

CHAPTER 8

SIMULTANEOUS-MOVE GAMES

OKAY, OOGA,
MOG UNDERSTAND
RULES!

READY?

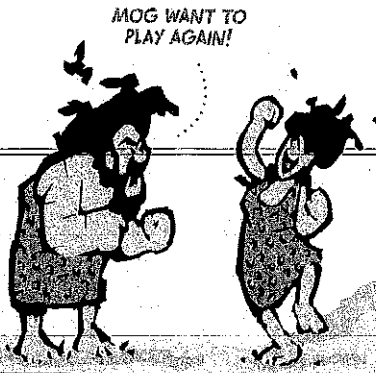
1...
2...
3...

ROCK!

PAPER!



ALL GAMES CAN BE ANALYZED AS SIMULTANEOUS-MOVE GAMES IN WHICH PLAYERS MOVE AT THE SAME TIME.

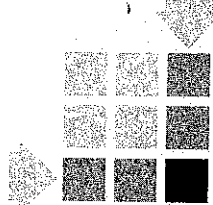
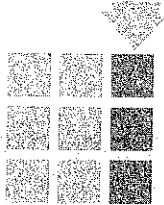
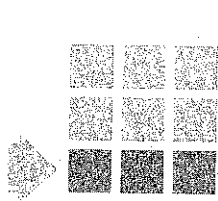


WE CAN ANALYZE SIMULTANEOUS-MOVE GAMES BETWEEN TWO PLAYERS USING A **PAYOFF MATRIX**.

EACH CHOICE FOR THE FIRST PLAYER GETS A ROW...

...AND EACH CHOICE FOR THE SECOND PLAYER GETS A COLUMN...

... AND THE OUTCOME FROM THOSE CHOICES APPEARS AT THE INTERSECTION.

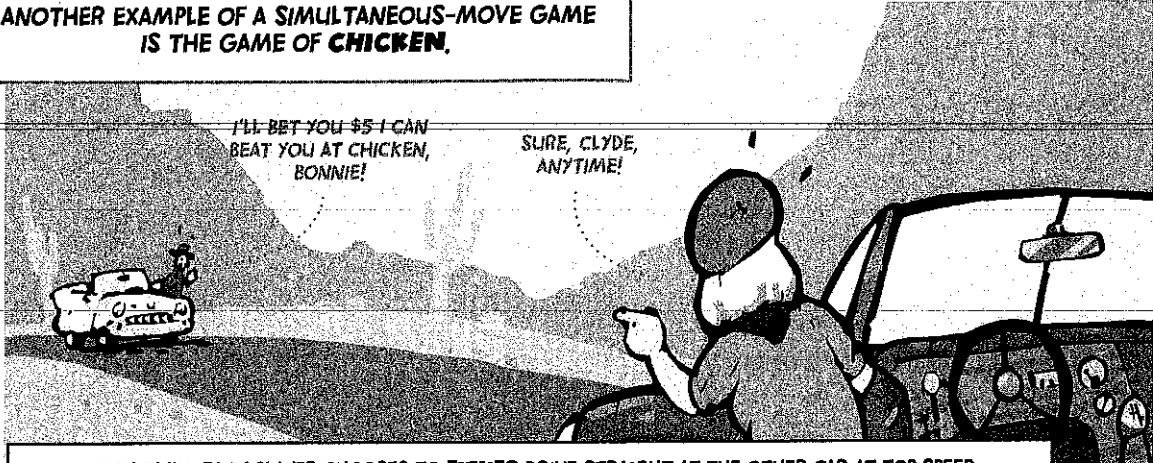


HERE'S A SIMPLE EXAMPLE: THE PAYOFF MATRIX FOR ROCK PAPER SCISSORS IF MOG AND OOGA PLAY FOR \$5.



		Rock	Paper	Scissors
Rock	Mog: \$0 Ooga: \$0	Mog: -\$5 Ooga: \$5	Mog: \$5 Ooga: -\$5	
Paper	Mog: \$5 Ooga: -\$5	Mog: \$0 Ooga: \$0	Mog: -\$5 Ooga: \$5	
Scissors	Mog: -\$5 Ooga: \$5	Mog: \$5 Ooga: -\$5	Mog: \$0 Ooga: \$0	

ANOTHER EXAMPLE OF A SIMULTANEOUS-MOVE GAME IS THE GAME OF **CHICKEN**.



I'LL BET YOU \$5 I CAN BEAT YOU AT CHICKEN, BONNIE!

SURE, CLYDE, ANYTIME!

IN CHICKEN, EACH PLAYER CHOOSES TO **EITHER** DRIVE STRAIGHT AT THE OTHER CAR AT TOP SPEED **OR** CHICKEN OUT BY TURNING AWAY.

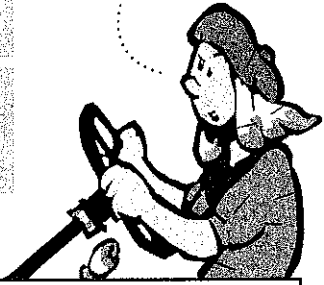


YOU CAN SEE THE 4 POSSIBLE OUTCOMES IN THIS PAYOFF MATRIX.

	Chicken Out	Speed Ahead
Chicken Out	Clyde: \$0 Bonnie: \$0	Clyde: -\$5 Bonnie: \$5
Speed Ahead	Clyde: \$5 Bonnie: -\$5	Both players perish in a horrible fiery crash!

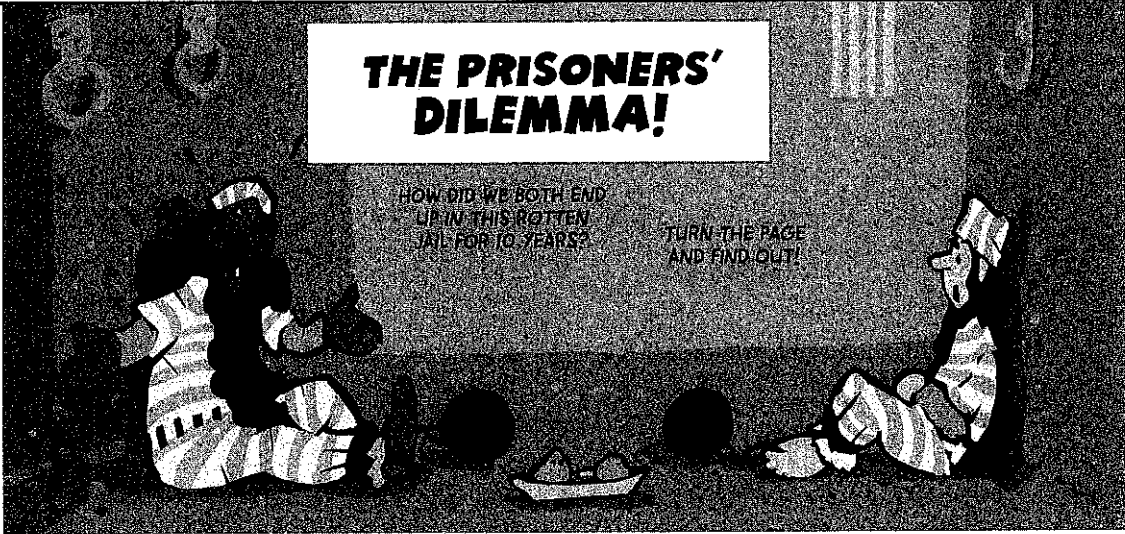
WAIT A MINUTE...

...MAYBE THIS ISN'T SUCH A GREAT IDEA.



IN THIS CHAPTER WE'RE GOING TO FOCUS ON THE MOST FAMOUS SIMULTANEOUS-MOVE GAME:

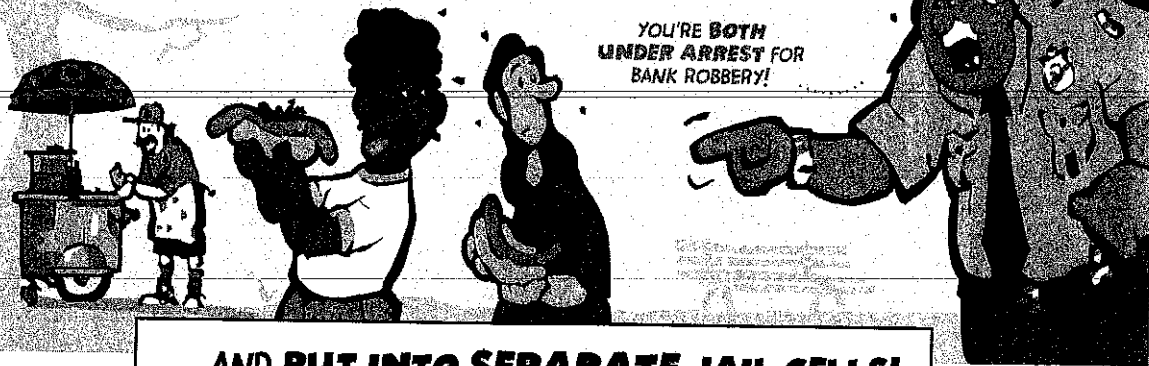
THE PRISONERS' DILEMMA!



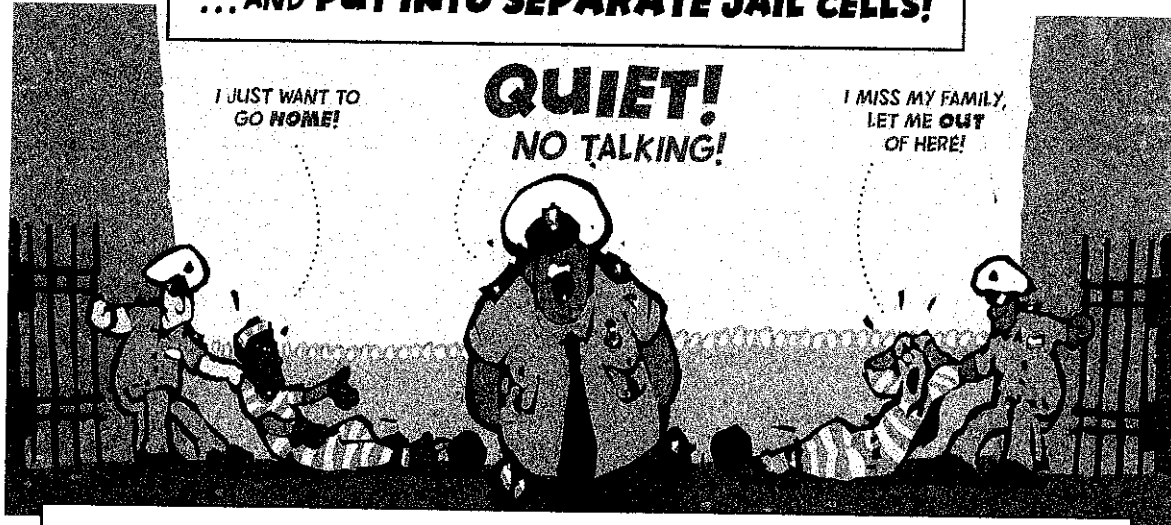
HOW DID WE BOTH END UP IN THIS ROTTEN JAIL FOR 10 YEARS?

TURN THE PAGE AND FIND OUT!

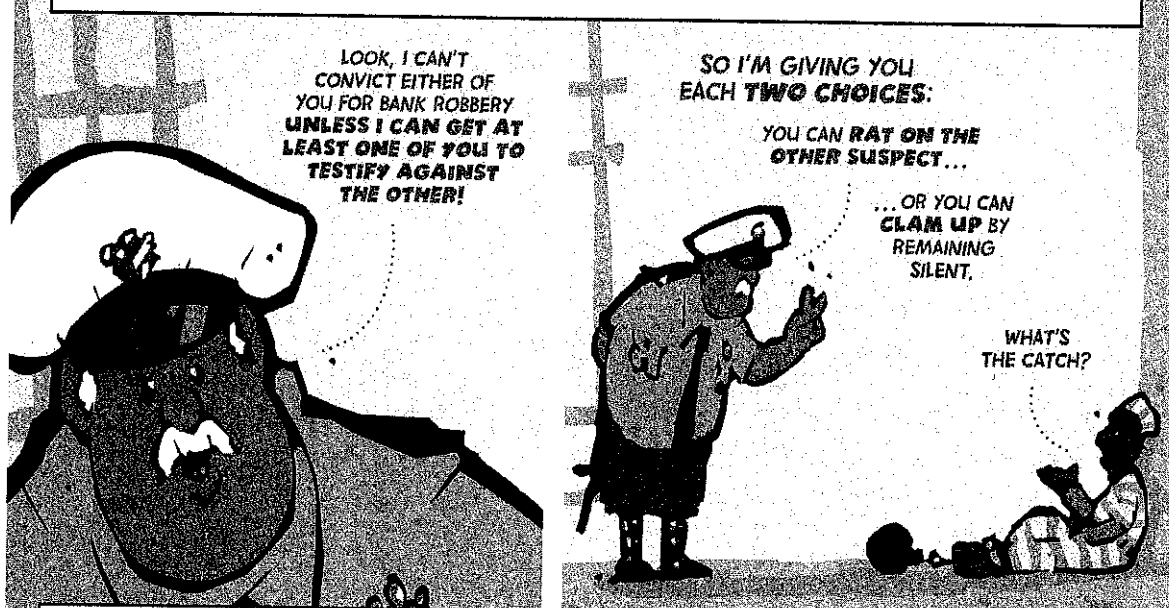
THE STORY OF **THE PRISONERS' DILEMMA** BEGINS WHEN TWO PEOPLE, BUCK AND PENNY, ARE **ARRESTED...**



...AND PUT INTO **SEPARATE JAIL CELLS!**



THEN THE **POLICE CHIEF** COMES AND TELLS EACH PRISONER THE SAME THING:



THE CATCH IS THAT THEIR JAIL SENTENCES DEPEND ON WHAT **BOTH** OF THEM DECIDE.

HERE'S WHAT THE POLICE CHIEF TELLS THE **FIRST PRISONER**:

IF YOU RAT ON THE OTHER PRISONER AND SHE RATS ON YOU...

... YOU BOTH GET 10 YEARS IN JAIL.

IF YOU RAT ON THE OTHER PRISONER AND SHE CLAMS UP...

... YOU GET OFF FREE, BUT SHE GETS 20 YEARS IN JAIL FOR THE ROBBERY.

IF YOU CLAM UP AND SHE RATS ON YOU...

... YOU GET 20 YEARS IN JAIL FOR THE ROBBERY, AND SHE GETS OFF FREE.

AND IF YOU BOTH CLAM UP...

... YOU BOTH GET A YEAR IN JAIL FOR SPOILING MY CLEVER PLAN!

I'LL GET YOU CONVICTED FOR LITTERING OR SOMETHING.

HE THEN TELLS THE **SECOND PRISONER** THE SAME STORY AND GIVES HER THE SAME CHOICE: **RAT OR CLAM UP!**

I JUST WANT TO GET OUT OF JAIL AS FAST AS POSSIBLE...

... WHAT SHOULD I DO?

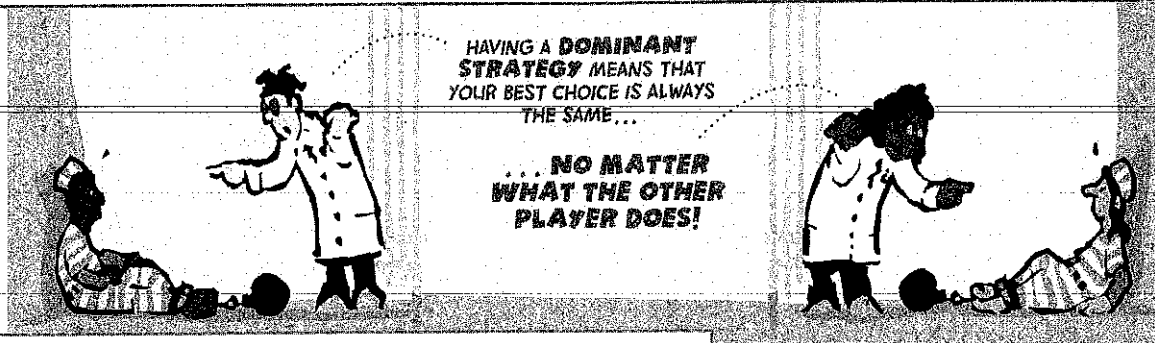
STUDY THIS **PAYOFF MATRIX!**

THE PAYOFFS ARE YEARS IN JAIL, AND THEY'RE NEGATIVE BECAUSE SPENDING TIME IN JAIL IS BAD.

	RAT	CLAM UP
RAT	Buck: -10 Penny: -10	Buck: 0 Penny: -20
CLAM UP	Buck: -20 Penny: 0	Buck: -1 Penny: -1



TWO THINGS MAKE THE PRISONERS' DILEMMA SPECIAL. THE FIRST IS THAT EACH PLAYER HAS A DOMINANT STRATEGY IF THEY JUST WANT TO GET OUT OF JAIL AS SOON AS POSSIBLE.



HAVING A **DOMINANT STRATEGY** MEANS THAT YOUR BEST CHOICE IS ALWAYS THE SAME...

... **NO MATTER WHAT THE OTHER PLAYER DOES!**

TO SEE THE **FIRST PRISONER'S DOMINANT STRATEGY**, WE JUST ASK HIM THESE QUESTIONS:

IF PENNY CHOOSES TO **RAT ON YOU**, WHAT'S YOUR BEST CHOICE?

TO **RAT ON HER**, BECAUSE THEN I GET **TEN YEARS** IN JAIL INSTEAD OF THE **TWENTY** I GET IF I CLAM UP.



		RAT	CLAM UP
RAT		Buck: -10 Penny: -10	Buck: 0 Penny: -20
CLAM UP		Buck: -20 Penny: 0	Buck: -1 Penny: -1

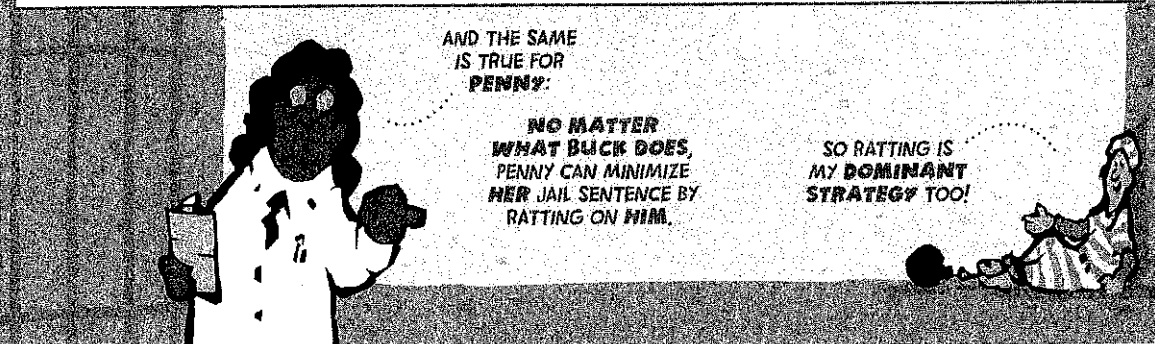
AND IF PENNY CHOOSES TO **KEEP QUIET**, WHAT'S YOUR BEST CHOICE?

TO **RAT ON HER**, BECAUSE THEN I GET **ZERO YEARS** IN JAIL INSTEAD OF THE **ONE** I GET IF I CLAM UP.



		RAT	CLAM UP
RAT		Buck: -10 Penny: -10	Buck: 0 Penny: -20
CLAM UP		Buck: -20 Penny: 0	Buck: -1 Penny: -1

REGARDLESS OF WHAT PENNY DOES, BUCK CAN MINIMIZE HIS JAIL SENTENCE BY RATTING. SO RATTING IS HIS DOMINANT STRATEGY.

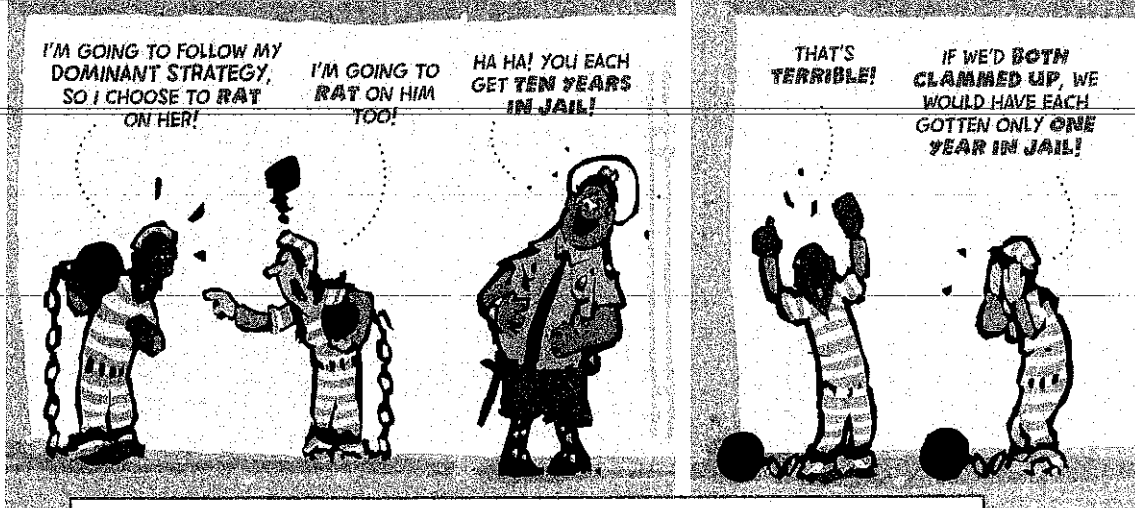


AND THE SAME IS TRUE FOR PENNY:

NO MATTER WHAT BUCK DOES, PENNY CAN MINIMIZE HER JAIL SENTENCE BY RATTING ON HIM.

SO RATTING IS **MY DOMINANT STRATEGY TOO!**


THE SECOND THING THAT MAKES THE PRISONERS' DILEMMA SPECIAL IS THAT DOMINANT STRATEGIES LEAD TO AN OUTCOME THAT IS BAD FOR BOTH PRISONERS!



IN THE LANGUAGE OF ECONOMICS, THE PRISONERS' DILEMMA FEATURES DOMINANT STRATEGIES THAT LEAD TO A PARETO INEFFICIENT OUTCOME...

DOMINANT STRATEGIES LEAD BOTH PLAYERS TO RAT ON EACH OTHER...



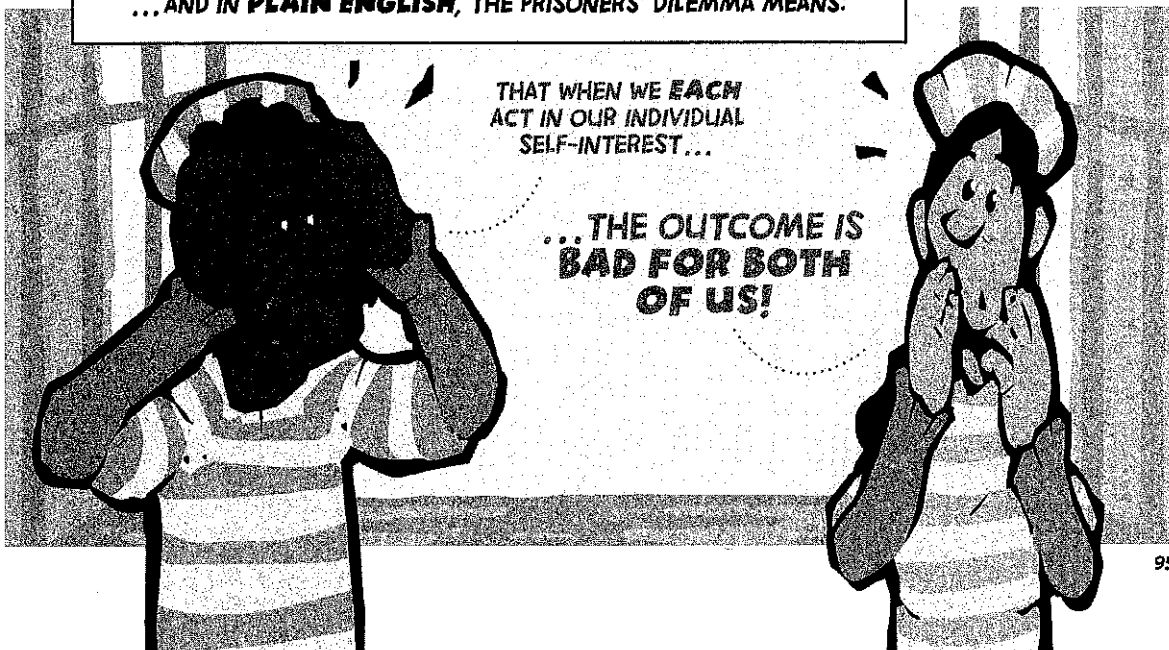
		
	RAT	CLAM UP
RAT	Buck: -10 Penny: -10	Buck: 0 Penny: -20
CLAM UP	Buck: -20 Penny: 0	Buck: -1 Penny: -1

PARETO IMPROVEMENT!

... EVEN THOUGH IT WOULD BE A PARETO IMPROVEMENT IF THEY BOTH CLAMMED UP.

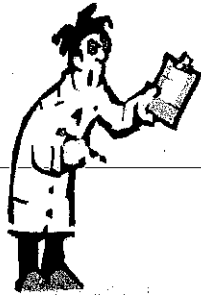


... AND IN PLAIN ENGLISH, THE PRISONERS' DILEMMA MEANS:



ECONOMISTS USE THE PHRASE **PRISONERS' DILEMMA** TO REFER TO ANY SITUATION WITH A **SIMILAR INCENTIVE STRUCTURE**.

HERE'S A **GENERIC PRISONERS' DILEMMA MATRIX**:



		2nd Player	
		A	B
1st Player	A	1st Player: BAD 2nd Player: BAD	1st Player: BEST 2nd Player: WORST
	B	1st Player: WORST 2nd Player: BEST	1st Player: GOOD 2nd Player: GOOD

IN THE STORY ABOUT THE PRISONERS, **CHOICE A** WAS TO **RAT** AND **CHOICE B** WAS TO **CLAM UP**.



WHAT THESE SITUATIONS HAVE IN COMMON IS THAT THEY ALL HAVE **DOMINANT STRATEGIES**...

IF SHE CHOOSES **A**, WHAT'S YOUR BEST CHOICE?



CHOICE A, BECAUSE A **BAD** OUTCOME IS BETTER FOR ME THAN THE **WORST** OUTCOME.



		2nd Player	
		A	B
A	A	1st Player: BAD 2nd Player: BAD	1st Player: BEST 2nd Player: WORST
	B	1st Player: WORST 2nd Player: BEST	1st Player: GOOD 2nd Player: GOOD

AND IF SHE CHOOSES **B**, WHAT'S YOUR BEST CHOICE?



CHOICE A, BECAUSE THE **BEST** OUTCOME IS BETTER FOR ME THAN A **GOOD** OUTCOME.



		2nd Player	
		A	B
A	A	1st Player: BAD 2nd Player: BAD	1st Player: BEST 2nd Player: WORST
	B	1st Player: WORST 2nd Player: BEST	1st Player: GOOD 2nd Player: GOOD

... THAT RESULT IN **PERETO INEFFICIENT OUTCOMES** FOR THE TWO PLAYERS!

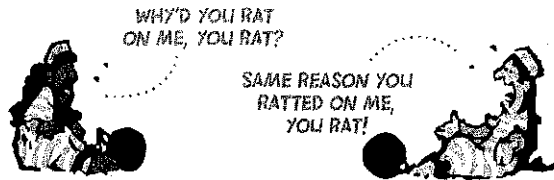


CHOICE A IS MY **DOMINANT STRATEGY** TOO.

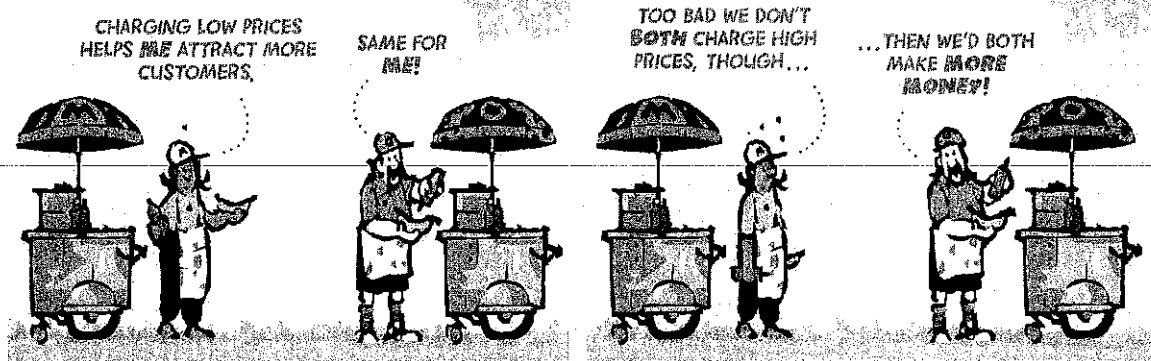
BUT WHEN WE BOTH CHOOSE **A** THE OUTCOME IS **BAD FOR BOTH** OF US!



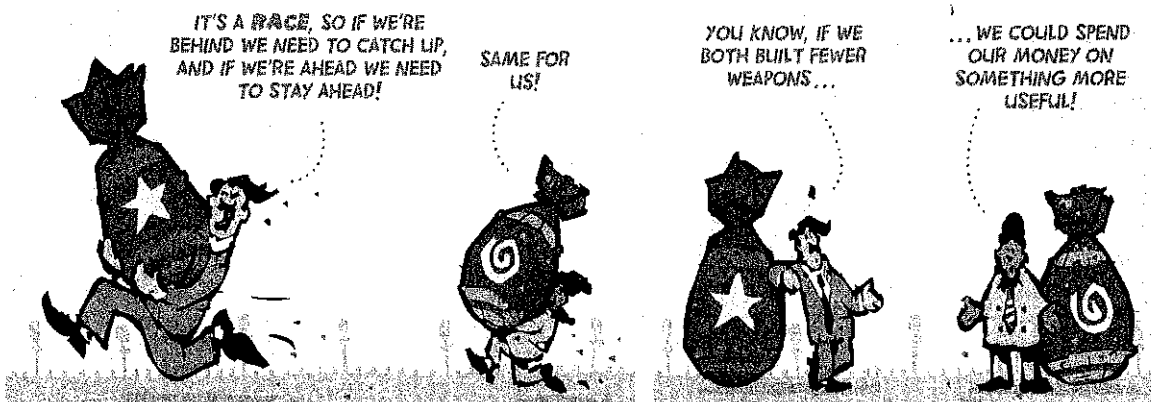
THE PRISONERS' DILEMMA CAN HELP US BETTER UNDERSTAND LOTS OF **MUTUALLY DESTRUCTIVE BEHAVIOR...**



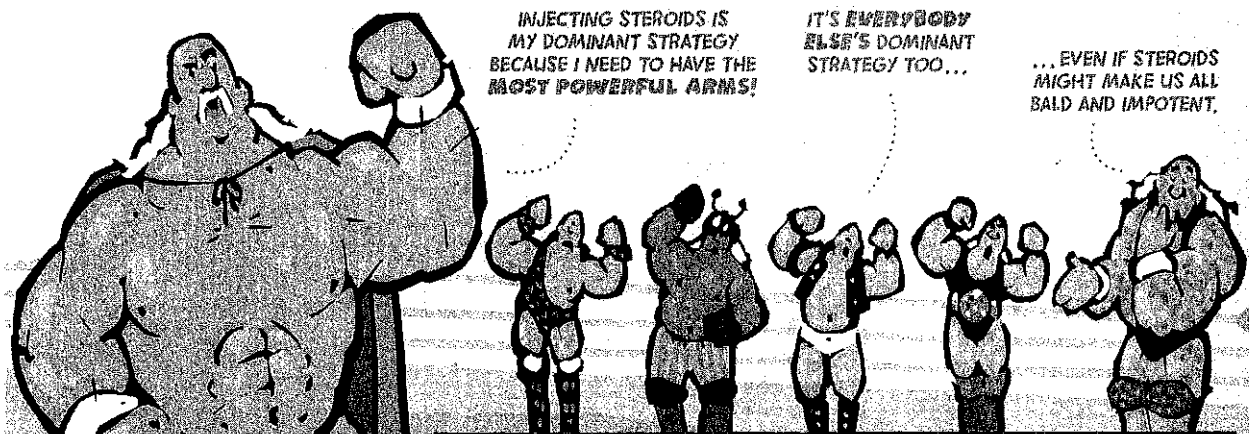
... LIKE PRICE WARS BETWEEN TWO COMPETING BUSINESSES ...



... AND ARMS RACES BETWEEN TWO NATIONS.



WE CAN EVEN GENERALIZE THE PRISONERS' DILEMMA TO SITUATIONS INVOLVING **MORE THAN TWO PLAYERS**, LIKE WHEN PROFESSIONAL WRESTLERS CHOOSE TO USE STEROIDS:



THIS GENERALIZED PRISONERS' DILEMMA IS CALLED THE **TRAGEDY OF THE COMMONS**.

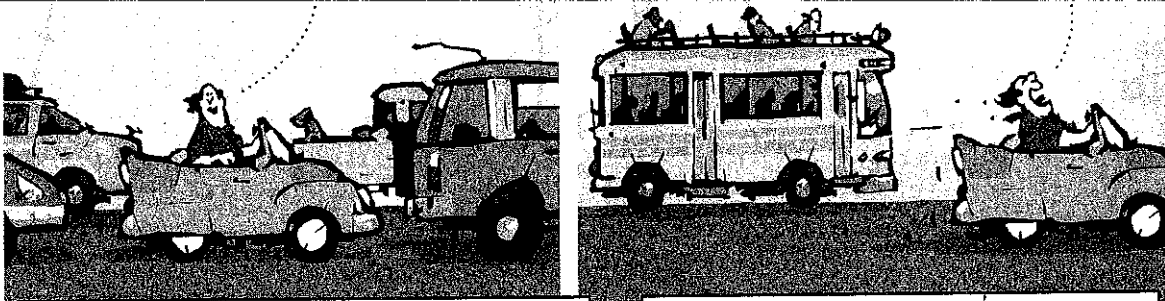
AS WE SAW ON PAGE 11, ANOTHER EXAMPLE OF THE TRAGEDY OF THE COMMONS IS TRAFFIC CONGESTION.

IN CITIES WHERE COMMUTERS CAN CHOOSE BETWEEN DRIVING AND TAKING THE BUS, DRIVING IS OFTEN A DOMINANT STRATEGY.

IF EVERYONE ELSE DRIVES, I'M GOING TO DRIVE...

... BECAUSE IT'D TAKE EVEN LONGER ON THE BUS.

AND IF EVERYONE ELSE TAKES THE BUS, I'M DEFINITELY GOING TO DRIVE!



SO EVEN THOUGH THE COMMUTE WOULD BE MUCH SHORTER IF EVERYONE TOOK THE BUS...

... WE GET TERRIBLE TRAFFIC BECAUSE EVERYONE FOLLOWS THEIR DOMINANT STRATEGY.

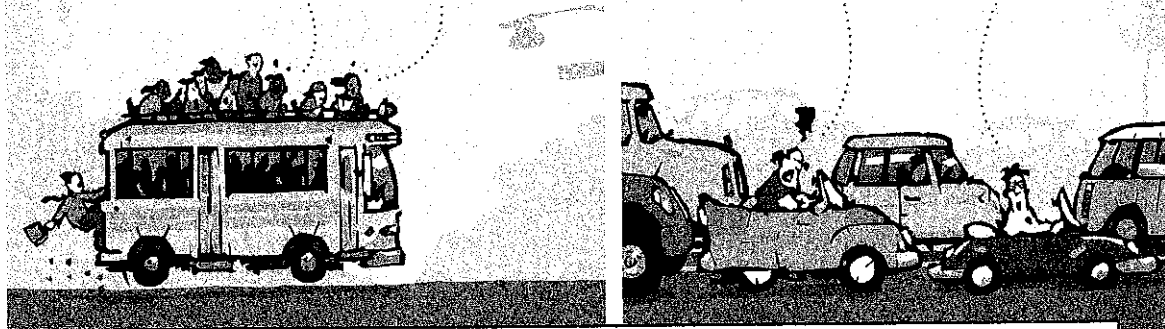
NO TRAFFIC...

... THIS IS AWESOME!

AND I CAN READ MY ECONOMICS BOOK ON THE BUS!

THIS IS A TRAGEDY!

YEAH, HOW PARETO INEFFICIENT!



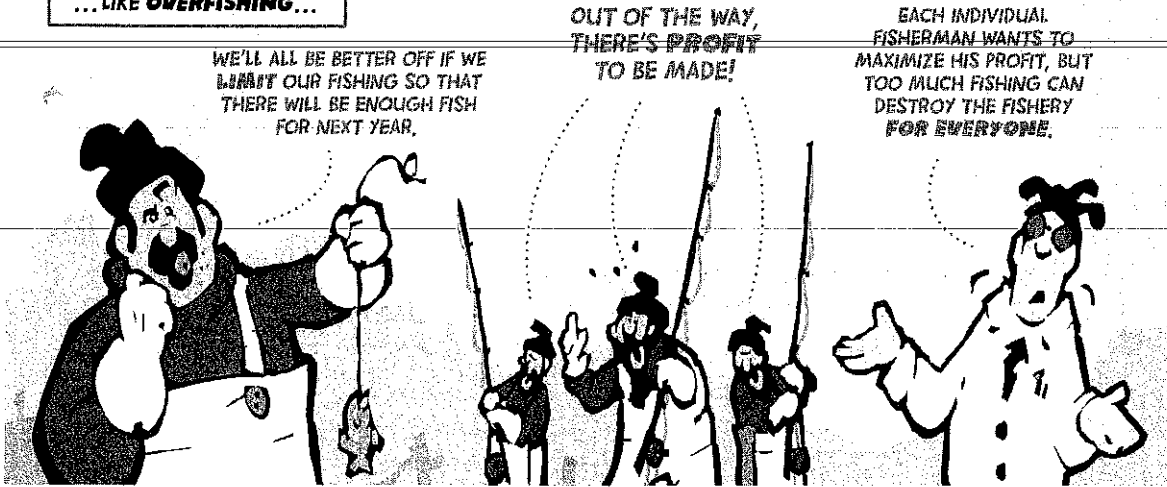
IN THIS KIND OF SITUATION, INDIVIDUAL SELF-INTEREST ACTS IN OPPOSITION TO OUR COLLECTIVE GOALS.

I HATE ECONOMICS.

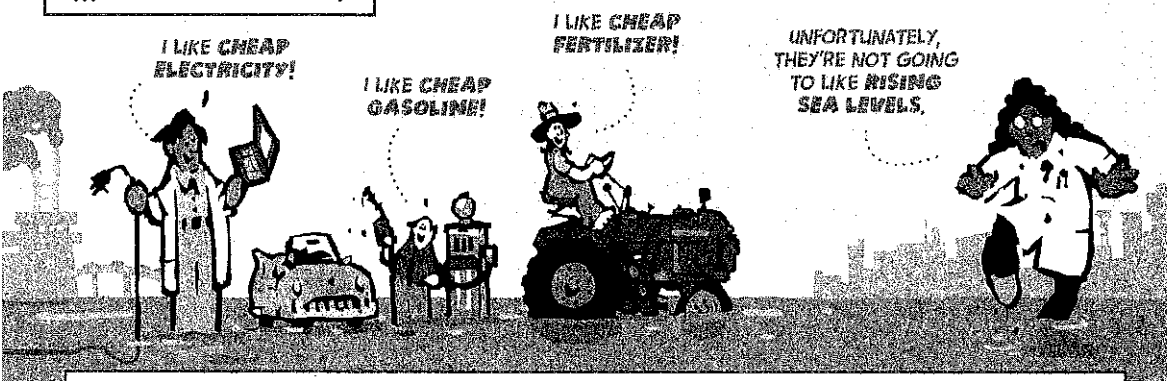


THE TRAGEDY OF THE COMMONS IDEA ALSO DESCRIBES MANY ENVIRONMENTAL PROBLEMS...

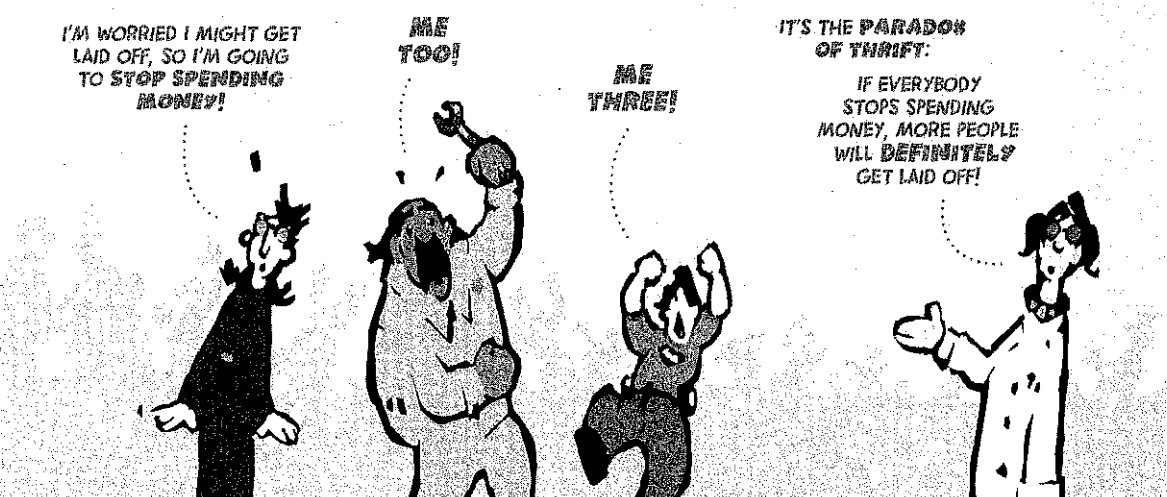
... LIKE OVERFISHING...



... AND CLIMATE CHANGE.



IT MIGHT EVEN HELP US UNDERSTAND WHY ENTIRE ECONOMIES SOMETIMES CRASH.



FORTUNATELY, THE NEWS IS NOT ALL BAD...

ONE PIECE OF GOOD NEWS COMES FROM THE COASE THEOREM.

IF THERE'S NOTHING TO STOP PEOPLE FROM TRADING, THEY WILL CONTINUE TRADING UNTIL THEY REACH A PARETO EFFICIENT OUTCOME!



THE COASE THEOREM CAN SOLVE THE PRISONERS' DILEMMA IF THE PRISONERS CAN TALK TO EACH OTHER AND NEGOTIATE AN AGREEMENT.

PSST, LET'S MAKE A DEAL SO WE BOTH KEEP QUIET. THAT WAY WE'LL BOTH GET OUT IN A YEAR!

SOUNDS LIKE A GOOD PLAN...

... BUT WE'LL HAVE TO FIGURE OUT A WAY TO MAKE SURE WE BOTH KEEP OUR WORD!

DARN, I SHOULD HAVE KEPT THEM IN SEPARATE CELLS.



NEGOTIATED AGREEMENTS CAN ALSO SOLVE THE TRAGEDY OF THE COMMONS!

THE PLAYERS JUST NEED TO FIND A WAY TO ALIGN THEIR INDIVIDUAL INCENTIVES WITH THE GOALS OF THE GROUP AS A WHOLE:

WE ALL AGREE TO SUBMIT TO STEROID TESTING...

... AND TO BAN ATHLETES WHO FAIL!

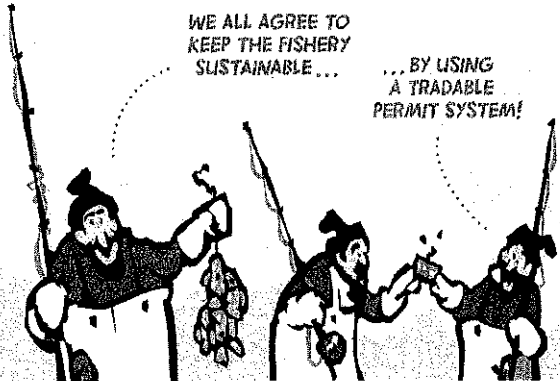


WE ALL AGREE TO KEEP THE FISHERY SUSTAINABLE...

... BY USING A TRADABLE PERMIT SYSTEM!

WE ALL AGREE TO IMPOSE A CARBON TAX ON FOSSIL FUELS...

... WE DON'T LIKE IT, BUT IT'S BETTER THAN RISING SEA LEVELS!

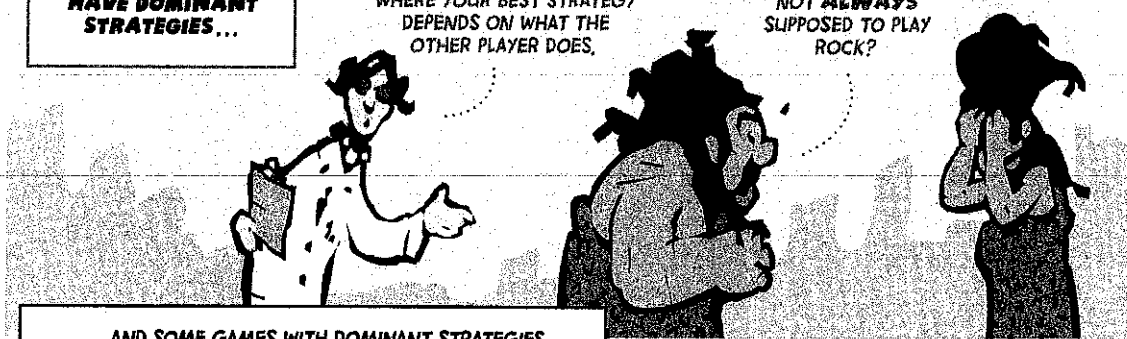


ANOTHER PIECE OF GOOD NEWS IS THAT LOTS OF SIMULTANEOUS-MOVE GAMES AREN'T LIKE THE PRISONERS' DILEMMA.

MANY GAMES DON'T HAVE DOMINANT STRATEGIES...

LIKE ROCK PAPER SCISSORS, WHERE YOUR BEST STRATEGY DEPENDS ON WHAT THE OTHER PLAYER DOES.

YOU MEAN MOG NOT ALWAYS SUPPOSED TO PLAY ROCK?



... AND SOME GAMES WITH DOMINANT STRATEGIES DON'T HAVE PARETO INEFFICIENT OUTCOMES.

LIKE THIS GAME, WHICH MIGHT BE CALLED THE PRISONERS' DELIGHT.

IN THIS PAYOFF MATRIX OUR INCENTIVE IS TO COOPERATE BY CHOOSING A!

	A	B
A	1st Player: GOOD 2nd Player: GOOD	1st Player: BEST 2nd Player: WORST
B	1st Player: WORST 2nd Player: BEST	1st Player: BAD 2nd Player: BAD



BUT THE BEST NEWS OF ALL IS THAT SOME PRISONERS' DILEMMA SITUATIONS HAVE UNEXPECTED BENEFITS!

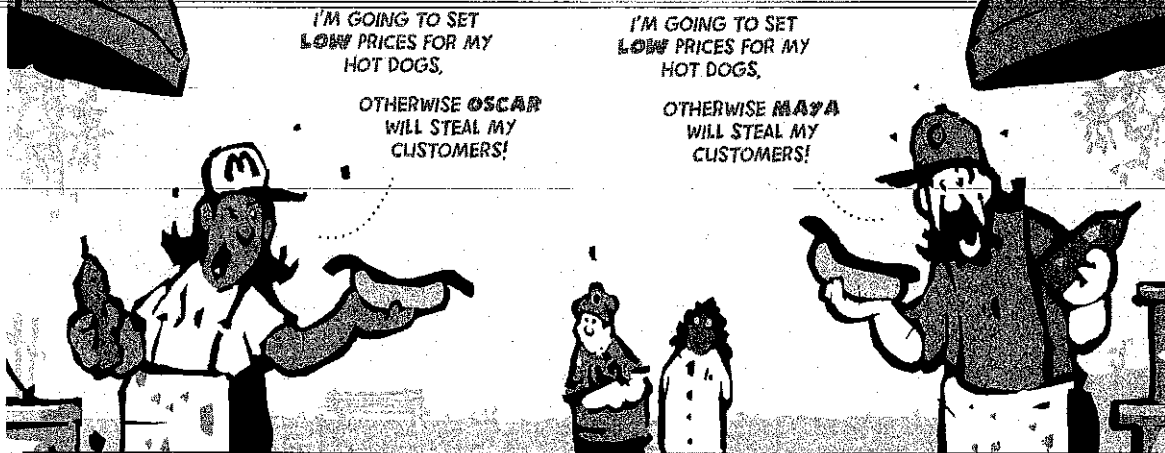
ESPECIALLY IF WE TAKE A BROADER PERSPECTIVE ON SITUATIONS LIKE THIS ONE...

CHARGING LOW PRICES HELPS ME ATTRACT MORE CUSTOMERS.

SAME FOR ME!



WE CAN SEE THESE **UNEXPECTED BENEFITS** MOST CLEARLY IN THE CASE OF **TWO COMPETING BUSINESSES** WHO EACH HAVE A **DOMINANT STRATEGY** OF SETTING **LOW PRICES**.



I'M GOING TO SET **LOW PRICES** FOR MY HOT DOGS,

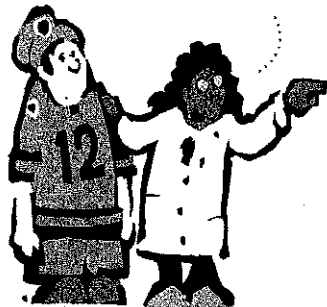
OTHERWISE **OSCAR** WILL STEAL MY CUSTOMERS!

I'M GOING TO SET **LOW PRICES** FOR MY HOT DOGS,

OTHERWISE **MAYA** WILL STEAL MY CUSTOMERS!

FROM THE **NARROW PERSPECTIVE** OF THE BUSINESSES, THIS IS A CLASSIC **PRISONERS' DILEMMA** SITUATION ...

BOTH PLAYERS HAVE A **DOMINANT STRATEGY** THAT LEADS TO A **PARETO INEFFICIENT** OUTCOME FOR THEM,



	SET LOW PRICE	SET HIGHER PRICE
SET LOW PRICE	Oscar: \$2m Maya: \$2m	Oscar: \$5m Maya: \$0m
SET HIGHER PRICE	Oscar: \$0m Maya: \$5m	Oscar: \$4m Maya: \$4m

PARETO IMPROVEMENT!

IF THEY **BOTH** SET HIGHER PRICES, THEY'D **BOTH** MAKE MORE MONEY!



... BUT FOR **CONSUMERS** THE RESULT IS **FANTASTIC!**

IT'S AS IF AN **INVISIBLE HAND** WERE GUIDING THEM TO PROVIDE ME WITH HOT DOGS AT **LOW PRICES!**



GEE, THANKS FOR THE **LOW PRICES!**

DON'T THANK ME-- I'M JUST TRYING TO **MAXIMIZE MY PROFIT!**

SELFISH JERK!

