the road" for the daily commute, or just to get away from it all on a Friday afternoon. For the project team members that drive the section of US101 between Thousand Oaks, California and Goleta, California on a daily basis (sitting in congested and gridlocked traffic for fathomless measure of time), this project held a deeper meaning and vision. Realizing there exists a strong economic argument to discover and implement solutions that reduce the real number of cars on our highways in general – the US101 between Thousand Oaks and Goleta in particular – gives hope that our elected officials will lend an ear to economic reason and take a serious look at how current policies and practices are unsustainable from both an economic and social perspective.

ACKNOWLEDGEMENTS

This project owes its success to the efforts of its team members whose dedication to discovery of the relevant issues, tireless hours of research, numerous meetings and discussions, more hours of research and discussion, writing, editing, re-writes, and finally… the presentation of the paper made it all possible. Amber and Cassie, you so graciously spent hours in front of their computer screens searching through countless sites for pertinent research and a special acknowledgement is owed: thank you for always being ready to lend a helping hand, it is truly appreciated.

A very special acknowledgement goes forth to Mr. Marty Vrieze, MS:A.E, for the time he unselfishly carved from his hectic schedule as Marketing Director at Harbor Freight Tools. Marty holds a Master of Science in Applied Economics from Marquette University, and his insight and guidance into the effect of Price Ceilings and Subsidies on Efficiency and Deadweight Loss of Social Welfare proved invaluable in helping us fit the pieces of the puzzle together.

Finally, the project team would like to thank the many students, faculty, and staff at Brooks Institute of Photography for their participation in focus group survey settings to assess: (a) consumer attitudes and behaviors, and (b) what the consumers themselves thought are viable methods for reducing the number of cars on the US101 between Thousand Oaks and Goleta, California. Their responses were overwhelmingly unique (some are ***very unique***), enlightened, and for the most part: immediately viable. We have presented some of their comments in the section on recommendations and alternatives.

It is the hope of all the members of this project team that future generations – through changes in policy, budgeting, implementing consumer and society friendly methods of alternative transportation – will never again utter the words, "[there are] ***Too Many Cars… and Not Enough Road!"***

Our sincere thanks to all who graciously provided their insight, opinion, wisdom, guidance, labor, and support to make this paper a reality.

INTRODUCTION

Congestion, and its evil-twin: **Gridlock**, are externalities that we in Southern California are all too familiar with – and constantly gripe about – yet, like the weather there seems nothing that can be done to reduce the number of cars on the road each day. In fact, communities throughout the United States that never thought traffic congestion as ever being part of their increasing dependency on the automobile – thus, an ever increasing demand on the number of lane miles (roadway) available – are now faced with serious planning, budgeting, and land use issues as they attempt to cope with runaway demand.

This paper takes the stand that there exist strong economic arguments for reduce the demand for lane miles, and as a direct consequence reduce the number of vehicles demanding access to a very inelastic and finite supply, and that implementation of economically sound policies and alternatives will reduce the cost to society at large as well.

To accomplish this, we have broken the paper into thee main areas: (1) An in-depth development of the **true cost of driving** versus the perceived cost that drivers currently realize; (2) The development and an explanation of the economic reasoning behind ***"Too Many Cars + Not Enough Road"***; and (3) The presentation of solutions and economic rationale that will reduce the number of cars on the road through the implementation of viable – albeit strong – economic policies. It is only through the implementation of efficient and effective economic solutions - and the bold political stances it will take to implement them - that the section of US101 from Thousand Oaks to Goleta, California will see a reduction of vehicles consuming its finite lane miles: and a return to a stress free commute.

Section I: A Snail Paced Rush Hour

The morning and afternoon commute between the cities of Thousand Oaks, California and Goleta, Ca. has become a driver's nightmare due to a persistently consistent increase in the physical number of cars on the road-often with only one occupant. Over the past fourteen years (1987-2002) as the number of drivers competing for limited lane miles has increased, so have such factors as the commute time, stress, accidents, need for road maintenance, or better yet, expansion. These factors have significant economic impact and consequences that reverberate throughout Santa Barbara and Ventura counties in the guise of lost productivity and profitability, rising risk factors, increased pollution from automobile exhaust, and other externalities that society must bear, In effect, society has "sanctioned the subsidizing of the driving commuter…by picking up the tab"; in actuality, 58% of the true cost of driving (Alvord 2000).

The obvious solution - the one heard from every driver on the road - is that we need to reduce the number of cars on the road. However, it is a solution easier said than done: particularly when California's expected population growth from 2000-2025 is 43% (United States Census Bureau 2000), and on average each household maintains and operates three cars (Alvord 2000). Moreover, 72% of the labor force in Santa Barbara and Ventura Counties elect to drive alone, while only 15% carpool and less than 5% utilize public transit or private vanpool (Department of Transportation (D.O.T.) 1990). Further fueling an overuse of the section of U.S. 101, running between Thousand Oaks and Goleta, California is the fact that out of a total combined population of 1,171,400 individuals for Ventura and Santa Barbara Counties, our research reveals only 419,370-36%-work in their county of residence, while 8%-93,424 individuals-work outside of the county of residence: Ventura County residents are twice as likely to drive alone as are residents of Santa Barbara County, and public transportation is also used to a greater extent (1.2%more) by Santa Barbara County residents than by Ventura County residents.

The answer to the problem of an ever-increasing amount of driver's demanding to exercise their driving privileges on a very limited amount of highway does exist- it is even plausible: although it may not be politically palatable. The question before us then is: How do we, from and economics viewpoint, reduce the number of drivers using U.S. 101-thus decreasing demand-between Thousand Oaks and Goleta, California?

Section II: Determining the True Cost of Driving

The true cost of driving is not what most driver's think it is. In fact, the gas we use in our vehicles accounts for only six cents of every mile we drive (AAA 1999). Prior to building the true cost of driving, and relating that to the supply and demand analysis, an understanding of the factors that contribute to the cost- or price- of driving and therefore, to the increasing demand for highway miles is needed.

Working Parameters & Assumptions

Assumptions made in building the cost of driving; and for our economic analysis are:

1) Facts and figures for averages relate equally to the United States and the sector of highway we are studying.

2) Our cost figures are based on a per car, per year allocation, with the time frame equal to a 5 year period of ownership and lending terms.
3) The physical supply of road surface (stated as lane miles) is for the most part, fixed for the majority of the distance (approximately 120 miles round trip) between Thousand Oaks, California and Goleta, California; no expansion plans are in process.
4) Historical data trends tell us that demand is Price inelastic under current conditions.
5) That physical alternatives to driving are currently available, or will be within the next 12 months, and that they are viable cost effective methods.
6) Regulatory changes are executed and enforceable.

Factors of Demand & Supply

As noted earlier, strong population growth rates and vehicle ownership per household (an average of the cars per household) are important non-price determinates affecting driver demand for existing lane-miles. Additional factors that impact the demand function are:

- Population Growth and Shifts (Includes: Immigration & Emigration Figures
- Government Land-Use & Development
- Population Density
- New Housing Starts
- Existing Home Resale's
- Household Size & Income Levels
- Car ownership per Household (# value)
- Consumer Ages
- Consumer Attitudes & Preferences
- Cost of Personal Vehicles
- The Price of Crude Oil (per barrel)
- Excise Taxes on Gasoline/Barrel&/Gallon
- The Price of Gasoline (pump price)
- Fuel Consumption (55% increase since 1970)
- Cost of Alternatives to Driving
- Per Capita Transit Usage
- Market Specific Labor Force Movements (changes in this factor have significant impact on vehicle & transit wage ratios & cost allocations)

Additional facts significantly affecting demand for lane miles include:

- 1990 D.O.T. figures show 9 out of 10 miles are traveled via personal auto;
- 1995 commute distances had increased 41.6% from 1970 figures to 12 miles per commute-yet commuter trips only account for 18% of all personal trips;
- Derived demand for fuel has increased 55% between 1970 and 1990-in 2001 demand was at 14.75 billion gallons, representing a 58% increase in demand since 1990;

- Americans now average three hours per day commuting to work; and
- Out of the 28% of energy used in the U.S. for transportation, 76% is allocated to cars, trucks and motorcycles. This means that these three modes of transportation for individuals and freight consume 21% of the total energy the U.S. uses each year (D.O.T. 1999; U.S. Energy Commission 1999)

Lane-mile demand places extreme pressure on supply, and makes it virtually impossible for the public sector to keep pace. A report published by the Surface & Transportation Policy Project (STPP) in 2000 states, "…between 1984 and 1997, at least 26,000 lane miles were added to California's road network[the 101 between Thousand Oaks and Goleta received zero added lane miles]…an overall increase of 13% (sans local streets." During the same time period, California's population grew 28% and driving increased 45% (STPP 2000). Backlogs for repair to existing infrastructure run close to one billion dollars in California, and new lane construction on major arteries is either not funded, or so far from implementation that planned capacity will never meet demand (STPP 2000).

Perceived Cost vs. The Real Cost

One economic fact is crystal clear: as long as the perceived per mile cost recognized by the driver remains below the actual cost of driving (i.e., perceived cost + externalities), then the service-in this case it is a public good, the lane miles of the highway system will experience excess demand. In effect, society at large, becomes responsible for paying the "extra" costs that driving generates.

Economic Incidence

In 1999 ***The Automobile Association of America*** (**AAA™**) reported that a 1992 study, found drivers only realize 42% of the costs of driving a car (e.g., gas, oil, maintenance, insurance, license, registration fees, financing, actual vehicle costs); the remaining 58% is passed on to society and the organization through lost work time, decreased productivity, road maintenance (i.e., cleaning, landscape, irrigation, signs, signals, police & emergency services, increased death tolls), and environmental impacts that include: (a) health, (b) pollution to air & water, (c) land use & habitual loss, (d) energy use, (e) manufacturing requirements, and (f) disposal problems (Beard 1992; Climate Change Solutions. Com, 2002). In the same study, **AAA™** calculated a car cost $6,720 per year to operate (i.e., the visible operating costs directly borne by the driver) - this represents the 42% the consumer realizes - and the 58% borne by society totaled $9,280 per car, per year. Alvord (2000) states that during peak hours the economic incidence shifts further from the car commuter, particularly where access into and from a central city is concerned, and only 20% to 25% of the true cost is being borne by car commuters. In stark contrast to this, Katherine Alvord (2000) observes that, "…inner-city transit users pay between 80% to 90% of the true cost…" of their commute.

Ownership and Operation: What the Driver Realizes

Drivers only realize a portion of what it really costs. These costs are the fixed costs of ownership (e.g., loan payment, insurance, license fee, etc), and the variable costs of operation (e.g., gas, oil, maintenance, registration fees, tickets, etc). According to a 1999 study conducted by **AAA™**, the fixed costs for owning a car that is driven 15,000 miles per year for a four year time span fall between

$14.96 and $22.12 per day (dependent on vehicle size and purchase price). This represents the ***fixed*** out-of-pocket **costs of ownership**. The **costs of operation** - the ***variable*** out-of-pocket costs - amount to $0.41 to $0.48 per mile. Gas and oil add another $0.06 per mile to these figures, and general maintenance adds another $0.05 per mile. Summing these costs gives us an overall operating cost range of $0.52 to $0.59 per mile-per car.

It is the out-of-pocket variable costs most drivers perceive as the total cost they pay to exercise their privilege to drive on "public" roadways; in truth, these operating costs only represent 13% of the overall driving costs (Litman, 1999). According to Todd Litman, the perception that out-of-pocket costs represent the "total cost" to the driver comes from the fact that "…we currently price cars and driving by putting most costs up front…"; from a financial perspective, more than 75% of a car's monetary costs are fixed-paid whether we drive it or not and are spread out so that it appears we pay less per unit of driving than we actually do. Since variable costs exist, our total costs (i.e., our personal Marginal Costs of driving) actually climb as we increase our mileage driven (Litman 1999; Holtz: The World Resource Institute 1992).

Society's Bill

Predictably, a factor seldom accounted for when calculating driving's cost is: the cost of time. Focus Group Surveys conducted by Richard Hockett during the past six months, and designed to ascertain the cost of driving aw well as alternatives expected to reduce the number of cars on the road, involved 225 individuals ranging in age from 19 - 63 years of age who regularly commute between Goleta and Thousand Oaks during peak-traffic hours. In the six month period, **two** participants accounted for the value of their time while sitting in traffic.

In Todd Litman's study, he states that non-monetary costs, such as crash risk (this carries with it additional non-monetary costs: (a) pain, (b) suffering; and (c) lost quality of life-together they are calculated at hundreds of billions of dollars per year), driving time, and stress add between $0.11 and $0.34 per mile (Litman 1999). Moreover, researchers place the cost of externalities - those costs borne by a third party separate (i.e., society-at-large) - in the region of $2 trillion dollars: 18% of the GDP. Economist Mark Delucchi (1991) estimates externality costs run between $9,927 - $15,053 per car, per year (Litman 1992; Delucchi 1990-1991; Alvord 2000). Separate research conducted by Brian Ketcham and Charles Komanoff (1999) approximate congestion and gridlock externalities total approximately $168 billion per year in the United States; of that, $100 billion is attributed to lost productivity. Lost time and productivity costs may also add an estimated 24 billion to 40 billion yearly to the costs of goods (Ketcham & Komanoff 1999)

The Grand Total

Litman (1999) estimates that "…every dollar spent on operating a car imposes $2.70 per car, per mile cost to society". Nevertheless, Litman's estimate does not include an important externality: Parking! Economist Mark Delucchi (1990-1991) estimates the external cost of off-street parking at homes, businesses and parking structures to be between $75 - $233 billion in the U.S. each year, thereby adding another $0.033 to $0.097 per mile, per car to the cost society pays (1991 figures). When this cost is added to Litman's $2.70 per mile, per car estimate of externality costs, it presents us with a cost to society between $2.73 - $2.80 per mile, per car.

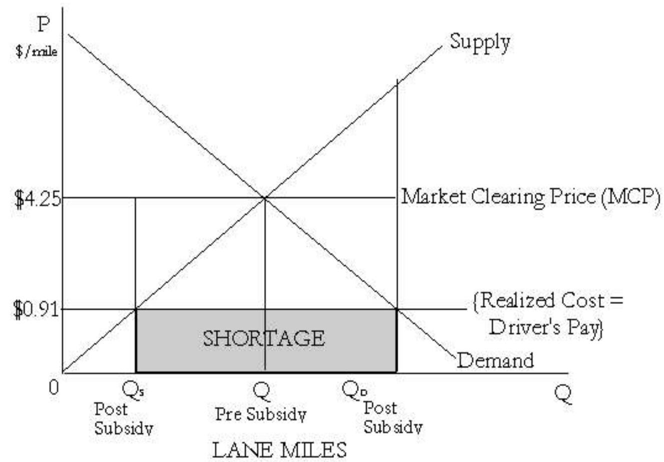
Simplifying*, and based on a 120 mile round trip commute, we have the following breakdown and calculation of total cost per mile driven: in other words, the ***real cost of driving***..

(1) Fixed Costs (per day)	$18.51	
(2) Out of Pocket Variable Costs/Mile	0.41	
a)Gas	0.06	
b)Maintenance	0.05	
		$0.52/mile
(3) Non-Monetary Cost (Time)		0.23/mile
	Total Variable Costs	$0.75 mile
(4) Externalities:		
a) Risk, productivity loss, increased consumer good pricing, stress, budget allocation, etc.		$2.70/mile
b) Parking, cost of land use and free parking		$0.65/mile
	Total Externalities	$3.35

Calculating for a 120 mile round trip (1 day's commute)

Fixed Costs	$18.51	
V.C. + Externality Costs(120 miles	$492.00	
	$510.51 / 120 miles = $4.25 /mile	

Section III: The Economic Perspective

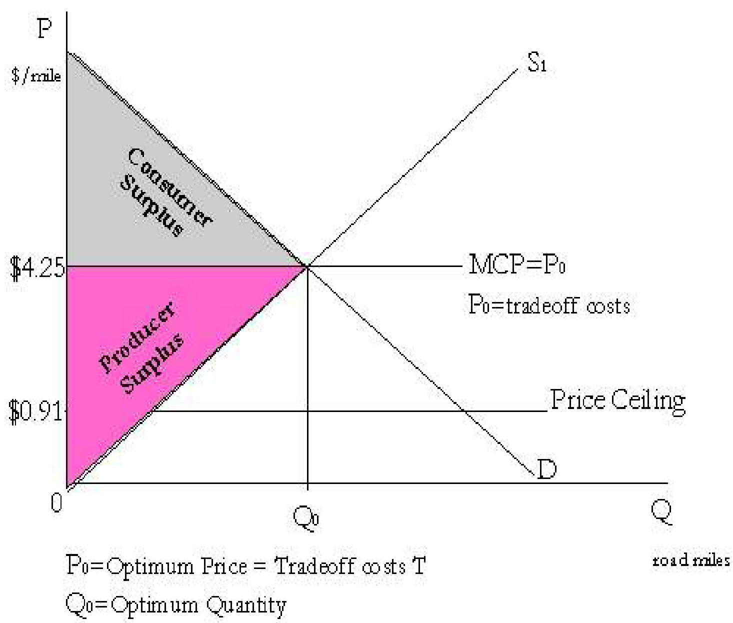


(Figure A)

At a realized cost (the prices that driver's are currently paying) of $0.91 per mile of lane mile consumption (road use) and a Market Clearing Price (MCP) of $4.25 per lane mile, it is apparent that society is effectively subsidizing the car commuter (Figure A). The subsidy amount due to the price ceiling is the difference between the MCP and the Realized Costs (RC) [MCP-RC=Subsidy Amount]. In our case, the RC at $0.91 is a price ceiling necessitating society pay the cost of diving's externalities. Because price ceilings are set below the MCP, shortages occur (QS_{pc}-QD_{pc}=Shortage Amount) and the physical reality is insufficient lane mile capacity exists to satisfy surfeit demand produced by the price ceiling's artificially low price. When under priced, demand will accelerate and place relentless pressure on supply: resulting in more congestion, gridlock, frustration, etc.; on the other hand, the supplier experiences lowered revenue (e.g., lost funding) and finds it nearly impossible to meet - or catch up with - demand (Litman 1999; McCarty 1997).

Dr. Haworth (2001) states, "…shortages demand a determination on product allocation…," and "…when the product is allocated by the goods supplier [as in the case at hand]…" the lack of supply [lane mile capacity] available to meet demand [lane mile consumption] establishes a queue-line as one method to control consumption of the good. Jeff McCloskey (2001) finds that because of under pricing, drivers continue to access lane miles even when their average total cost (ATC) - expressed in terms of stress, wait time, accident risk, etc. - exceeds their average benefit (AB) of using the roadway. Consumers will compete against one another to acquire the product when the allocation of the good is supplier controlled (Haworth 2001), and this is quite evident to those of us that commute via car as we watch other drivers (and ourselves) continually "jockey for position" and stake out our own "territories": often defending them through anything except safe driving habits.

Dr. Haworth (2001) further states that, "..we expect that the high value consumers will be willing to pay extra for the good- up to the difference between their respective reservation price and the ceiling price". According to Dr. Haworth (2001), one way consumers pay is to wait in line-thus they must consider their ***opportunity cost*** of time vs. the time-wait involved, and if the opportunity cost is too great the high value customer will) leave the line(in our case they exit the main roadway). To the individual - particularly the commuter - time is a **real resource** (Haworth 2001), and giving up time that could be spent in productive pursuit (e.g., providing labor in the

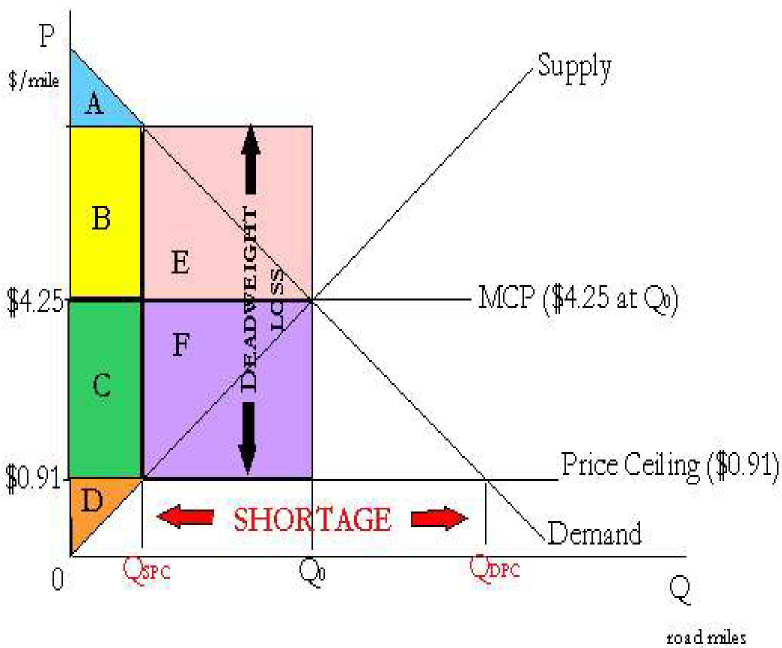


(Figure B)

production of goods and services, taking an economics class, etc.) is an additional welfare loss to society (Haworth, 2001).

Figure B illustrates additional effects of a subsidy/price ceiling and the affect on society's cost.

At the MCP, we have (P_O, Q_O), and because Market Equilibrium is efficient there is no Deadweight Loss. Price controls (imposed or implied) create inefficiencies in the market and a deadweight loss occurs. In other words, at MCP, you would have equal incidences (sharing, in this case) of consumer surplus (the difference between willingness to pay and the price paid by the buyer) and producer surplus (the difference between Opportunity Cost and Selling Price). Consumer surplus is represented on the graph (without the price ceiling) as the area of the triangle below demand, above market price. Producer surplus is represented by the area of the triangle below the demand curve, below market price level, and above the supply line boundary.



(Figure C)

When a price ceiling is introduced into the market, it triggers even greater inefficiencies within that market. Figure C illustrates that the CS increases significantly, while the PS drops to the point where there is very little trade off between opportunity costs and market price; thus, no incentive to supply the good. Consumers on the other hand- particularly in our case concerning excess demand on available road miles-find their willingness to be greatly enhanced by the price ceilings low price. The new CS=A+B+C; the old CS=A+B+E; the new PS=D; while the old PS=C+D+F; and the area formed by E+F is the Deadweight Loss the price ceiling (realized costs at $0.91 per mile) creates (Vrieze & Nourzad 1995). In the case of a per unit subsidy (the per car, per mile externality cost) the Deadweight Loss (also referred to as Deadweight Social Welfare Loss or Deadweight Welfare Loss) emphasizes the fact that as long as driving continues to be subsidized, too much of society's resources will be devoted to the car user. We see that society's true cost extends beyond dollars and cents: encompassing issues of resource allocation, relative costs associated with opportunity costs, and policy that establishes budget constraints, population density planning, and land use. Moreover, the public is taught that roads are a public good accessible by all – one reason why only 42% of the true cost of driving is realized by the consumer – and per unit cost/use allocations are difficult to ascertain. There exists the potential of a "free ride" situation existing that is reflected in the size of the Deadweight Loss Zone (Vrieze & Nourzad 1995).

Section IV: Alternatives, Possibilities and…The Consumer

The discussion up to this point is intended to provide an understanding of (a) the true cost of driving the car into work every day; (b) the portion of total cost actually paid (realized) by the consumer; (c) the portion of the true cost that is pushed forward onto society at large, (d) what composes society's cost; and (e) an economic explanation for excess demand. What's more, the issues and factors under discussion hold relevance and applicability to many areas within the United States and other countries (Heggie and Vickers 1998).

To be able to build effective economic solutions that provide the desired consequences - the reduction in the number of cars on the road - we introduced the concepts of Consumer Surplus, Producer Surplus, and Deadweight Loss. We observe from Figure C, that as long as the consumer has a large surplus (the difference between consumer willingness to pay and the price paid by the consumer) they will take full advantage of the "cheap" price and attempt to consume as much of the good as possible; in our case, we encounter congestion and gridlock - among other externalities - that plague the car commuter.

Let us now focus specifically on the 120 mile (round trip) portion of U.S.101 that traverses the Gold Coast between Thousand Oaks and Goleta, California. The situation existing throughout this section of highway is an excellent example of the market inefficiency we have identified, and one in which the low realized cost of driving (consumption) creates an artificial Price Ceiling that results in society's cost per car, per mile increasing, and that a corresponding increase in the Deadweight Loss Zone also exists.

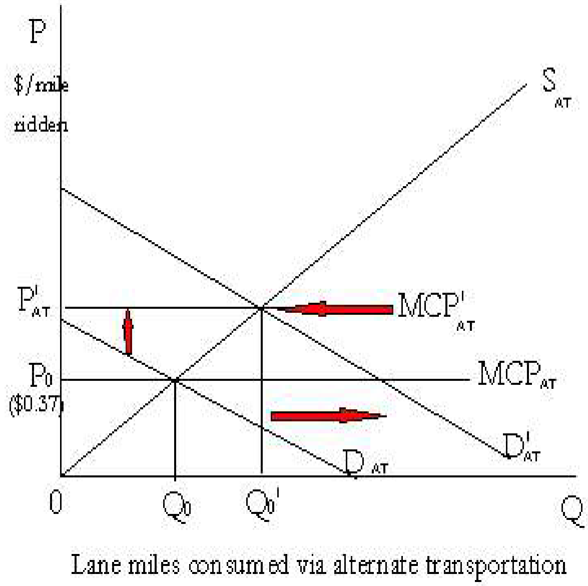
How do we reduce the number of cars on the 101 between Thousand Oaks and Goleta, California? That question was asked of 225 Brooks Institute of Photography students, teachers, and staff over the past six months. Ages of consumers range from 19 to 63; income levels varied from "deficit spending" (these *are* students after all to $100,000+ per year. The mean income level under consideration was approximately $25,600, and the mean number of cars per household was 2.68. (**Note:** Values expressed are ***mean*** values.) From our research standpoint, and more important, is the diversity within the survey group regarding location of residency prior to attending the Santa Barbara, California school, their learned and/or entrenched attitudes and beliefs toward non-car alternatives, consumer willingness to use alternative transportation methods, and at what price level does driving become "too expensive". Regarding this last point, we were interested in understanding the level at which the convenience factor associated with car use reached a point of Diminishing Marginal Utility and the consumer will cross over to the substitute good (e.g., public transit, car pool, etc.).

We looked at the suggestions made for alternative modes of transport as being substitute goods for driving. To date we have found that the level at which consumers cross over is more dependent on access and convenience factors than on price alone. Very few participants (less than 2%) were willing to cease commuting on a daily basis because public transit options did not meet their time constraints; a few participants did state they would be willing to use alternative transportation provided there was a guarantee that it would be on time. The most frequent complaint is that throughout this corridor, commuters North of Oxnard, California seem to be ignored. In the rest of this paper, we will be looking at the economic impacts of both price and non-price determinants to facilitate an understanding of market effects different alternative actions pose. To accomplish this, we will confine our discussion to simple linear demand and supply curves and movements thereof-or thereon.

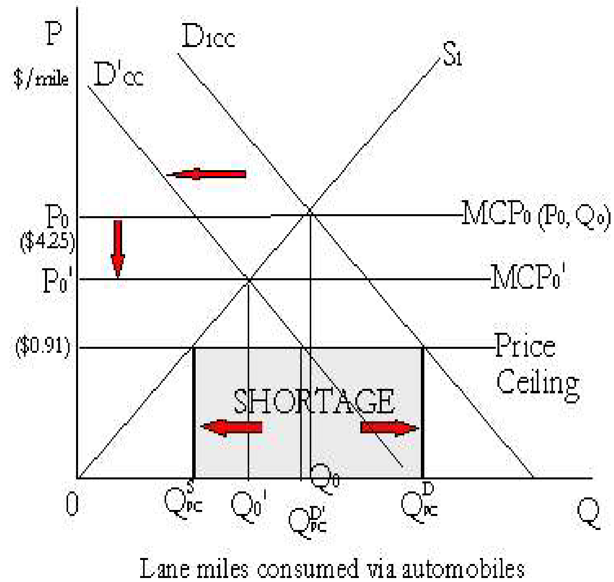
Interestingly, there was a great deal of consistency in the recommendations made by the different groups participating in the survey. The following responses proved to be the most consistently preferred methods for reducing the number of cars on the 101; they are also the more credible ones as well.

- Add Metro-Link Service from Oxnard to Goleta.
- Add two additional runs in the morning and late evening to the new Coastal Express bus service (on the same note, add more coaches to peak-hour routes to eliminate wait time; i.e., improve service).
- Increase private sector involvement and provide incentives to business organizations to emulate Rayethon, Hughes and Rocketdyne - these companies either provide outright, sponsor, or give minor subsidies to - commuter bus service for their employees. Rayethon, Inc. is instrumental in maintaining the Goleta Express (formerly the Clean-Air Express). Currently there is a five-month wait list for this full cost paid by the rider service.
- More accessibility to and quantity of, Van Pools.
- From Camarillo Airport to Santa Barbara Airport (one stop in Oxnard), run commuter flights at 30 minute intervals. (This may be a viable option for an organization with senior level management who lives outside the area).
- Add "Fast Track" lanes or Peak-hour entry tolls.

Economically, we want to look at the market behavior, and subsequent consequences as it pertains to taking cars off the 101; thus, supply (road capacity expressed as lane miles) receives less demand pressure. Using a standard supply and demand diagram and comparative statistics, we are able to demonstrate the movements and changes occurring. Remember, we are assuming that the alternatives suggested are perfect substitutes for the car commuter; therefore, when demand increases for the substitute good it will decrease for the primary good (See Figures D and E). Note: The mean cost per mile for public transportation systems and use is $0.37 per mile ridden.



(Figure D)



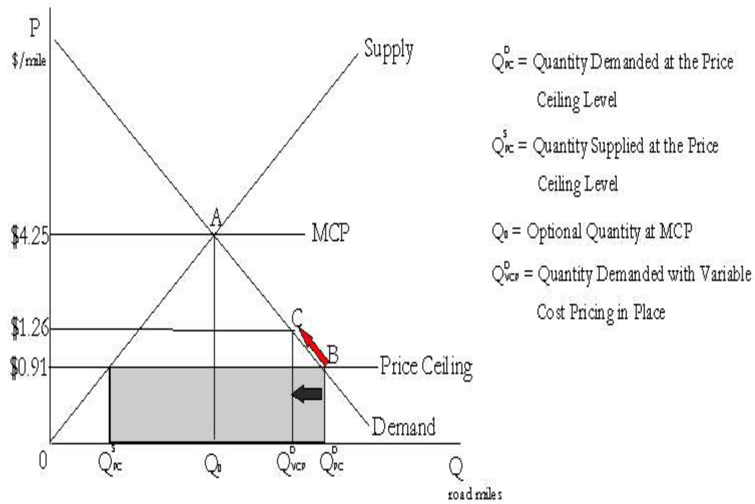
(Figure E)

The diagrams display that when consumption (Demand) of lane miles via Alternate Transportation - the substitute good - increases (shown by the rightward shift of the demand curve from D_{AT} to $D*_{AT}$) there will be a corresponding, and simultaneous, leftward shift of the demand curve for lane-miles consumed via automobile due to the cross-over effect. Assuming that the movement is a long-term shift in consumer preferences and usage patterns, the increased demand for alternate transportation will place upward pressure on price in this market, and over time the market will reach a new market clearing price ($MCP*_{AT}$); there are resultant increases in consumer and producer surplus values. Holding all other things equal, the decrease in lane-mile demand (simply stated: less cars being driven translates into less cars vying for limited roadway) reduces the cost to society as externality costs decline by means of a decline in car usage. The amount of Deadweight Loss is reduced for the reason that lower demand levels free resources once allocated to pay for driving's externalities to be utilized more efficiently in other areas. There is a corresponding reduction in the overall shortage of lane miles since alternative transportation modes (e.g., busses, van pools, car pools, etc.) exploit lane-mile usage more efficiently than do personal vehicles.

Variable Cost Pricing: Pay - to – Use

The variable cost, flexible volume pricing model received a great deal of newsprint in Southern California during its origination and implementation phase in Orange County, California. The concept is deceivingly simple: to use the road (The "Fast-Track") lanes, you pay a price to do so, and that price varies in conjunction with the time of day and the traffic-flow volume. While toll roads are not a new concept - Illinois and other states have used them for four decades or more - what is unique to the Fast-Track™ lanes running along a ten mile stretch of CA-91 is that the pricing structure allows for an automatic increase in price during peak traffic flow periods (McCaskey 2001). A second unique aspect of the Fast-Track™ system is that it is private road - owned and operated by The California Private Transportation Company (CPT) - and profit-maximizing incentives to control costs and maximize revenue exist. According to Jeff McCaskey (2001), the variable pricing scheme was chosen for the following reasons: (a) the pricing scheme is widely used in a wide range of applications (e.g., hotel room pricing, long distance rates, and elasticity pricing) where during periods of peak demand prices are increased; (b) this pricing method increases revenues; and (c) for those who would like to find less cars in front of them when commuting, this pricing model reduces demand on the "public thoroughfare".

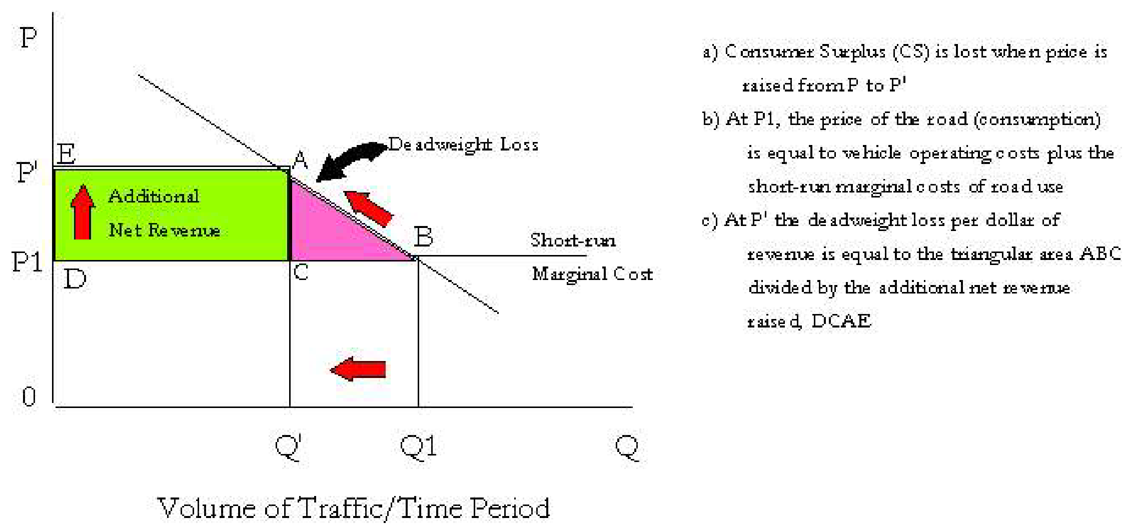
This particular alternative attempts to decrease demand pressure on limited resources, as opposed to increasing the resource supply (McCaskey, 2001), and is a possible solution for the section of U.S.101 under study. Whether a Fast Track™ system is installed, or peak-flow variable cost pricing access/exit ramps are implemented, the economic impact is a reduction in quantity demanded.



(Figure F)

Variable Cost Pricing (VCP), based on the Fast Track™ model, adds (on average) $0.35 per mile to the realized cost during peak traffic hours. This is a direct charge to the consumer for consumption of the good (highway use) and is therefore an increase in the usage price. In Figure F, this price increase is shown by an upward movement ***on the demand curve*** from $0.91 to $1.26 per mile, and at which we now find the quantity demanded has decreased to Q^{D}_{VCP}. VCP also effectively reduces the Consumer Surplus, improves producer surplus, and reduces the Deadweight Loss. Implementing a VCP scheme effectively reduces the quantity of cars entering the highway to those willing to pay the cost of using the road.

Heggie and Vickers (1992, 1998) used an Inverse Elasticity Rule to determine an optimal road-use charges while studying road development and financing in South Africa and other developing economies (World Bank Technical Paper No409, p.130). While the complexities of their full model are beyond the scope of this paper, for [according to Heggie and Vickers (1998p.131)] "...when roads are congested and the short run marginal costs are not constant, the analysis must include the supply elasticities, which greatly complicates the



(Figure G)

(Source: Commercial Management and Finance of Roads; The World Bank)

analysis". Their diagram (Figure G), shows that raising the price to a level that "finances" the road (assuming that the short-run marginal costs are constant – i.e., no congestion – and that cross-price elasticity is small enough to be ignored) reduces quantity demanded and reduces consumer surplus and deadweight loss as well. In-depth research of their work yields the belief that the Fast Track™ system is priced on such a model and that this pricing model should be considered for the 101.

Placing the Cost Where It Belongs

An effective way to improve efficiency, and decrease the Deadweight Loss, is to thrust the externality costs society borne by society onto suppliers. The guinea pig product when this is attempted is gasoline: the most visible, most consumed, and inelastic complimentary good car operation is associated with. Gasoline is consistently subjected to increasing excise taxes for this reason and is used by the Federal and State governments to raise revenue for road maintenance and construction: often under the premise of reducing and/or eliminating congestion and gridlock. For example, the implementation of Proposition 111: "***The Traffic Congestion and Relief Spending Limitation Act of 1990"*** promised the voters that this bill - which doubled the excise taxes on gasoline in California from $.09 cents per gallon to $0.18 cents per gallon – would go far to reduce congestion on California's overburdened roads. The California Energy Commission's 2002 Report on Energy Use states, "Taxes for gasoline in California are: 18.3 cents/gallon for federal excise taxes; 18 cents/gallon for state excise taxes [the result of Proposition 111]: and local and state sales taxes… (which vary) but on average the sales tax adds between 9 and 12 cents/gallon at the pump, depending on final price." Yet according to the statistics, driving in California has increased 30% - 35% since that time (Sources: Ventura County Star 1/30/02 B7; California Energy Commission 2002).

The explanation rests in the fact that the Price Elasticity of Demand for gasoline is inelastic, and the effect price changes will have on lowering the demand for using the road is negligible (as history demonstrates). Bearing in mind that gas is the primary complimentary good for automobiles, it becomes apparent that gasoline excise taxes do little to curtail the demand for driving; rather, it is used as an effective means to add money to treasury accounts that – hopefully – are established to pay for the cost of driving's externalities. We calculated the Price Elasticity of Demand for gasoline using figures from the California Energy Commission's 2002 Report on Energy Use to empirically demonstrate that this commodity's demand is highly insensitive (inelastic) to price changes. In 1999 there were 14.5 billion gallons of fuel sold (Q_1); in 2001 the amount is 14.75 billion gallons (Q_2). Prices (open market averages) are (P_1) = \$1.25 per gallon (1999), and (P_2) = \$1.61 per gallon (2001). Calculating for the Arc Elasticity:

$$E_p^A = \left(\frac{Q2-Q1}{P2-P1}\right)\left(\frac{P2+P1}{Q2+Q1}\right) = \left(\frac{0.25gal}{0.36gal}\right)\left(\frac{\$1.61+\$1.25}{14.75gal+14.5gal}\right)$$

$$= (0.694)\left(\frac{\$2.86}{29.25gal}\right) = (0.694)(0.098) = 0.067$$

$$= \mathbf{0.067}$$

With an $E_p^A < 1$, we confirm that the price elasticity of demand is inelastic; in fact, at 0.067 we know that demand will change less than one percent alongside a one percent increase in price at the pump. An additional conclusion we can draw from this is that consumer behavior – and the consumer's preference to drive versus using public transit - drives the demand for gasoline, and not the changing price of gasoline changing the demand for driving. A powerful example of this occurred in 2000 when pump prices were steadily rising due to production problems (capacity had been severely diminished due to refinery fires, outmoded reactors, and maintenance), and changing world crude prices; American drivers complained bitterly – many called for Judicial review of Oil Company pricing policies and strategies – yet, overall driving continued to increase (STPP 2002). The effect that rising gasoline prices have on the market is not a lessening of miles driven (thus no fewer cars on the road); rather, it changes consumer's purchasing preferences among substitutes within the automobile market. In other words, instead of purchasing that new Ford Expedition (average fuel mileage of 9mpg) that costs $60/tank to fill (Source: James Hockett, 2001 model year Ford Expedition owner), will now purchase a vehicle that professes better fuel mileage and results in a lower realized cost of operation.

With gas pricing being the least susceptible to demand changes resulting from price changes, and the least likely ones to use to reduce society's cost, what areas present themselves as means to shift externality costs onto suppliers and away from society? Recommendations that we discovered during our research include:

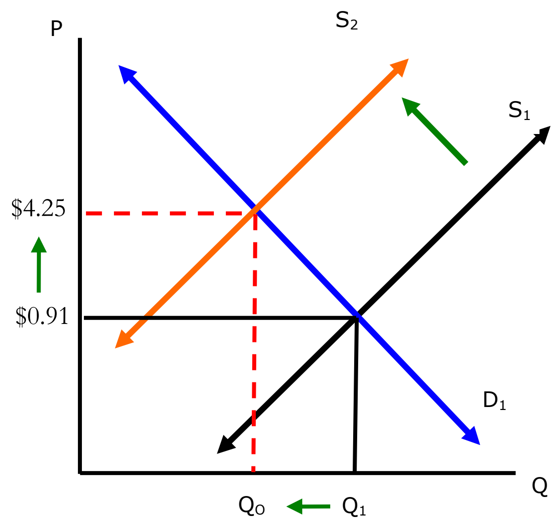
- Increasing Fuel Taxes
- Increase Road Use Fees for Transportation Companies
- Increase Taxes on Commercial Trucks
- Increase budget allocations for transit systems, and away from new lane-mile construction
- Implement zoning and land-use reforms. It has been shown by Ketcham and Komanoff (1999) that "…a doubling of residential population is associated with a 25 to 30 percent reduction in the number of miles people need to travel by car."

(Source: Ketcham and Kamanoff, "Win-Win Transportation" 1999)

- Environmental regulations that place externality costs of pollution and environmental degradation directly on the oil producers and the refineries
- Through regulation, make automobile manufactures (and their suppliers) directly responsible for paying the cost associated with the negative externalities an automobile produces (e.g., increased health costs of stress, respiratory ailments from internal combustion fumes and pollution, loss of life premiums, etc.)

(Source: The Research Group's Roundtable Discussions & Survey Responses)

The results of implementing these measures is shown in Figure H (for simplicity we are assuming that demand and supply are linear functions).



When policies, regulations, and excise taxes are enacted and implemented on the suppliers of vehicles (and associated industries) to allocate externality costs to the owners and suppliers of automobiles, then the supply curve will move left and upward to reflect the increased costs of production. The ultimate purpose of policies and regulations is to raise the cost from the to the true cost of $4.25 for every vehicle on the road; thus shifting the costs to the end user rather than onto society. With the upward, left shift of the supply curve for the reasons given, overall supply will be less, and the demand for road miles will decrease by the same amount from Q_1 to Q_O. The point ($4.25, Q_O) represents that the true costs have been shifted from society to the driver and toward a more social optimal equilibrium price.

SECTION V: RECOMMENDATIONS AND CONCLUSION

In this paper we have brought to light some ways in which the number of cars on our roads can be reduced. In particular, we are concerned with the increasing volume of traffic on US101 between Thousand Oaks and Goleta, California and what the counties of Ventura and Santa Barbara can do to achieve a reduction in the vehicles accessing the road; thereby, reducing the overall number of cars. Furthermore, we have presented economic evidence that implementation of a long-range strategy is necessary – and desirable – to keep demand for a very finite amount of lane miles from accelerating to the point where no forward motion becomes possible during peak traffic hours. From experience we know that the commute time between Thousand Oaks and Goleta have increased steadily over the past ten years to where it now takes fifty to ninety minutes to make a commute that at one time took less than thirty to forty-five minutes (and speed limits were slower ten years ago than they are now).

It is our recommendation that the counties of Ventura and Santa Barbara join forces to plan and implement the following measures designed to: (a) shift the cost of driving to the end user, thus lifting the artificial price ceiling and lowering society's cost; (b) increase population densities as opposed to opening up new areas of sprawl; and (c) through intelligent use of incentives, policies, and regulations, get the business sector involved in actively removing their employees from their cars through active sponsorship of company buses, van pools, and special rewards for car pooling. There are a number of economic reasons that business should be involved; the most potent, is a real increase of productivity because the non-car commuter arrives at work with less stress, or need for time to "cool down" after a hectic commute – this translates into increased profit through a reduction in health related and productivity related marginal costs.

To reduce the number of cars on the road it will take a multi-pronged approach that affects both supply and demand sides of the equation. A first step is a more detailed study of usage patterns and traffic flow followed by a study that determines the externality costs for this section of highway. Secondly, put more commuter friendly transit in place. There exists several options to driving that are currently in operation; however, as in road use: demand outpaces supply. Add additional routes and ensure seamless connection times between inter-county systems to make mass transit a viable alternative to the "convenience" of driving the personal car. Third, work to increase the Metro Line from Oxnard, California to UCSB in Goleta, California. This is a high-speed rail solution that our surveys reveal would be consistently used providing: (a) the service is made available, (b) the service has convenient arrival and departure times (i.e., schedules are consumer friendly), and (c) the price is lower than the perceived realized costs of driving on a per mile basis. With this in mind, we further recommend that Ventura and Santa Barbara counties embark on an educational campaign to enlighten their citizens as to what the true cost of driving is.

It is only through the use of both demand-side and supply-side economics that the number of cars on the US101 in Ventura and Santa Barbara counties will be reduced. Now is the time to implement, regardless of the unpopularity of the process. As a learned professor once stated, "Long-term solutions require bold economic measures." This project team unequivocally agrees; in fact, the sooner some bold economic measures are implemented… the sooner we can drive between Thousand Oaks and Goleta, California and see the scenery – not just more cars.

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APPENDIX:

"HOW MUCH DOES YOUR DRIVING COST?" – A WORKSHEET