Reforming road user charges: A research challenge for regional science

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Role of transportation in regional science

Cost of distance

50th anniversary issue of *Papers in Regional Science* (2004)

Glaeser and Kohlhase: Historical decline in transport costs; implications for city & regional development

Rietveld and Vickerman: Continuing importance of transport costs ("death of distance" is premature)

Reform of road user charges

1. Limitations of status quo (U.S.)
2. A Vehicle Mileage Traveled (VMT) fee
3. Research questions and challenges

Motivation

Forward-looking

Roads dominate passenger & freight transport

Potential impacts on travel behavior, urban form, regional development, direction of trade

Endogenizes transport costs {asymmetric, dependent on infrastructure investment}

Interdisciplinary. A policy issue to align the groups {transport, urban, NEG, trade, public finance, public choice, environmental, behavioral?; Engineers, economic geography, urban planners…}

Another way to price roads in New York City

Limitations of status quo in the U.S.

1. Road user charges do not match marginal social costs of travel
2. Growing gap between revenues and road infrastructure needs

Estimated marginal external costs [2006 cents]

	Passenger (per passenger-mile)	**Freight (per ton-mile)**
Congestion delay[a]	0.88 - 7.5	0.54
Road damage[b]	0	0.235
Accidents (external)[a]	1.4 - 14.4	0.11 - 2.0
Air pollution (health)[a]	0.09 - 6.7	0.10 - 18.7
Climate change[a]	0.06 - 4.8	0.02 - 5.9
Noise[a]	0.0 - 3.5	0.0 - 5.3
Water pollution[a]	0.01 - 0.05	0.003 - 0.05
Energy security[a]	0.20 - 0.84	0.22 - 0.84

[a] Delucchi and McCubbin (2009) [b] Parry (2008)

Variation of marginal external costs

Externality	Dependence				
	Time	Location	Road type	Vehicle type	Stochastic
Distance-related externalities					
Congestion delay	X	X	X	X	Accidents, special events, weather
Road damage		X	X	No. axles, axle spacing, axle weight	Weather
Accidents (external)	X	X	X	Weight, height, stability *Also driver characteristics*	Weather
Air pollution (health)	X	X		Emissions	Weather
Noise	X	X		Engine, gear ratios, tires, weight	Weather
Fuel-related externalities					
Climate change					
Energy security					
Other externalities					
Parking congestion	X	X		X	Special events
Water pollution		X			

Existing road user charges

Fixed charges

- Unrelated to usage

Fuel taxes

+ Nearly ideal for covering fuel-related externalities
- Poor for covering distance-related externalities
- Fuel-related externalities < 0.1 distance-related externalities (Parry et al., 2007)

Tolls

- 5,000 miles of tolled facilities (less than 1%)
- Time-varying or usage-dependent tolls on only 25 of 277 tolled facilities
- Truck tolls rarely based on axle weight

Shortage of funds

1. Deteriorating infrastructure
2. Declining revenues
   - Declining real tax rates
   - Improving vehicle fuel economy
   - Alternative-powered vehicles
3. Flawed revenue allocation mechanism
   - Earmarking of Highway Trust Fund

Estimated annual infrastructure gap 2008-2035:

43-71% of needs (NSTIFC, 2009)

A Vehicle Mileage Traveled (VMT) fee

1. Efficient pricing

Potential to internalize all road transport externalities with appropriate differentiation by time, location, etc.

2. Generate revenues

Supplement or replace fuel taxes

- Gasoline, diesel
- Federal, state

Satellite-based technology

Existing and proposed VMT schemes

Existing schemes

- Heavy goods vehicles (Germany, Austria, Switzerland, Czech Republic)

European national proposals

- Britain (2004)
- Netherlands (Dutch Mobility Plan, 2008)
  - Trucks (2011), cars (2016)

US trials

- Puget Sound (2005), Oregon (2006), Iowa (underway)

US proposals

- NSTPRSC (2008) and NSTIFC (2009)

Estimated annual benefits

United States		
Urban congestion pricing	$40 billion	Winston and Langer (2008)
Pay as you drive insurance	$50-60 billion Progressive	Bordoff and Noel (2008)
Great Britain		
All roads, congestion and emissions	£2.6-2.9 billion	Glaister and Graham (2005)
	Approx. welfare neutral	Graham et al. (2009)

Questions addressed in paper

1. Appropriate coverage of externalities and differentiation of VMT fee.
2. Choice of transportation models for evaluation (microsimulation, … , national).
3. Cost recovery.
4. Implementation path.
5. Effect of VMT fee on transport costs.
6. Response of users.
7. Optimal road capacity and road design.

Effect of VMT fee on transport costs

Thisse/Duranton

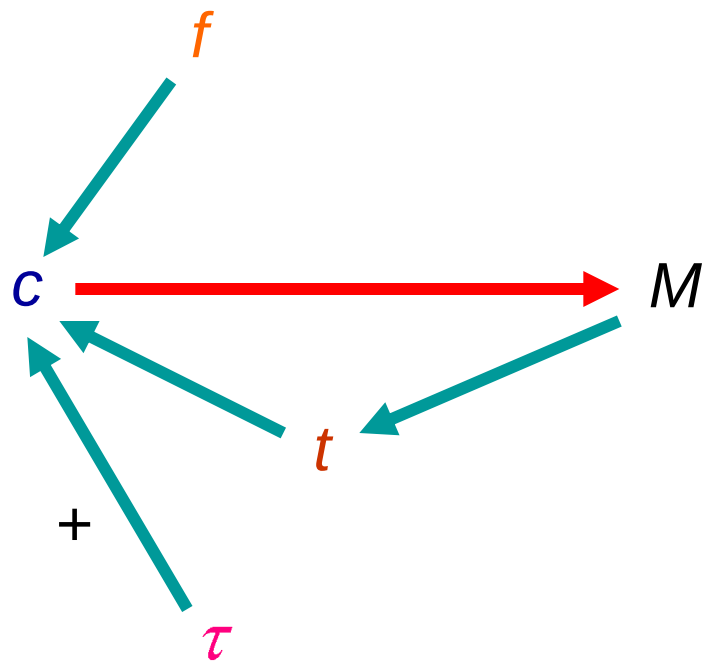
- Transport cost for freight
- Transport cost for commuting

Agglomeration depends on relative magnitudes of the two costs.

Effect of VMT fee on transport costs

Generalized cost per mile

$$c = \underbrace{\tau}_{VMT} + \underbrace{f / e \quad f}_{fuel} + \underbrace{t \quad M \quad c \quad , K}_{travel\ time}$$



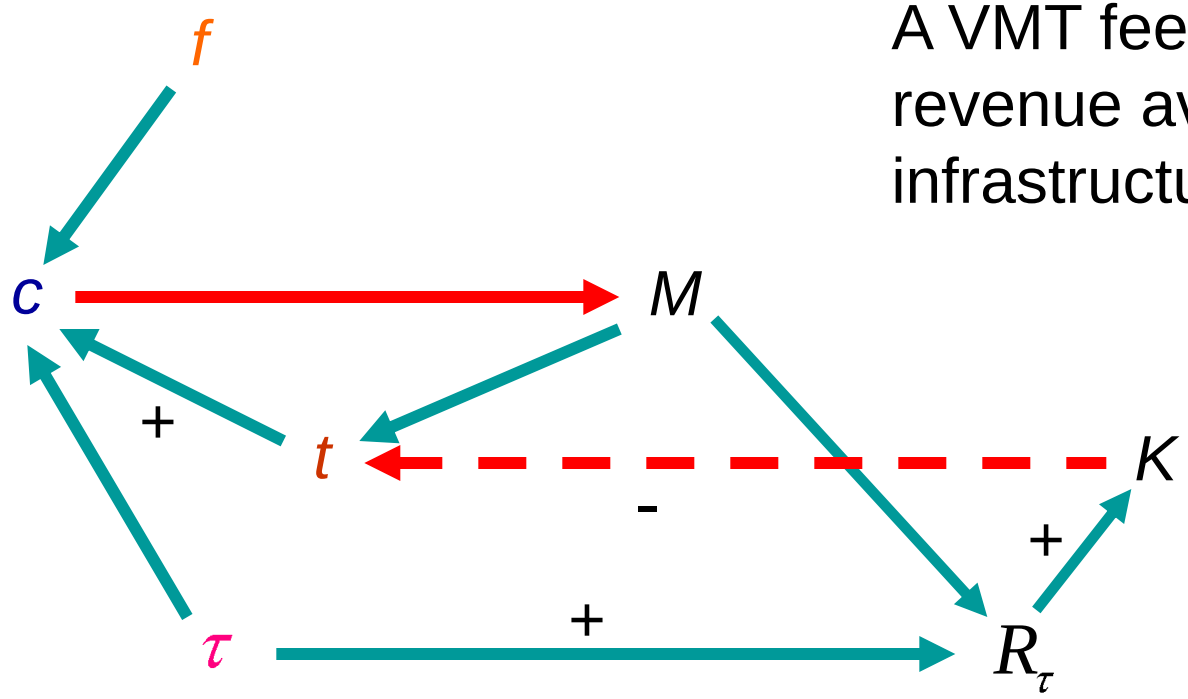
Direct effect

A VMT fee increases cost

Effect of VMT fee on transport costs

Indirect effect

A VMT fee increases revenue available for infrastructure.



Effect of VMT fee on transport costs

+ Monetary cost
- Travel time, unreliability
+ Marginal insurance cost
- Total insurance cost $\Rightarrow$ higher vehicle ownership?
- Use of information technology
- Higher road capacity and better road quality?

Some costs may rise, others fall:

Passenger vs freight

Urban vs. rural

From second-best to first best

A VMT fee brings economic analysis closer to first best!

Lipsey and Lancaster (1956/57)
Verhoef et al. (2000s)

Information required on cross-price elasticities
Danger of making things worse

Remaining distortions

Other transport modes
Other economic sectors (labor markets)

Optimal road capacity

Two opposing factors

1. Demand falls $\Rightarrow$ optimal capacity falls

2. Eliminate latent demand $\Rightarrow$ optimal capacity increases

    Strength depends on price elasticity of demand

Additional consideration

3. Tolling may increase lane capacity.

Optimal road design

Highways overbuilt for light-duty vehicles and for speed

- Truck-only toll lanes and corridors (Samuel, Poole and Holguín-Veras, 2002)
- Sacrifice speed for capacity (Small, 2008)

  Case perhaps weakened with a VMT fee

Response of users

- Traveler heterogeneity (value of time, value of reliability, …)
  - Adjustments made by marginal travelers
  - Welfare impacts felt by all travelers
- Most evidence on response to tolls comes from individual toll roads, not comprehensive road pricing
- Greater informational demands on users
- Role of Advanced Traveler Information Systems

Response of users

Cognitive limits, nonstandard preferences

- Drivers underestimate monetary costs of driving
- Drivers overestimate travel time saved by taking toll lanes or toll roads
- GPS measurements differ from perceptions (e.g. distance)
- Loss aversion?

  Averse to what? Tolls? Travel time? Generalized cost of travel? (Lindsey, 2009)

Future developments

1959 → 2009 → 2059

Technological

- Logistics: Just in time … Just in case
- Vehicle safety, emissions control
- Automated roads
- Personal helicopters (1950s); Segway & PUMA …

Demand

- Internet, telecommuting
- Car-sharing

Policy

- Cap-and-trade system or carbon tax
- High-speed intercity rail ($9 billion is a small start)