Cooperation and Coordination

- **Adam Smith's Invisible Hand**: "Goverment should not interfere with individuals' attempts to maximize their selfish interests. The market mechanism will lead to an efficient outcome."

- Unfortunately this statement is not correct in many situations. For example in the Prisoner's Dilemma selfish interests lead to shirking which in turn results in inefficient outcomes.

The following is Adam Smith's reasoning: When I buy a good, say a loaf of bread, I am using valuable resources to the society. I do not overuse these resources; because:

- I buy the loaf only if it's value to me exceeds it's price.
- In a competitive market the price equals the cost of these resources; the baker will not sell it to me unless he covers the cost and the competition will not allow him to charge more.
- Therefore I buy the loaf only if it's value to me exceeds it's cost to society and hence market mechanism leads me to buy it just at the right amount.

- There are several points missing in this argument: Most notably not every market is perfectly competitive and moreover we may not have a market for every good that we consume.

  Factory's are rarely charged for using up clean air or water, nor they are compensated for training a worker who may later quit the job and work somewhere else.

  In the Prisoner's Dilemma when one of the prisoners confess, he harms the other one but he is not fined for that.

- Adam Smith's invisible hand can fail in many ways (especially in a world with externalities). Everyone might do the individually best thing but that may lead to a poor outcome for the whole society. Some of these inefficiencies may be handled with social policies and others not.

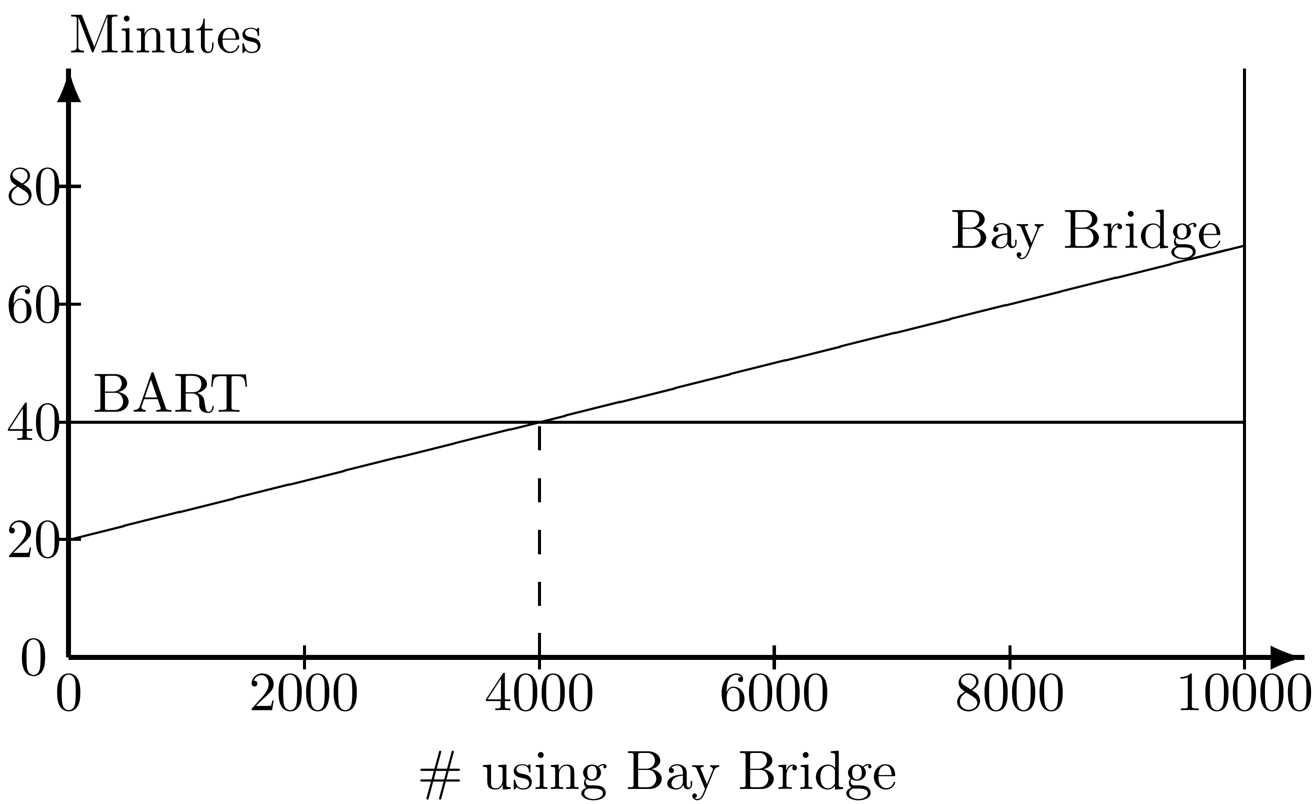
Example: For simplicity suppose that there are two means of transportation for commuting between Berkeley and San Fransisco:

- Bay Bridge: It takes 20 minutes if there is no one else using the bridge and 10 minutes delay for every 2000 people.
- Bay Area Rapid Transit (BART): 40 minutes no matter what.

Suppose for simplicity that there are 10,000 commuters and they all care for minimizing the commuting time.

Question: How will the 10,000 commuters be distributed between the two routes?

Answer: 40% will drive and 60% will take the BART.



- If less commuters drive then some BART users will realize that they can save time by driving.
- If more commuters drive then some of them will realize that they can save time by using the BART.
- Is this distribution efficient? NO!

- Suppose we reduce the number of drivers to 2000. Then commuting takes 30 minutes for them and 40 minutes for everyone else. Therefore we can save $2000 \times 10 = 20{,}000$ person-minutes.
- Externalities cause the inefficiency: When someone drives he/she inflicts a cost on every other driver for which he/she is not liable for. There are several ways to attack this problem:
  - 2000 licences for driving may be issued and rotated.
  - For simplicity suppose each hour is worth $12 so that each 10 minutes is worth $2. Then by setting the toll of the Bay Bridge $2 above the BART rate can achieve the efficient mix.
  - Sell the Bay Bridge. The owner will maximize profits by maximizing the minutes saved.

Example: Suppose there is a large number of drivers in a city. Every driver has the following utility function over driving:

$$u = 30 - t^2 + 8t - 4t_o$$

where

t: the number of hours of own driving

t_o: average hours of driving by the others

Since you cannot control the hours others drive, you will maximize the utility with appropriate choice of t. To do that you should differentiate your utility function with respect to t and equate that to 0.

$$\partial u/\partial t = -2t + 8 = 0 \Longrightarrow t = 4$$

Therefore you (and everyone else) will drive 4 hours every day and have a utility of

$$u = 30 - 4^2 + 8 \times 4 - 4 \times 4 = 30$$

This is not efficient. Suppose everyone drives 3 hours/day. Then the utility for everyone is

$$u = 30 - 3^2 + 8 \times 3 - 4 \times 3 = 33$$

What is the most efficient hours to drive? Suppose everyone collectively agreed to drive s hours/day. We should maximize the utility which reduces to

$$u = 30 - s^2 + 8s - 4s = 30 - s^2 + 4s$$

Differentiating this with respect to s and equating to 0 we obtain:

$$\partial u / \partial s = -2s + 4 = 0 \Longrightarrow s = 2$$

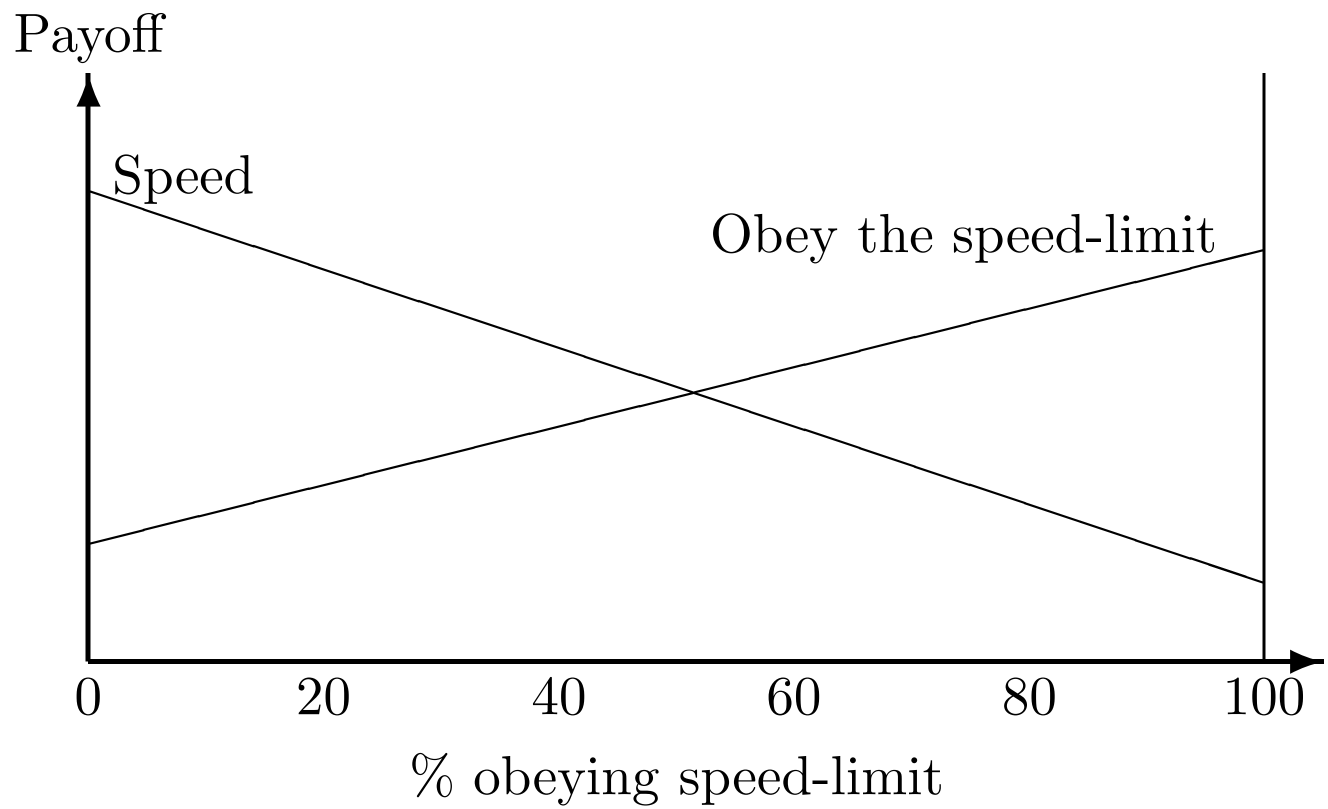
Therefore the most efficient hours to drive is 2 hours. In this case every drivers utility is

$$u = 30 - 2^2 + 4 \times 2 = 34$$

Example: Consider a driver who tries to decide how fast to drive and in particular whether to abide by the speed-limit or not. Consider a situation where almost nobody abides by the speed limit. Then one may be tempted to drive faster for the following two reasons:

- Some experts argue that the safest speed is the speed of the flow of the traffic,
- Chances of getting a ticket are small.

As more and more people become law abiding both reasons vanish. Therefore as the percentage of the drivers abiding by the speed-limit increases, the payoff from speeding decreases and the payoff from obeying the speed-limit increases.



There are three equilibria:

1. Everyone obeys the speed-limit,
2. Everyone speeds,
3. A mixed equilibrium (at the intersection).

- In the commuter example the dynamics converged to the mixed equilibrium. Here the tendency is towards the extremes.
- What can the lawmakers learn from that simple exercise? The key is to get a critical mass of drivers obeying the speed-limit. Therefore a short phase of extremely strict enforcement (as opposed to the same effort in a longer period) can do the trick and impose the equilibrium where everyone abides by the speed limit.