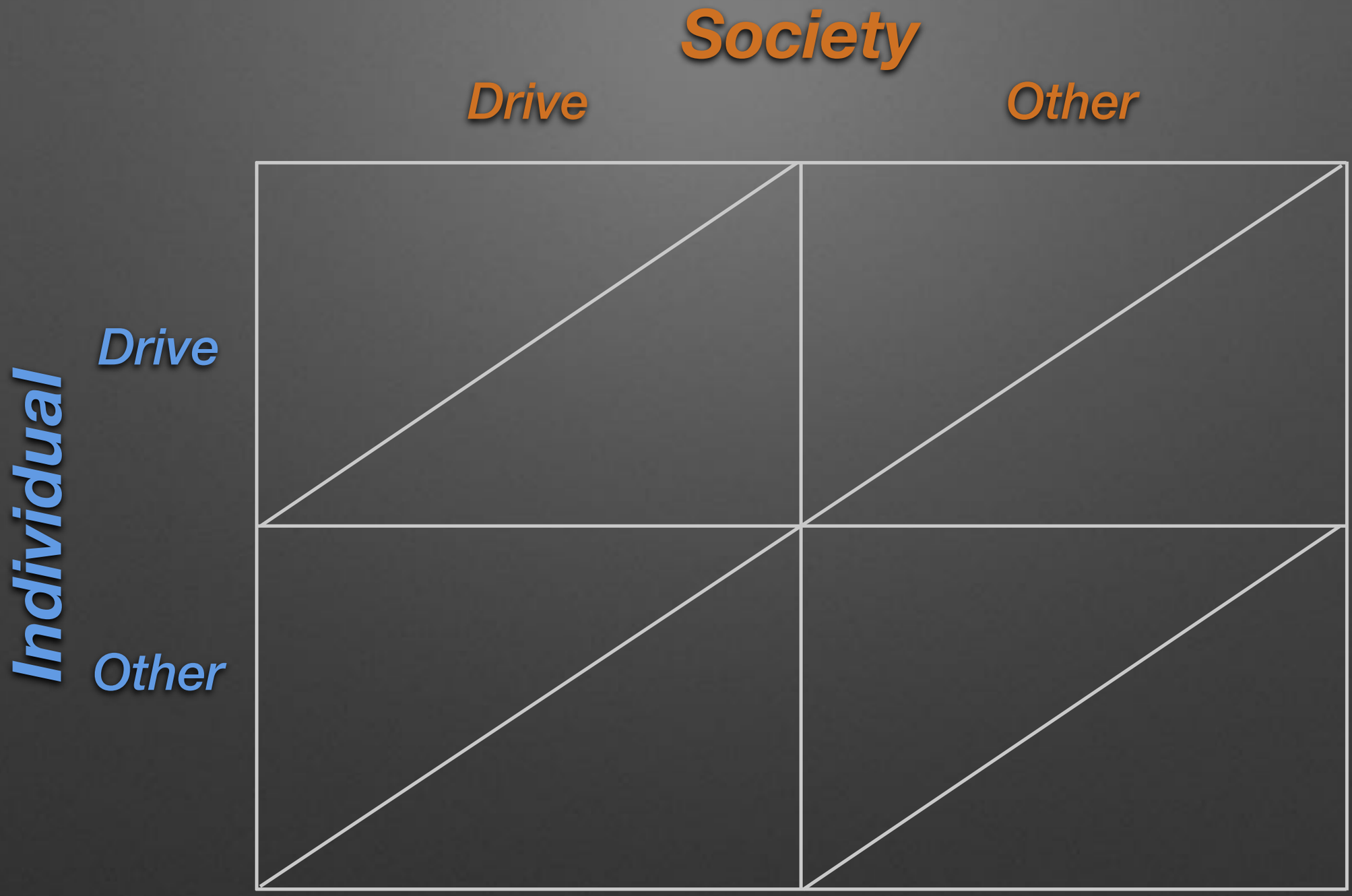
Transportation Economics in Bend:
Supply, Demand, Prices & Costs

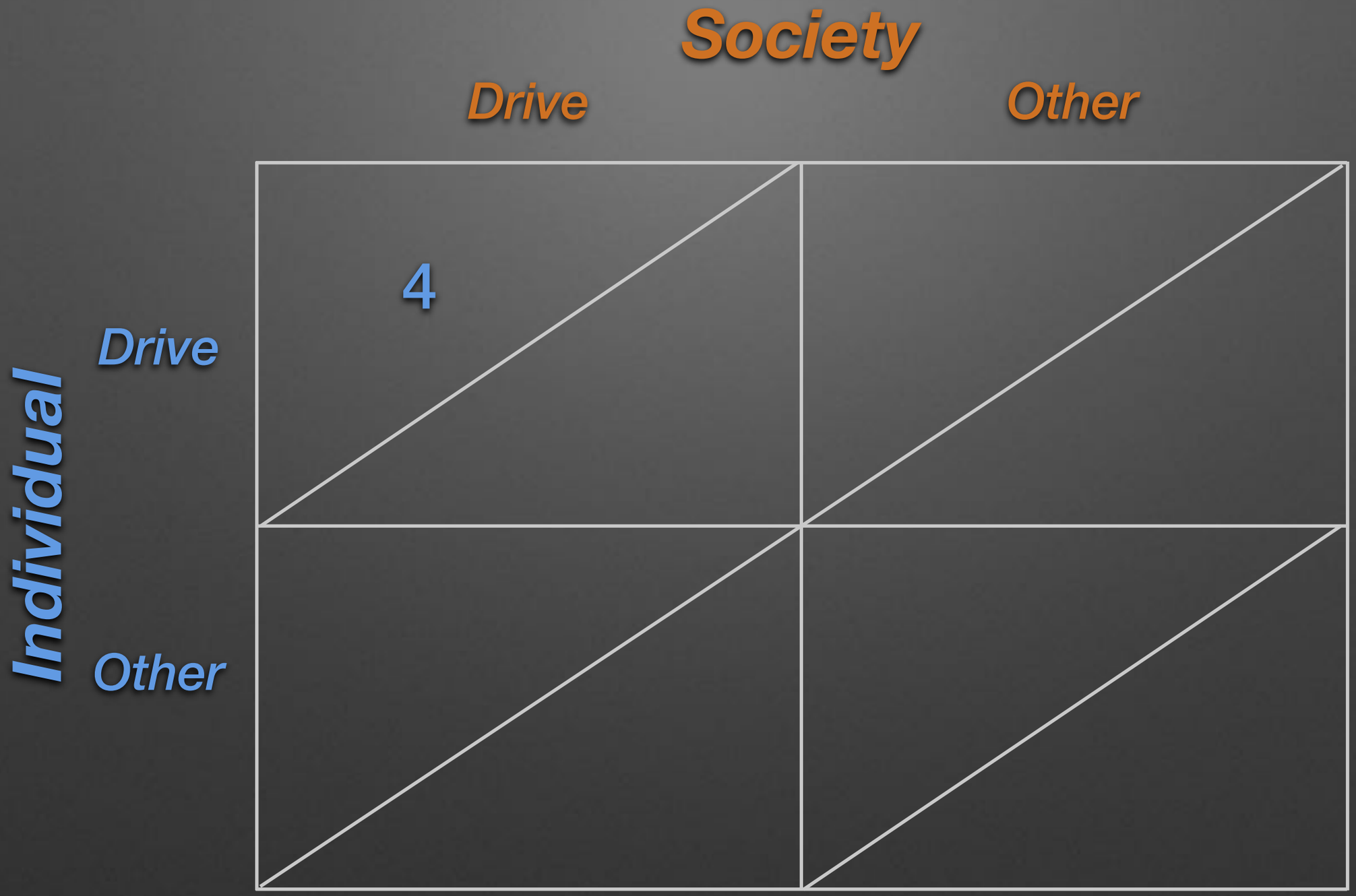
Prepared for: MOVE BEND

Presented by: Steve Porter & Michelle Porter

Bend's Dilemma



Bend's Dilemma



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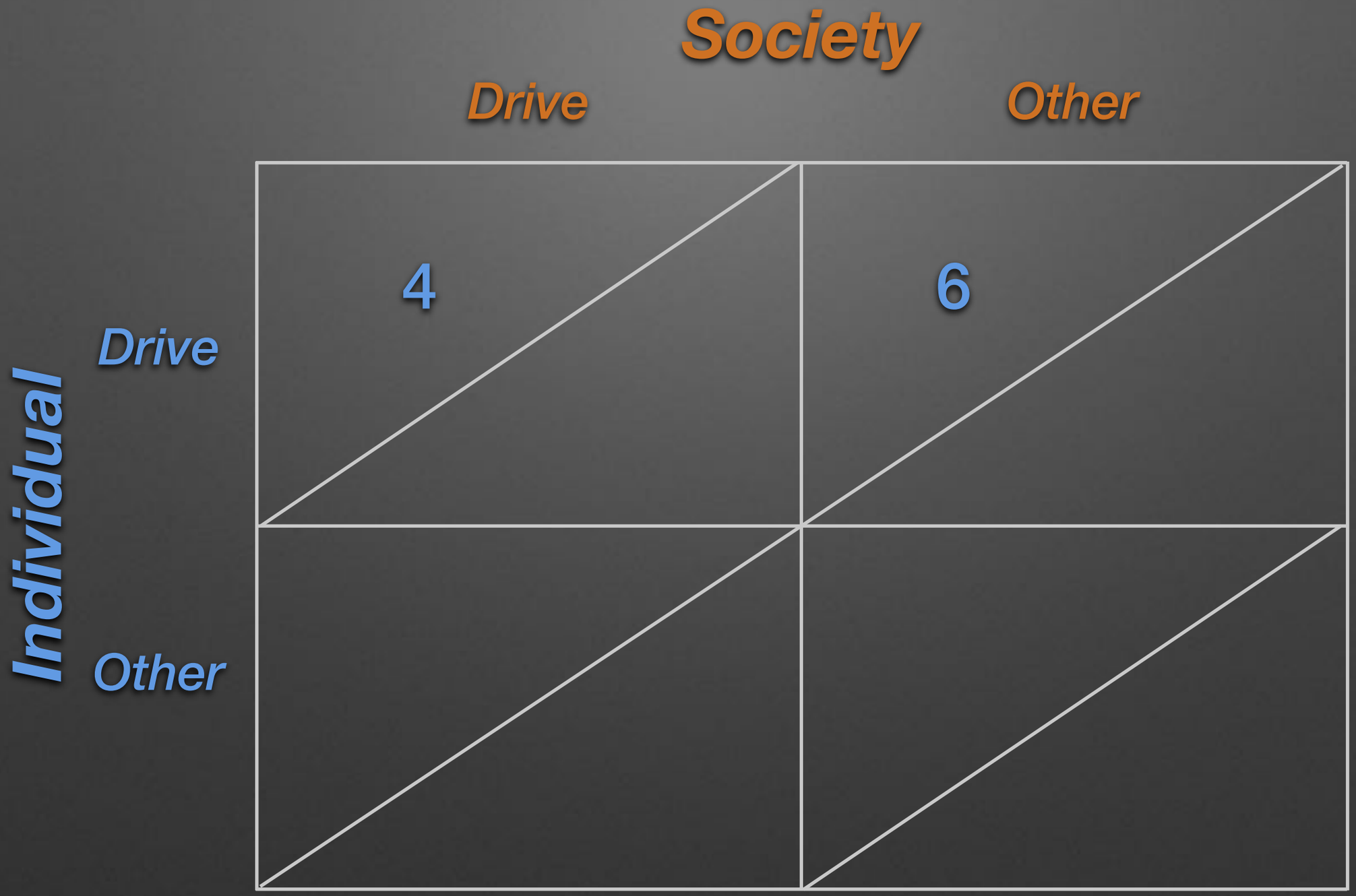

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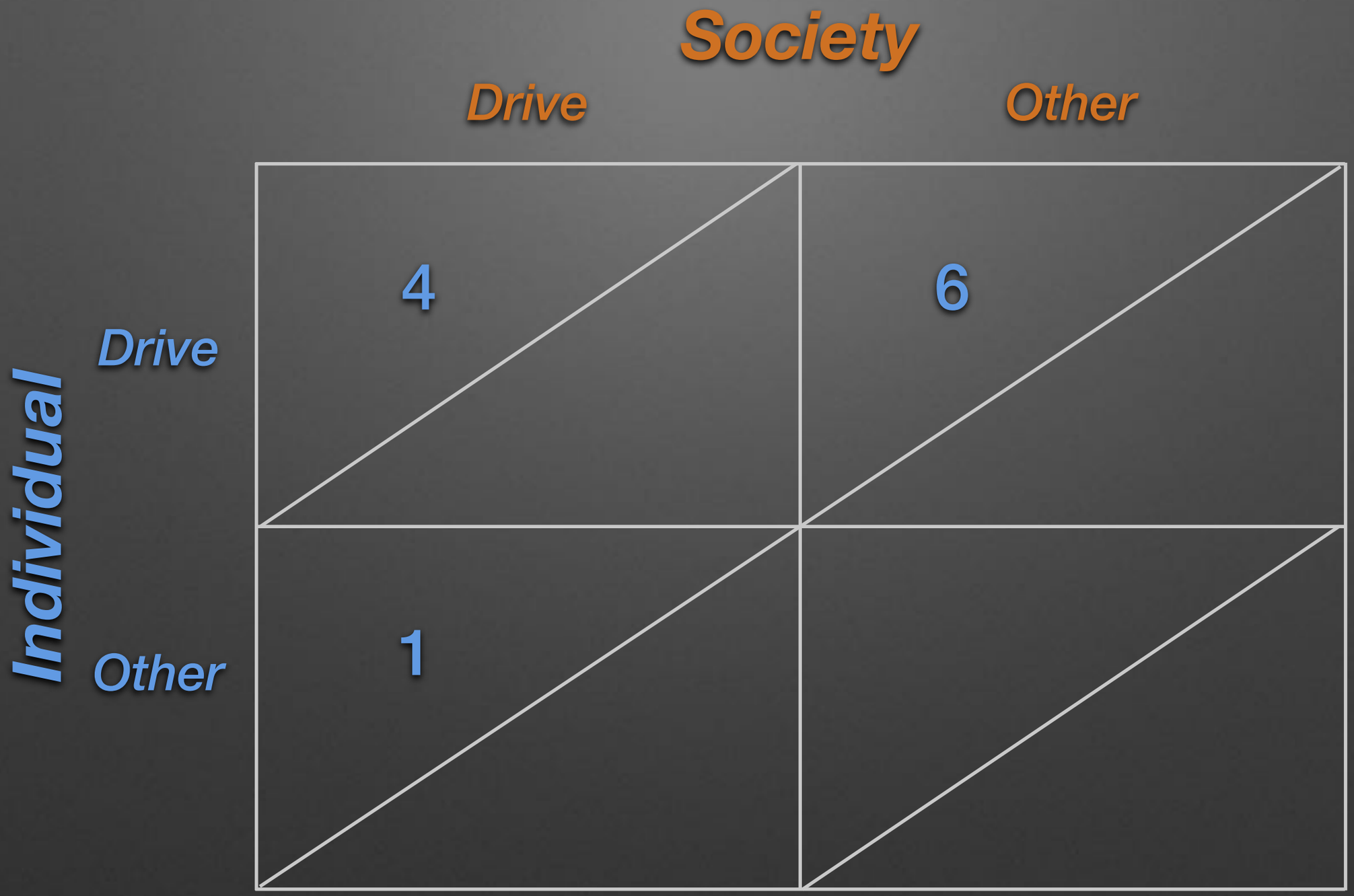

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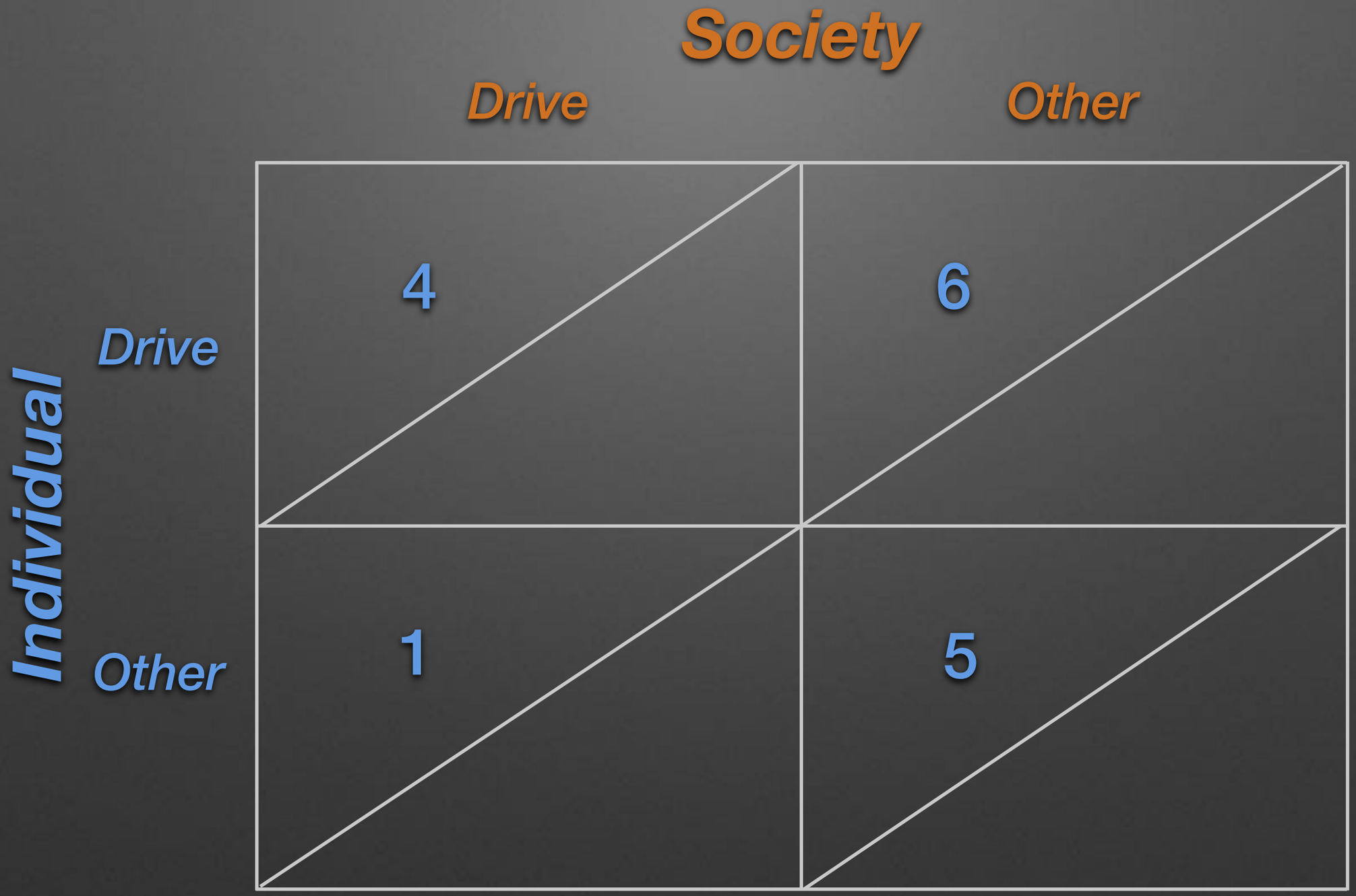
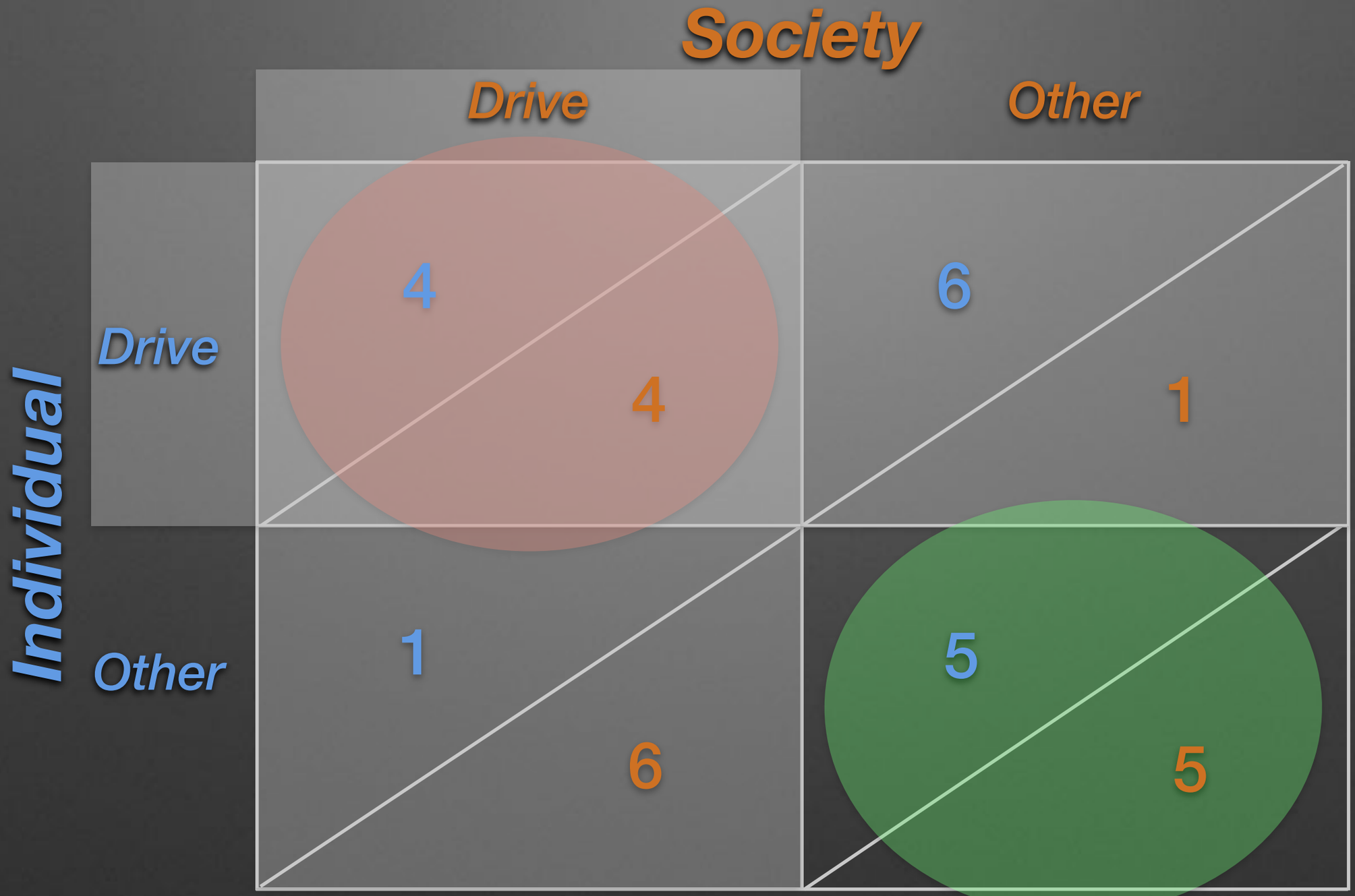


Bend's Dilemma



Agenda: How to Break Out of Prison

Alter the Payouts…Change the Outcome

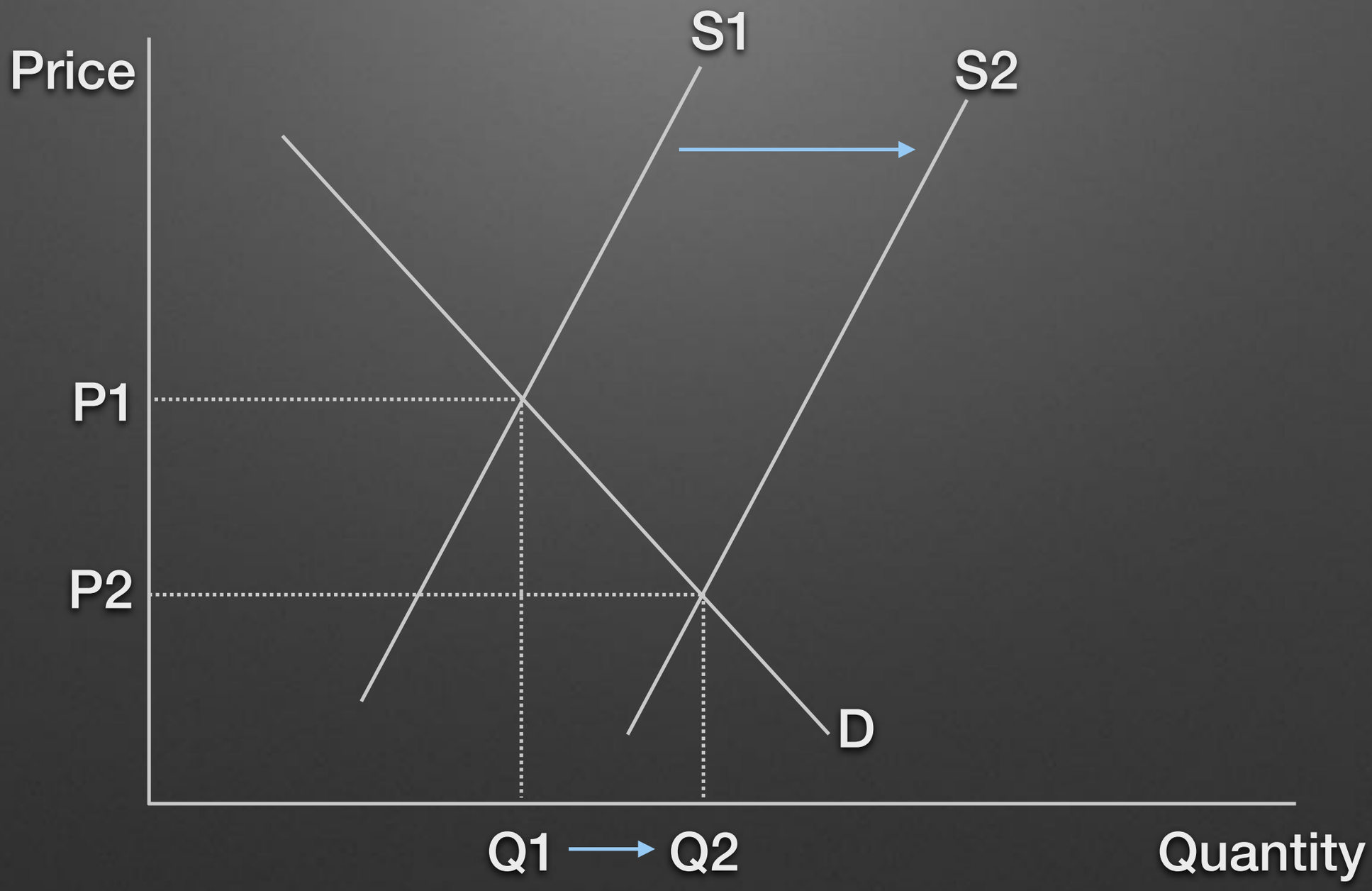
1. Moderate Road Expansion
   Supply-Induced Demand: Elasticity

2. Let People Pay Their Own Way
   Funding Mechanisms: Moral Hazard & Price

3. Stop Subsidizing Driving
   Parking Policy Reform: Shoup's Trifecta

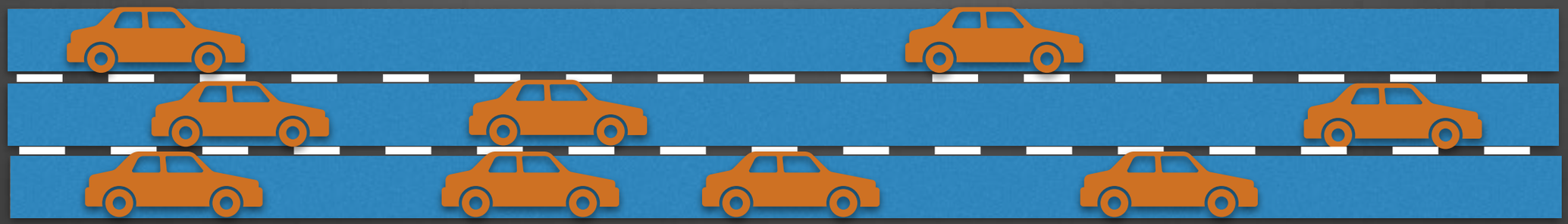
4. Slow The Roll
   20MPH Speed Limits: ROI of 305,000%

Supply-Induced Demand



Supply-Induced Demand

What is the effect of adding lane-miles on VMTs?



<u>Elasticity (E):</u>

d%VMT / d%Lane-Miles

Supply-Induced Demand

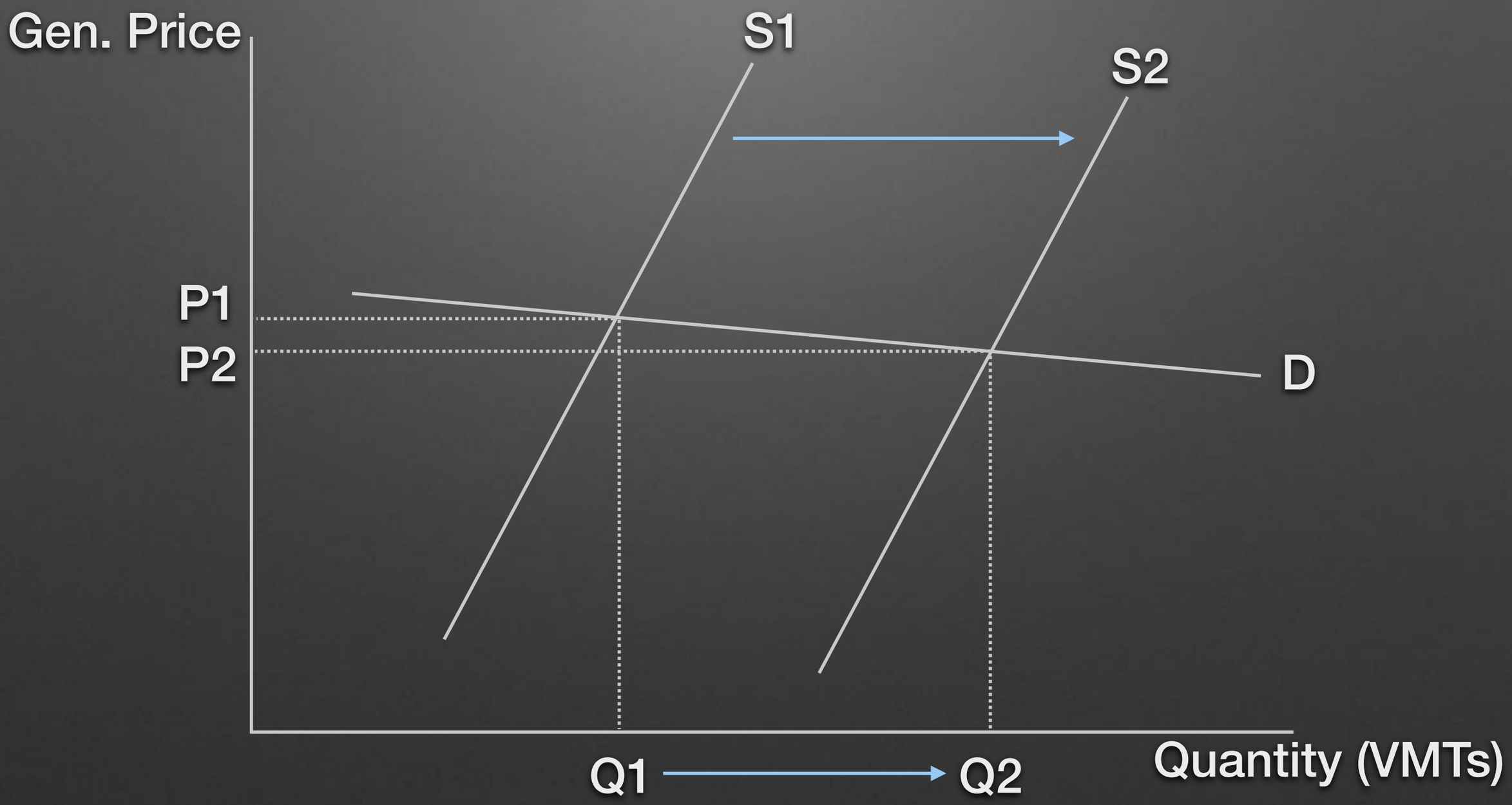
Estimated Long-Run Demand Elasticity for Automotive Roadways
Summary of Empirical Studies

Analysis	Demand Elasticity Estimate Range	
	Low	High
UK Study	1.00	1.00
Hansen Study	0.90	0.90
Noland 1	0.70	1.00
Noland/Cowart	0.80	1.00
Cervero/Hansen	0.56	0.56
Duranton Study	0.67	1.03
Rodier	0.80	1.10
Average	**0.78**	**0.94**

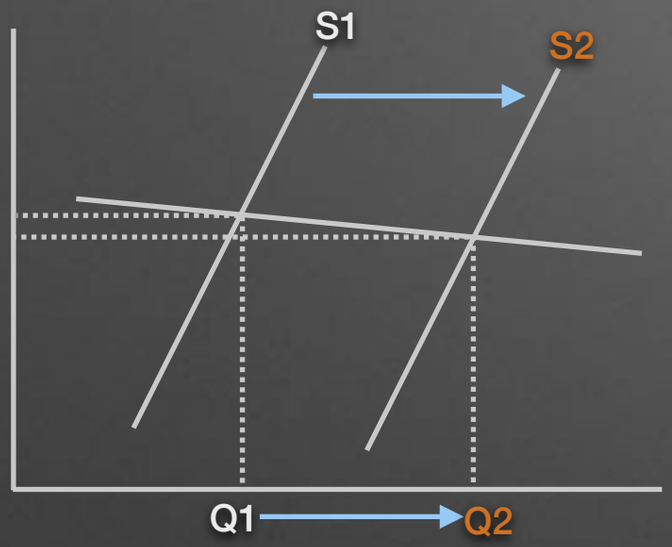
Note:
Calculated demand elasticity average ranges include values from studies specifying long-run demand effects. All figures shown in absolute value.

Note: Not all roads exhibit induced demand. But every road that matters does.

Supply-Induced Demand



Supply-Induced Demand



Math:

(S2 - S1) = Change in Lane-Miles

(Q2 - Q1) = Change in VMTs

(S2 - S1) ≈ (Q2 - Q1)

English:

An increase in lane-miles generates an approximately equal increase in VMTs.

The “fundamental law of road congestion.”
—Duranton & Turner, *American Economic Review*

Supply-Induced Demand

“Latent Demand”

(CC 4.0 License)

Displacement

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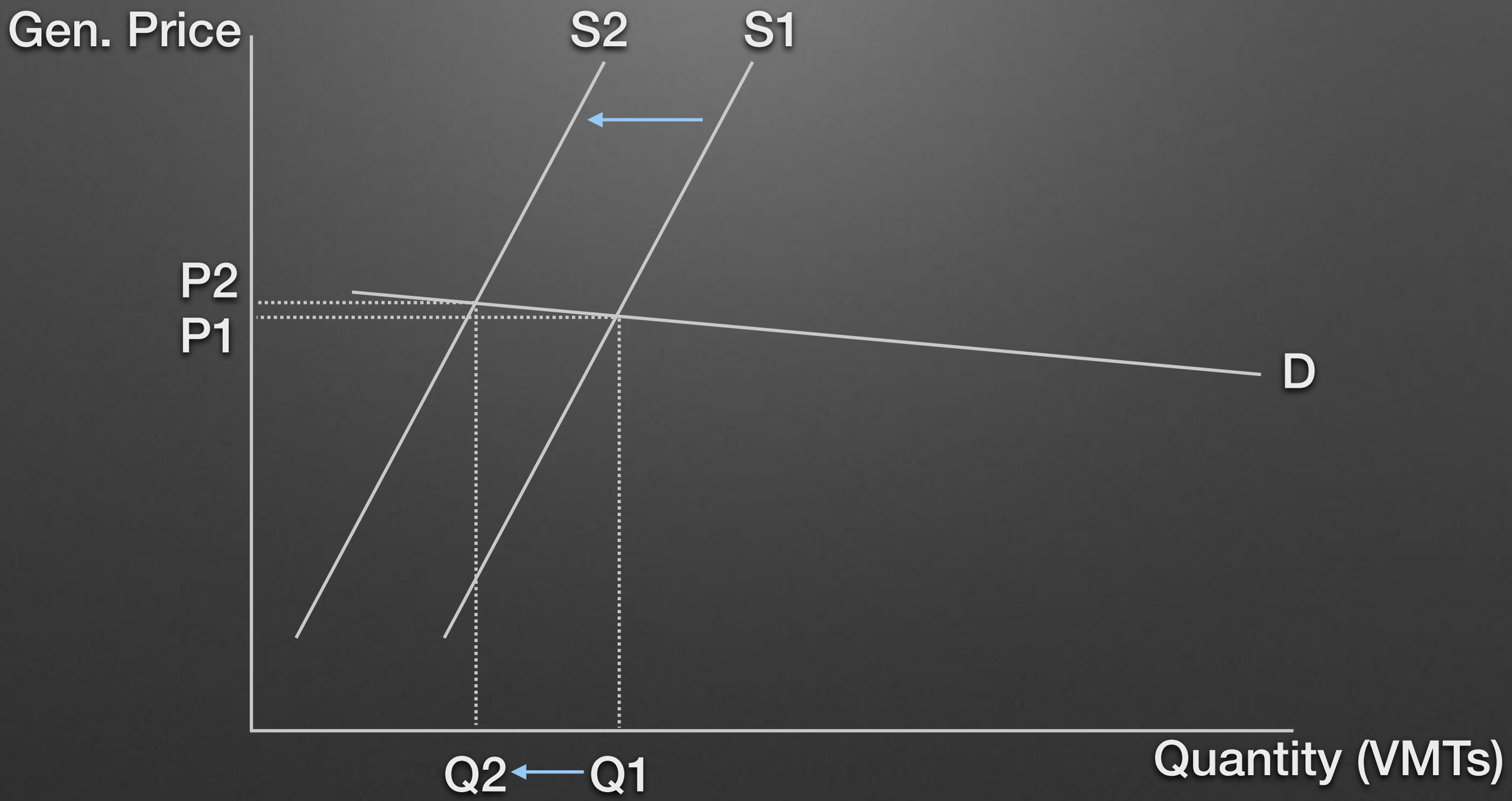
Land Use

(CC 4.0 License)

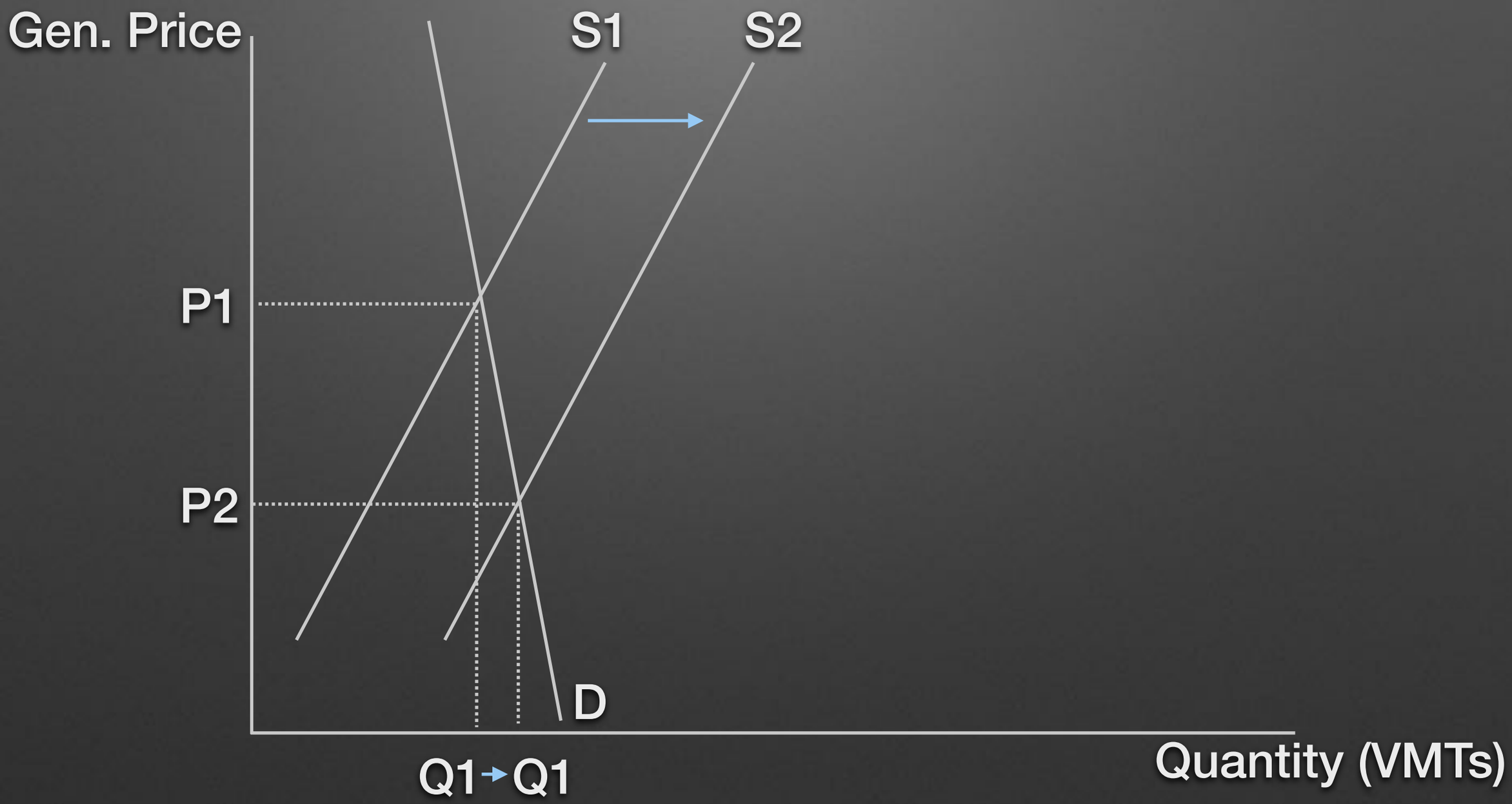
Supply-Induced Demand

“Reduced Demand”



Supply-Induced Demand

The Traffic Model Perspective



Supply-Induced Demand

Relevant to Non-Driving Modes: Cycling

Growth in Bikeway Networks and Bicycle Trips
Pucher Study

City	Years	Growth in Bikeway Network (%)	Growth in Bicycle Trips (%)	Bicycle Trip Demand Sensitivity to Infrastructure Growth
Portland, OR	2000-2015	53%	391%	7.4
Washington, DC	2000-2015	101%	384%	3.8
New York, NY	2000-2015	381%	207%	0.5
Minneapolis, MN	2000-2015	113%	203%	1.8
San Francisco, CA	2000-2015	172%	167%	1.0
Cambridge, MA	2000-2015	27%	134%	5.0
Chicago, IL	2005-2015	135%	167%	1.2
Seattle, WA	2005-2015	236%	123%	0.5
Los Angeles, CA	2005-2015	130%	114%	0.9
Philadelphia, PA	2008-2015	17%	51%	3.0
Average				**2.5**

Source:
Pucher, J. and R. Buehler, "Safer Cycling Through Improved Infrastructure," *American Journal of Public Health*, Vol. 106, No. 12 (2016).

Note:
Bike Trip Demand Sensitivity to Infrastructure Growth calculated as Growth in Bicycle Trips (%) / Growth in Bikeway Network (%).

Supply-Induced Demand

Conclusions:

1. We can’t build our way out of traffic congestion.
2. Virtually all road expansion costs = waste.
3. Road expansion reduces quality of life - “externalities.”
4. Congestion is self-regulating: “reduced demand.”
5. Induced demand does not only apply to vehicles.
6. Current usage patterns are *not* prescriptive.

Funding Mechanisms

Does funding reflect imposition of costs on the system?

Does funding cause *more* cost, or *less* cost?

Are users paying fair share?

Is the funding amount sufficient to operate the system?

Can the system sustain itself?

What is the right price?

Funding Mechanisms

If somebody else is paying for your dinner,
do you order an extra bottle of wine?

Or two?

What if *everybody* else is paying for your dinner,
and your consumption is hard to monitor?

Show me to the cellar!

Principal-Agent Problem

(Or: The problem of letting anybody spend everybody else's money.)

"Moral hazard"

Funding Mechanisms

Ideal funding mechanisms
link *consumption* and *payment*.

Connects private gains with social costs
(Everybody spends their own money)

& Makes the system sustainable

& Reduces inefficient consumption

& Halts sprawl…

Funding Mechanisms

3 Efficient Mechanisms; 3 Pricing Approaches

1. Congestion Pricing
   - Singapore, since 1975!
   - London & (almost) NYC
   - Prices dynamically respond to road demand
   - *Revenue used to support transit*

2. Fuel Tax (sort of)
   - Europe
   - Taxes reflect “social cost”/externalities
   - $2.30/gallon… Germany ~$6/gallon

3. Paid Parking/Dynamic Pricing
   - OK City (1935); New Haven, CT; San Fran., CA
   - Prices dynamically respond to parking demand
   - Shoup’s Trifecta: Portland! (8/2018)

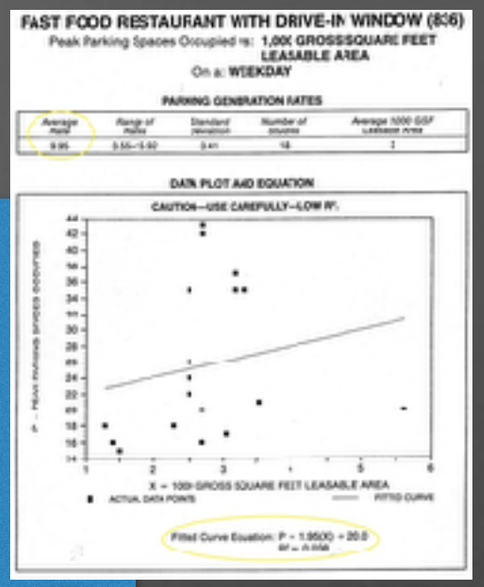
Parking Policy Reforms

Bend's Status Quo

Current Policies:	Effects:	Results:
1. Abundant free public parking.	1. Incentivizes & subsidizes driving.	1. Elevates VMTs, pollution…
2. High minimum parking requirements.	2. Raises prices of everything.	2. Harms business results & investment.
3. Everybody loves free parking & hates paid parking.	3. Principal-agent problem & no price mechanism.	3. Causes wealth transfer, sprawl & housing crisis.

Parking Policy Reforms

How We Got Here


FAST FOOD RESTAURANT WITH DRIVE-IN WINDOW (836)
Peak Parking Spaces Occupied vs: 1,000 GROSS/SQUARE FEET LEASABLE AREA
On a: WEEKDAY
PARKING GENERATION RATES
DATA PLOT AND EQUATION
CAUTION—USE CAREFULLY—LOW R².
X = 1000 GROSS SQUARE FEET LEASABLE AREA
ACTUAL DATA POINTS
FITTED CURVE
Fitted Curve Equation: P = 1.95(X) + 20.8

(Shoup, *Access* (2002))

Current Policies:	Source:
1. Abundant free public parking.	1. Political choice; uninformed businesses.
2. High minimum parking requirements.	2. ITE's *Parking Generation* Manual.
3. Everybody loves free parking & hates paid parking.	3. Money paid for parking "disappears"; no linkage between payment & benefit.

Parking Policy Reforms

ITE's *Parking Generation* Manual

FAST FOOD RESTAURANT WITH DRIVE-IN WINDOW (836)

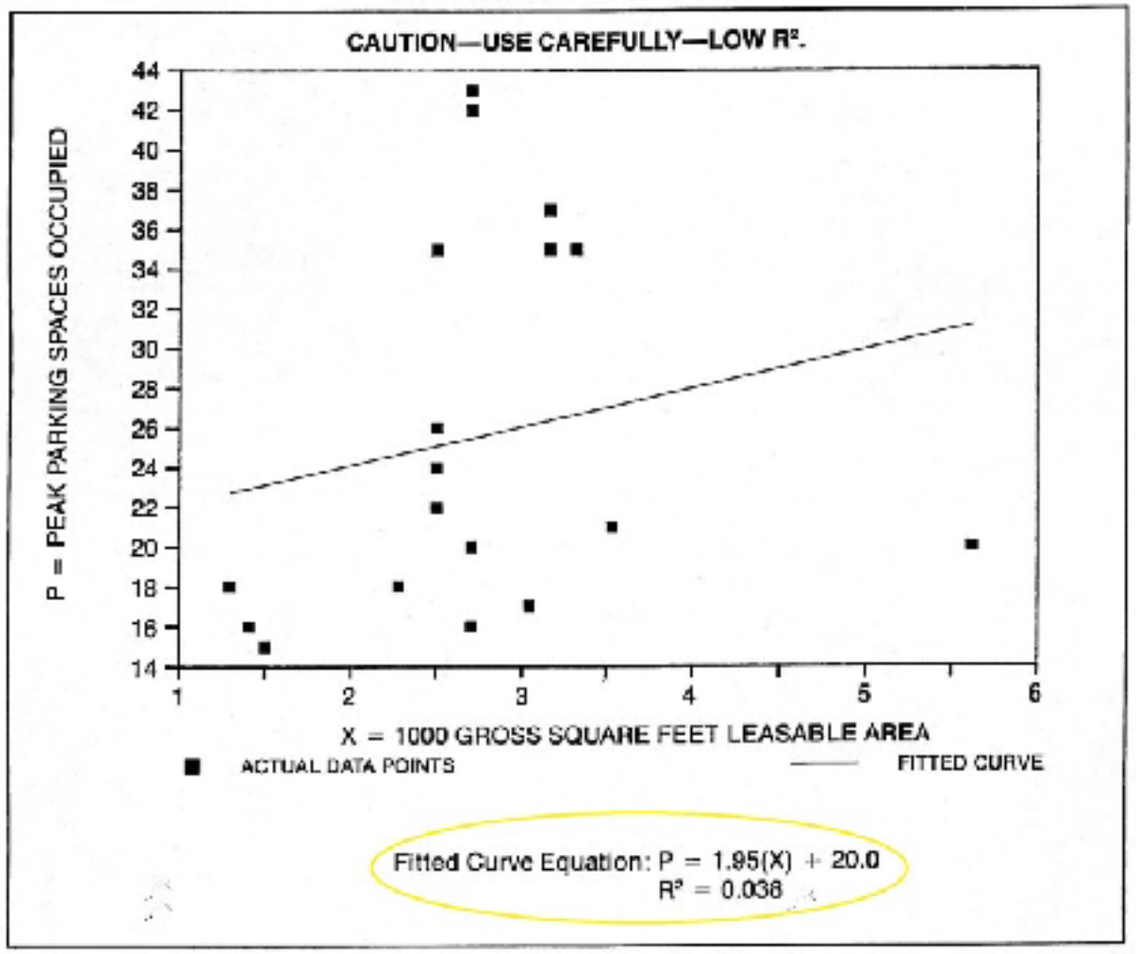
Peak Parking Spaces Occupied vs: 1,000 GROSS SQUARE FEET LEASABLE AREA

On a: WEEKDAY

PARKING GENERATION RATES

Average Rate	*Range of Rates*	*Standard Deviation*	*Number of Studies*	*Average 1,000 GSF Leasable Area*
9.95	3.56–15.92	3.41	18	3

DATA PLOT AND EQUATION



(Shoup, *Access* (2002))

Parking Policy Reforms

ITE's *Parking Generation* Manual

"A vast majority of the data…is derived from suburban developments with little or no significant transit ridership.

The ideal site for obtaining reliable parking generation data would…contain ample, convenient parking facilities for the exclusive use of the traffic generated by the site.

The objective of the survey is to count the number of vehicles parked at the time of peak parking demand."

—*Parking Generation*

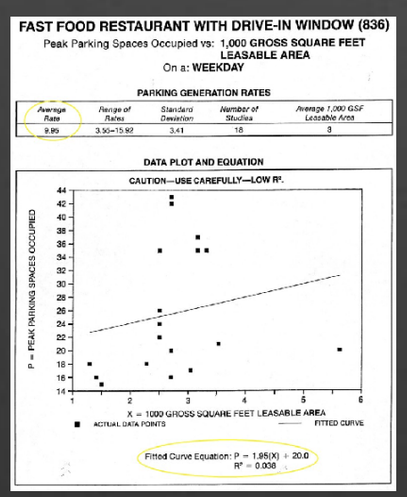
Parking Policy Reforms

ITE's *Parking Generation* Manual (Or: *How Not to Do Statistics*)

Samples largely suburban areas; 1980s	Upward bias; Unrepresentative; Dated
Reports "peak occupancy"	Observed *maximums* = Required *minimums*
n=1 (22%); n≤4 (50%)	*Zero* statistical survey value
R-squared ≈ 0	Own data shows evidence of faulty approach

Parking Policy Reforms

R-squared ≈ 0



FAST FOOD RESTAURANT WITH DRIVE-IN WINDOW (836)
Peak Parking Spaces Occupied vs: 1,000 GROSS SQUARE FEET LEASABLE AREA
On a: WEEKDAY

PARKING GENERATION RATES

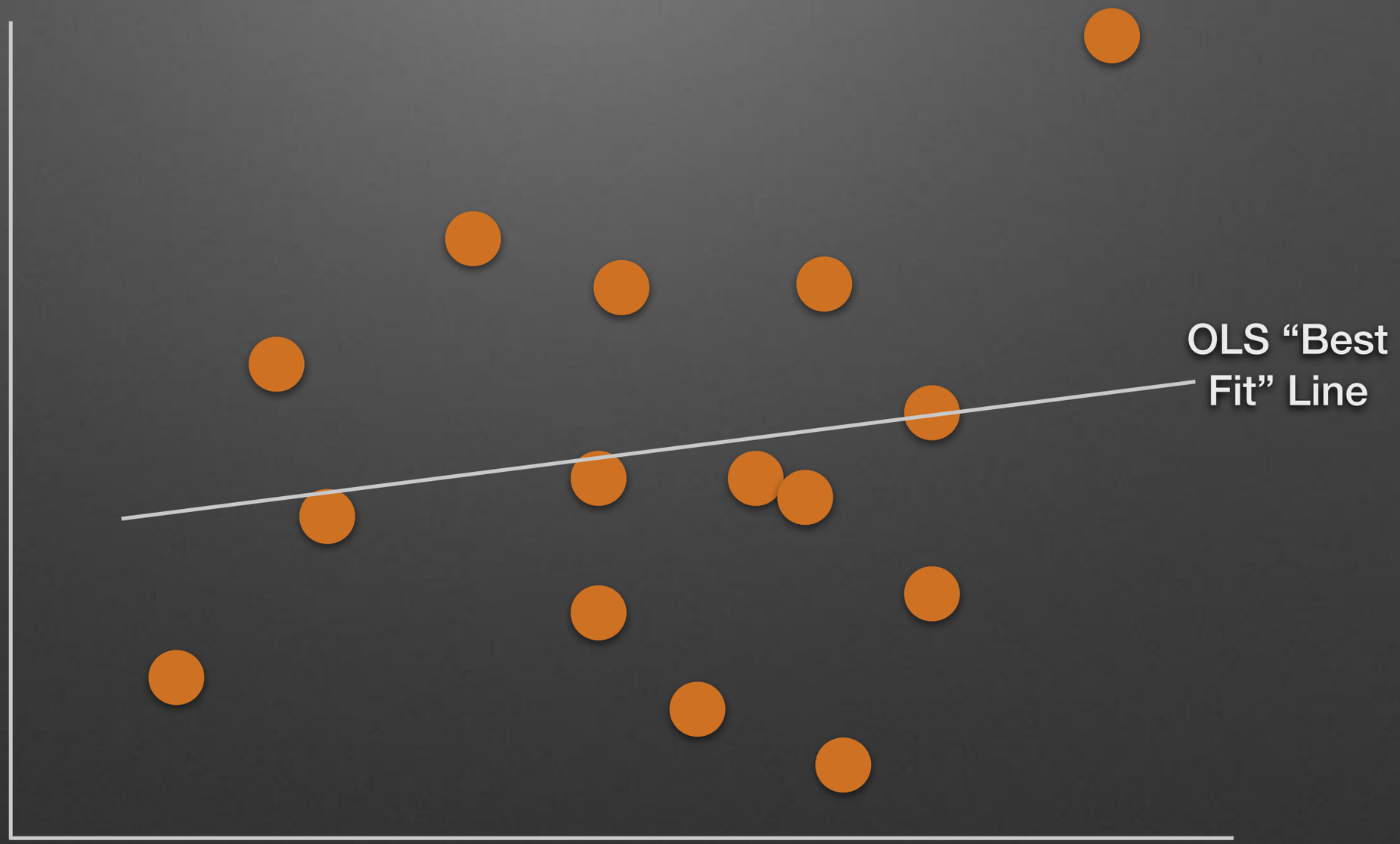
Average Rate	Range of Rates	Standard Deviation	Number of Studies	Average 1,000 GSF Leasable Area
9.95	3.50–15.92	3.41	18	3

DATA PLOT AND EQUATION
CAUTION—USE CAREFULLY—LOW R^2.

P = PEAK PARKING SPACES OCCUPIED
X = 1000 GROSS SQUARE FEET LEASABLE AREA
ACTUAL DATA POINTS — FITTED CURVE

Fitted Curve Equation: P = 1.95(X) + 20.0
R^2 = 0.038

(Shoup, *Access* (2002))



y = a + bx

R-squared = 0.01

Parking Policy Reforms

Bend's Status Quo

Effects:

1. Incentivizes & subsidizes driving.

2. Raises prices of everything.

3. Principal-agent problem & no price mechanism.

Generalized Price of Travel:

Total "Price" = f{Time, Money}

"Sunk Cost Claiming":

"Free" parking is already paid for in higher prices; only way to claim benefit is to park (i.e., drive).

Parking Policy Reforms

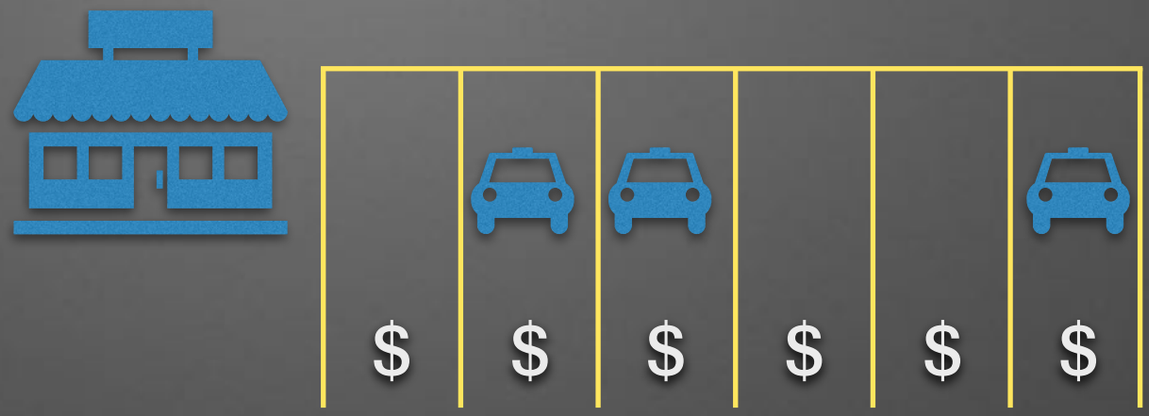
High Prices; Low Profits

Effects:

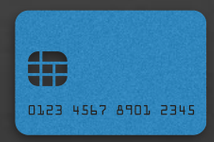
1. Incentivizes & subsidizes driving.

2. Raises prices of everything.

3. Principal-agent problem & no price mechanism.



↑ Rent



↑ Prices

For everybody, not just drivers

↓ Profit

Reduces reinvestment & raises risk

Parking Policy Reforms

Costs of Parking

<u>Cash Costs*:</u> Land (160 sqft.) Paving & Painting Maintenance Security	$5k (Easy-build street level) to $50k (Complex-build garage)
<u>Opportunity Cost:</u> What else could use this space?	Rent @ $2sqft./month** 5% discount rate = Capitalized opp. cost of $77k
	$5k… $83k-$127k

Note:
*Ignores debt financing costs.
**Food truck “commissary” costs = $400-$800/month, or about $2.50 to $5.00 rent sqft./month.

Parking Policy Reforms

Wealth Transfer

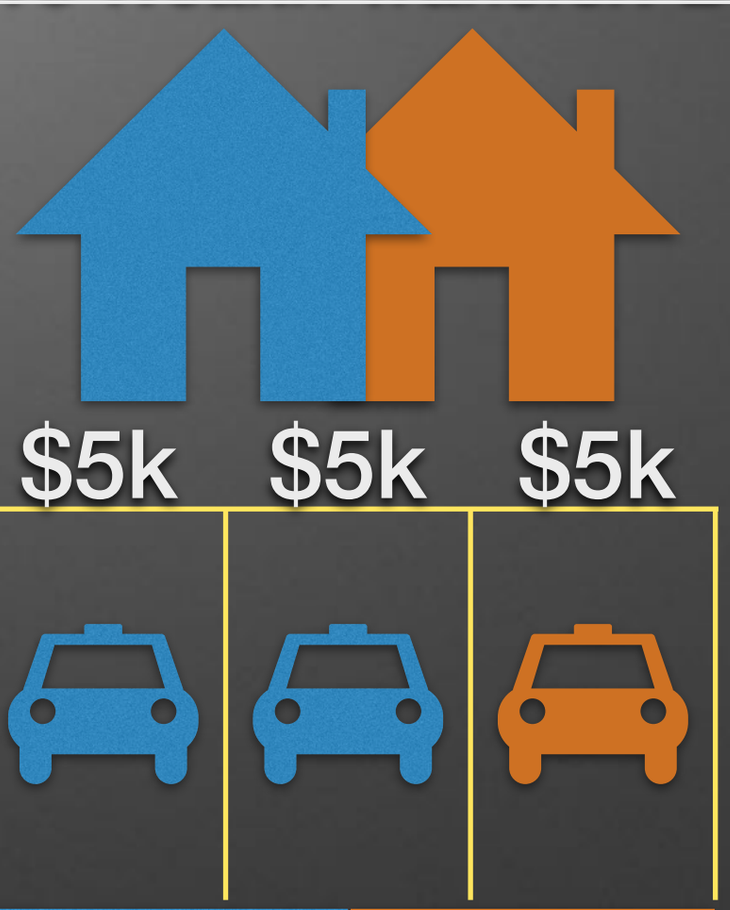
Results:

1. Elevates VMTs, pollution…

2. Harms business results & investment.

3. Causes wealth transfer, sprawl & housing crisis.

Regressive Wealth Transfer: Bundling



Parking Policy Reforms

Housing

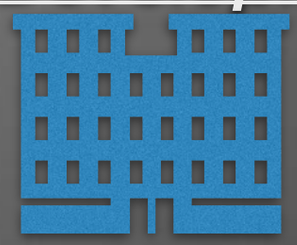
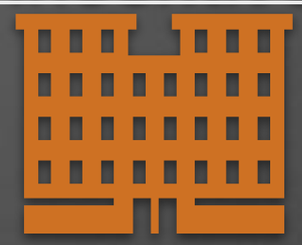
Results:

1. Elevates VMTs, pollution…

2. Harms business results & investment.

3. Causes wealth transfer, sprawl & housing crisis.

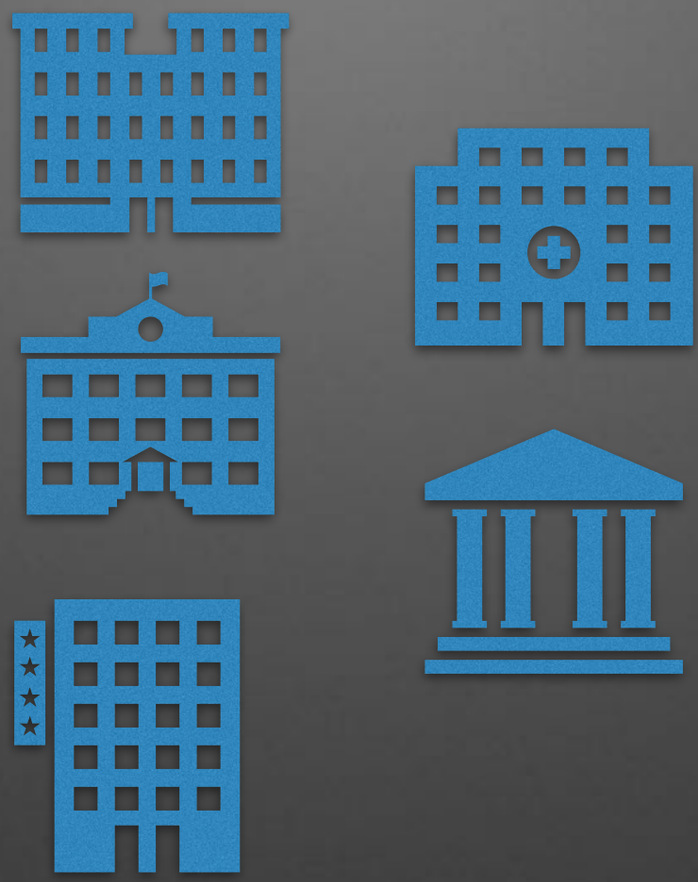
Housing Crisis: Development Incentives

Housing Size	1,000sqft.	2,000sqft.
Cost/Sqft.	$100/sqft.	$100/sqft.
Housing Cost	$100,000	$200,000
Parking Req.	1.5 spaces	1.5 spaces
Total Cost	$107,500	$207,500
Mkt. Rate	$250/sqft.	$250/sqft.
Price	$250,000	$500,000
Profit/Unit	$142,500	$292,500
Profit/Unit%	132.5%	141.0%

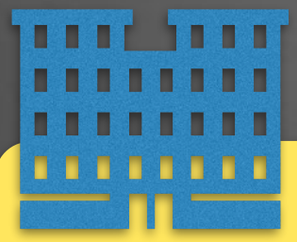
Parking Policy Reforms

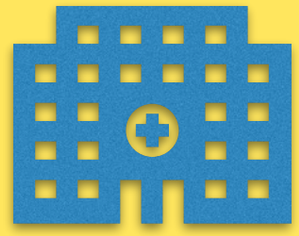
Sprawl

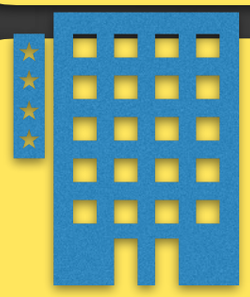


Parking Policy Reforms

Sprawl

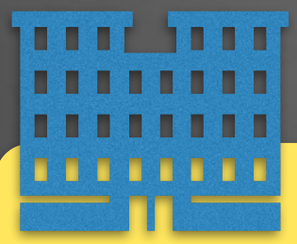






Parking Policy Reforms

Sprawl Begets Sprawl



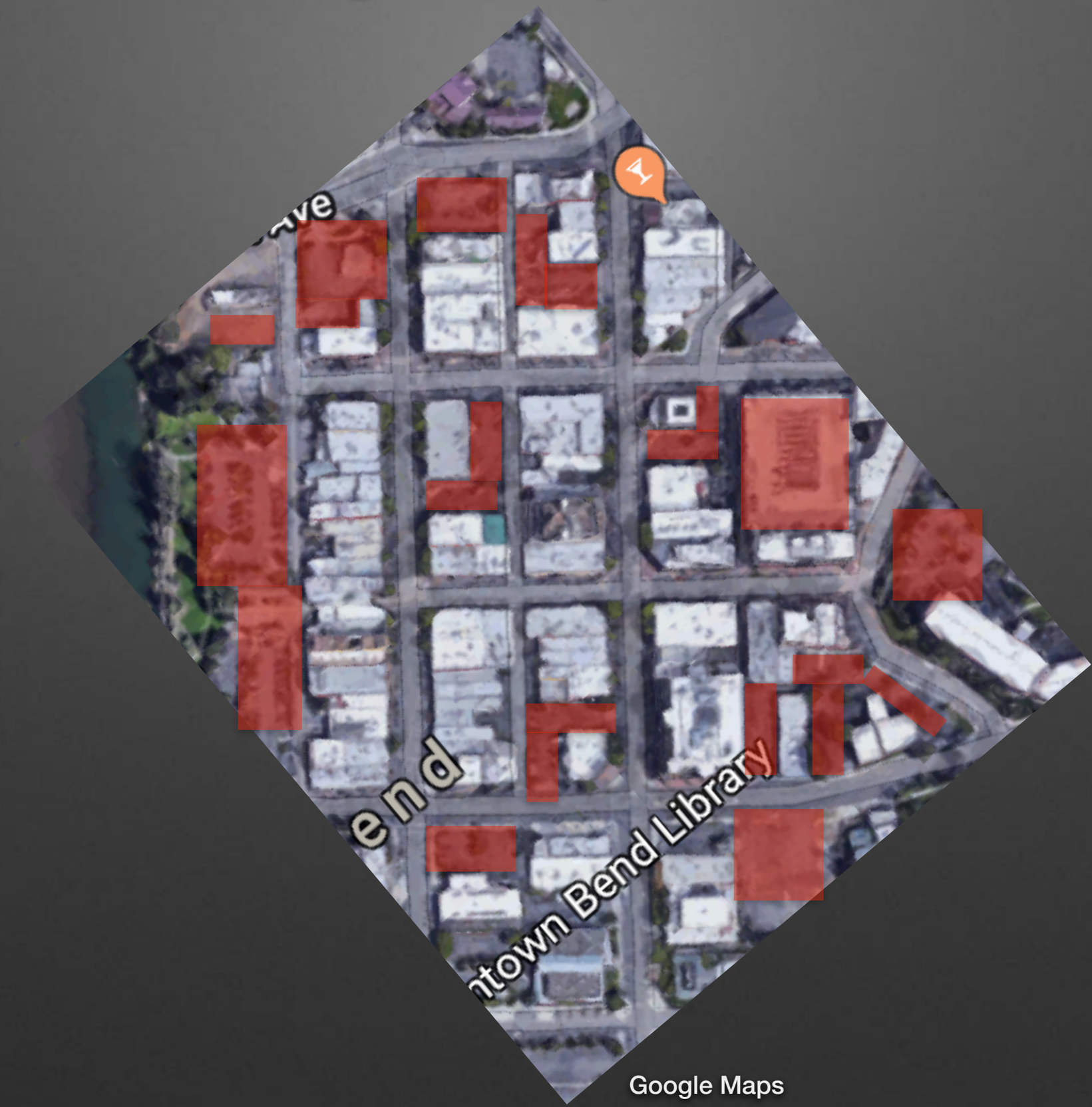
Minimum parking requirements generate sprawl.

Which creates car dependency…

And increases the apparent demand for *more free parking*!

(Everybody loves free parking.)

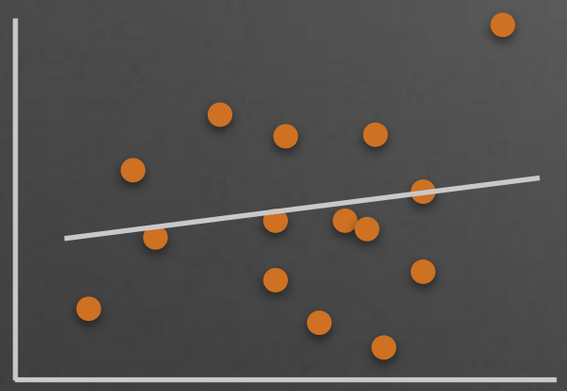
Parking Policy Reforms

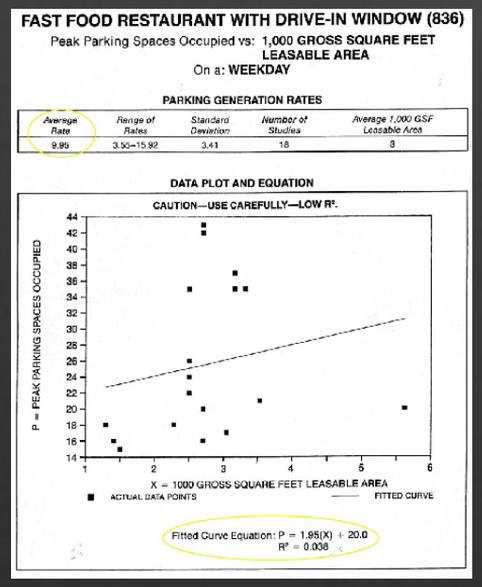


Parking Policy Reforms

Bend's Parking Policy Status Quo

Bad Foundations



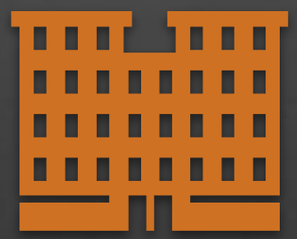


(Shoup, *Access* (2002))

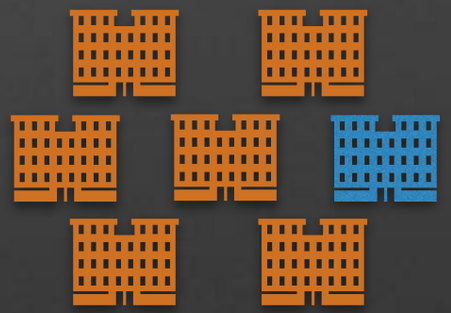
Bad Incentives

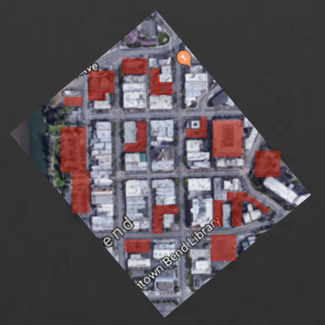
Total "Price" = f{Time, Money}

VMTs



Bad Results



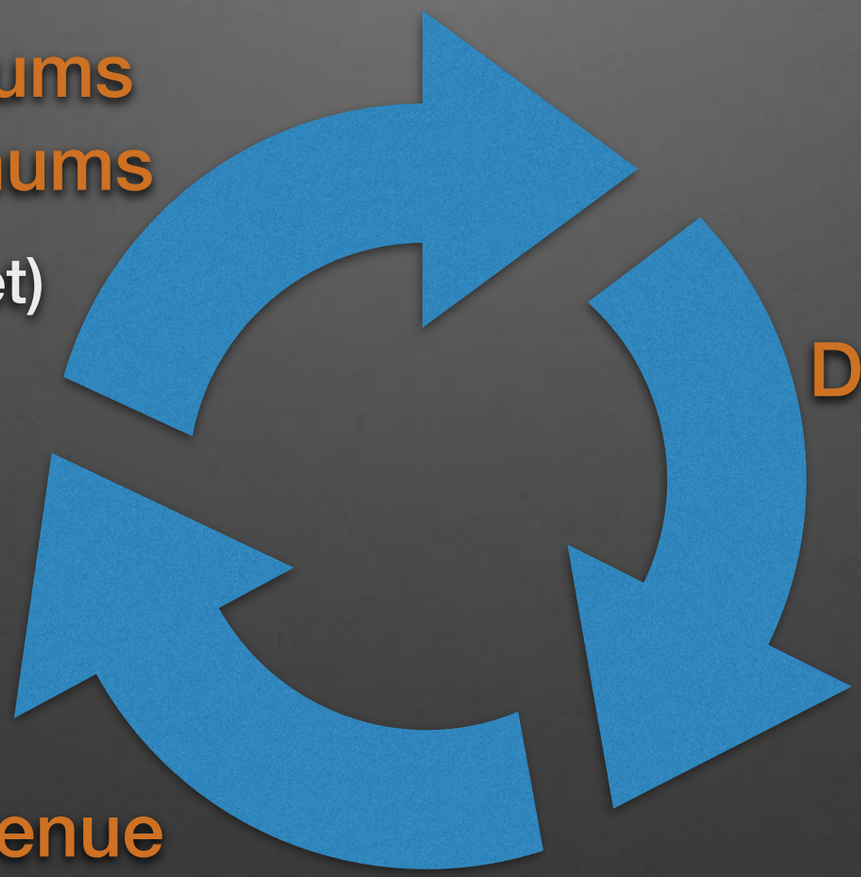


Parking Policy Reforms

Donald Shoup's 3 Parking Reforms

Parking minimums become maximums

(Make a market)



Dynamically price public parking

(Let price clear)

Return revenue to parking districts

(Win the politics)

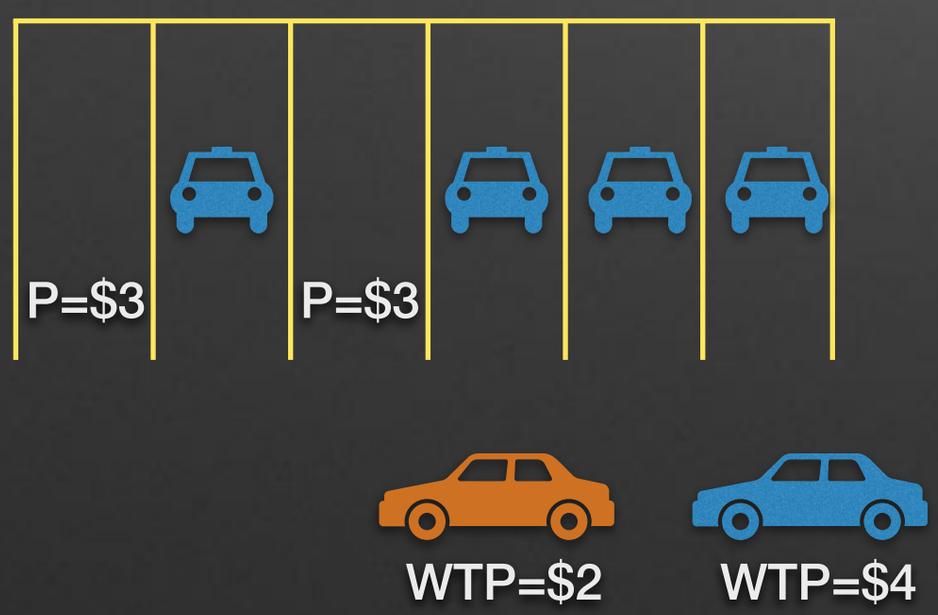
Parking Policy Reforms

Dynamically price
public parking

How:

Target 85% occupancy per block-hour.

Let price adjust to maintain consumption rate.



Why:

Efficient allocation of space on WTP…
Equilibrates price & value.

Maintains availability - no “cruising.”

Incentivizes turnover.

Parking Policy Reforms

Parking minimums
become maximums

How:

Change zoning code word “minimum” to “maximum.”

Don’t adjust any of the numbers.

Why:

Reduces supply of “free” parking…
Supports public parking prices.

Lets market decide on spaces.

Unlocks land value & investment.

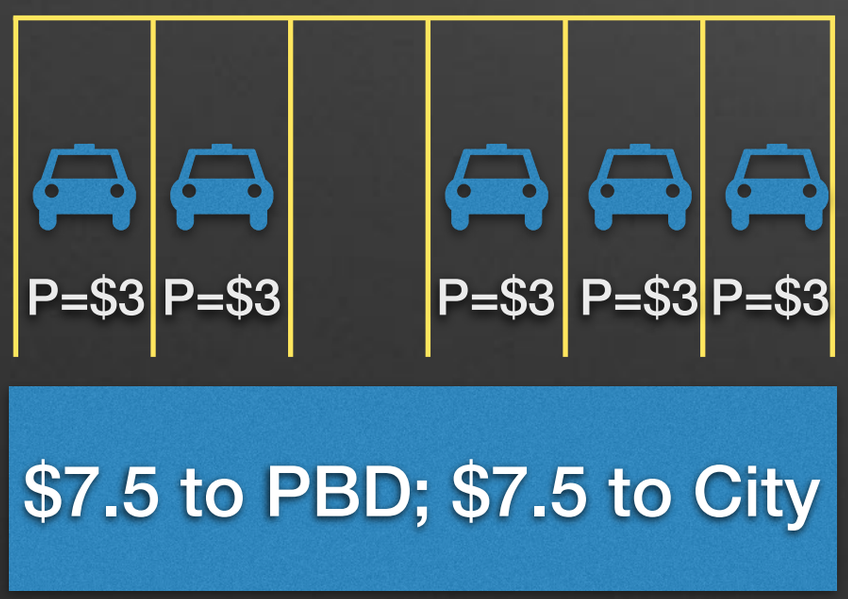
Parking Policy Reforms

Return revenue
to parking districts

How:

Earmark ~50% to local services improvement.

Let local parking benefit districts determine which services.



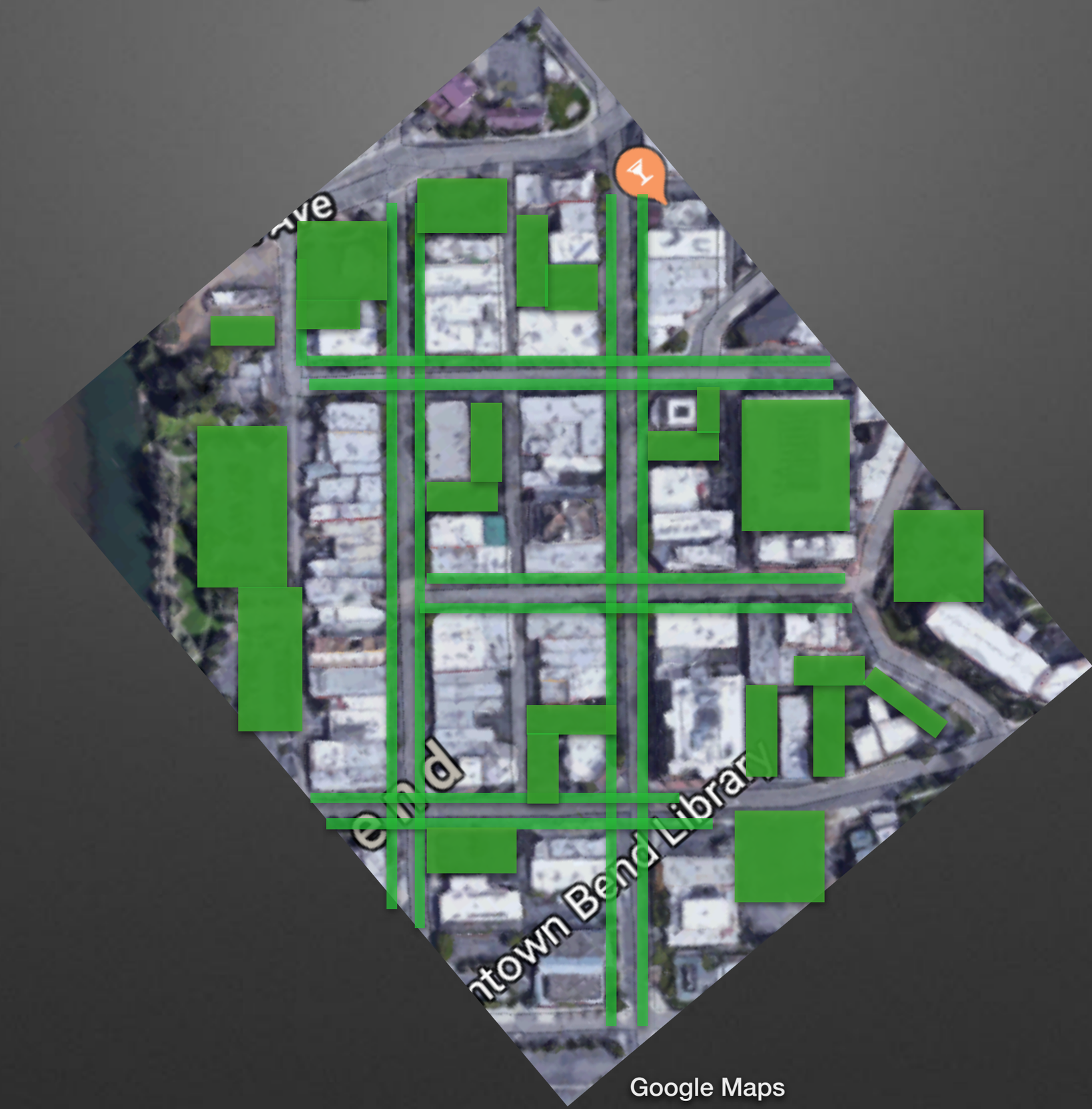
Why:

Generates natural political support…
Aligns value creation & value receipt.

Turns parkers from eyesore to ATM.

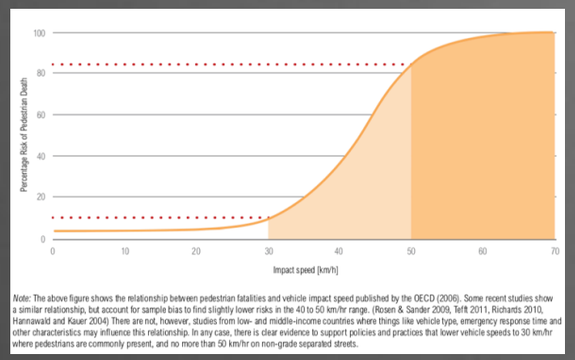
Compensates negative externalities.

Parking Policy Reforms



20MPH Speed Limits

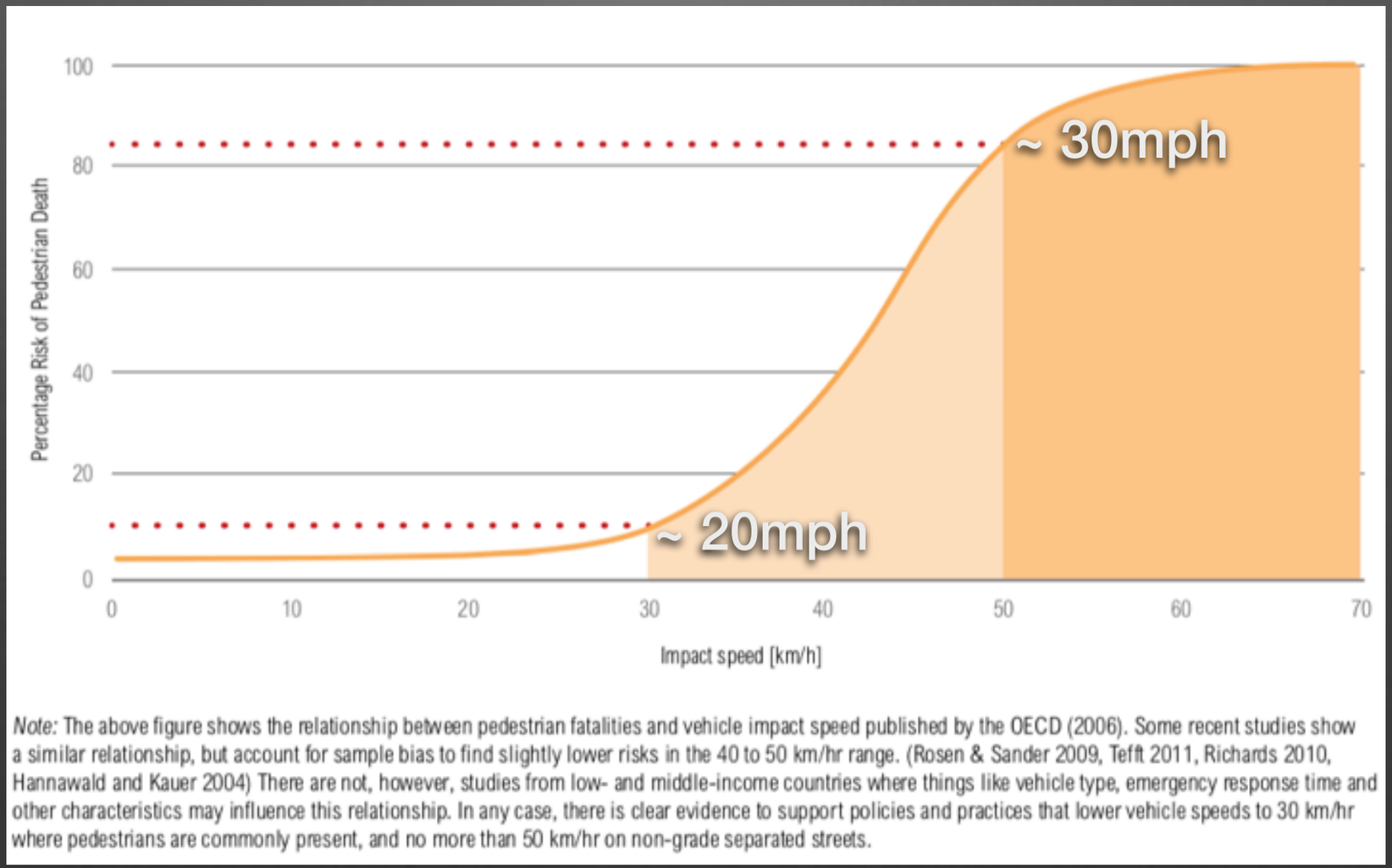
Safety



Note: The above figure shows the relationship between pedestrian fatalities and vehicle impact speed published by the OECD (2006). Some recent studies show a similar relationship, but account for sample bias to find slightly lower risks in the 40 to 50 km/hr range. (Rosen & Sander 2009, Tefft 2011, Richards 2010, Hannawald and Kauer 2004) There are not, however, studies from low- and middle-income countries where things like vehicle type, emergency response time and other characteristics may influence this relationship. In any case, there is clear evidence to support policies and practices that lower vehicle speeds to 30 km/hr where pedestrians are commonly present, and no more than 50 km/hr on non-grade separated streets.

20MPH Speed Limits

Safety: Impact Speed & Fatality Risk



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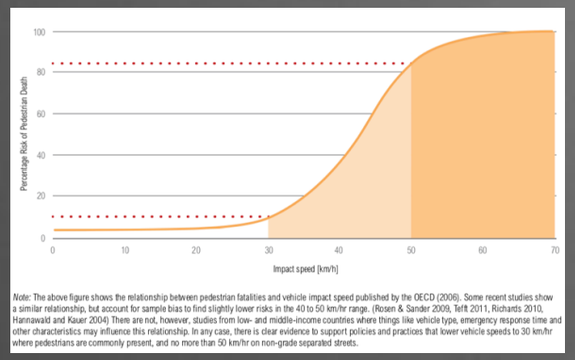
Source: “Cities Safer by Design,” World Resources Institute (2015):
Graphic entitled “The Relationship Between Pedestrian Safety and the Impact Speed of Vehicles.”

20MPH Speed Limits

Safety



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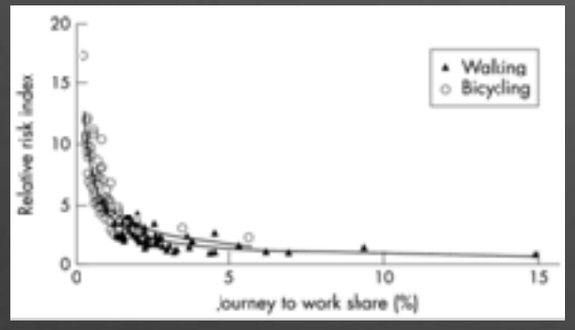
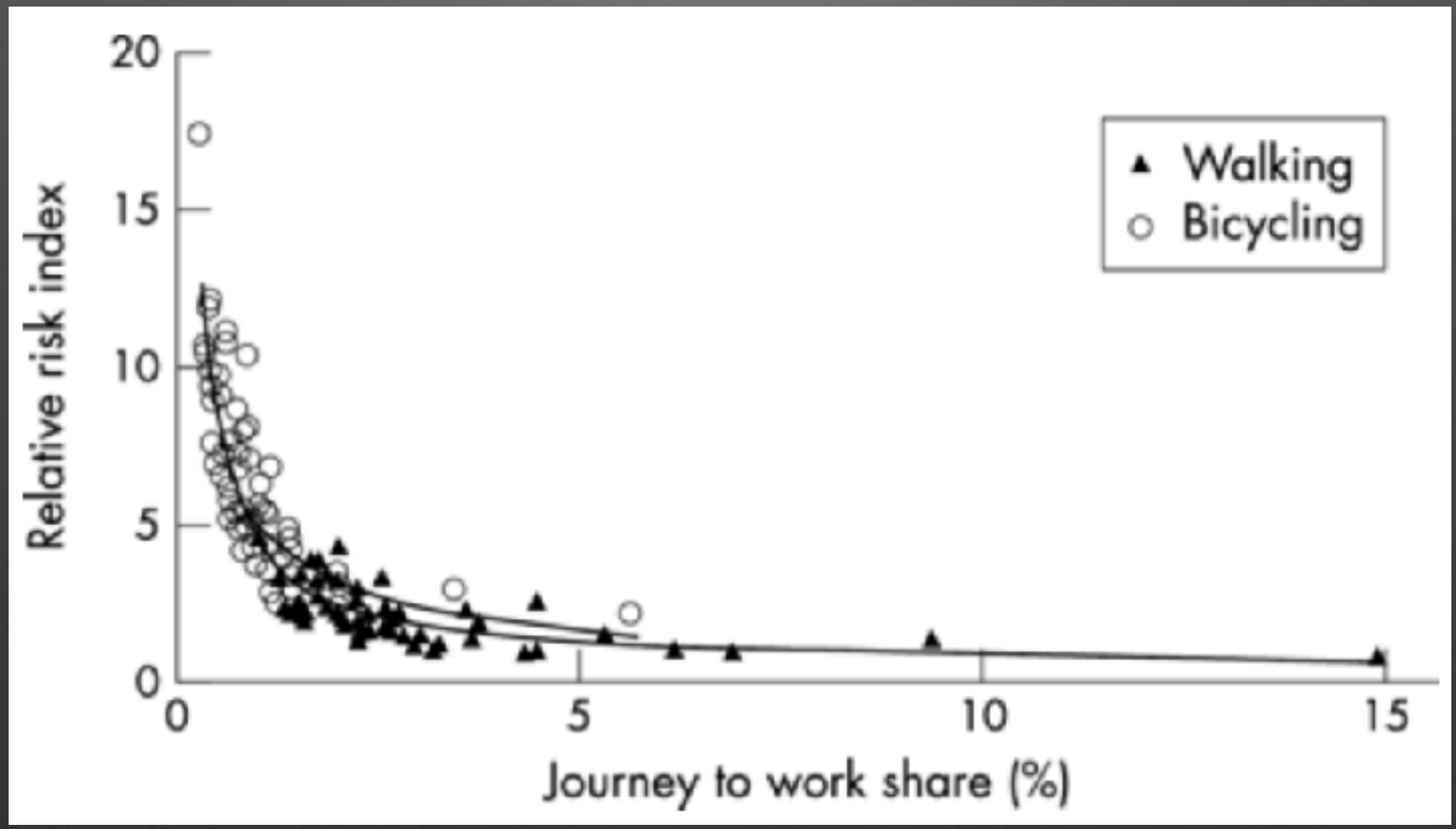
SPEED LIMIT 20



20MPH Speed Limits

Safety: “Network Effect” of Pedestrian/Cyclist Share

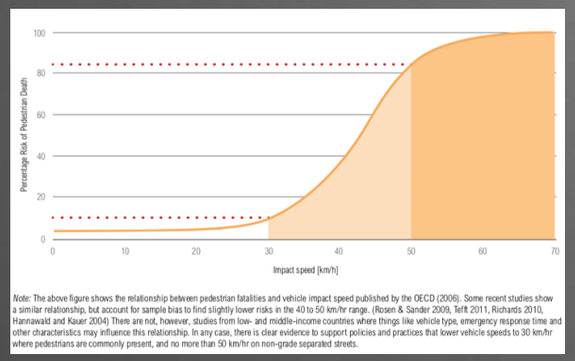


Source: Jacobsen, P., “Safety in Numbers: More Walkers and Bicyclists, Safer Walking and Bicycling,” *Injury Prevention*, Vol. 9 (2003).

20MPH Speed Limits

SPEED LIMIT 20

Safety



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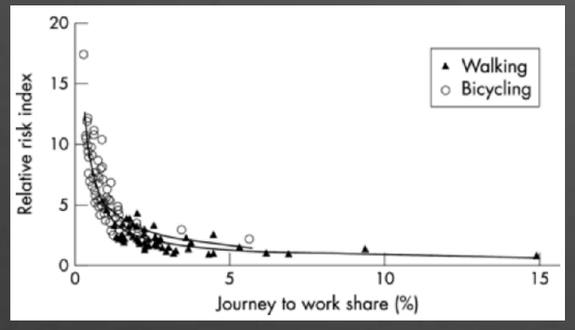


⬇ Crime

Mode Share

⬇ VMTs

⬆ Share

Results

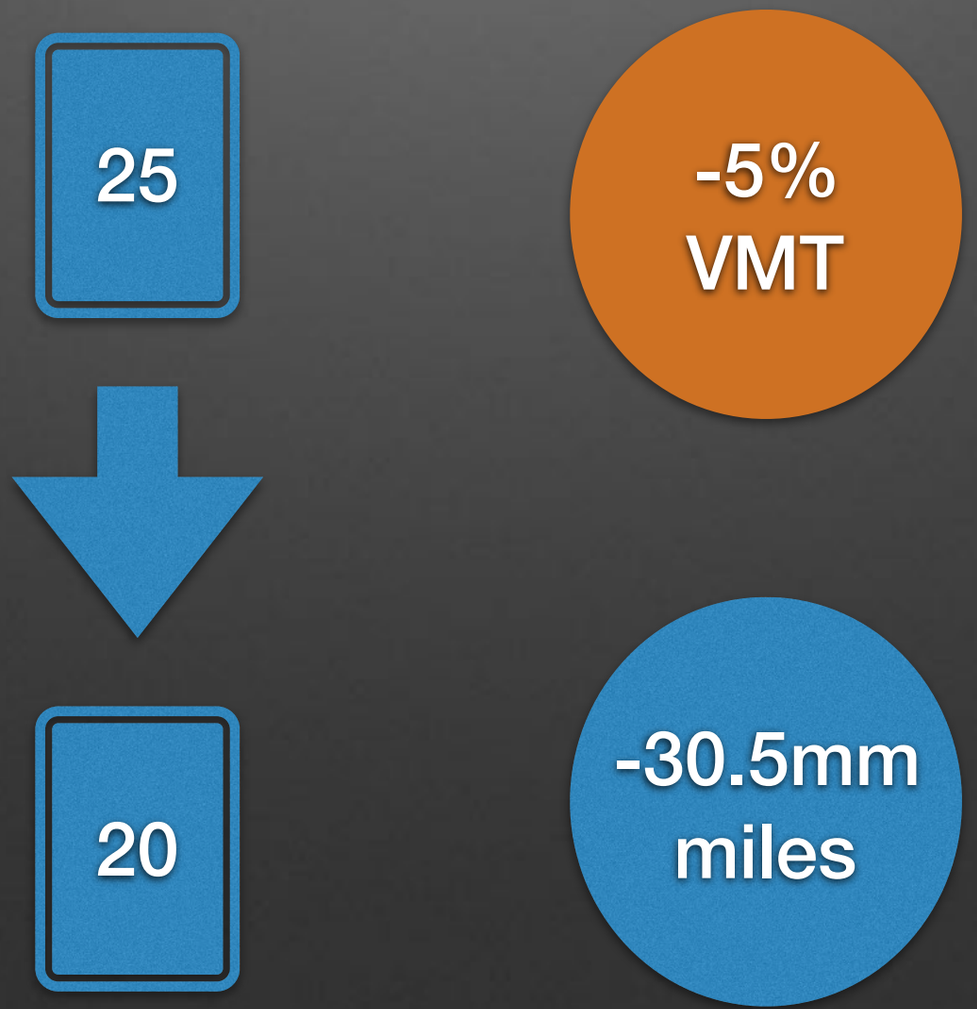
1. ⬇ Collisions
2. ⬇ Congestion
3. ⬇ Fuel Use
4. ⬇ Pollution
5. ⬇ Maintenance
6. ⬆ Health

20MPH Speed Limits

VMT Reduction: How Much?

Empirical Evidence

What does this mean for Bend?



20MPH Speed Limits

	Indication of Value
Reduced collision counts & severity	$7.2 million/year
Fuel savings	$4.5 million/year
Decreased CO2 emissions	$1.6 million/year
Lowered PMs	$58.7 million
Diminished noise	$110.7 million
Saved maintenance	$1.0 million/year
Total	$170mm + $14mm/year

Implementation cost ~$60k…305,000% ROI

20MPH Speed Limits

Particulate Matter & Noise: Hedonic Price Method

1% Particulate Matter = 0.1% Housing Value

$58.7mm Gain in Quality of Life

1 Decibel Traffic Noise = 0.29% Housing Value

$110.7mm Gain in Quality of Life

20MPH Speed Limits

Traffic Flow and Trip Duration?

Spacing: Less at lower speeds = higher road capacity.

Filtering: Easier to merge at lower cruising speed.

Collisions: Fewer lane closures.

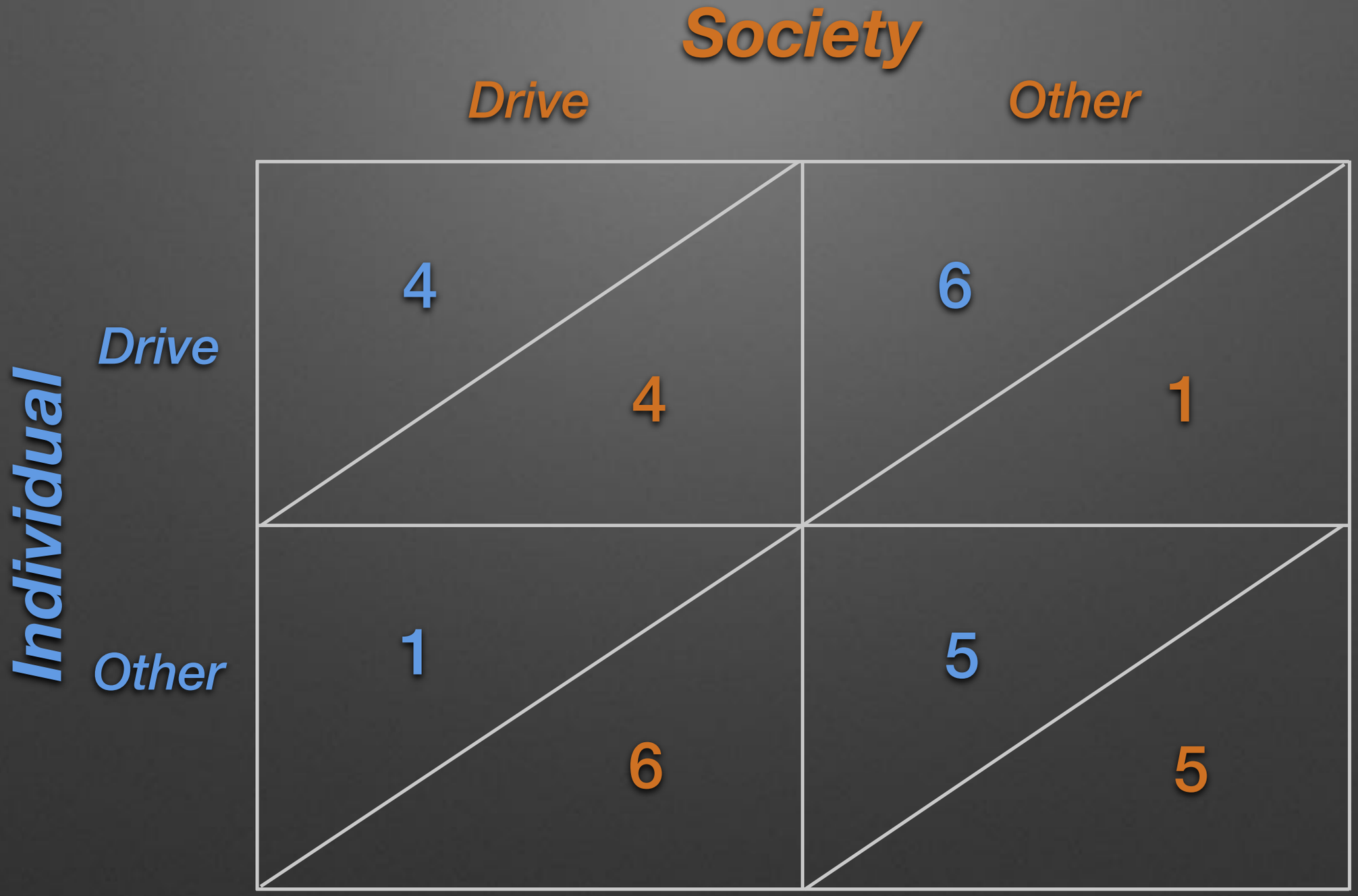
Not accounting for VMT effect: 3% travel time ↑ (~.5 min./trip)

20MPH Speed Limits

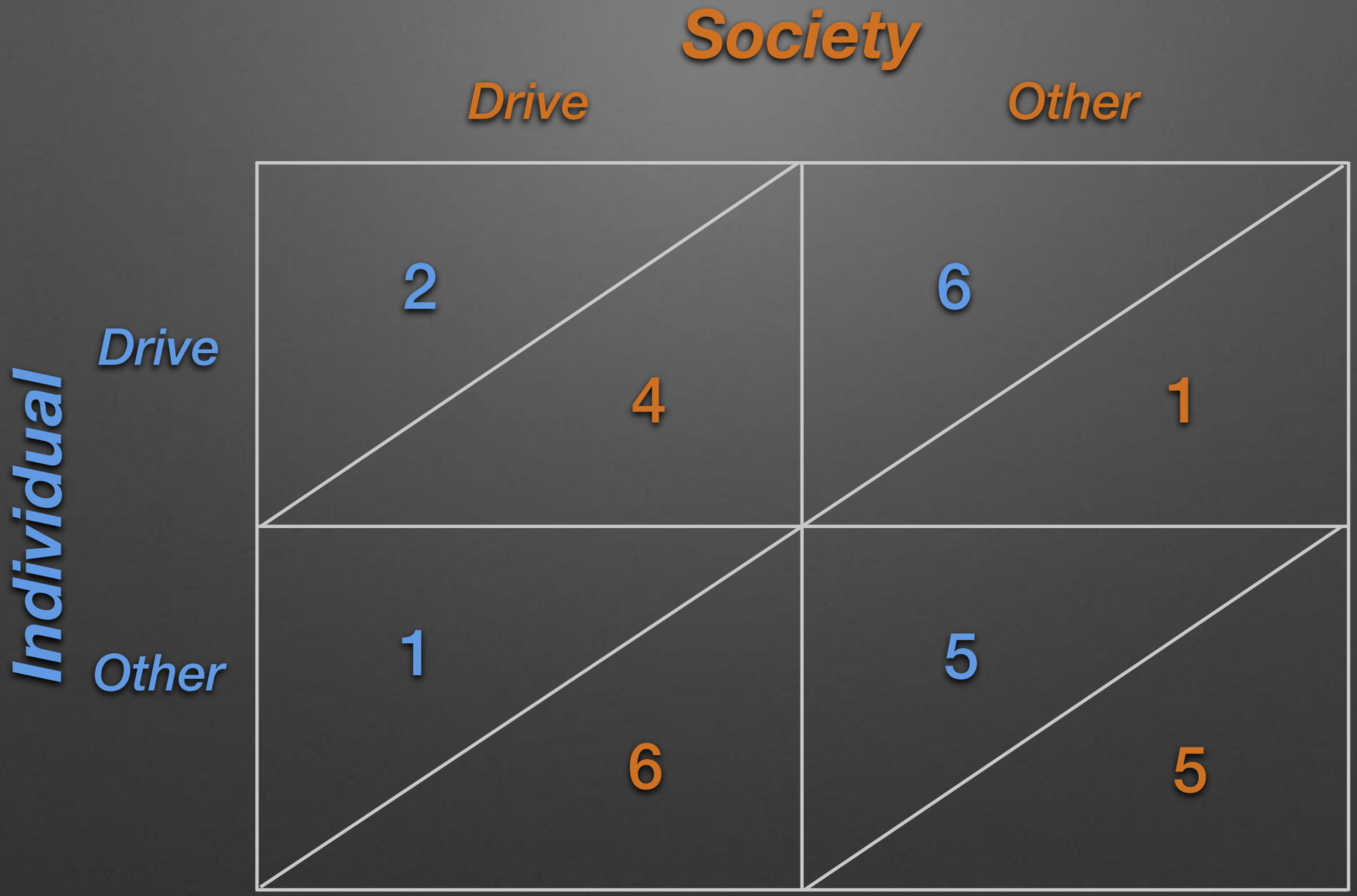
Conclusions:

1. Safety is a non-linear function of speed…max. ~20mph.
2. Mode shares reflect safety.
3. Lower VMTs generate large financial and well-being gains.
4. Costs of 20mph easily covered by maintenance savings.
5. Travel times not materially increased, if at all.

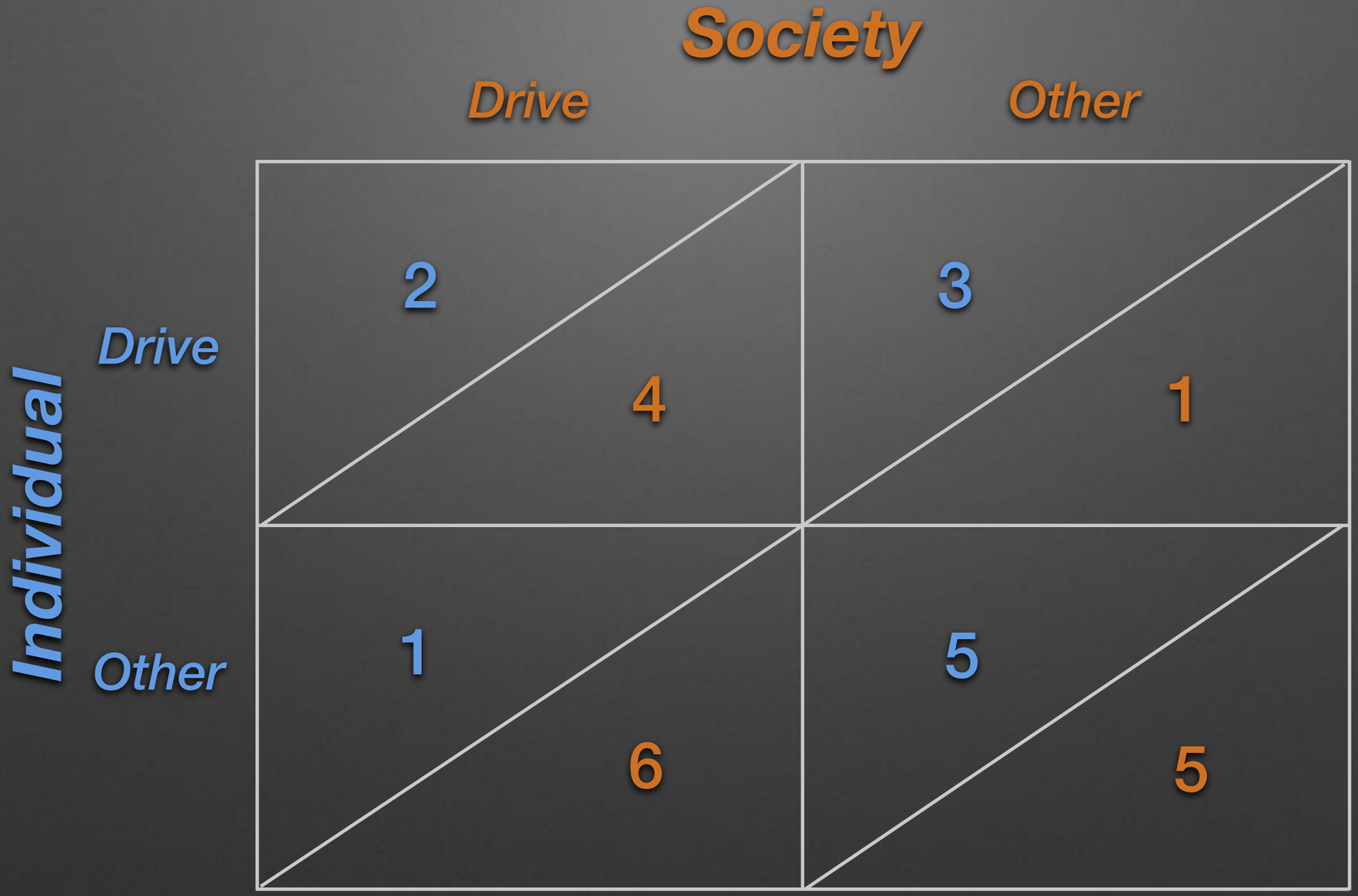
Bend's Solution



Bend's Solution



Bend's Solution



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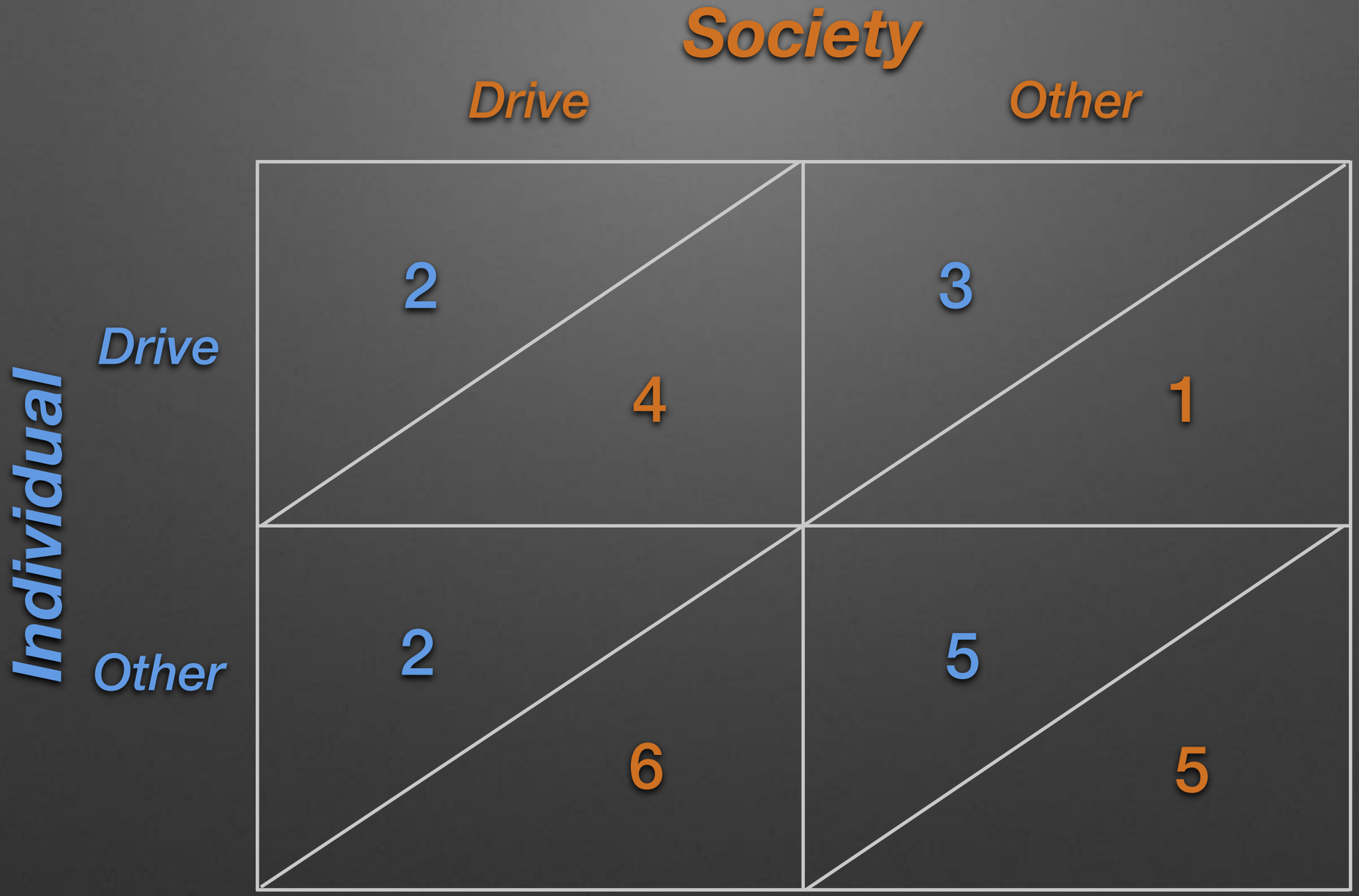

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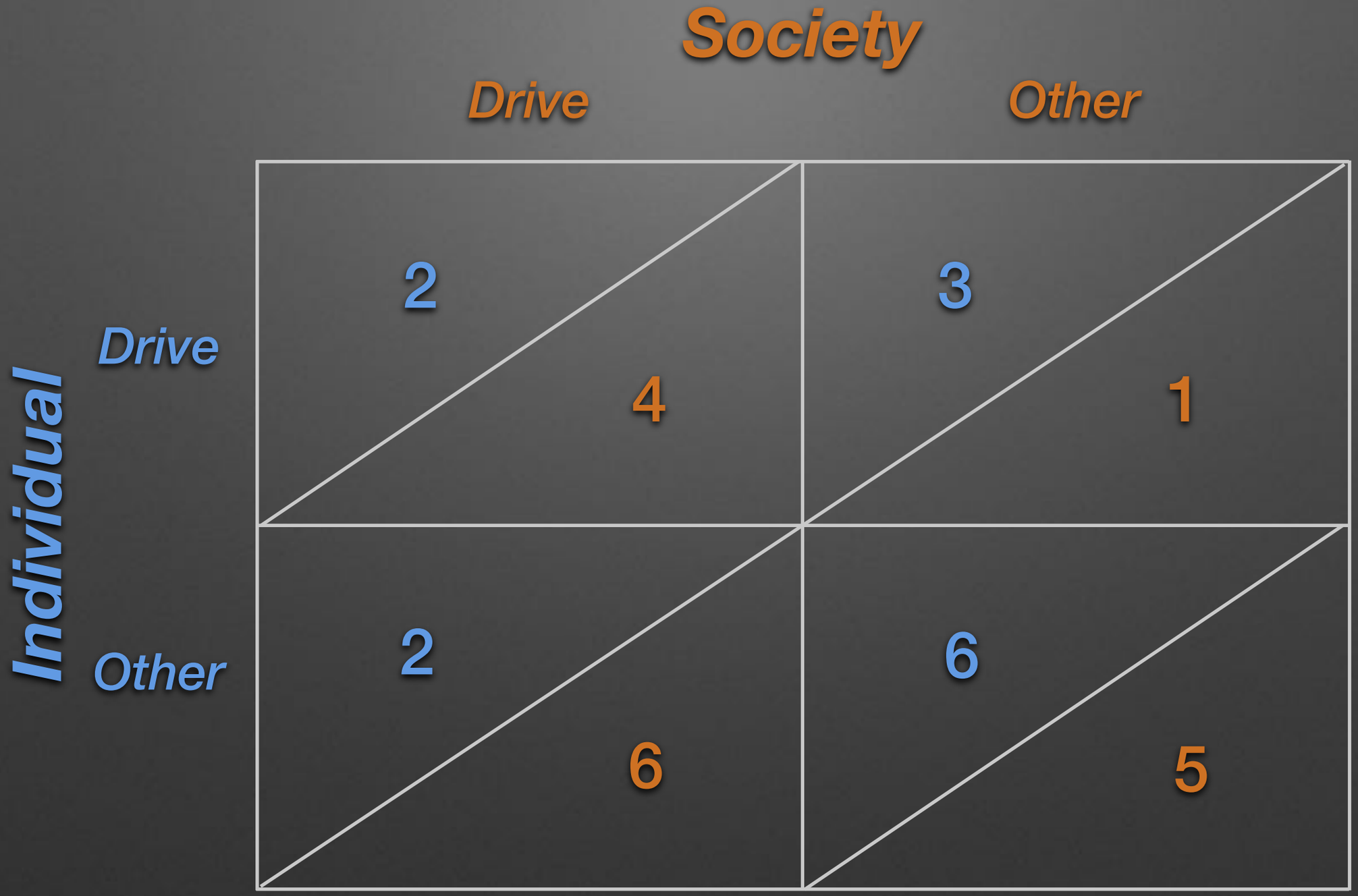

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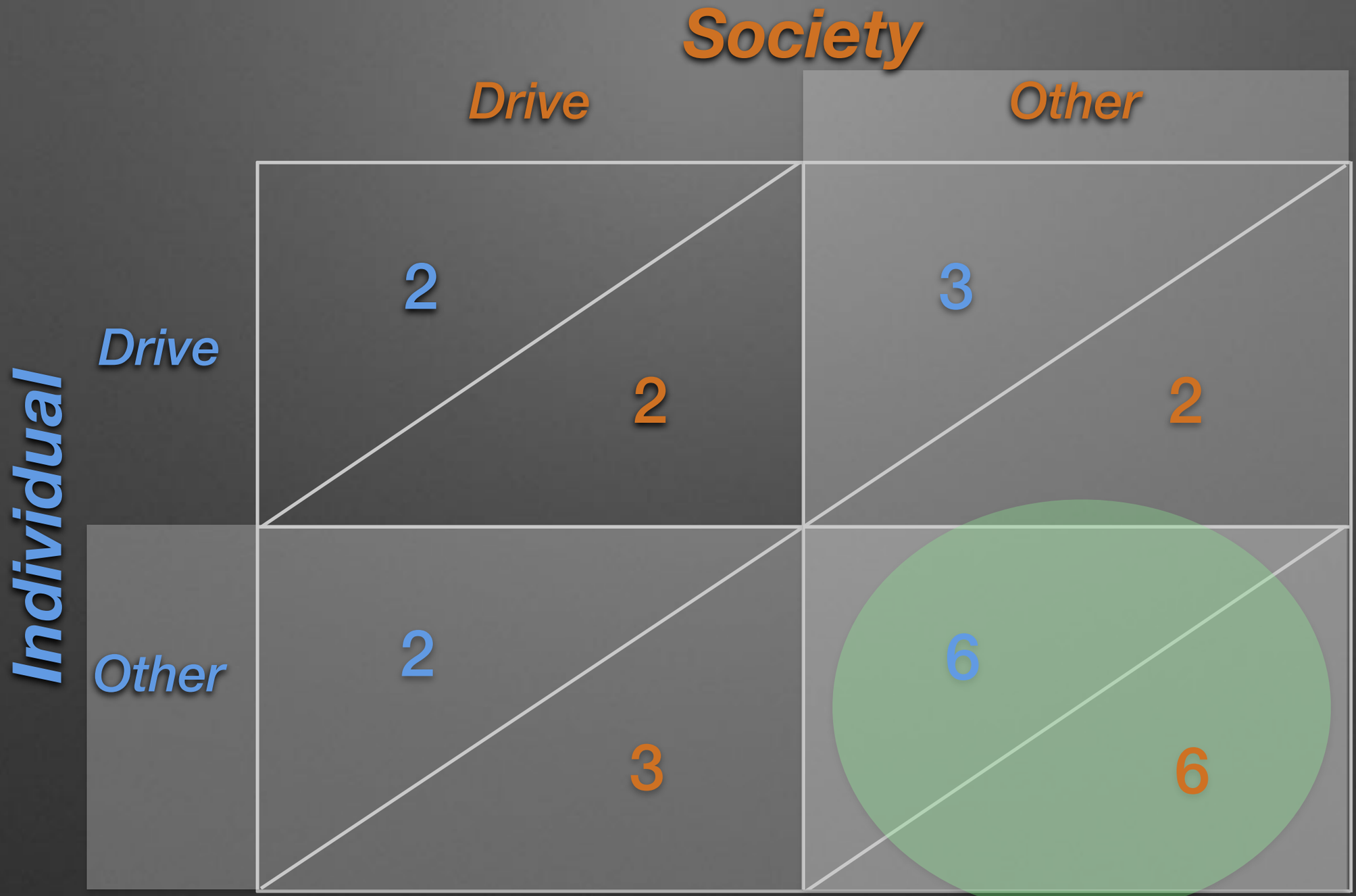

Transportation Economics in Bend:
Supply, Demand, Prices & Costs

Prepared for: MOVE BEND

Presented by: Steve Porter & Michelle Porter