



THE CARTOON INTRODUCTION TO ECONOMICS

VOLUME ONE: MICROECONOMICS



BY GRADY KLEIN AND
YORAM BAUMAN, Ph.D.
THE WORLD'S FIRST AND ONLY STAND-UP ECONOMIST

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FOR JANE AND LISA AND BENJAMIN
OF

FOR ADRIAN AND BETTY
AND IN MEMORY OF HOLLY AND HELEN
OF

CONTENTS

PART ONE: THE OPTIMIZING INDIVIDUAL 	Chapter 1	Introduction
	Chapter 2	Decision Trees
	Chapter 3	Time
	Chapter 4	Risk
	Chapter 5	From One to Some
PART TWO: STRATEGIC INTERACTIONS 	Chapter 6	Cake Cutting
	Chapter 7	Pareto Efficiency
	Chapter 8	Simultaneous-Move Games
	Chapter 9	Auctions
	Chapter 10	From Some to Many
	PART THREE: MARKET INTERACTIONS 	Chapter 11
Chapter 12		Taxes
Chapter 13		Marginal
Chapter 14		Elasticity
Chapter 15		The Big Picture
Chapter 16		Conclusion



PART ONE

**THE OPTIMIZING
INDIVIDUAL**

CHAPTER 1

INTRODUCTION

THIS BOOK IS ABOUT
ONE VERY IMPORTANT
TYPE OF PERSON...

...A PERSON WE
ECONOMISTS CALL
**THE OPTIMIZING
INDIVIDUAL!**



THERE IS OF COURSE A
STEREOTYPE ABOUT
THE OPTIMIZING
INDIVIDUAL ...

... THE STEREOTYPE
OF THE **SELFISH
JERK!**

THE ONLY REASON I DON'T SELL
MY CHILDREN IS THAT I THINK
THEY'LL BE WORTH MORE LATER
... HEH HEH

YES!

BRILLIANT!

HOW TOTALLY
RATIONAL!



**BUT IN TRUTH, THE MAIN ASSUMPTION IN ECONOMICS IS THAT
EVERY SINGLE PERSON IS AN OPTIMIZING INDIVIDUAL!**

EVEN THAT
TREE-HUGGER?

... AND THAT
LAZY BUM?

YUP!

HUM, HER, YOU, ME,
ALL OF US.



**EVEN THE PERSON
READING THIS BOOK IS AN
OPTIMIZING INDIVIDUAL!**



**IN THE EYES OF ECONOMISTS, ALL
OPTIMIZING INDIVIDUALS ARE CREATED EQUAL.**

SO YOU'RE SAYING HE'S
JUST AS GOOD AS ME?

SURE!

HE MAY NOT BE
MAXIMIZING HIS
INCOME...

... BUT HE IS
MAXIMIZING HIS
HAPPINESS!



**THAT'S BECAUSE OPTIMIZING INDIVIDUALS ARE SIMPLY PEOPLE
TRYING TO SATISFY THEIR OWN PREFERENCES!**

I HAVE A DEEP NEED
TO PROTECT ALL
LIVING THINGS!

SO YOU SEE,
ECONOMICS IS
NOT JUST ABOUT
MAKING
MONEY!

**BUT THEN WHAT
IS ECONOMICS
ABOUT?**

I GET WAY MORE
SLEEP THAN ANY
OF YOU!



**ECONOMICS IS ABOUT
THE ACTIONS OF
OPTIMIZING INDIVIDUALS...**

LIFE ME!

AND ME!

LOVE!



**I'M MAXIMIZING
MY PROFIT!**

**I'M SAVING
THE PLANET!**

**I'M JUST TRYING
TO GET COZY!**



...AND **THE INTERACTIONS
BETWEEN THEM.**

GET UP, YOU BUM,
DON'T FORGET
THAT YOU'RE MY
EMPLOYEE!

**MOW THIS
LAWN!**

OH, NO
YOU DON'T!

THAT GRASS
NEVER HURT
ANYONE!

AND BESIDES,
LAWNMAOWERS
POLLUTE LIKE
CRAZY!

I JUST WANNA
NAP, MAN!



THIS BOOK LOOKS AT
MICROECONOMICS
BY STUDYING **ONE**
OPTIMIZING INDIVIDUAL...



WELL, NOW THAT I'M STUCK
HERE, I MIGHT AS WELL STUDY
DECISION THEORY.



...AND THEN INTERACTIONS
BETWEEN **TWO OR MORE**
OPTIMIZING INDIVIDUALS...

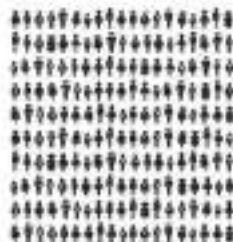


HOW DID WE END UP
IN THIS ROTTEN JAIL
FOR 10 YEARS?

IT'S THE
PRISONERS'
DILEMMA.



...AND THEN INTERACTIONS
BETWEEN **LOTS OF**
OPTIMIZING INDIVIDUALS.



SUPPLY
AND DEMAND
ANSWERS ALL SORTS
OF QUESTIONS!

WHY ARE
OIL PRICES
SO HIGH?

HOW
ARE INTEREST
RATES SET?

WHERE DO
BABIES COME
FROM?



THIS BOOK **DOESN'T** COVER
MACROECONOMICS...

... WHICH LOOKS AT **BIGGER-PICTURE** ISSUES
THAT AFFECT THE **WHOLE ECONOMY**, LIKE INFLATION,
UNEMPLOYMENT, AND ECONOMIC GROWTH.

MACROECONOMISTS HAVE
SUCCESSFULLY PREDICTED
NINE OUT OF THE LAST
FIVE RECESSIONS.

CONGRATULATIONS:
YOU WIN THE
NOBEL PRIZE!



IF YOU'RE CONFUSED ABOUT THE DIFFERENCE BETWEEN **MICRO** AND **MACRO**,
YOU CAN REMEMBER THIS LINE ADAPTED FROM WRITER P. J. O'ROURKE:

MICROECONOMISTS
ARE **WRONG** ABOUT
SPECIFIC THINGS...

...AND MACROECONOMISTS
ARE **WRONG** ABOUT
THINGS IN GENERAL!



OR YOU CAN JUST
REMEMBER THAT
MICROECONOMISTS
FOCUS IN CLOSELY
ON OPTIMIZING INDIVIDUALS.

WOW,
I THINK I SEE
A **WIDGET**!



IN ADDITION TO STUDYING HOW OPTIMIZING INDIVIDUALS ACT AND INTERACT,
MICROECONOMISTS WANT TO ANSWER **ONE BIG QUESTION**...

**THE BIG QUESTION
IN MICROECONOMICS IS:**

**UNDER WHAT
CIRCUMSTANCES
DOES INDIVIDUAL
OPTIMIZATION LEAD TO
OUTCOMES THAT ARE
GOOD FOR THE
GROUP AS A
WHOLE?**

IN OTHER
WORDS

WHEN I DO
WHAT'S GOOD
FOR **ME**...

...AND YOU DO
WHAT'S GOOD
FOR **YOU**...

...AND EVERYONE ELSE
DOES WHAT'S GOOD FOR
THEMSELVES ..

... WHEN ARE THE
RESULTS GOOD FOR
ALL OF US?



**IN SOME SITUATIONS, LIKE TRAFFIC JAMS,
OPTIMIZING INDIVIDUALS LEAD ONE ANOTHER
DOWN THE ROAD TO RUIN.**

EACH DRIVER IS JUST TRYING TO GET TO
WORK AS **FAST** AS POSSIBLE...

... BUT THE RESULT IS CONGESTION THAT
SLOWS EVERYONE DOWN!



**AS WE'LL SEE IN CHAPTER 8, THIS IS THE IDEA OF
THE TRAGEDY OF THE COMMONS.**

THE TRAGEDY OF THE COMMONS ALSO EXPLAINS OVERFISHING AND AIR POLLUTION
AND EVEN THINGS LIKE **DIRTY KITCHENS IN COLLEGE DORMS.**



LUCKILY, THIS TRAGEDY ISN'T THE WHOLE STORY...

**IN OTHER SITUATIONS,
OPTIMIZING INDIVIDUALS
WORK TOGETHER SO WELL
THAT THE RESULTS SEEM
MIRACULOUS!**

JUST LOOK AROUND
YOU AND YOU'LL
SEE LOTS OF THESE
MIRACLES!

TAKE EVEN A
SIMPLE PENCIL,
FOR EXAMPLE,

**RUBBER
FROM
INDONESIA!**

**METAL
FROM
AUSTRALIA!**

**CEDAR
WOOD
FROM
OREGON!**

**GRAPHITE
FROM BRAZIL!**

THE PARTS OF THAT PENCIL WERE
PRODUCED ALL OVER THE WORLD
BY PEOPLE WHO PROBABLY HAD NO
IDEA THEY WERE HELPING TO MAKE
A PENCIL!



**PERHAPS THE MOST MIRACULOUS MIRACLE IS HOW COMPETITION BETWEEN
PROFIT-MAXIMIZING SELLERS LEADS TO LOWER PRICES FOR CONSUMERS.**

I'LL SELL YOU
A HOT DOG
FOR \$2!

GEE, THANKS FOR
THE LOW PRICES!

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

I'LL SELL
YOU ONE
FOR \$1!



**THIS IS THE IDEA OF THE INVISIBLE HAND,
WHICH SAYS THAT SELF-INTEREST CAN SERVE THE COMMON GOOD!**

THE METAPHOR OF **THE INVISIBLE HAND**
WAS COINED BY **ADAM SMITH** IN 1776...



... AND ECONOMISTS HAVE BEEN **REPEATING IT** EVER SINCE,

HEY GUYS, HOW MANY
ECONOMISTS DOES IT TAKE
TO CHANGE A LIGHTBULB?



ZERO...
BECAUSE THE
INVISIBLE HAND
DOES IT!



IN CONTRAST TO THE PESSIMISM OF THE
TRAGEDY OF THE COMMONS...



... THE OPTIMISM OF THE INVISIBLE
HAND SUGGESTS THAT THE WORLD
CAN LOOK HEAVENLY!



NOW, IT'S NO SURPRISE THAT THE
WORLD WILL LOOK HEAVENLY IF
IT'S **FULL OF ANGELS**.



THE TRUE MIRACLE OF
THE INVISIBLE HAND IS THAT
IN CERTAIN SITUATIONS THE
WORLD WILL LOOK HEAVENLY EVEN
IF IT'S FULL OF **SELFISH JERKS!**



BUT **WHICH**
SITUATIONS?

**THAT'S WHAT THIS
BOOK IS ALL ABOUT!**





CHAPTER 2

DECISION TREES

THERE ARE **ALL KINDS** OF
OPTIMIZING INDIVIDUALS...



... BUT ULTIMATELY, **ALL**
OPTIMIZING INDIVIDUALS
HAVE **ONE** THING
IN COMMON...



... THEY LOOK AT
THE **AVAILABLE**
OPTIONS ...



... AND PICK THE **BEST** ONE!



THAT'S WHAT IT
MEANS TO BE AN
OPTIMIZING
INDIVIDUAL!



IT SOUNDS SIMPLE,
BUT STUDYING **HOW**
INDIVIDUALS MAKE
OPTIMAL DECISIONS
IS HARD...



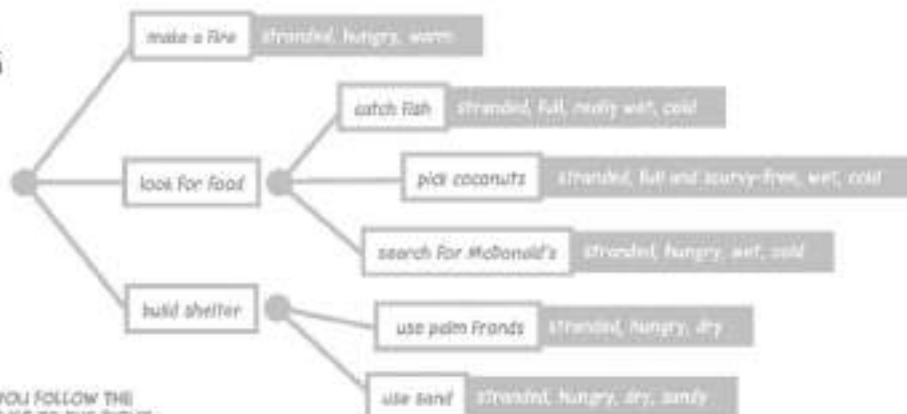
WHAT SHOULD
I DO NOW?

MAKE A
FIRE?

LOOK FOR
FOOD?

BUILD A
SHELTER?

...SO ECONOMISTS USE
DECISION TREES TO MAP OUT
THE **AVAILABLE OPTIONS**.



AS YOU FOLLOW THE
BRANCHES TO THE RIGHT,
NOTE THAT SOME OF
YOUR CHOICES BRANCH
INTO **ADDITIONAL**
CHOICES...

...AND EACH PATH ENDS IN
AN **OUTCOME BOX** THAT
DESCRIBES THE RESULT.

NEXT WE'LL GET
DECISION TREES TO LEARN
ABOUT **SUNK COSTS**
AND **MARGINAL**
ANALYSIS.



OUR FIRST LESSON IS ABOUT **SUNK COSTS**.

OH MY!
I'VE DECIDED TO
MAKE A FIRE...
... **BECAUSE I'M
STRANDED!!**

**WAIT A
MINUTE!**

BEING STRANDED
**CAN'T BE THE
ENTIRE REASON FOR
YOUR DECISION!**

"STRANDED" APPEARS
IN ALL THE OUTCOME
BOXES.

NO MATTER
WHICH CHOICE YOU
MAKE, YOU'LL STILL
BE STRANDED!

**SUNK COSTS
APPEAR IN ALL THE
OUTCOME BOXES.**



IT MAKES **NO SENSE**
TO BASE YOUR WHOLE
DECISION ON A
SUNK COST!

SUNK COSTS ARE LIKE
THAT TREASURE CHEST
I **DROPPED INTO
THE OCEAN.**

I'LL NEVER
GET IT BACK!

EXACTLY!

LIKE WATER
UNDER THE
BRIDGE OR
SPILT MILK.

**ANOTHER EXAMPLE OF SUNK COSTS IS
THE MONEY YOU PAID TO BUY THIS BOOK!**

NOW THAT YOU'VE
BOUGHT IT, YOU FIND
YOURSELF FACED WITH
THIS CHOICE,

study this
book

learn the principles of economic
choice, wealth and happiness.
Spend mom's money buying the book.

play video
games

have fun now, but die penniless and sad.
mom will kill you for wasting her money.
Spend mom's money buying the book.

IT DOESN'T MAKE
MUCH SENSE TO BASE
MY DECISION ON THE
SUNK COST,

BUT IT DOES MAKE SENSE TO
STUDY THE BOOK BECAUSE
OTHERWISE YOUR MOM
WILL KILL YOU!

...OR BECAUSE YOU
DON'T WANT TO DIE
PENNILESS AND SAD!

WE CAN ALSO ZOOM IN ON THE
DETAILS OF SOME DECISION TREES.

LET'S SAY YOU'VE DECIDED TO
STUDY THE BOOK, AND NOW
YOU HAVE TO DECIDE HOW
MUCH TIME TO SPEND
STUDYING!

study for
5 hours

get a B in economics,
spend 10 hours on Facebook

study for
6 hours

get a B+ in economics,
spend 9 hours on Facebook

study for
7 hours

get an A- in economics,
spend 8 hours on Facebook

WHEN ECONOMISTS START
COMPARING **VERY SIMILAR CHOICES**
LIKE THESE, WE ENTER THE REALM OF
MARGINAL ANALYSIS!

MARGINAL ANALYSIS MEANS COMPARING SIMILAR CHOICES.



ECONOMISTS LOVE MARGINAL ANALYSIS BECAUSE IT GENERATES POWERFUL INSIGHTS...



COMPARING 6 HOURS WITH 5 OR 7 HOURS IS MARGINAL ANALYSIS BECAUSE THEY'RE VERY SIMILAR CHOICES...

study for 5 hours

get a B- in economics; spend 10 hours on Facebook

study for 6 hours

get a B+ in economics; spend 9 hours on Facebook

study for 7 hours

get an A- in economics; spend 8 hours on Facebook



...BUT COMPARING 7 HOURS WITH 26 HOURS IS NOT MARGINAL ANALYSIS BECAUSE THEY'RE NOT EVEN IN THE SAME BALLPARK!

study for 26 hours

get an A+++ in economics; get rid of Facebook account!

ESPECIALLY IF YOU KNOW CALCULUS, BUT THAT WOULD REQUIRE 496 HOURS OF STUDY!

...AND BECAUSE IT ALLOWS US TO TRANSLATE PLAIN ENGLISH INTO ECONOMIC GIBBERISH!

Facing market price p , a firm in a competitive market chooses quantity q to maximize profit π :

$$\pi = pq - c(q)$$

$$\frac{d\pi}{dq} = 0 \Rightarrow p = c'(q)$$

So either $q=0$ or the firm produces until marginal cost equals the market price!

ANYTHING YOU CAN DO I CAN DO MARGINALLY BETTER!

???

PLAIN ENGLISH

I'M PLANNING TO SPEND 120 MINUTES FISHING, BUT MAYBE I SHOULD SPEND A FEW MORE?

ECONOMIC GIBBERISH

IS YOUR MARGINAL BENEFIT FROM A FEW MORE MINUTES OF FISHING GREATER THAN YOUR MARGINAL COST?

PLAIN ENGLISH

I'M PLANNING TO SPEND \$12 ON APPLES AND \$6 ON BANANAS...

... BUT MAYBE I SHOULD SPEND ONE DOLLAR MORE ON APPLES AND ONE DOLLAR LESS ON BANANAS?

ECONOMIC GIBBERISH

IS YOUR MARGINAL UTILITY FROM EATING ONE MORE DOLLAR'S WORTH OF APPLES GREATER THAN YOUR MARGINAL UTILITY FROM EATING ONE MORE DOLLAR'S WORTH OF BANANAS?

PLAIN ENGLISH

I'M PLANNING TO HIRE FIVE COOKS, BUT MAYBE I SHOULD HIRE ONE MORE?

ECONOMIC GIBBERISH

IS THE VALUE OF THE MARGINAL PRODUCT OF LABOR GREATER THAN THE WAGE RATE?

**NOW LET'S SEE HOW DECISION TREES RELATE
TO HOW COMPANIES MAKE DECISIONS.**

BUT WAIT!
I THOUGHT WE WERE
TALKING ABOUT OPTIMIZING
INDIVIDUALS...

... COMPANIES AREN'T
INDIVIDUALS!

YOU'RE RIGHT!
IN REALITY, COMPANIES
ARE MADE UP OF MANY
INDIVIDUALS, EACH WITH
THEIR OWN GOALS:

climbing the
corporate ladder!

plotting
mutiny!

studying
economics!



SOME BRANCHES OF ECONOMICS LOOK
AT THE CHALLENGES OF **MANAGING**
ALL THE INDIVIDUALS IN A COMPANY...

PRINCIPAL-AGENT LESSON #6:
THINK ABOUT CARROTS AS
WELL AS STICKS...

... YOU CAN'T JUST MAKE
EVERYONE WALK THE
PLANK!



... BUT WE'RE GOING TO DO WHAT MOST BRANCHES
OF ECONOMICS DO AND **CHEAT** A LITTLE BIT...

DID SOMEBODY SAY
CHEATING?

WE LOVE
CHEATING!



WE'RE GOING TO TREAT
ENTIRE COMPANIES LIKE A
SINGLE OPTIMIZING INDIVIDUAL
THAT HAS JUST ONE GOAL:

GET TOGETHER,
YE SCURVY DOGS, AND
**MAXIMIZE
PROFIT!**



AS AN EXAMPLE, LET'S LOOK AT A
PROFIT-MAXIMIZING **DRUG COMPANY**...

YOU'LL OFTEN HEAR SOMETHING
LIKE THIS FROM A DRUG COMPANY:

WE'RE CHARGING A HIGH PRICE
FOR ~~WARRORRA~~® BECAUSE
WE HAVE TO RECOVER THE
MONEY WE SPENT ON RESEARCH
AND DEVELOPMENT!

THIS IS
NOT TRUE...

... BECAUSE BY THE TIME THE COMPANY HAS THE PRODUCT AND IS MAKING ITS PRICING
DECISION, THE MONEY SPENT ON RESEARCH AND DEVELOPMENT (R&D) IS A **SUNK COST!**



THE TRUTH IS THAT
OUR PROFIT-MAXIMIZING
PRICE WILL BE THE SAME
WHETHER R&D COSTS WERE
\$50 MILLION OR
JUST \$50!

BUT SURELY R&D
COSTS MATTER AT
SOME POINT?

YES, THEY **DO**: SUNK COSTS MATTER **BEFORE** THEY ARE SUNK,

BEFORE INVESTING IN R&D, COMPANIES CONSIDER
A VARIETY OF COSTS AND BENEFITS, INCLUDING
R&D COSTS AND PROJECTED REVENUE...

BEFORE WE INVEST IN THIS
RESEARCH, LET'S COMPARE HOW
MUCH IT WILL COST TO DEVELOP
THIS DRUG....

...WITH HOW MUCH
REVENUE WE CAN EXPECT
TO GET FROM SELLING IT)

AARRH!

**MAXIMIZE
PROFIT!**

... BUT **AFTER** R&D COSTS ARE SUNK THEY DON'T AFFECT PRICING DECISIONS,

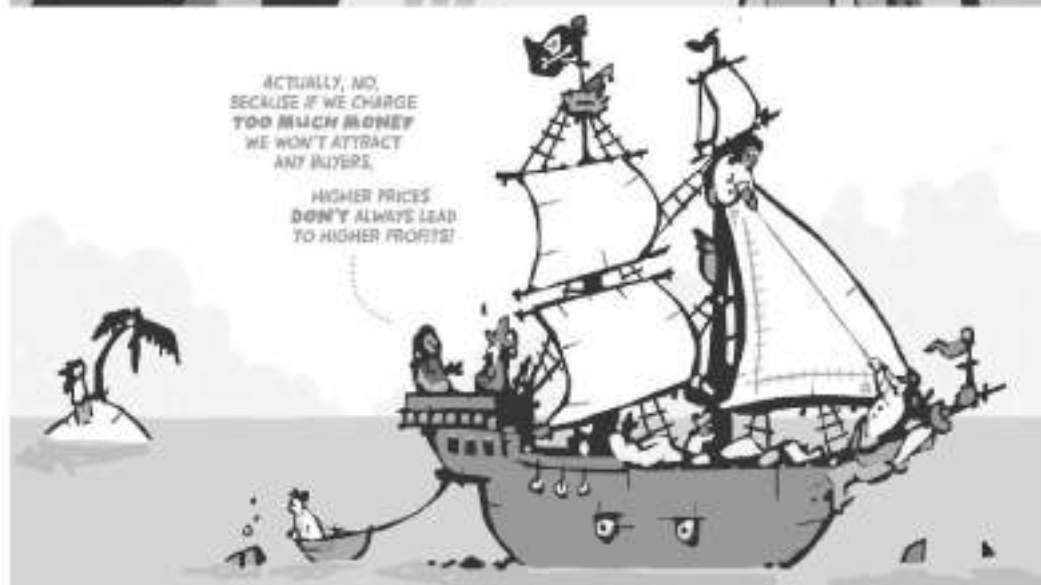
**WHAT DOES AFFECT
PRICING DECISIONS IS:**

AARRH!

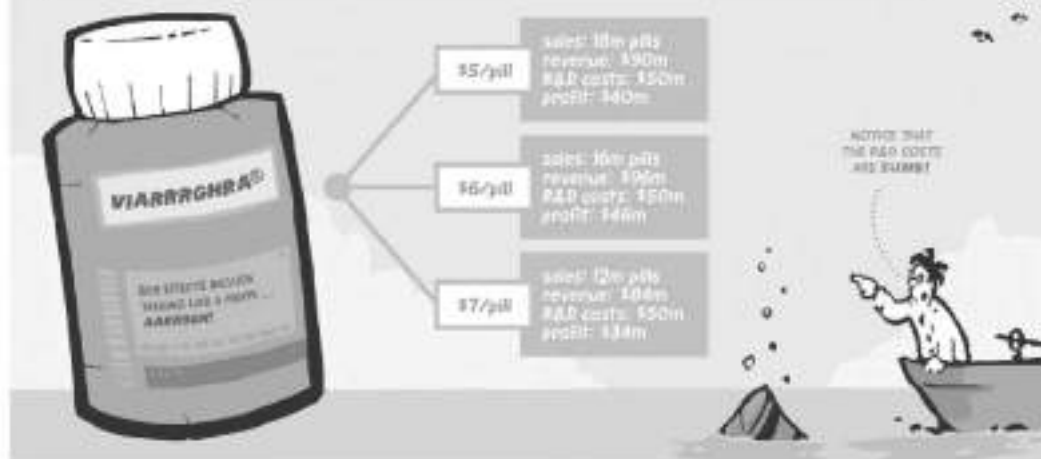
AARRH!

THAT'S RIGHT,
**MAARRHGINAL
ANALYSIS!**

COMPANIES CAN USE **MARGINAL ANALYSIS** TO MAKE PRICING DECISIONS!



ULTIMATELY, IF \$6 PER PILL IS THE **PROFIT-MAXIMIZING PRICE**, CHARGING \$1 LESS OR \$1 MORE PER PILL **CANNOT** GENERATE MORE PROFIT.



CHAPTER 3

TIME

BUT ENOUGH ABOUT
COMPANIES, LET'S GET BACK
TO THE **OPTIMIZING**
INDIVIDUAL.

I WON THE
LOTTERY!
\$20
MILLION!



NOW I FORGET TO
READ THE FINE
PRINT...



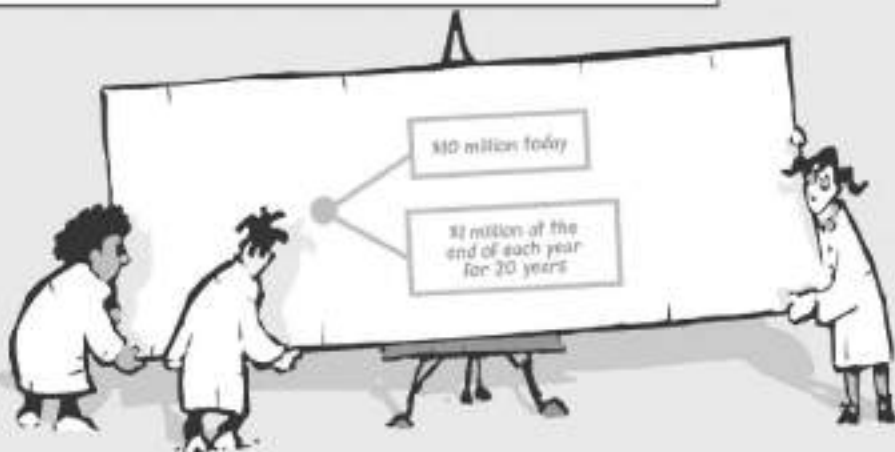
THE FINE PRINT SAYS
YOU CAN GET \$10 MILLION
IMMEDIATELY...

YOU COULD
BLOW IT ALL
NOW!

...OR YOU CAN GET
\$20 MILLION IN EQUAL
INSTALLMENTS, \$1 MILLION
AT THE END OF EACH YEAR
FOR 20 YEARS!

THAT'S SURELY
THE RESPONSIBLE
CHOICE!

IT LOOKS LIKE YOU HAVE A PROBLEM, AN **ECONOMICS PROBLEM**,
THAT WE CAN DESCRIBE WITH A **DECISION TREE**:



DUDE, WHAT'S THE
PROBLEM? THIS IS AN
EASY DECISION!

I'LL TAKE THE
INSTALLMENTS

... \$20 MILLION IS
WAY MORE THAN
10 MILLION!

**NOT
SO FAST,
BUDDY...**



THE KEY IDEA IN THIS
CHAPTER IS:

**MONEY TODAY AND
MONEY TOMORROW
CAN'T BE DIRECTLY
COMPARED!**

WE KNOW \$20 MILLION
OVER TIME LOOKS LIKE
IT'S MORE THAN
\$10 MILLION TODAY...

...BUT IT
DOESN'T WORK
THAT WAY!

YOU'D BE BETTER
OFF THINKING OF
MONEY TODAY
LIKE APPLES...

...AND MONEY
TOMORROW
LIKE ORANGES!



THE RELATIONSHIP BETWEEN **MONEY TODAY**
AND **MONEY TOMORROW** IS COMPLICATED.

THAT'S PARTLY BECAUSE OF **INFLATION**, A GENERAL INCREASE IN PRICES OVER TIME.

IS IT TRUE THAT WHEN
YOU WERE A KID IT ONLY
COST 10 CENTS TO GO
TO THE MOVIES?

YEAH, BUT I ONLY
MADE \$50 A
MONTH!

BUT EVEN WITHOUT INFLATION
MOST PEOPLE HAVE A
PREFERENCE FOR **SOONER**
RATHER THAN **LATER**.



WOULD YOU RATHER
HAVE THIS **NEW TV**
TODAY OR TOMORROW?

WOULD YOU RATHER HAVE
THIS **BICYCLE** TODAY OR
TOMORROW?

WOULD YOU RATHER
HAVE \$5 TODAY OR
TOMORROW?

OHAY! OHAY!
I GET THE POINT!



THE BOTTOM LINE IS THAT **MONEY TODAY** IS MORE
HIGHLY VALUED THAN **MONEY TOMORROW**!

MONEY CLOSE UP
LOOKS LARGER THAN
MONEY AT A DISTANCE...

...AND THE VALUE OF MONEY
TODAY ACTUALLY IS LARGER
THAN THE VALUE OF MONEY
TOMORROW!



OKAY, SO HOW
DO I SOLVE MY
LOTTERY TICKET
PROBLEM?

SURE! YOU JUST
HAVE TO LEARN TO
THINK LIKE
A BANK.

AND THAT MEANS PAYING CLOSE
ATTENTION TO THE INTEREST
RATE THAT BANKS USE TO
EXCHANGE MONEY TODAY AND
MONEY TOMORROW!



**THE INTEREST RATE ALLOWS US TO TURN MONEY TODAY
INTO MONEY TOMORROW, AND VICE VERSA.**

**IF YOU PUT MONEY IN A BANK TODAY,
THE INTEREST RATE DETERMINES HOW MUCH MONEY YOU'LL HAVE IN THE FUTURE**



... THEN IN A YEAR I'LL HAVE \$105,
MY \$100 PRINCIPAL PLUS
\$5 INTEREST.



**AND IF YOU BORROW MONEY FROM A BANK TODAY,
THE INTEREST RATE DETERMINES HOW MUCH MONEY YOU'LL OWE THEM IN THE FUTURE.**

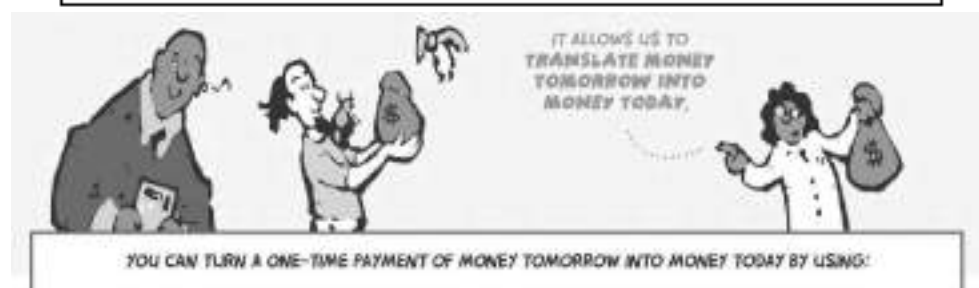


... THEN IN A
YEAR I'LL OWE
THEM \$105.



**IN ECONOMICS LINGO, THIS MEANS THAT \$100 IS THE PRESENT VALUE OF
GETTING \$105 IN ONE YEAR IF THE INTEREST RATE IS 5%.**

PRESENT VALUE IS THE VALUE TODAY OF ONE OR MORE FUTURE PAYMENTS.



THE FORMULA FOR THE PRESENT VALUE OF A LUMP SUM

PV is the present value

$$PV = \frac{x}{(1+r)^n}$$

x is the amount of money to be received in the future (at the end of n years.)

r is the interest rate
(i.e. 0.05 for a 5% interest rate)

FOR EXAMPLE, HERE'S THE PRESENT VALUE OF GETTING \$100 ONE YEAR FROM NOW IF THE INTEREST RATE IS 5%:



AND HERE'S THE PRESENT VALUE OF GETTING \$100 TWO YEARS FROM NOW IF THE INTEREST RATE IS 5%:



AND FINALLY, HERE'S THE PRESENT VALUE OF GETTING 100 ONE HUNDRED YEARS FROM NOW IF THE INTEREST RATE IS 5%.

$$\frac{100}{(1+.05)^{100}} = \$0.76!$$

YOU MEAN I PUT JUST 76 CENTS IN THE BANK NOW AT 5% INTEREST AND NOW I'LL HAVE 100 MILLION YEARS LATER?



COMPOUND INTEREST IS THE ACCUMULATION OF INTEREST OVER MORE THAN ONE YEAR,

IT GROWS EXPONENTIALLY BECAUSE YOU GET INTEREST PAYMENTS ON TOP OF INTEREST PAYMENTS!



IT'S THE MOST POWERFUL FORCE IN THE UNIVERSE!

THAT'S WHY YOU SHOULD START SAVING EARLY FOR RETIREMENT!



OKAY, SO NOW CAN WE SOLVE MY LOTTERY TICKET PROBLEM?

YES!

ALL WE NEED TO DO IS CALCULATE THE PRESENT VALUE OF BOTH OF YOUR OPTIONS.

\$70 million today

\$1 million at the end of each year for 20 years



CALCULATING THE **PRESENT VALUE** OF YOUR FIRST CHOICE, \$10 MILLION TODAY, IS EASY...

...BUT CALCULATING THE **PRESENT VALUE** OF YOUR SECOND CHOICE, \$1 MILLION EACH YEAR FOR 20 YEARS, LOOKS HARD:



THE FORMULA FOR THE PRESENT VALUE OF AN ANNUITY

AN ANNUITY JUST MEANS YOU GET A FIXED AMOUNT OF MONEY ON AN ANNUAL BASIS FOR SOME NUMBER OF YEARS.

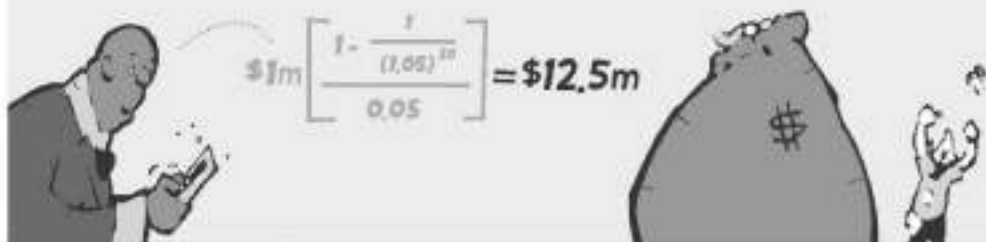
x is the amount to be received at the end of each year for n years

$$PV = x \left[\frac{1 - \frac{1}{(1+r)^n}}{r} \right]$$

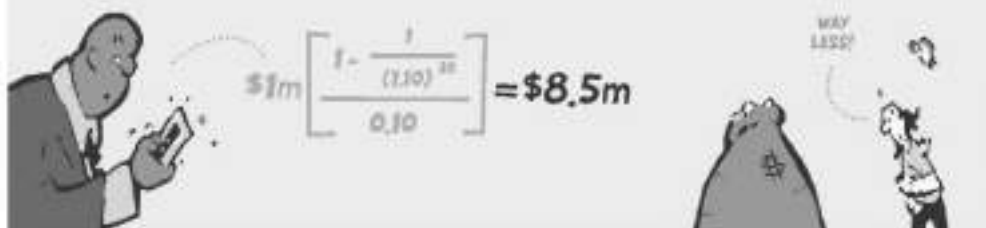
r is the interest rate ($r=0,05$ for a 5% interest rate)



SO HERE'S THE PRESENT VALUE OF THE LOTTERY ANNUITY IF THE INTEREST RATE IS 5%:



AND HERE'S THE PRESENT VALUE OF THE LOTTERY ANNUITY IF THE INTEREST RATE IS 10%:



**SO THE LOTTERY DECISION DEPENDS ENTIRELY ON
THE VALUE OF THE INTEREST RATE!**

IT TURNS OUT THAT IF r IS 7.76% OR MORE,
THE ANNUITY WILL HAVE A PV OF...

...less than
\$10 million!

Lump sum
 $PV = \$10$ million

IN THIS CASE,
YOU'LL WANT
TO TAKE THE
LUMP SUM.



BUT IF r IS 7.75% OR LESS,
THE ANNUITY WILL HAVE A PV OF...

...more than
\$10 million!

Lump sum
 $PV = \$10$ million

IN THIS CASE,
YOU'LL WANT
TO TAKE THE
ANNUITY.



IT'S IMPORTANT TO NOTE THAT NO MATTER WHICH CHOICE YOU MAKE,
YOU CAN STILL DECIDE TO **SPEND** THE MONEY **NOW** OR **LATER**!

IF YOU TAKE THE LUMP SUM,
YOU CAN PUT THE MONEY IN THE
BANK AND TAKE IT OUT IN EQUAL
AMOUNTS OVER 20 YEARS.

AND IF YOU TAKE THE ANNUITY,
YOU CAN GO TO THE BANK AND
BORROW MONEY USING THE
ANNUITY TO PAY OFF THE LOAN.

SO YOU CAN STILL
ACT RESPONSIBLY
EVEN IF YOU TAKE THE
LUMP SUM!



SO YOU CAN STILL
BLOW IT ALL TODAY
EVEN IF YOU TAKE THE
ANNUITY!



**LIKE THE LOTTERY CHOICE, ALL DECISIONS INVOLVING TIME AND MONEY
DEPEND ON THE VALUE OF THE INTEREST RATE.**

"IT REALLY IS
ALMIGHTY!"



"THAT'S ONE
THING WE CAN
AGREE ON."

FOR EXAMPLE, ***r*** MATTERS IF YOU'RE **THINKING OF STARTING A SMALL BUSINESS:**

give it
a try

borrow \$100,000 now, and
then earn \$60,000 a year
for the next 20 years

keep your
day job

earn \$50,000 a year
for the next 20 years

THE LOWER THE INTEREST
RATE, THE MORE ATTRACTIVE
IT IS TO BORROW MONEY AND
GIVE IT A TRY!



OR IF YOU'RE **THINKING OF BUYING A NEW CAR:**

buy Toyota
Prius hybrid

spend \$20,000 now; plus
\$2,000 for gas each year for
the next 10 years

buy Toyota
Corolla

spend \$20,000 now, plus
\$3,000 for gas each year for
the next 10 years

THE LOWER THE INTEREST
RATE, THE MORE ATTRACTIVE
IT IS TO BUY THE HYBRID!



OR IF YOU'RE A **PROFIT-MAXIMIZING FORESTER**:

cut the trees
down **NOW**

cut the proceeds in the bank
and let the money grow

cut the trees
down **later**

let the trees grow so you'll
have more lumber to sell later

TO MAXIMIZE MY PROFIT,
I HAVE TO COMPARE THE GROWTH
RATE OF THE TREES WITH THE GROWTH
RATE OF MONEY IN THE BANK!

THAT'S WHY
ECONOMISTS SAY THAT
TREES ARE CAPITAL.

MONEY DOESN'T
GROW **ON** TREES,
BUT IT DOES GROW
LIKE TREES!

**IT EVEN MATTERS IF YOU'RE TRYING TO DECIDE BETWEEN A LUMP SUM
AND A NEVER-ENDING STREAM OF PAYMENTS THAT WILL LAST FOREVER!**

Get \$2,000
now

Get \$500 at the
end of every year
Forever

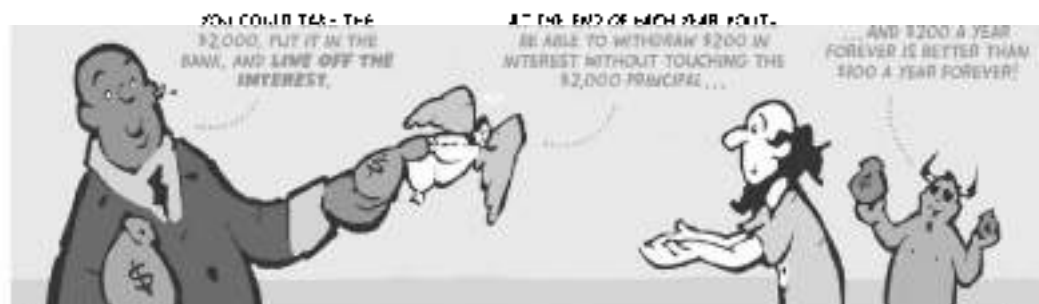
WAIT A MINUTE!

WHY WOULD ANYBODY
TAKE A **FINITE** AMOUNT
OF MONEY WHEN THEY
COULD GET AN **INFINITE**
AMOUNT OF MONEY?

FOR THE SAME
REASON YOU MIGHT TAKE
\$10 MILLION NOW INSTEAD OF
\$20 MILLION OVER TIME!

IT ALL
DEPENDS ON
THE VALUE
OF **r**!

TO SEE WHY \$2,000 NOW MIGHT BE BETTER THAN \$100 AT THE END OF EVERY YEAR FOREVER, CONSIDER AN INTEREST RATE OF 10%:



IN FACT, THE PRESENT VALUE OF GETTING A FIXED AMOUNT OF MONEY ON AN ANNUAL BASIS FOREVER IS GIVEN BY:

A PERPETUITY IS SIMPLY A CAPITAL ANNUITY

IN OTHER WORDS IT'S AN ANNUITY THAT LASTS FOREVER!

THE FORMULA FOR THE PRESENT VALUE OF A PERPETUITY

X is the amount to be received at the end of each year forever.

$$PV = \frac{X}{r}$$

r is the all-powerful interest rate.



If you remember, note that the annuity formula turned into the perpetuity formula if you set n (the number of years) to infinity!

FOR EXAMPLE, THE PRESENT VALUE OF RECEIVING \$100 EVERY YEAR FOREVER AT A 5% INTEREST RATE IS \$2,000:

$$\frac{\$100}{0.05} = \$2,000$$

BECAUSE IF YOU PUT \$2,000 IN THE BANK AT 5% INTEREST...

...YOU'LL BE ABLE TO TAKE \$100 OUT AT THE END OF EACH YEAR FOREVER.

AND THAT'S WHY FOREVER IS A LONG TIME!

CHAPTER 4

RISK

IS IT GONNA
RAIN TODAY?

SHOULD I BUY
STOCK IN
GODGLE?

IS THIS USED
CAR A PEACH
OR A LEMON?



OPTIMIZING INDIVIDUALS CAN HAVE
ONE OF THREE DIFFERENT ATTITUDES ABOUT RISK:

SOME ARE
RISK-LOVING.



I LIKE TO GO SKYDIVING,
START NEW BUSINESSES,
AND OTHERWISE SEEK
OUT RISK!

SOME ARE
RISK-AVERSE.



I BUCKLE MY SEAT BELT, BUY
INSURANCE, AND OTHERWISE
TRY TO AVOID RISK!

AND SOME ARE **RISK-NEUTRAL.**



DUDE, I'M
INDIFFERENT.

YOU CAN BE ANY ONE OF THESE THREE TYPES, WHICH TYPE ARE YOU?

LET'S GO
BUMPER-
JUMPING!



LET'S GO
SLATHER ON
SUNSCREEN!

I CAN'T
DECIDE.

HERE'S AN **EASY WAY TO TEST**
YOUR ATTITUDE TOWARD RISK...

CONSIDER A SIMPLE BET IN
WHICH I FLIP A COIN AND
YOU WIN \$2 IF IT'S HEADS,
AND LOSE \$2 IF IT'S TAILS.

Accept
bet

50% chance: win \$2
50% chance: lose \$2



IF YOU ACCEPT THE BET,
YOU'RE **RISK-LOVING**.



IF YOU REJECT IT,
YOU'RE **RISK-AVERSE**.

Reject
bet

win nothing
lose nothing



AND IF YOU JUST
DON'T CARE, YOU'RE
RISK-NEUTRAL.

ONE WAY TO STUDY RISK IS TO GO TO A **CASINO**.



ONCE WE'RE INSIDE, WE'LL LEARN HOW **ECONOMISTS** THINK ABOUT **RISK**.

IN PARTICULAR
WE'LL LOOK AT
**EXPECTED
VALUE,**
VARIANCE,
AND **THE LAW
OF LARGE
NUMBERS.**

WHY IS HE
WINNING SO
MUCH?

HE
OWNS THE
CASINO!



LET'S START WITH THIS QUESTION:
**WHAT EXACTLY DOES IT MEAN
FOR A BET TO BE FAIR?**

WHO
CARES?



FOR ECONOMISTS, THE **FAIRNESS** OF
A BET DEPENDS ON ITS **EXPECTED VALUE**.

YOU CAN THINK
OF EXPECTED VALUE AS THE
AVERAGE PAYOFF.

IT'S WHAT YOU CAN
EXPECT TO WIN **ON
AVERAGE**.



A **FAIR BET** HAS
AN EXPECTED VALUE OF **ZERO**.

IN CONTRAST, AN **UNFAIR BET** HAS
AN EXPECTED VALUE **BELOW ZERO**.

A GOOD EXAMPLE IS
FLIPPING A COIN.
A COIN FLIP.

HALF THE TIME YOU
WIN \$2, HALF THE
TIME YOU LOSE \$2.

SO, ON AVERAGE,
YOU COME AWAY
WITH **ZERO**!



A GOOD EXAMPLE OF AN
UNFAIR BET IS **ROULETTE**.

ON AVERAGE, YOU'RE
GOING TO LOSE MONEY!



THERE ARE ALSO BETS WITH
EXPECTED VALUES **ABOVE ZERO**,
BUT YOU WON'T FIND THOSE
IN A CASINO...

... UNLESS YOU OWN
THE CASINO!



LET'S USE A \$1 BET ON ROULETTE TO LOOK MORE CLOSELY AT HOW EXPECTED VALUE WORKS.

YOU PICK ONE
NUMBER OUT OF THE
38 NUMBERS ON THE
ROULETTE WHEEL...

...AND THEN I SPIN
THE WHEEL.

IF THE MARBLE LANDS ON YOUR
NUMBER, YOU WIN \$35!

AND IF IT DOESN'T,
YOU LOSE \$1!



TO CALCULATE THE EXPECTED VALUE, WE NEED TO DETERMINE
THE WEIGHTED AVERAGE OF ALL THE POSSIBLE OUTCOMES.

IN OUR ROULETTE GAME THERE ARE TWO POSSIBLE OUTCOMES,
SO FIRST WE **LOOK AT EACH POSSIBLE OUTCOME.**



← you might win \$35

→ you might lose \$1



X

$1/38$

=

+\$0.92

THEN WE **MULTIPLY** EACH
ONE BY THE **PROBABILITY**
OF THAT OUTCOME
ACTUALLY HAPPENING.

X

$37/38$

=

-\$0.97

AND FINALLY WE **ADD**
THE RESULTS TOGETHER!

$+0.92 - \$0.97 = -\0.05

ON AVERAGE, YOU'LL
LOSE 5 CENTS FOR
EVERY DOLLAR YOU BET!

HEH HEH.

BY CALCULATING ITS EXPECTED
VALUE, WE'VE PROVEN THAT
ROULETTE IS AN **UNFAIR BET**
FOR THE GAMBLER!

BUT THAT'S NOT WHAT
MAKES IT **RISKY**...



WHAT MAKES ROULETTE **RISKY** IS NOT WHAT HAPPENS
ON AVERAGE BUT WHAT MIGHT HAPPEN
ON ANY PARTICULAR SPIN OF THE WHEEL!

PUT MY
LIFE SAVINGS ON
NUMBER 23,
PLEASE!



FOR ECONOMISTS, THE **RISKINESS** OF A BET
DEPENDS ON ITS **VARIANCE**.

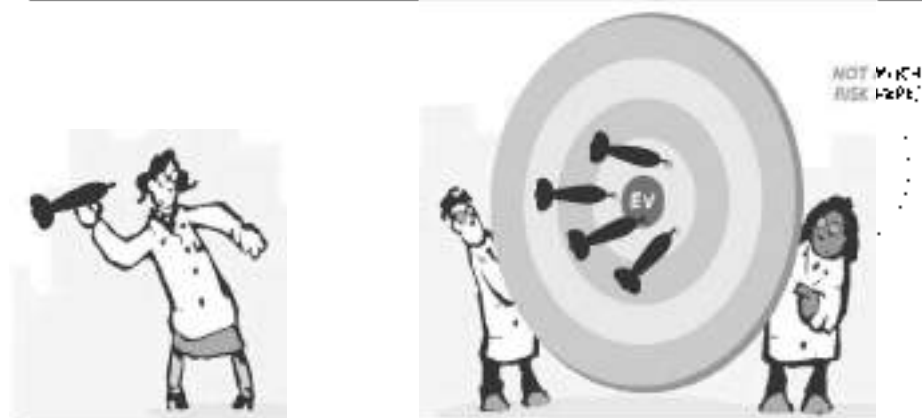
VARIANCE IS A MEASURE
OF HOW FAR ANY **ONE**
PARTICULAR OUTCOME
IS LIKELY TO BE FROM THE
EXPECTED VALUE.

IT'S LIKE MEASURING
NOW FAR ONE DART IS
LIKELY TO DEVIATE FROM
THE BULL'S-EYE!

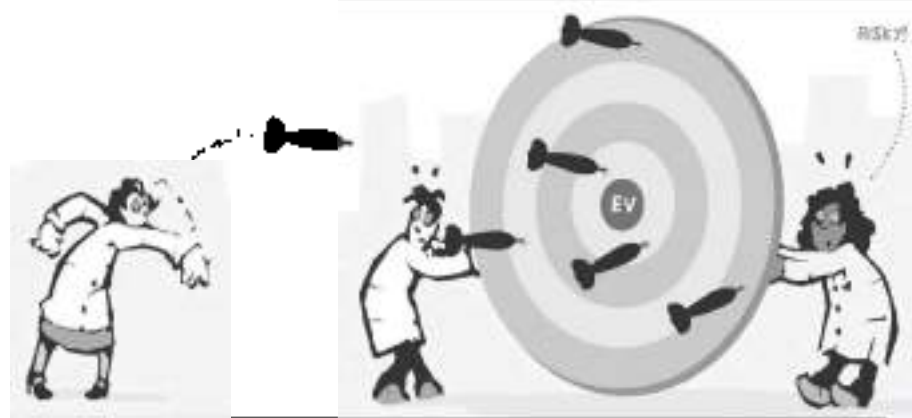
THIS DISTANCE
IS CALLED **ONE**
STANDARD
DEVIATION.



IN A RISKY SITUATION WITH **SMALL VARIANCE**, LIKE BETTING \$2 ON A COIN TOSS,
THE DARTS CLUSTER NEAR THE AVERAGE...



... BUT IN A RISKY SITUATION WITH **LARGE VARIANCE**, LIKE ROULETTE,
THE DARTS CAN FALL MUCH FARTHER AWAY.



ITS LARGE VARIANCE MAKES ROULETTE RISKY FOR GAMBLERS, BUT CURIOUSLY...

...IT TURNS OUT THAT **ROULETTE IS MUCH LESS RISKY FOR CASINOS!**



THE LAW OF LARGE NUMBERS

SAYS THAT PLAYING A GAME LIKE ROULETTE
OVER AND OVER IS LIKELY TO PRODUCE
AN AVERAGE RESULT CLOSE TO
THE EXPECTED VALUE!

EACH GAMBLER ONLY PLAYS
ROULETTE A FEW TIMES, BUT
THE CASINO PLAYS ROULETTE
THOUSANDS OF TIMES.

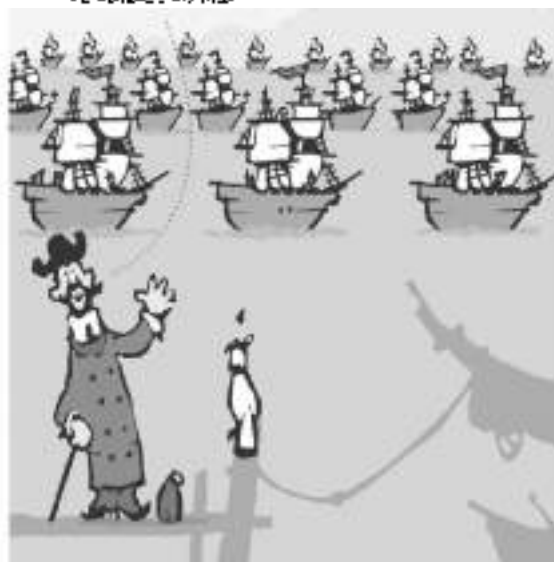
SO I'M CONFIDENT THAT
ON AVERAGE I WILL
MAKE ABOUT 5 CENTS FOR
EVERY DOLLAR WAGERED!



THE LAW OF LARGE NUMBERS ALSO WORKS FOR INSURANCE COMPANIES.

IF I INSURE ONLY A FEW
SHIPS AND ONE OF THEM
GETS ATTACKED BY PIRATES,
I COULD LOSE MY SHIRT!

BUT IF I AM COVERING LOTS
OF SHIPS, THE LAW OF
LARGE NUMBERS HELPS
ME MANAGE MY RISK.



BECAUSE OF THE LAW OF LARGE NUMBERS, RUNNING A CASINO OR AN INSURANCE COMPANY IS **NOT** AS RISKY AS IT SOUNDS!

FOR BOTH OF US, MORE CUSTOMERS CAN MEAN LESS RISK.

SO COME ON IN AND ENJOY THE FREE BUFFET!



THE LAW OF LARGE NUMBERS CAN EVEN WORK **FOR YOU** IF YOU INVEST IN THE STOCK MARKET.

YOU CAN REDUCE YOUR RISK SIMPLY BY BUYING A WIDER VARIETY OF STOCKS!

GIRL, WHICH STOCKS WOULD YOU LIKE IN YOUR RETIREMENT ACCOUNT?

MAKE ME ONE WITH EVERYTHING.



THIS IS CALLED **DIVERSIFICATION**, AND IT'S ONE PART OF THE THEORY OF OPTIMAL INVESTMENT FOR WHICH **JAMES TOBIN** WON THE NOBEL PRIZE IN 1981.

DON'T PUT ALL YOUR EGGS IN ONE BASKET.

CONGRATULATIONS, YOU WIN THE NOBEL PRIZE!



AND THIS BRINGS US TO ONE FINAL RISKY SITUATION: **ADVERSE SELECTION.**

TO ILLUSTRATE **ADVERSE SELECTION**,
LET'S LOOK AT A SIMPLE EXAMPLE INVOLVING **USED CARS**.

SOME USED CARS ARE **PEACHES**...

THIS CAR RUNS
LIKE A CHARM!

I'M ONLY SELLING
IT TO PAY OFF MY
GAMBLING DEBTS.



...AND SOME ARE **LEMONS**...

YOU'LL NEVER HAVE
A SINGLE PROBLEM
WITH THIS CAR,
TRUST ME!



...BUT YOU **CAN'T ALWAYS TELL WHICH IS WHICH!**



WAIT A MINUTE,
WHO'S TELLING
THE TRUTH?



THIS IS A PROBLEM OF **ASYMMETRIC INFORMATION**, WHICH MEANS THAT
SELLERS KNOW SOMETHING THAT BUYERS DO NOT (OR VICE VERSA).

IN THIS CASE THE PROBLEM IS
THAT SELLERS KNOW IF THEIR
CAR IS A PEACH OR A LEMON...

...BUT BUYERS ARE
IN THE DARK!

WHAT'S THE
PROBLEM WITH
"HAT"?



IN OUR USED CAR EXAMPLE, ASYMMETRIC INFORMATION CAN MAKE IT **IMPOSSIBLE** TO BUY A GOOD USED CAR!

FEAR OF GETTING A LEMON LEADS BUYERS TO **REDUCE** HOW MUCH THEY'LL PAY FOR A USED CAR...

I CAN'T TELL THE PEACHES FROM THE LEMONS, SO THERE'S NO WAY I'M PAYING FULL PRICE!



...BUT LOWER PRICES LEAD THE OWNERS OF PEACHES TO LEAVE THE MARKET...

I REFUSE TO SELL MY PEACH AT THAT PRICE!



...AND THIS IN TURN **INCREASES** THE LIKELIHOOD THAT BUYERS WILL GET A LEMON!

HEY, I'LL STILL SELL YOU A CAR.



THIS EFFECT IS CALLED **ADVERSE SELECTION**.

GEORGE Akerlof SHARED THE NOBEL PRIZE IN 2001 FOR HIS WORK ON ADVERSE SELECTION. THE MOST PROMINENT EXAMPLE IS THE MARKET FOR INDIVIDUAL HEALTH INSURANCE IN THE UNITED STATES.



BUYING AN INDIVIDUAL HEALTH INSURANCE POLICY CAN BE A REAL PAIN IN THE NECK.

CONGRATULATIONS, YOU WON THE NOBEL PRIZE!



TO SEE HOW **ADVERSE SELECTION** AFFECTS THE MARKET FOR **HEALTH INSURANCE**,
LET'S IMAGINE THREE **RISK-ADVERSE** INDIVIDUALS SEEKING HEALTH COVERAGE.

MS. PEACH

MY EXPECTED HEALTH
CARE COSTS THIS YEAR
ARE \$200...

...BUT TO AVOID RISK
I'D PAY UP TO \$500
FOR INSURANCE.



MS. APPLE

DON'T TELL ANYONE, BUT
I'VE GOT A TERRIBLE RASH!

MY EXPECTED
COSTS ARE \$800...

...BUT I'D PAY UP
TO \$1,200 FOR
INSURANCE.



MS. LEMON

DON'T TELL ANYONE, BUT I'M
COUGHING UP BLOOD!

MY EXPECTED COSTS
ARE \$2,000...

...BUT I'D PAY UP
TO \$3,000 FOR
INSURANCE.



IN ORDER TO STAY IN BUSINESS, THE
INSURANCE COMPANY HAS TO CHARGE
A **PREMIUM THAT IS HIGH ENOUGH
TO COVER ITS EXPECTED COSTS...**

I CAN'T TELL THE PEACHES FROM THE
LEMONS, SO I'VE GOT TO CHARGE EACH
OF THEM AT LEAST THE EXPECTED VALUE
OF THEIR COSTS!

$$\frac{1}{3}(\$200) + \frac{1}{3}(\$800) + \frac{1}{3}(\$2,000) = \$1,000$$



...BUT THIS CAN CAUSE
INDIVIDUALS LIKE MS. PEACH
TO **NOT BUY INSURANCE**.

INSURANCE WILL
COST YOU AT
LEAST \$1,000.

I'M NOT GOING TO PAY
THAT MUCH!
THAT'S WAY MORE THAN
MY EXPECTED YEARLY
COSTS!



WITHOUT MS. PEACH, THE INSURANCE COMPANY NEEDS TO **CHARGE EVEN MORE** TO COVER ITS EXPECTED COSTS...

NO MORE PEACHES,
SO NOW THE EXPECTED
COST IS:

$$\frac{1}{2} (\$800) + \frac{1}{2} (\$2,000)$$

=\$1,400!



...BUT THIS CAN CAUSE THE MARKET TO **UNRAVEL FURTHER.**

INSURANCE WILL
COST YOU AT
LEAST \$1,400.

I'M WILLING TO PAY
\$1,000, BUT \$1,400 IS
TOO MUCH FOR ME!



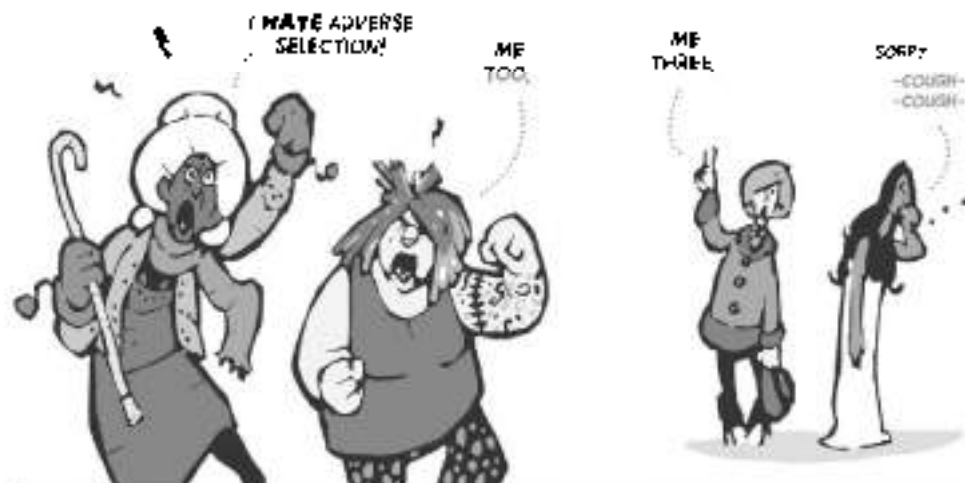
THE END RESULT IS THAT EVEN **HEALTHY PEOPLE**
CAN'T GET INDIVIDUAL INSURANCE AT A REASONABLE PRICE!

THIS BRINGS US BACK TO
THE **BIG QUESTION IN**
MICROECONOMICS:

**UNDER WHAT
CIRCUMSTANCES
DOES INDIVIDUAL
OPTIMIZATION LEAD TO
OUTCOMES THAT ARE
GOOD FOR THE
GROUP AS A
WHOLE?**



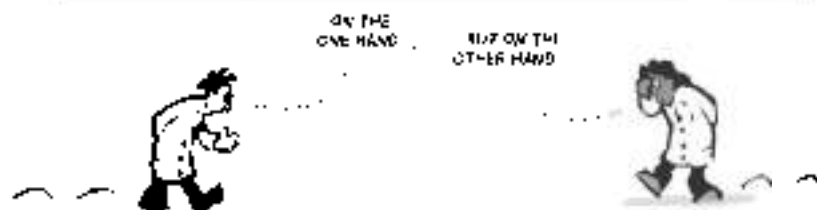
ADVERSE SELECTION IS ONE EXAMPLE OF A SITUATION WHERE INDIVIDUAL OPTIMIZATION DOES NOT LEAD TO GOOD OUTCOMES FOR THE GROUP AS A WHOLE!



OF COURSE, THIS DOESN'T MEAN THAT GOVERNMENT-RUN HEALTH INSURANCE WILL **NECESSARILY** LEAD TO A **BETTER** OUTCOME...



... BUT IT DOES HELP EXPLAIN WHY ECONOMISTS SPEND SO MUCH TIME DEBATING HEALTH CARE POLICY.



CHAPTER 5

FROM ONE TO SOME

THE LAST FEW CHAPTERS LOOKED AT THE BEHAVIOR OF **ONE** OPTIMIZING INDIVIDUAL.

NOW WE'RE GOING TO LOOK AT INTERACTIONS **BETWEEN** OPTIMIZING INDIVIDUALS!

LET'S START WITH ONE OF **THE MOST IMPORTANT TOPICS** IN ECONOMICS...



TRADING IS SOMETHING
WE'VE ~~ALL~~ DONE SINCE WE
WERE CHILDREN...

I HATE SALAMI,
I WANT PEANUT
BUTTER!

I HATE PEANUT
BUTTER, I WANT
SALAMI!



... AND IT'S PROBABLY SOMETHING HUMANS HAVE **ALWAYS** DONE!



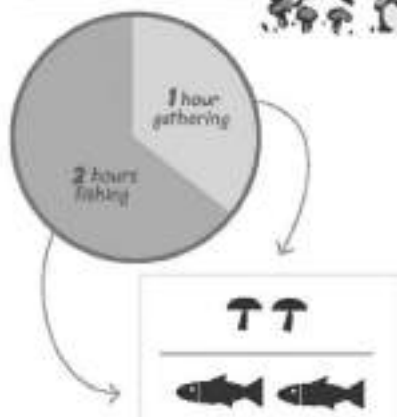
JOKING ASIDE, WE TRADE BECAUSE IT MAKES US **BETTER OFF**.

IN FACT, INDIVIDUALS CAN GET MUTUAL BENEFITS FROM TRADE
EVEN IN UNLIKELY SITUATIONS LIKE THIS ONE:



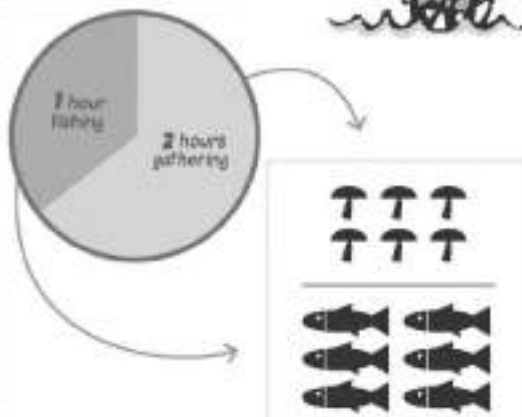
MOG BY HIMSELF
CAN CATCH 1 FISH OR
GATHER 2 MUSHROOMS
PER HOUR...

...SO TO GET A
BALANCED DIET, THIS
IS HOW HE MUST
SPEND HIS 3 HOURS:



OOGA BY HERSELF
CAN CATCH 6 FISH OR
GATHER 3 MUSHROOMS
PER HOUR...

...SO TO GET A
BALANCED DIET,
THIS IS HOW SHE MUST
SPEND HER 3 HOURS:



NEXT LET'S SEE WHAT CAN HAPPEN IF THEY **TRADE** WITH EACH OTHER...



WAIT A MINUTE!

I'M BETTER THAN
THAT NEANDERTHAL
AT EVERYTHING!

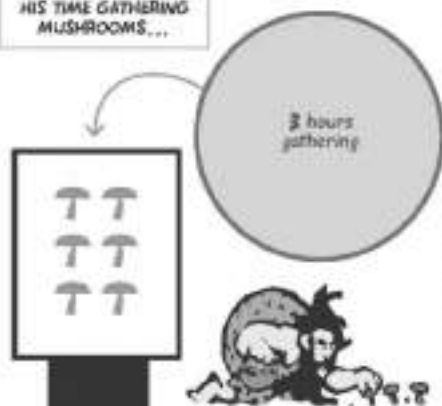
HOW CAN TRADING
WITH HIM POSSIBLY
HELP ME?

MOG GETTING
MAD ANGRY!



BELIEVE IT OR NOT, BOTH MOG AND OOGA **CAN** GAIN FROM TRADE! HERE'S ONE WAY:

MOG CAN SPEND ALL
HIS TIME GATHERING
MUSHROOMS...

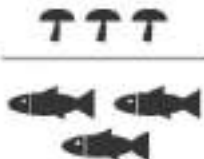


...AND OOGA
CAN SPEND HER
TIME LIKE THIS...



...AND THEN MOG CAN
TRADE 3 MUSHROOMS...

...FOR 3 OF
OOGA'S FISH.



MOG'S TOTAL
(AFTER TRADE)

INSTEAD OF 2 OF
EACH, MOG NOW
HAS...

UM...

UM...

...MORE!



WHOA!

BY MYSELF I COULD
ONLY GET 6 OF EACH, BUT
NOW I CAN GET 7!



OOGA'S TOTAL
(AFTER TRADE)

SO EVEN THOUGH OOGA
IS BETTER AT BOTH
FISHING AND GATHERING
MUSHROOMS...

...SHE IS SO
MUCH BETTER
AT FISHING...

...THAT MOG HAVE
**COMPARATIVE
ADVANTAGE**
IN GATHERING
MUSHROOMS!

I GUESS
NEANDERTALS AREN'T
DOOS FOR NOTHING
AFTER ALL!

THIS SAME **THEORY OF COMPARATIVE ADVANTAGE** CAN ALSO
EXPLAIN TRADE BETWEEN PEOPLE IN DIFFERENT **COUNTRIES**.

EVEN THOUGH ONE COUNTRY
MAY NOT BE BETTER THAN ANOTHER
AT MAKING BOTH CLOTHING AND
COMPUTER CHIPS...

...THEY CAN BOTH GAIN FROM
TRADE BY FOCUSING ON THEIR
**RESPECTIVE COMPARATIVE
ADVANTAGES!**

ONCE PEOPLE DISCOVER THE ADVANTAGES OF TRADING,
THEIR DRIVE TO TRADE CAN BECOME **INSATIABLE**.

I CAN TRADE WITH
NEANDERTALS!

AND
FOREIGNERS!

...AND **MULTINATIONAL
CORPORATIONS!**

...AND ON THE
WEEKEND!

IN FACT, TRADING IS ALMOST LIKE A **FORCE OF NATURE!**

I WANT MY
TRACTOR
FIXED!

I WANT A NEW
VIDEO GAME?

I WANT SOME
MILK?

I WANT A
FANCY
MODERN
HOUSE!

I WANT SOME
PAINKILLERS!



dairy farmer



pharmaceutical
biochemist



architect



computer
programmer



mechanic



WHOA
COOL!



IT'S LIKE
MAGIC!



THANK
HEAVENS!

PEOPLE ARE DRAWN TO TRADE BECAUSE THE **GAINS FROM TRADE** ARE SO IMPRESSIVE.

THE BOTTOM
LINE IS THIS:

IF THERE'S NOTHING
TO STOP PEOPLE
FROM TRADING...

...THEN PEOPLE
WILL **CONTINUE**
TRADING...

...AND THEY
WON'T STOP UNTIL
THEY'VE EXHAUSTED
**ALL POSSIBLE GAINS
FROM TRADE!**



THE ECONOMIST WHO WON THE 1991 NOBEL PRIZE FOR THIS IDEA WAS **RONALD COASE**.

IF THERE'S NOTHING
TO STOP PEOPLE FROM
TRADING...

...**NOTHING**
WILL STOP PEOPLE
FROM TRADING.

CONGRATULATIONS,
YOU'VE WON THE
NOBEL PRIZE!



HIS IDEA IS NOW KNOWN AS
THE **COASE THEOREM**.

THE COASE THEOREM MAY SOUND LIKE A TAUTOLOGY, BUT IT'S IMPORTANT IN PART BECAUSE IT FOCUSES ATTENTION ON **IMPEDIMENTS** TO TRADE,

A PEOPLE ABOUT TRADING,
SOMETHING **MUST** BE
STOPPING THEM!

THEY **TAKES** LAWS,
OR **REGULATIONS** ...

OR **INCOMPLETE**
PROPERTY RIGHTS...

...OR **INABILITY** TO
WRITE AND ENFORCE
CONTRACTS.

WE'LL SEE PLENTY
OF **EXAMPLES** IN THE
COMING CHAPTERS!



AND WHEN THERE ARE **NO** IMPEDIMENTS TO TRADE, THE COASE THEOREM SAYS
THE DRIVE TO TRADE WILL PRODUCE SOCIAL **ORDER** INSTEAD OF **CHAOS**.

PENCILS AND COMPUTERS AND
GLOBES AND MAGNIFYING
GLASSES?

IT'S AS IF THERE WERE A
MASTERMIND IN CHARGE OF
THE WORLD...

... BUT IT'S ALL PRODUCED
BY INTERACTIONS BETWEEN
OPTIMIZING INDIVIDUALS!



WHEREVER THEY LOOK IN THE WORLD, ECONOMISTS LIKE COASE SEE THE WORKINGS OF
ADAM SMITH'S INVISIBLE HAND!

IT'S EASY TO **JOKE** ABOUT
ECONOMISTS' FASCINATION
WITH THE INVISIBLE HAND...

LOOK, PROFESSOR,
A RED BILL!

IMPOSSIBLE! IF IT
WERE REALLY A RED BILL,
SOMEBODY ELSE WOULD
HAVE ALREADY
PICKED IT UP.

... BUT IN TRUTH WE CAN SEE IT WORKING **EVERYWHERE**.

FOR EXAMPLE, THERE'S **THE LAW OF ONE PRICE**:

A COMMODITY THAT IS
EASY TO TRADE, LIKE
COFFEE BEANS...

... WILL SELL AT
APPROXIMATELY THE
SAME PRICE...

... EVEN ON THE
OTHER SIDE OF THE
PLANET!

SIMILARLY, ON CROWDED FREEWAYS THERE'S **THE LAW OF ONE SPEED**:

DIFFERENT LANES OF TRAFFIC
ON A CONGESTED FREEWAY ARE
LIKELY TO MOVE AT ABOUT THE
SAME SPEED...

... BECAUSE IF ONE
LANE WAS MOVING
FASTER...

... OTHER DRIVERS
WOULD MOVE INTO IT
AND SLOW IT DOWN!

Lane 1

Lane 2

Lane 3

WHAT'S TRUE WITH **DRIVERS** LOOKING FOR **FAST-MOVING LANES** IS ALSO TRUE FOR **INVESTORS** LOOKING FOR **FAST-GROWING STOCKS**:

WITH EVERYBODY TRYING TO GET AHEAD ...

... IT'S HARD FOR ANYONE TO GET AHEAD OF ANYONE ELSE!

Stock 1

Stock 2

Stock 3

THE **EFFICIENT MARKET HYPOTHESIS** SAYS THAT EVEN THE WORLD'S SMARTEST INVESTORS CAN'T PICK STOCK MARKET WINNERS ANY BETTER THAN **MOG**!

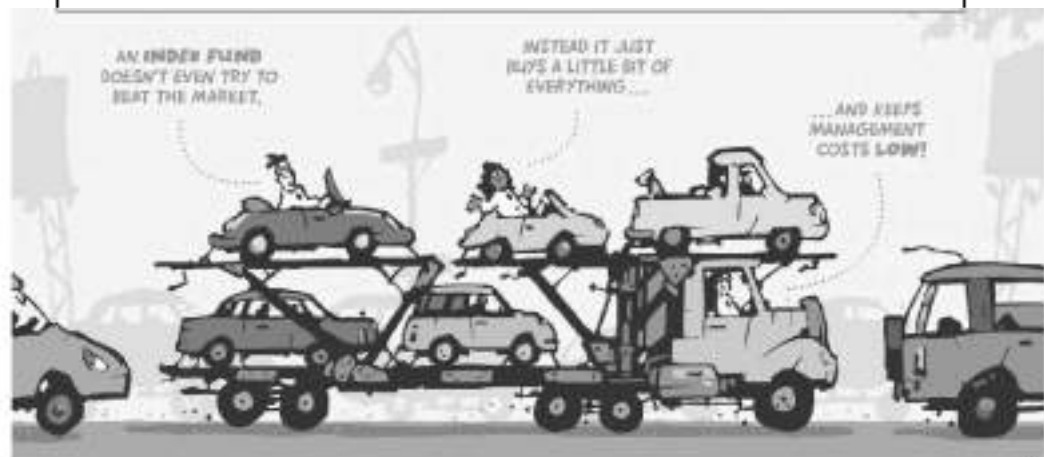


THAT'S WHY MANY ECONOMISTS RECOMMEND BUYING A **DIVERSIFIED INDEX FUND**.

AN INDEX FUND DOESN'T EVEN TRY TO BEAT THE MARKET,

INSTEAD IT JUST BUYS A LITTLE BIT OF EVERYTHING ...

... AND KEEPS MANAGEMENT COSTS LOW!



HEY OGGA! MOG
DEVELOP FANCY
STOCK-PICKING
TECHNIQUE!



LEMME
TALK TO
YOU USE
ROCK PAPER
SCISSORS?



NO!
COURSE
NOT!
MOG USE
ROCK ROCK
ROCK!

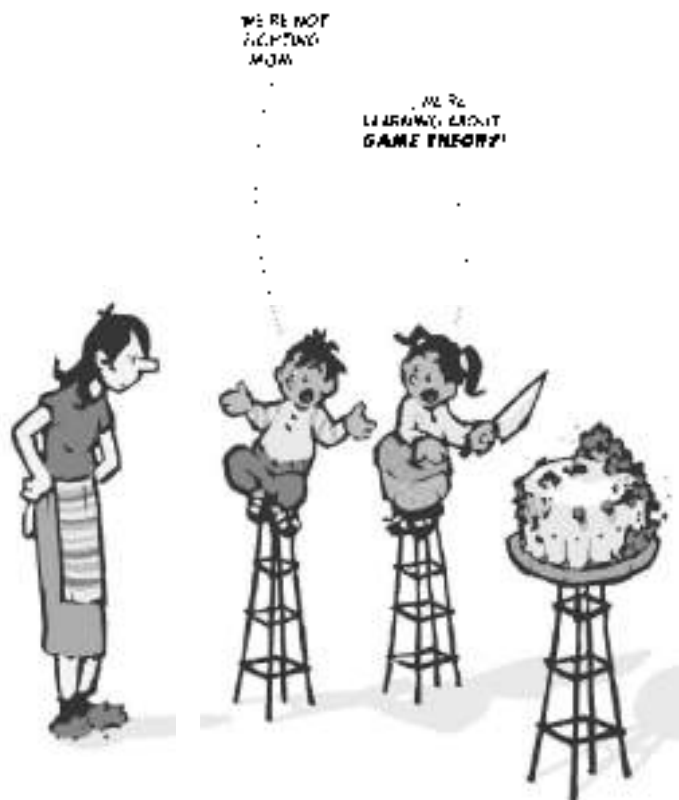




**PART
TWO**
STRATEGIC
INTERACTIONS

CHAPTER 6

CAKE CUTTING



GAME THEORY GOT ITS NAME BECAUSE SOME OF ITS EARLIEST TOPICS WERE **GAMES** LIKE POKER...

WE'RE EXPERTS
AT THIS!

SO HOW COME
YOU CAN'T HANDLE
TO make a profit?



...BUT TO ECONOMISTS, A **GAME** IS ANY SITUATION WITH **INTERDEPENDENCE** BETWEEN **MULTIPLE PLAYERS**.

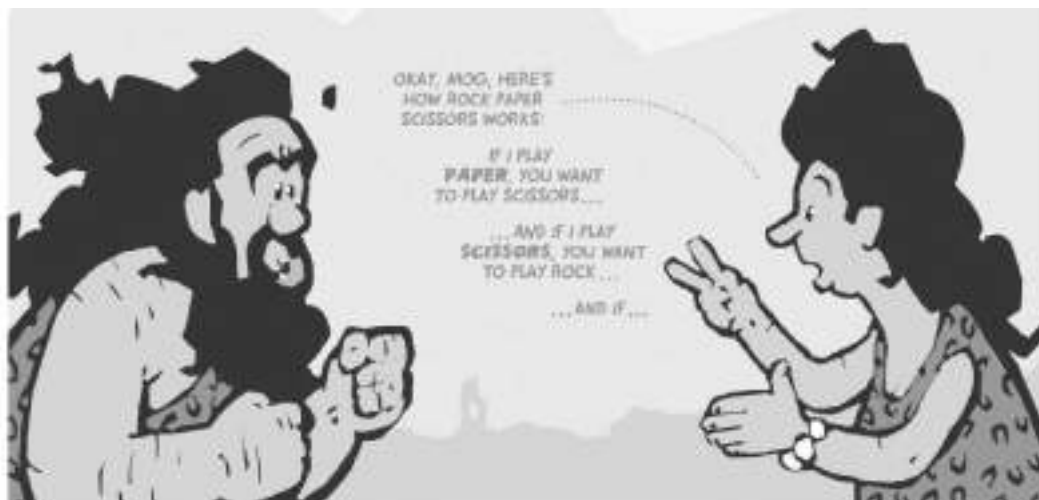
INTERDEPENDENCE MEANS THAT **WHAT HAPPENS TO ONE PLAYER DEPENDS ON WHAT THE OTHER PLAYERS DO.**

OKAY, MOO, HERE'S
HOW ROCK PAPER
SCISSORS WORKS!

IF I PLAY
PAPER, YOU WANT
TO PLAY SCISSORS...

...AND IF I PLAY
SCISSORS, YOU WANT
TO PLAY ROCK...

...AND IF...



EACH PLAYER IN A GAME HAS TO THINK ABOUT WHAT ALL THE OTHER PLAYERS ARE THINKING.

THAT'S WHY DISTINGUISHES THE ~~PROBABILITY~~
OPTIMIZATION WE STUDIED IN PART ONE...

... FROM **GAME THEORY**.

SHOULD I MAKE
A FIRE OR LOOK
FOR FOOD?



IF I MAKE A FIRE,
IS SHE GOING
TO HELP ME OR
STEAL MY FOOD?

I DON'T HE MAKES
A FIRE SO I CAN
STEAL HIS FOOD?



WHEN ECONOMISTS STUDY GAMES, THEY ANALYZE
ALL THE STRATEGIES OF ALL THE PLAYERS.

YOUR STRATEGY IS A
COMPLETE DESCRIPTION
OF YOUR ACTIONS IN
A GAME.



IF SHE MOVES HER FAH, WHAT ARE YOU
GOING TO DO?

AND IF SHE MOVES
HER BISHOP, WHAT
ARE YOU GOING
TO DO?

AND IF SHE
MOVES ...



SHUT UP, I'M
TRYING TO
THINK!



JOHN NASH SHARED
THE NOBEL PRIZE IN
1994 FOR HIS ANALYSIS
OF GAME THEORY
STRATEGIES.



I'VE FIGURED OUT THE
OPTIMAL STRATEGY
FOR ROCK PAPER
SCISSORS.

CONGRATULATIONS,
YOU WIN THE
NOBEL PRIZE!



OF COURSE, GAME THEORY IS NOT JUST ABOUT ROCK PAPER SCISSORS,
IT ALSO COVERS **DEADLY SERIOUS TOPICS...**

LIKE WARFARE...

LOOKS LIKE THERE'S
A **FIRST-MOVER
ADVANTAGE** IN
THIS GAME!



AND BUSINESS...

THIS BEACH IS
ENTIRELY COVERED
WITH PEOPLE...

BECAUSE WE'RE BOTH
TRYING TO CAPTURE THE
MIDDLE GROUND...

... WHY DID YOU PUT
YOUR HOT DOG CART
RIGHT NEXT TO MY
HOT DOG CART?

... IT'S CALLED
HOTELLING'S LAW!



AND BIOLOGY...

WHY ARE THERE ROUGHLY
EQUAL NUMBERS OF BOY
BARKS AND GIRL BARKS?

IT'S **EVOLUTIONARY
GAME THEORY!**



AND AUCTIONS...

HOW SHOULD THE
GOVERNMENT SELL
BILLIONS OF DOLLARS
WORTH OF WIRELESS
SPECTRUM?

THEY SHOULD
TRY EBAY...

...IT WORKED WHEN
MY SISTER SOLD
HER SARAH DOLL
COLLECTION!

AND DIVIDING CAKE BETWEEN SIBLINGS.

THIS IS THE MOST
READILY SERIOUS
EXAMPLE YET!

CAKE CUTTING MAY SOUND SILLY, BUT IT APPLIES ANY TIME YOU NEED TO
DIVIDE THINGS FAIRLY!

I DEMAND A
FAIR PORTION!

SO
DO I!

WE CALL THIS A **FAIR DIVISION** PROBLEM.

FAIR DIVISION PROBLEMS APPEAR ALL OVER THE PLACE:

IN DIVORCE SETTLEMENTS...

MRS. SMITH, I'VE DECIDED TO SPLIT EVERYTHING SO THAT YOUR EX-HUSBAND GETS TEN TIMES MORE THAN YOU.

IN THAT CASE, I'D LIKE TO HAVE A MILD HEART ATTACK!

...AND CORPORATE PROFIT-SHARING...

AARGH, HOW DO WE DIVVY UP THE LOOT?

...AND GOVERNMENT POLICY...

OKAY, SO WE'RE GOING TO LIMIT OVERFISHING BY USING A SYSTEM OF TRANSFERABLE FISHING PERMITS.

HOW DO WE ALLOCATE THE PERMITS?

...AND POLITICAL NEGOTIATIONS.

I HAVE A GOOD IDEA, LET'S PRETEND THE ENTIRE MIDDLE EAST IS LIKE A BIRTHDAY CAKE!

THAT'S WHY THERE ARE SO MANY BOOKS ABOUT THE CAKE-CUTTING PROBLEM!



IN ADDITION TO **MODERN SOLUTIONS** LIKE THE MOVING KNIFE PROCEDURE...

DON'T WORRY, I READ ABOUT THIS IN AN ECONOMICS BOOK!

...THERE'S AN **ANCIENT SOLUTION** TO THE CAKE-CUTTING PROBLEM:

I CUT, YOU CHOOSE!

OKAY...
...THAT SOUNDS FAIR.

THIS LEADS US TO OUR FIRST INTERESTING **GAME THEORY** QUESTION:

IS IT BETTER TO BE THE CUTTER OR THE CHOOSER?

THINK ABOUT IT BEFORE YOU TURN THE PAGE!

ACTUALLY, THE ANSWER IS IN YOUR HEAD... AND IN THE OTHER PLAYER'S HEAD!

IT DEPENDS ON WHAT
YOU KNOW ABOUT
THE OTHER PERSON...

AND WHAT
THEY KNOW
ABOUT YOU...

AND WHAT YOU
KNOW THEY KNOW
ABOUT YOU!



IF YOU KNOW **A LOT** ABOUT THE OTHER PERSON,
YOU SHOULD TRY TO BE **THE CUTTER**.

I KNOW THAT
JIMMY LOVES
RACE CARS...

...SO IF I CARVE OFF A TINY
PORTION WITH THAT RACE
CAR ON IT, HE'LL CHOOSE IT
AND LEAVE THE REST TO ME!



**BUT IF YOU *DON'T KNOW MUCH* ABOUT THE OTHER PERSON,
YOU'RE PROBABLY BETTER OFF BEING THE CHOOSER,
ESPECIALLY IF THEY DON'T KNOW MUCH ABOUT YOU!**

I CAN'T REMEMBER
DOES SALLY LIKE
CHOCOLATE OR
FLOWERS BETTER?

I'D BETTER LET HER CUT,
BECAUSE THEN I CAN
CHOOSE BASED ON
MY PREFERENCES!

THAT WILL WORK GREAT...
AS LONG AS SHE DOESN'T
REMEMBER HOW MUCH
I LOVE RACE CARS!



THE BOTTOM LINE—AND THIS IS TRUE
EVERYWHERE IN GAME THEORY—IS:

INFORMATION MATTERS!



ECONOMISTS WHO STUDY GAMES FOCUS ON TWO QUESTIONS.
THE FIRST GAME THEORY QUESTION IS:

CAN WE PREDICT THE OUTCOME OF A GAME?



THIS IS WHAT WE CALL A
POSITIVE QUESTION,
BECAUSE IT DEALS WITH WHAT'S
ACTUALLY GOING TO
HAPPEN IN A GAME.



IF YOU GO THERE
HE'S GOING TO TAKE
YOUR ALIEN AND
CHECKMATE YOU!

HAI! WE'LL SEE
ABOUT THAT!

CHECKMATE!

I TOLD
YOU SO!



ONCE WE FIGURE OUT HOW TO PREDICT THE OUTCOME OF A GAME,
WE CAN MOVE TO THE SECOND GAME THEORY QUESTION:

IS THE PREDICTED OUTCOME GOOD?

THIS IS WHAT WE CALL A
NORMATIVE QUESTION,
BECAUSE IT DEALS WITH WHAT
SHOULD HAPPEN.



THIS QUESTION IS CENTRAL TO **ALL FAIR DIVISION PROBLEMS**:

YOU SHOULD GIVE ME
A BIGGER PIECE OF
CAKE BECAUSE
I'M BIGGER!

BUT SHE DON'T
DO ALL HER
CHORES!

WE WENT TO DIVVVY
UP THE LOOT!

TIME TO USE
AARRITHMETIC!

I SHOULD GET MORE
LAND BECAUSE
MY PEOPLE HAVE
LIVED HERE FOR
MILLENNIA!



UNFORTUNATELY, IT'S NOT ALWAYS CLEAR WHAT MAKES AN OUTCOME FAIR,
AND THAT BRINGS US BACK TO **THE BIG QUESTION**...

UNDER WHAT
CIRCUMSTANCES DOES
INDIVIDUAL OPTIMIZATION
LEAD TO OUTCOMES
THAT ARE **GOOD** FOR
THE GROUP AS
A WHOLE?

UM, WHAT EXACTLY
DOES '**GOOD**' MEAN,
ANYWAY?



CHAPTER 7

PARETO EFFICIENCY

LET ME TELL YOU
IT SOUNDS GOOD
TO YOU...

... DOESN'T MEAN
IT SOUNDS GOOD
TO ME!



THE QUESTION OF **WHAT MAKES AN OUTCOME GOOD** HAS OCCUPIED PHILOSOPHERS AND THINKERS FOR CENTURIES.

AN OUTCOME IS GOOD
IF IT **MAXIMIZES
THE WELFARE
OF THE POOREST
INDIVIDUAL.**

AN OUTCOME IS GOOD
IF IT **MAXIMIZES
INDIVIDUAL
FREEDOM.**

AN OUTCOME IS GOOD
IF **EVERYONE GETS
TO EAT CAKE!**



**NOBODY HAS A COMPLETE ANSWER TO THIS QUESTION,
BUT ECONOMISTS DO HAVE ONE POWERFUL CONTRIBUTION...**

... A GOOD OUTCOME
SHOULD AT LEAST BE
**PARETO
EFFICIENT!**

ECONOMISTS ARE
ALWAYS TALKING ABOUT
**EFFICIENCY THIS AND
INEFFICIENCY THAT.**

WHAT WE'RE
ACTUALLY TALKING
ABOUT IS **PARETO
EFFICIENCY...**

... AND THE
RELATED CONCEPT
OF **PARETO
IMPROVEMENT.**



THESE TERMS ARE NAMED AFTER THE ITALIAN ECONOMIST **VILFREDO PARETO.**

HERE'S HOW YOU
CAN REMEMBER
HIS NAME

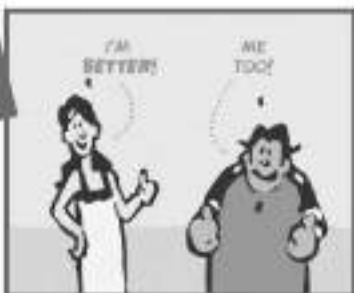
MY NAME IS
VILFREDO PARETO
AND I LOVE PASTA
ALFREDO!



VILFREDO PARETO IDENTIFIED A WAY TO
COMPARE DIFFERENT OUTCOMES:

ONE OUTCOME
IS A **PERETO**
IMPROVEMENT
OVER ANOTHER ...

... IF SWITCHING
MAKES AT LEAST ONE
PERSON BETTER OFF
AND MAKES **NOBODY**
WORSE OFF!



REMEMBER, A SWITCH IS A
PARETO IMPROVEMENT
ONLY IF IT MAKES AT LEAST ONE
PERSON BETTER OFF...

...AND MAKES
NOBODY
WORSE OFF!



SO FOR EXAMPLE, IF TWO PEOPLE
ARE MISTAKENLY SERVED THE
OTHER PERSON'S MEAL...

I DIDN'T
ORDER **THIS!**



...IT WOULD BE A **PARETO IMPROVEMENT**
FOR THEM TO SWAP...



... BUT IT WOULD **NOT** BE A **PARETO IMPROVEMENT**
FOR ONE PERSON TO END UP WITH ALL THE FOOD.



THESE COMPARISONS
ALSO WORK GREAT FOR
CAKE CUTTING AND
OTHER FAIR DIVISION
PROBLEMS.



AND FOR DESSERT
WE CAN DEFINE
PARETO EFFICIENT
AND **PARETO**
INEFFICIENT...

**AN OUTCOME IS
PARETO INEFFICIENT
IF IT CAN BE
PARETO IMPROVED...**

**... MEANING THERE IS ANOTHER OUTCOME
THAT MAKES SOMEONE BETTER OFF WITHOUT
MAKING ANYONE WORSE OFF.**



FOR EXAMPLE, IF MOM DECIDES TO DISTRIBUTE THE FIRST HALF OF THE CAKE EVENLY BUT TO THROW THE SECOND HALF IN THE GARBAGE, THE OUTCOME IS **PARETO INEFFICIENT**...

... BECAUSE THERE ARE OUTCOMES THAT ARE PARETO IMPROVEMENTS OVER IT.

I HAVE 1/4 OF THE CAKE

SO DO I.



INSTEAD OF THROWING THE SECOND HALF AWAY, YOU COULD GIVE IT TO ME.

... OR TO ME.



YOU CAN HAVE **CHAINS** OF PARETO INEFFICIENT OUTCOMES AS LONG AS YOU CAN MAKE **MORE** PARETO IMPROVEMENTS!



AN OUTCOME IS
PARETO EFFICIENT
IF IT **CANNOT** BE
PARETO IMPROVED...

... MEANING THERE IS **NO OTHER** OUTCOME
THAT MAKES SOMEONE BETTER OFF WITHOUT
MAKING ANYONE WORSE OFF.



IF THE WAITER SERVES EACH OVER EXACTLY WHAT THEY
ORDERED, THE OUTCOME IS **PARETO EFFICIENT**...

... BECAUSE YOU **CAN'T** MAKE ANYONE **BETTER OFF** OR
WITHOUT MAKING SOMEONE ELSE WORSE OFF.

I GOT WHAT I
ORDERED!

SO
DID I!

I DON'T WANT
TO FRAY!

ME NEITHER!



HERE'S A MORE SURPRISING EXAMPLE:
IF MOM GIVES ALL THE CAKE TO ONE KID,
THE OUTCOME IS **PARETO EFFICIENT**...

... BECAUSE THERE IS **NO OTHER** OUTCOME THAT IS
A PARETO IMPROVEMENT OVER IT!

I DIDN'T GET
ANY CAKE.

MOM, I
GOT IT ALL!



YOU CAN'T MAKE
ME BETTER OFF...

... WITHOUT MAKING
ME WORSE OFF!



WAIT A
MINUTE!

HOW IS THAT
OUTCOME
FAIR?



IT'S NOT,
LET ME
EXPLAIN...

A PARETO INEFFICIENT OUTCOME IS CLEARLY BAD: IF YOU CAN MAKE THINGS BETTER FOR ONE PERSON WITHOUT HARMING ANYBODY ELSE, WHY NOT DO IT?



BUT A PARETO EFFICIENT OUTCOME IS NOT NECESSARILY GOOD BECAUSE IT DOESN'T ADDRESS FAIRNESS!



ECONOMISTS CAN'T GUARANTEE GOOD OUTCOMES...

... BUT THEY CAN HELP YOU AVOID BAD OUTCOMES BY AVOIDING PARETO INEFFICIENCIES!





IT'S DEE & MY ALL
OVER AGAIN!



TRADE BETWEEN TWO PEOPLE ALLOWS THEM TO MAKE PARETO IMPROVEMENTS...

SINCE WE'RE BOTH
TRADING VOLUNTARILY
IT MEANS THAT WE'RE
BOTH BETTER OFF!



IN OTHER WORDS,
WE'RE MAKING PARETO
IMPROVEMENTS!

...AND IF THERE'S **NOTHING STOPPING** PEOPLE FROM TRADING, THEN THEY
WILL CONTINUE TRADING UNTIL THEY REACH A **PARETO EFFICIENT OUTCOME!**

IT'S THE
COASE THEOREM,
FROM PAGE 60!



**INDEED, ANOTHER DEFINITION OF PARETO EFFICIENCY
IS THAT ALL POTENTIAL GAINS FROM TRADE HAVE BEEN EXHAUSTED!**

IN THE END, PARETO EFFICIENCY GIVES ECONOMISTS A **UNIQUE PERSPECTIVE**
ON THE WORLD'S FAIR DIVISION PROBLEMS.

LIKE EVERYONE ELSE,
ECONOMISTS **DISAGREE**
ABOUT HOW TO FAIRLY DIVIDE
GOODS, WHETHER IT'S A PIECE
OF CAKE OR THE ALLOCATION
OF FISHING PERMITS...

... BUT ECONOMISTS
DO **AGREE** THAT IT'S
CRUCIAL TO LET PEOPLE
TRADE!

THAT'S TO HELP
ACHIEVE **PARETO**
EFFICIENCY!



BUT THEN? SO NOW THAT
WE'VE CREATED ALL POSSIBLE
GAINS FROM TRADE DO YOU
KNOW WHAT THAT MEANS?

WELL, PEAR
BUT WHAT
ELSE?

YES...
ALWAYS

**IT'S TIME
TO EAT
CAKE!**

THAT WE NOW
HAVE A PARETO
EFFICIENT
OUTCOME!



... AND THEN LET'S PLAY MORE GAMES!

CHAPTER 8

SIMULTANEOUS-MOVE GAMES

OKAY, OOGA
YOU UNDERSTAND
THAT?

ALREADY?

1
2
3

ROCK!

PAPER



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

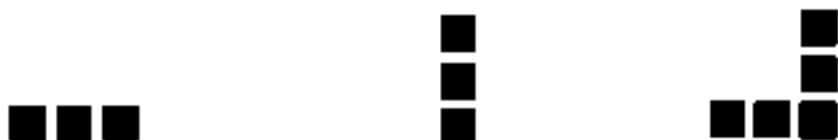
MOG WANT TO PLAY AGAIN?

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 DOGA PLAY FOR \$5.

READY?

1...
2...
1..



Mog: \$0
Doga: \$0

Mog: -\$5
Doga: \$5

Mog: \$5
Doga: -\$5

Mog: \$5
Doga: \$5

Mog: \$0
Doga: \$0

Mog: \$5
Doga: \$5

Mog: -\$5
Doga: \$5

Mog: \$5
Doga: -\$5

Mog: \$0
Doga: \$0

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



YOU CAN GET
76 POSSIBLE
OUTCOMES IN THIS
PAYOFF MATRIX.



WAIT A
MINUTE...

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



	Chicken Out	Speed Ahead
Chicken Out	Clyde: 50 Boawie: 50	Clyde: -95 Boawie: 50
Speed Ahead	Clyde: 95 Boawie: -95	Both players perish in a horrible fiery crash!

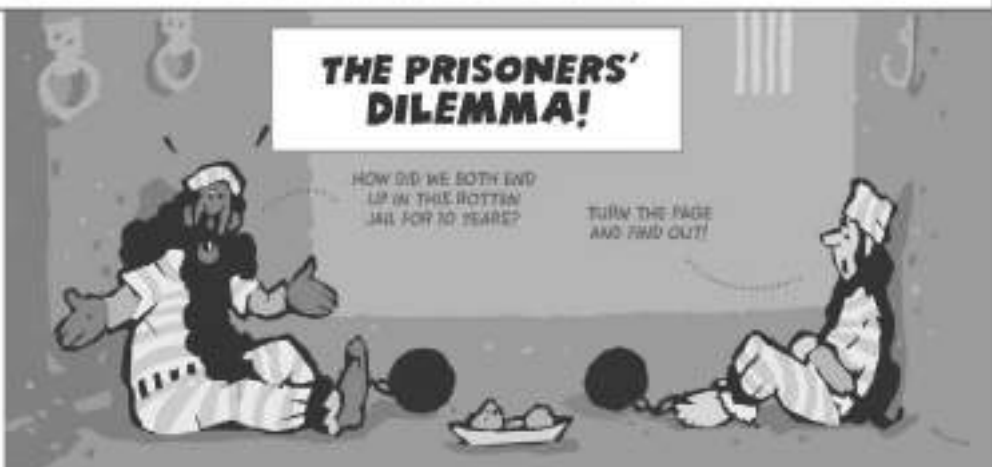


IN THIS CHAPTER WE'RE GOING TO FOCUS ON THE MOST FAMOUS SIMULTANEOUS-MOVE GAME:

THE PRISONERS' DILEMMA!

HOW DID WE BOTH END
UP IN THIS BOTTOM
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!**



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

STUDY THIS
**PAYOFF
MATRIX!**

The **PAYOFFS** ARE
YEARS IN JAIL
AND THEY DO NEGATIVE
BECAUSE SPENDING
TIME IN JAIL IS BAD.

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

...WHAT
SHOULD I
DO?



RAT

CLAM UP

RAT

Both 10
Prisoners 20

Prisoner 20
Prisoner 10

CLAM
UP

Both 1
Prisoner 0

Both 1
Prisoner 1

TWO THINGS MAKE THE PRISONERS' DILEMMA SPECIAL. THE FIRST IS THAT EACH PLAYER HAS A DOMINANT STRATEGY IF THEY 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.



RAY
CLAM UP

RAY	CLAM UP
Buck: -10 Penny: -10	Buck: 0 Penny: -20
Buck: -20 Penny: 0	Buck: -10 Penny: -10

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.



RAY
CLAM UP

RAY	CLAM UP
Buck: -10 Penny: -10	Buck: 0 Penny: -20
Buck: -20 Penny: 0	Buck: -10 Penny: -10

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!**

I'M GOING TO FOLLOW MY DOMINANT STRATEGY, SO I CHOOSE TO RAT ON HER!

I'M GOING TO RAT ON HIM TOO!

HA HA! YOU EACH GET TEN YEARS IN JAIL!

THAT'S TERRIBLE!

IF WE'D BOTH CLAMMED UP, WE WOULD HAVE EACH GOTTEN ONLY ONE YEAR IN JAIL!

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 Rat: -10 Perry: -10	CLAM UP Rat: 0 Perry: -20
	CLAM UP	CLAM UP Rat: -20 Perry: 0
		CLAM UP Rat: -1 Perry: -1

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



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

THAT WHEN WE EACH ACT IN OUR INDIVIDUAL SELF-INTEREST...

...THE OUTCOME IS **BAD FOR BOTH OF US!**



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

HERE'S A GENERIC PRISONERS' DILEMMA MATRIX:

IN THE PRISONERS' DILEMMA, EACH PLAYER CHOOSES A STRATEGY AND CHOOSES A WAY TO CLIMB UP.



		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



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
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

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
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

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

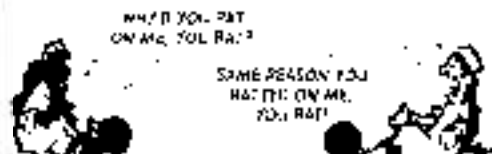


CHOICE A IS MY DOMINANT STRATEGY TOO.

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...**



...ARE PRICE WARS BETWEEN TWO COMPETING BUSINESSES...

CHARGING LOW PRICES
HELPS ME ATTRACT MORE
CUSTOMERS

SAME FOR
ME!

TOO BAD WE GONY
BOTH CHARGE HIGH
PRICES THOUGH...

THEN WE'D BOTH
MAKE MORE
MONEY!



...AND ARMS RACES BETWEEN TWO NATIONS.

IT'S A RACE, SO Y ME'N!
BEHIND WE NEED TO CATCH UP,
AND IF WE'RE AHEAD WE NEED
TO STAY AHEAD!

SAME FOR
US!

YOU KNOW IF WE
BOTH BUY FEWER
WEAPONS...

...WE COULD SPEND
OUR MONEY ON
SOMETHING MORE
USEFUL!

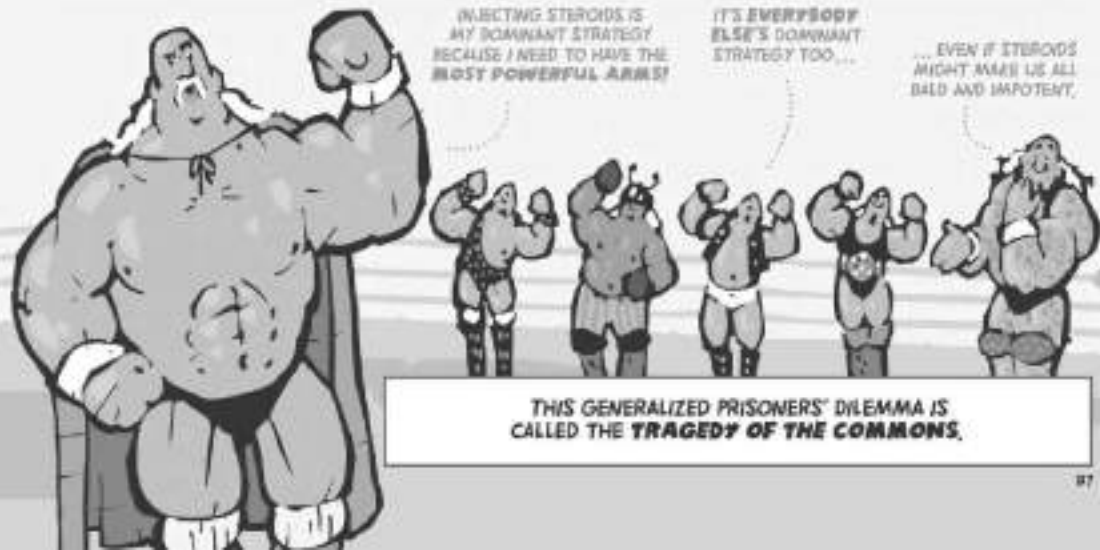


WE CAN EVEN GENERALIZE THE PRISONERS' DILEMMA TO SITUATIONS INVOLVING
MORE THAN TWO PLAYERS, LIKE WHEN PROFESSIONAL WRESTLERS CHOOSE TO USE STEROIDS:

INJECTING STEROIDS IS
MY DOMINANT STRATEGY
BECAUSE I NEED TO HAVE THE
MOST POWERFUL ARMS!

IT'S EVERYBODY
ELSE'S DOMINANT
STRATEGY TOO...

...EVEN IF STEROIDS
MIGHT MAKE US ALL
DIED AND IMPOTENT.



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.



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



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



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



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

...LIKE **OVERFISHING**...

WE'LL ALL BE BETTER OFF IF WE
LIMIT OUR FISHING SO THAT
THERE WILL BE ENOUGH FISH
FOR NEXT YEAR.

OUT OF THE WAY,
THERE'S **PROFIT**
TO BE MADE!

EACH INDIVIDUAL
WANTS TO
MAXIMIZE HIS PROFIT, BUT
TOO MUCH FISHING CAN
DESTROY THE FISHERY
FOR EVERYONE.



...AND **CLIMATE CHANGE**.

I LIKE **CHEAP**
ELECTRICITY!

I LIKE **CHEAP**
GASOLINE!

I LIKE **CHEAP**
FERTILIZER!

UNFORTUNATELY
THEY'RE NOT GOING
TO LIKE **RIISING**
SEA LEVELS.



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

I'M WORRIED I MIGHT GET
Laid Off, SO I'M GOING
TO STOP SPENDING
MONEY!

ME
TOO!

ME
THREE!

IT'S THE **PARADOX**
OF THRIFT

IF EVERYBODY
STOPS SPENDING
MONEY, MORE PEOPLE
WILL DEFINITELY
GET Laid Off!



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.

PEST, 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!

OH NO, 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 MAY, 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 THE INCENTIVE IS TO COOPERATE BY CHOOSING A!



A	1st Player: 0000 2nd Player: 0000	1st Player: 0001 2nd Player: 0000
	1st Player: 0002 2nd Player: 0001	1st Player: 0003 2nd Player: 0002
B	1st Player: 0004 2nd Player: 0003	1st Player: 0005 2nd Player: 0004
	1st Player: 0006 2nd Player: 0005	1st Player: 0007 2nd Player: 0006

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...

CHAPMAN'S LOW PRICES HELPS HIM ATTRACT MORE CUSTOMERS.

SAME FOR ALBERT



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**.



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
(Not Truly)



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



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

PARETO IMPROVEMENT!



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



CHAPTER 9

AUCTIONS

WHAT THE HECK
IS THIS THING?

I DUNNO,
I BOUGHT IT
ON EBAY.



FOR PEOPLE ENGAGED IN TRADE, AUCTIONS ARE USEFUL BECAUSE THEY CAN HELP REVEAL HOW MUCH SOMETHING IS WORTH...



... AND BECAUSE THEY CAN PREVENT CORRUPTION ...



... AND BECAUSE THEY CAN BE USED TO **SELL STUFF FAST**.



WE'RE GOING TO PUT TOGETHER WHAT WE'VE LEARNED ABOUT
GAME THEORY TO **STUDY HOW AUCTIONS WORK**.

IN PARTICULAR, WE'RE GOING TO LOOK AT THE
STRATEGIES THAT BIDDERS USE...

SHOULD I BID LESS
OR MORE THAN MY
TRUE VALUE?

SHOULD I BID BELOW
MY TRUE VALUE BY
SHADING MY BID?

DO I HAVE A
DOMINANT
STRATEGY?

...AND WE'LL ASK **WHAT KIND OF AUCTION MAKES YOU
THE MOST MONEY** IF YOU HAVE SOMETHING TO TRADE,

YOU MEAN THERE ARE
DIFFERENT KINDS OF
AUCTIONS?!

THERE ARE 4 BASIC TYPES OF AUCTIONS:



AN ASCENDING AUCTION

STARTS WITH A LOW PRICE AND THEN BIDS GO UP UNTIL NOBODY WANTS TO BID ANY MORE.



SILENT AUCTIONS AT CHARITY EVENTS ARE ASCENDING AUCTIONS...



...AND SO ARE AUCTIONS ON EBAY.



A DESCENDING AUCTION

STARTS WITH A HIGH PRICE AND GOES DOWN.

WE'LL START AT \$1,000, AND EACH SECOND I'LL CUT THE PRICE BY \$50.

THE FIRST PERSON TO SAY 'MINE' WINS, AND THAT'S THE PRICE YOU PAY!



THE REMAINING TYPES ARE CALLED **SEALED-BID AUCTIONS** BECAUSE BIDDERS SUBMIT BIDS IN SEALED ENVELOPES.



IN A 1ST-PRICE SEALED-BID AUCTION
THE HIGHEST BIDDER WINS AND PAYS THE AMOUNT THAT THEY BID.



AND THE WINNER IS JEANO, WHO WINS THESE FARM TOOLS...

...AND PAYS THE AMOUNT SHE BID, \$100.



IN A 2ND-PRICE SEALED-BID AUCTION
THE HIGHEST BIDDER WINS BUT ONLY PAYS THE SECOND-HIGHEST BID.



BELLY WINS THIS AUTOGRAPHED BASEBALL...

...BUT ONLY PAYS THE 2ND-HIGHEST BID, WHICH WAS EARLY'S BID OF \$85.

WAIT A MINUTE!

IF I AM SELLING SOMETHING, WHY WOULD I TAKE THE 2ND-HIGHEST PRICE WHEN I COULD GET THE 1ST-HIGHEST PRICE?

THE ANSWER TO THAT QUESTION WAS TO DO WITH STRATEGIES



BIDDERS USE DIFFERENT **STRATEGIES** IN DIFFERENT KINDS OF AUCTIONS!

THIS WAS ONE OF THE INSIGHTS OF **WILLIAM VICKREY**, WHO SHARED THE NOBEL PRIZE IN 1996.

CONGRATULATIONS,
YOU WON THE
NOBEL PRIZE!

I WONDER HOW
MUCH I COULD
AUCTION THIS
OFF FOR?



THE TWO MOST COMMON **STRATEGIES** IN SEALED-BID AUCTIONS ARE ...

... TO BID YOUR
**TRUE
VALUE**,
WHICH MEANS BIDDING
THE **MAXIMUM** YOU
ARE WILLING TO PAY!

I WOULDN'T PAY
ANYTHING MORE
THAN \$100 FOR
THOSE FARM TOOLS.

BUT I'D TAKE THEM
FOR ANYTHING LESS
THAN \$100.

AT EXACTLY
\$100 I'M
INDIFFERENT!



... OR TO
**SHADE
YOUR BID**,
WHICH MEANS BIDDING
LESS THAN YOUR
TRUE VALUE!

MY TRUE VALUE IS
\$100 BUT I'M GOING
TO BID \$75.

THEN IF I WIN I'LL
GET A STEAL OF
A DEAL!





**IT TURNS OUT THAT THE BEST APPROACH IN A
1ST-PRICE SEALED-BID AUCTION
IS TO SHADE YOUR BID.**

SINCE YOU'RE **INDIFFERENT**
BETWEEN THE FARM TOOLS
AND \$100, BIDDING \$100
MAKES NO SENSE.

YOU HAVE TO SHADE YOUR
BID IF YOU WANT TO HAVE
A CHANCE OF COMING
OUT AHEAD!

BUT DON'T SHADE
YOUR BID TOO MUCH
BECAUSE YOU'LL RUN
YOUR CHANCE OF
WINNING THE AUCTION!



**SHADING YOUR BID IS ALSO THE BEST APPROACH IN A
DESCENDING AUCTION.**

YOU DEFINITELY SHOULDN'T
CALL "MINE" AT YOUR TRUE
VALUE BECAUSE THEN YOU'LL
NEVER GET A DEAL!

SO SHADE YOUR BID BY
WAITING UNTIL THE PRICE
FALLS BELOW YOUR
TRUE VALUE...

...BUT DON'T WAIT
TOO LONG OR
SOMEONE ELSE WILL
CALL "MINE" FIRST!





IN CONTRAST, THE BEST APPROACH IN A
2ND-PRICE SEALED-BID AUCTION
IS TO BID YOUR **TRUE VALUE**.

THERE'S NO
DOWNSIDE TO
BIDDING YOUR
MAXIMUM ...

... BECAUSE IF YOU
WIN YOU'LL ONLY PAY
THE 2ND-HIGHEST
PRICE ANYWAY!

THIS IS WHY A 2ND-PRICE
AUCTION SHOULD YIELD
HIGHER BIDS THAN A
1ST-PRICE AUCTION.

IN FACT, BIDDING YOUR TRUE VALUE IN A 2ND-PRICE SEALED-BID
AUCTION IS A **DOMINANT STRATEGY**.

NO MATTER WHAT EVERYONE ELSE
BIDS, YOU CAN'T DO ANY
BETTER THAN BIDDING
YOUR TRUE VALUE!

IT'S A DOMINANT STRATEGY BECAUSE YOU
CAN'T DO BETTER IF **SOMEBODY ELSE**
BIDS MORE THAN YOUR TRUE VALUE...

...AND YOU CAN'T DO BETTER IF EVERYONE ELSE BIDS
LESS THAN YOUR TRUE VALUE.

IF MY TRUE VALUE IS \$100
AND SOMEBODY ELSE BIDS \$120,
I DON'T WANT TO OUTBID THEM
BECAUSE THEN I'D BE STUCK
PAYING TOO MUCH!

IF I WIN I ONLY PAY THE
2ND-HIGHEST PRICE, SO
SHADING MY BID CAN'T
HELP ME...

... BUT IF MY TRUE VALUE IS
\$100 AND I ONLY BID \$75,
I'LL BE SORRY IF SOMEBODY
ELSE BIDS \$85!



BIDDERS IN AN **ASCENDING AUCTION** ALSO HAVE A **DOMINANT STRATEGY THAT INVOLVES THEIR TRUE VALUES.**

I'M JUST GOING TO KEEP
BIDDING UNTIL I WIN THAT
SCULPTURE ...

HE'S AT A **FOOL** TO
STOP BIDDING **BELOW**
HIS TRUE VALUE!

AND HE'D BE AN **EVEN**
BIGGER FOOL TO KEEP
BIDDING **PAST HIS**
TRUE VALUE!

...OR UNTIL THE
PRICE EXCEEDS MY
TRUE VALUE.



SO BIDDING YOUR TRUE VALUE IS A DOMINANT STRATEGY IN **BOTH**
2ND-PRICE SEALED-BID AUCTIONS AND ASCENDING AUCTIONS.

IN FACT, ALTHOUGH
THEY LOOK DIFFERENT...

...THESE TWO AUCTIONS
ARE **BASICALLY**
THE SAME!

YOU MEAN THEY'RE
INTERCHANGEABLE?

YES!

WE CAN LOOK AT
SEAY TO SEE WHY
THIS IS TRUE...



THE AUCTIONS ON EBAY ARE **ASCENDING AUCTIONS**...



@*#%!



... BUT EBAY ALSO HAS A FEATURE CALLED **AUTOMATIC BIDDING**.



NOW IMAGINE WHAT HAPPENS IF **EVERYBODY** USES AUTOMATIC BIDDING.



EBAY'S COMPUTER DOES
THE CALCULATIONS AND
CAN EASILY PREDICT THE
OUTCOME!

I'M GOING TO WIN AND PAY
ABOUT \$125 BECAUSE AT
THAT POINT THE 2ND-HIGHEST
BIDDER WILL DROP OUT!



WITH AUTOMATIC BIDDING, EBAY HAS BASICALLY TURNED
AN ASCENDING AUCTION INTO A 2ND-PRICE SEALED-BID AUCTION!

THIS IS WHY WE SAY THAT
ASCENDING-PRICE AUCTIONS AND
2ND-PRICE SEALED BID AUCTIONS
ARE **STRATEGICALLY
EQUIVALENT!**

BIDDING YOUR TRUE
VALUE IS A **DOMINANT
STRATEGY** IN BOTH
AUCTIONS.

...AND THE WINNING
BIDDER IN EACH AUCTION
WILL PAY ONLY THE
2ND-HIGHEST BID.

WHAT A
BARGAIN!



THERE IS ALSO A **STRATEGIC EQUIVALENCE**
BETWEEN DESCENDING AUCTIONS AND 1ST-PRICE SEALED-BID AUCTIONS,

TO SEE WHY, IMAGINE THAT A BIDDER IN A **DESCENDING AUCTION** HAS TO LEAVE AND GO TO THE BATHROOM,



NOW IMAGINE THAT **ALL** THE BIDDERS HAVE TO LEAVE AND GO TO THE BATHROOM,



BUT IF EVERYBODY DOES THIS THEN IT'S OBVIOUS WHO'S GOING TO WIN THE AUCTION!

LISA'S WRITTEN INSTRUCTIONS TELL ME TO SAY "WIN!" WHEN THE PRICE FALLS TO \$175. .

BART'S WRITTEN INSTRUCTIONS TELL ME TO SAY "WIN" WHEN THE PRICE FALLS TO \$150.

SWIFT LISA GOT THE HIGHEST BID, SHE'S GOING TO WIN AND PAY THE AMOUNT SHE WROTE DOWN...

JUST LIKE IN A 1ST-PRICE SEALED-BID AUCTION!



THIS SHOWS THAT A DESCENDING AUCTION IS **STRATEGICALLY EQUIVALENT** TO A **HIGHEST-PRICE SEALED-BID AUCTION**.



IN CONCLUSION, OUR FOUR BASIC AUCTIONS CAN BE DIVIDED INTO **TWO SETS**:



IN THESE AUCTIONS
BIDDERS WILL BID THEIR
TRUE VALUES.

...BUT THE WINNING
BIDDER MUST PAY THE
2ND-HIGHEST BID



IN THESE AUCTIONS
BIDDERS WILL
**SHADE THEIR
BIDS**...

...BUT THE WINNING
BIDDER PAYS THE **1ST
HIGHEST BID**.



AND THAT'S NOT ALL...

THERE'S AN EVEN DEEPER RESULT THAT **CONNECTS ALL FOUR BASIC AUCTION TYPES.**

IF I WANT TO MAKE AS MUCH
MONEY AS POSSIBLE FROM
AUCTIONING THIS OFF...

... WHICH TYPE OF
AUCTION SHOULD
I USE?

IT DOESN'T
MATTER!

THE REVENUE EQUIVALENCE THEOREM SAYS THAT IN MANY CIRCUMSTANCES
ALL FOUR OF THESE AUCTIONS GENERATE THE **SAME EXPECTED REVENUE** FOR THE SELLER!

WHETHER YOU'RE THE
2ND HIGHEST BIDDER IN THESE
TWO TYPES OF AUCTIONS...

... SHOULD EQUAL THE
HIGHEST BID IN THESE
TWO TYPES OF AUCTIONS!

\$175

\$150

\$142

\$135

\$130

\$128

\$126

\$150

\$145

\$140

\$132

\$129

\$127

\$124

EITHER WAY, THE SELLER CAN EXPECT
TO GET THE SAME AMOUNT!

CHAPTER 10

FROM SOME TO MANY

IN THE LAST FEW CHAPTERS WE
DISCOVERED THAT INTERACTIONS
BETWEEN ONLY A FEW OPTIMIZING
INDIVIDUALS CAN BE **VERY
COMPLICATED.**

AS WE ADDED MORE AND MORE
OPTIMIZING INDIVIDUALS TO THE
MIX, GAME THEORY GOT
EVEN MORE COMPLEX!

LUCKILY FOR US, THINGS ARE **ABOUT TO GET...**

... MUCH SIMPLER!

WELCOME TO
PRICE THEORY,
THE STUDY OF
**COMPETITIVE
MARKETS!**



THE FORMAL DEFINITION OF A COMPETITIVE MARKET IS:

A MARKET WITH
LOTS OF BUYERS,
EACH ONE SMALL RELATIVE TO
ALL THE BUYERS TOGETHER...

...AND **LOTS OF SELLERS,**
EACH ONE SMALL RELATIVE TO ALL
THE SELLERS TOGETHER!



IN OTHER WORDS, IN A COMPETITIVE MARKET
EACH BUYER AND EACH SELLER IS LIKE
ONE SINGLE GRAIN OF SAND...



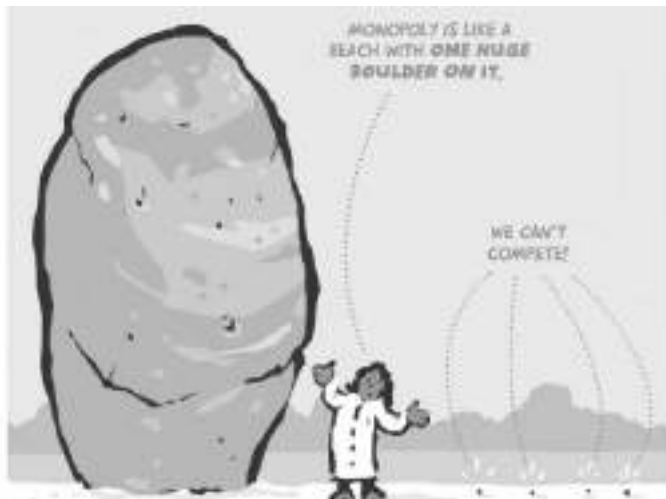
... AND THE MARKET ITSELF IS LIKE A HUGE BEACH THAT HAS
LOTS OF GRAINS OF SAND AND NO BIG ROCKS!

IT'S IMPORTANT TO NOTE THAT **NOT EVERY MARKET IS A COMPETITIVE MARKET!**



FOR EXAMPLE, THERE'S **MONOPOLY**, WHICH IS A MARKET WITH **ONLY ONE SELLER**...

...AND **MONOPSONY**, WHERE THERE'S ONLY ONE BUYER...



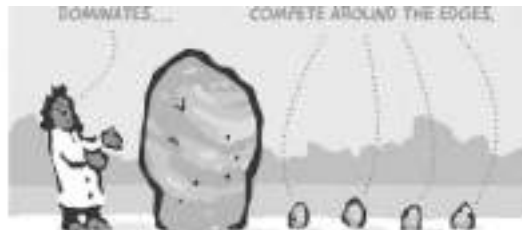
...AND THERE'S **DUOPOLY** AND **DUOPSONY**...

...AND THERE ARE LOTS OF OTHER EXAMPLES, INCLUDING A MARKET WITH A **DOMINANT FIRM** AND A **COMPETITIVE FRINGE**.

THESE ARE MARKETS WITH ONLY **TWO SELLERS** OR **ONLY TWO BUYERS**.

THAT'S WHEN ONE SELLER LIKE **WAL-MART** DOMINATES...

BUT LOTS OF LITTLE SELLERS COMPETE AROUND THE EDGES.



ULTIMATELY, MARKETS THAT AREN'T COMPETITIVE ARE **ALL DIFFERENT...**

IF YOU WANT TO STUDY ONE OF
THOSE OTHER MARKETS YOU'LL HAVE
TO HEAD BACK INTO THE SAME
THEORY JUNGLE!



... **BUT COMPETITIVE MARKETS ARE ALL THE SAME!**

LABOR MARKETS, CURRENCY
MARKETS, AGRICULTURAL
MARKETS

...THEY ALL WORK
THE SAME WAY!

**I LOVE
IT!**



BUT THERE'S ANOTHER
REASON **ECONOMISTS LOVE
COMPETITIVE MARKETS...**

REMEMBER THE
BIG QUESTION
IN MICROECONOMICS?

UNDER WHAT
CIRCUMSTANCES
DOES **INDIVIDUAL**
OPTIMIZATION LEAD TO
OUTCOMES THAT ARE
GOOD FOR THE
GROUP AS A
WHOLE?



WELL, AS WE'LL LEARN IN THE
UPCOMING CHAPTERS...

**...COMPETITIVE
MARKETS
ARE A BIG PART
OF THE ANSWER!**



HERE'S THE **SECRET OF COMPETITIVE MARKETS:**

JUST AS EACH GRAIN OF SAND IS
TOO SMALL TO INFLUENCE THE
SHAPE OF THE ENTIRE BEACH...

MAN DO
I FEEL TINY!

... IN A COMPETITIVE MARKET, EACH BUYER OR SELLER IS
TOO SMALL TO INFLUENCE THE ENTIRE MARKET!

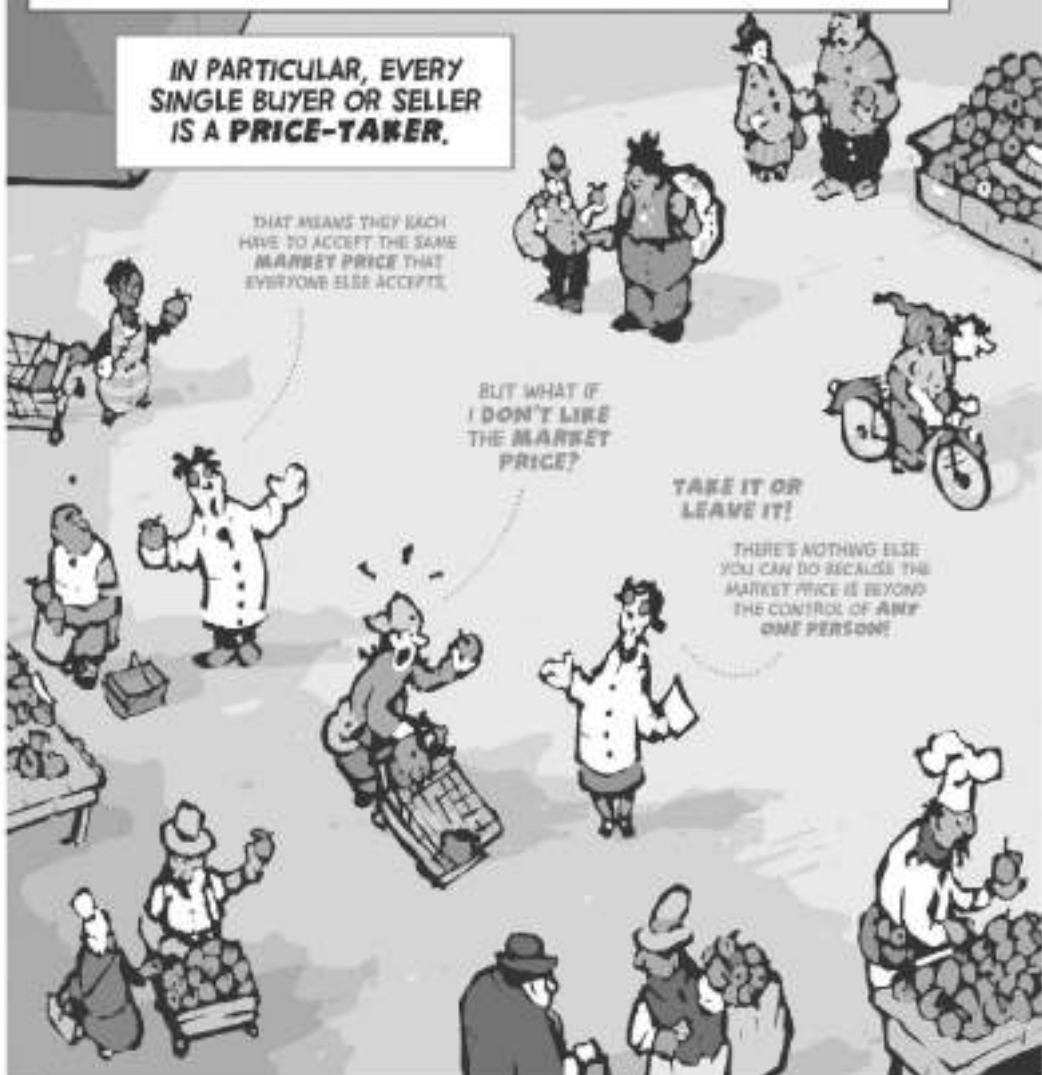
IN PARTICULAR, EVERY
SINGLE BUYER OR SELLER
IS A **PRICE-TAKER**.

THAT MEANS THEY EACH
HAVE TO ACCEPT THE SAME
MARKET PRICE THAT
EVERYONE ELSE ACCEPTS.

BUT WHAT IF
I DON'T LIKE
THE **MARKET**
PRICE?

**TAKE IT OR
LEAVE IT!**

THERE'S NOTHING ELSE
YOU CAN DO BECAUSE THE
MARKET PRICE IS BEYOND
THE CONTROL OF ANY
ONE PERSON!



**IN THE END, THE KEY DIFFERENCE BETWEEN
GAME THEORY AND PRICE THEORY...**

...IS THAT GAME THEORY
IS ALL ABOUT **STRATEGIC
INTERACTIONS...**

YOUR NEXT MOVE
COULD AFFECT THE
OUTCOME OF THE
ENTIRE GAME!



...BUT PRICE THEORY HAS
NO STRATEGIC INTERACTIONS!

**OW!
OW!
OW!**

ACTING
STRATEGICALLY IN A
COMPETITIVE MARKET DOES
ABOUT AS MUCH GOOD AS
BANGING YOUR HEAD
AGAINST A WALL!



SORRY, BUDDY,
STILL NO CHANGE IN
THE MARKET PRICE!

OKAY, BUT I HAVE
ONE QUESTION:

IF EVERYBODY IS A
PRICE-TAKER, THEN
**WHERE DOES THE
MARKET PRICE
COME FROM?**

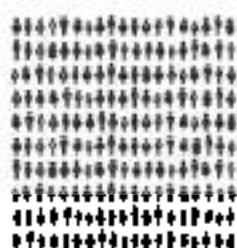


AS WE'LL SEE
IN THE NEXT
CHAPTER ...

... THE MARKET PRICE
COMES FROM MIXING
THE BUYERS...

... WITH THE
SELLERS!





PART THREE

MARKET INTERACTIONS

CHAPTER 11

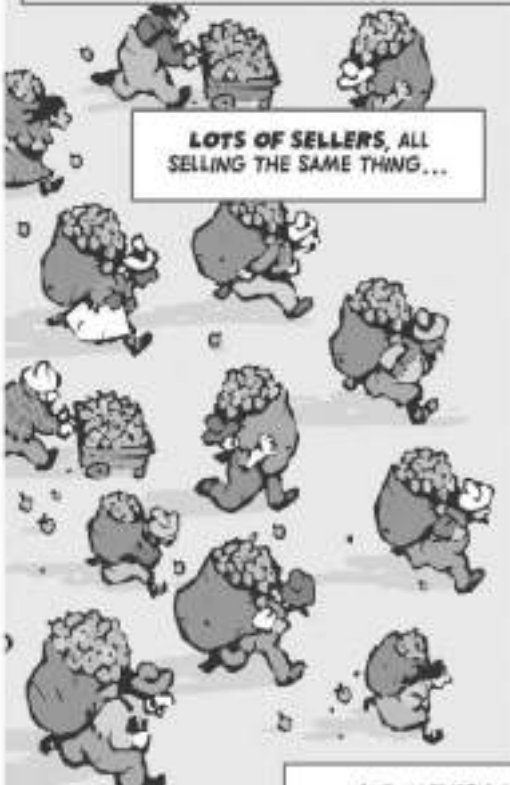
SUPPLY AND DEMAND

WHY ARE YOU
CHARGING \$5.00
FOR THIS APPLE?

HOW SHOULD
I KNOW? I'M NOT
AN ECONOMIST!



REMEMBER THAT **COMPETITIVE MARKETS ARE ALL THE SAME!**



**LOTS OF SELLERS, ALL
SELLING THE SAME THING...**



**...AND LOTS OF BUYERS, ALL
BUYING THAT SAME THING...**

**...AND IN EVERY COMPETITIVE MARKET
THERE'S A SINGLE **MARKET PRICE!****

IT'S THE LAW OF
ONE PRICE, FROM
PAGE 62.

\$1.52
each

\$1.52
each

\$1.52
each

\$1.52
each

ECONOMISTS SPENT MANY YEARS WONDERING **WHERE MARKET PRICES CAME FROM,**

AT FIRST THEY THOUGHT THAT PRICES WERE DETERMINED **By SUPPLY.**

IT'S ALL ABOUT THE
SELLERS' COST OF
PRODUCTION!



THEN, IN THE 19TH CENTURY, SOME
RENEGADE ECONOMISTS ARGUED THAT
PRICES WERE DETERMINED **By DEMAND.**

THAT'S BALDERDASH,
YOU OLD COOT!

IT'S ALL ABOUT
THE BUYERS'
WILLINGNESS
TO PAY!



FINALLY, IN 1890, **ALFRED MARSHALL** CLEARED THINGS UP
BY TELLING THE FIRST-EVER ECONOMICS JOKE:

ARGUING ABOUT WHETHER
IT'S **SUPPLY OR DEMAND**
IS LIKE ARGUING...

"... WHETHER IT IS THE
UPPER OR THE UNDER BLADE
OF A PAIR OF SCISSORS THAT
CUTS A PIECE OF PAPER!"



SO NOW WE KNOW IT'S **SUPPLY AND DEMAND.**

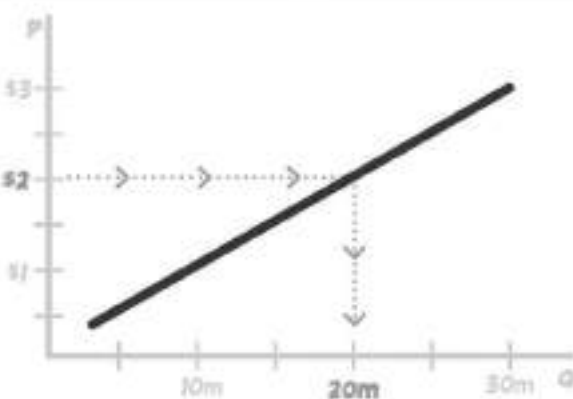
THE THEORY OF SUPPLY AND DEMAND SAYS THAT PRICES IN COMPETITIVE MARKETS ARE DETERMINED BY TWO CURVES:

LET'S USE THE MARKET FOR RED DELICIOUS APPLES AS AN EXAMPLE.



A MARKET SUPPLY CURVE DESCRIBES **HOW MANY APPLES SELLERS WOULD WANT TO SELL** IF THE MARKET PRICE WERE \$2, OR \$3, OR ANY OTHER PRICE.

FOR EXAMPLE, IF THE PRICE OF APPLES WERE \$2 PER APPLE,...

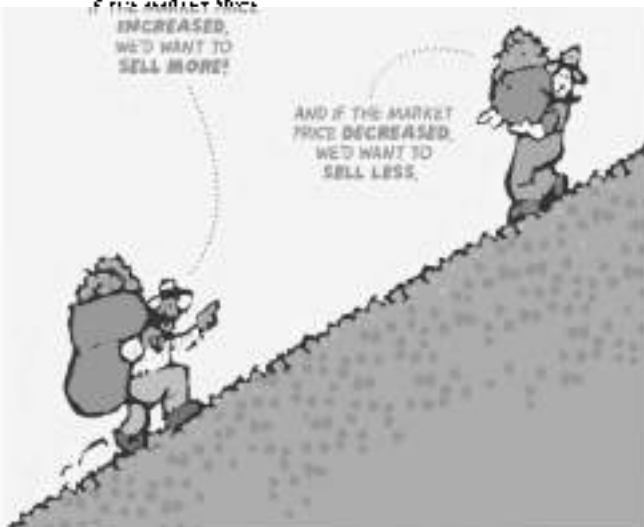


... SELLERS WOULD WANT TO SELL 20 MILLION APPLES PER DAY.



IF THE MARKET PRICE INCREASED, WE'D WANT TO SELL MORE!

AND IF THE MARKET PRICE DECREASED, WE'D WANT TO SELL LESS.



WE COULD SPEND WEEKS
EXPLORING THE DETAILS OF
SUPPLY CURVES:



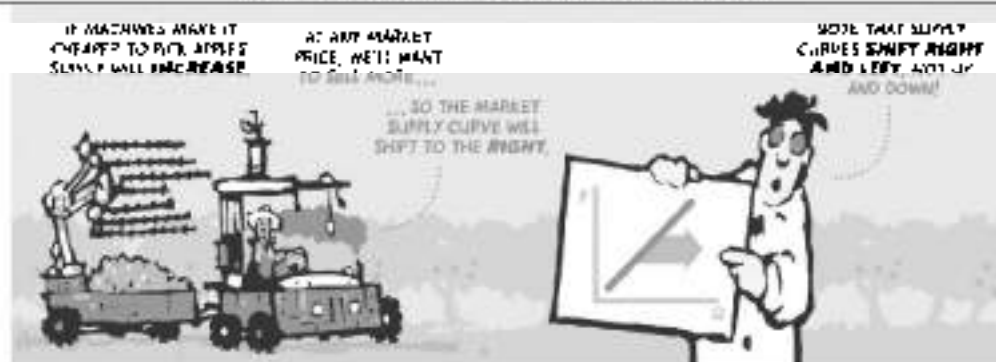
LIKE HOW **MARKET** SUPPLY CURVES COME FROM ADDING UP LOTS OF **INDIVIDUAL** SUPPLY CURVES



...AND HOW **INDIVIDUAL** SUPPLY CURVES COME FROM **INDIVIDUAL** OPTIMIZATION...



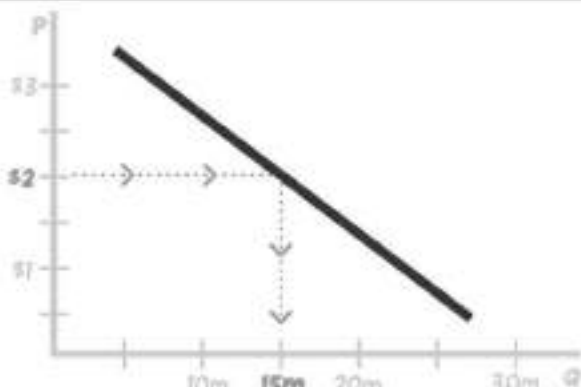
...AND HOW **DIFFERENT** EVENTS SHIFT SUPPLY CURVES...



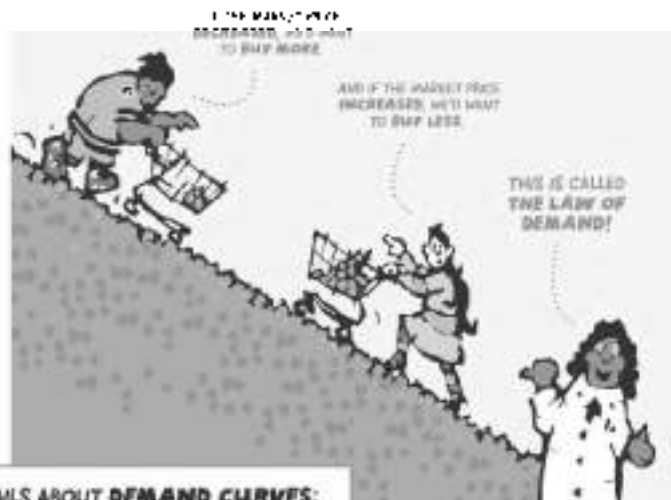
...BUT INSTEAD LET'S TURN OUR ATTENTION FROM **PRODUCER** THEORY TO **CONSUMER** THEORY.

A MARKET DEMAND CURVE DESCRIBES HOW MANY APPLES BUYERS WOULD WANT TO BUY IF THE MARKET PRICE WERE \$2, OR \$3, OR ANY OTHER PRICE.

FOR EXAMPLE, IF THE PRICE OF APPLES WERE \$2 PER APPLE...



... BUYERS WOULD WANT TO BUY 15 MILLION APPLES PER DAY.



THERE ARE LOTS OF DETAILS ABOUT DEMAND CURVES:

LIKE HOW MARKET DEMAND CURVES COME FROM ADDING UP LOTS OF INDIVIDUAL DEMAND CURVES...



...AND HOW INDIVIDUAL DEMAND CURVES COME FROM INDIVIDUAL OPTIMIZATION...



...AND HOW DIFFERENT EVENTS SHIFT DEMAND CURVES...



...AND HOW DEMAND CURVES ARE USED TO DEFINE OTHER ECONOMIC CONCEPTS.

WHEN THE PRICE OF BEEF
GOES UP, DEMAND FOR
CHICKEN INCREASES...

...SO BEEF AND
CHICKEN ARE
SUBSTITUTES!

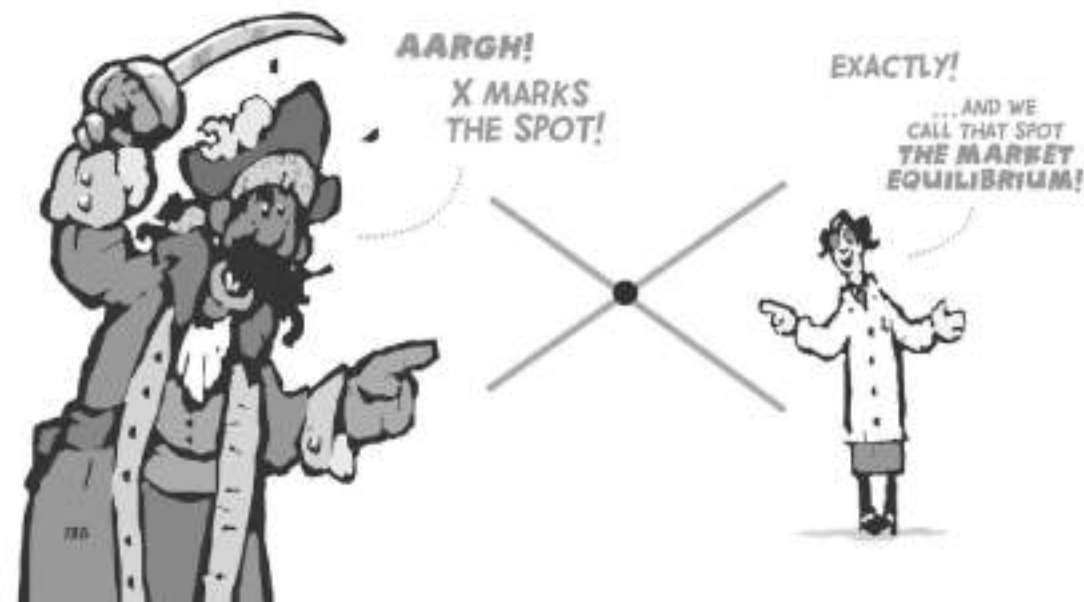
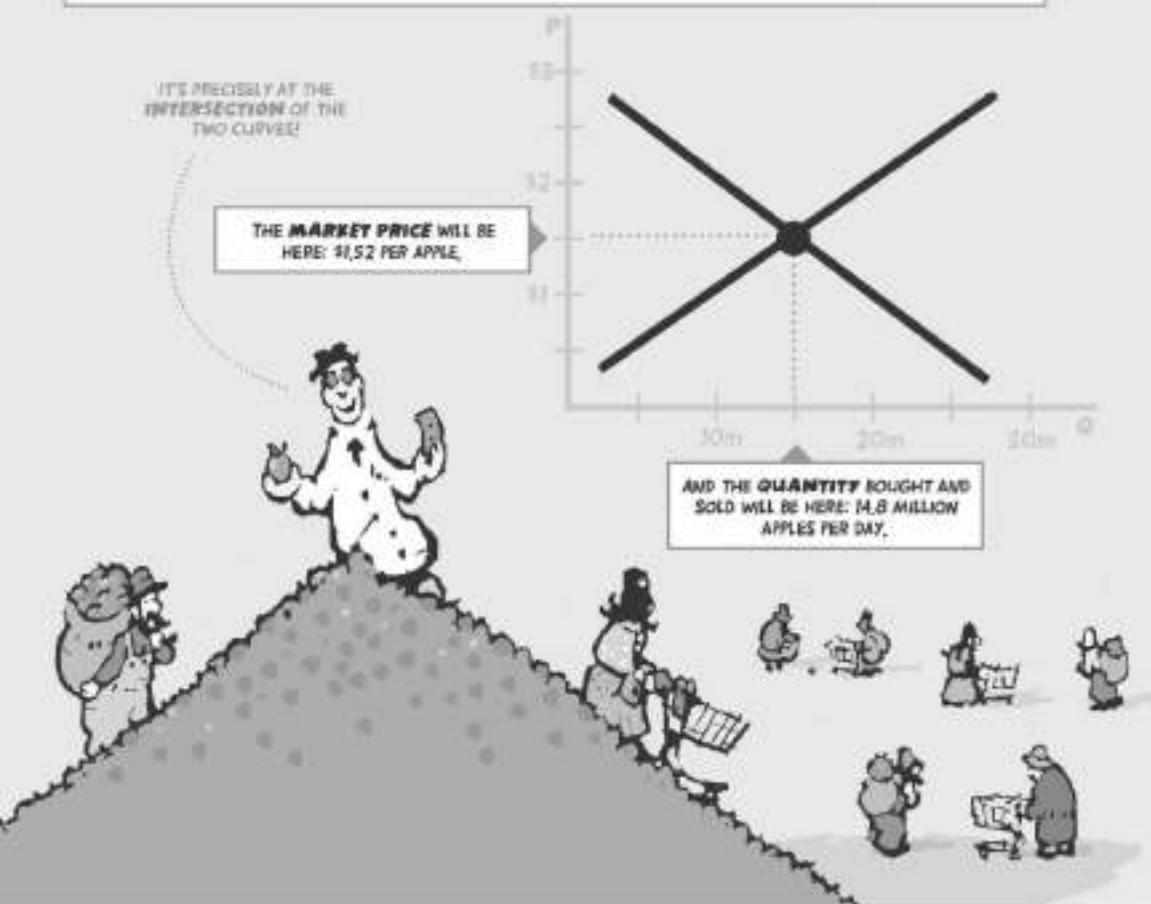
WHEN THE PRICE OF
BUTTER GOES UP, DEMAND
FOR FRENCH FRIES
DECREASES...

...SO BEEF AND
FRENCH FRIES ARE
COMPLEMENTS!



WE COULD SPEND **MONTHS**
STUDYING THESE DETAILS, BUT
INSTEAD LET'S GET BACK TO
SUPPLY AND DEMAND.

**BY COMBINING THE MARKET SUPPLY AND MARKET DEMAND CURVES,
WE CAN PREDICT WHAT THE MARKET PRICE WILL BE.**



IT'S CALLED THE **MARKET EQUILIBRIUM PRICE** BECAUSE AT THIS PRICE THE AMOUNT THAT SELLERS WANT TO SELL IS **EQUAL** TO THE AMOUNT THAT BUYERS WANT TO BUY...

IF THE PRICE IS
\$2.52 PER APPLE...

...WE'D LIKE TO SELL
10.5 MILLION APPLES

THAT'S GREAT BECAUSE
IF THE PRICE IS \$1.52
PER APPLE

...THAT'S EXACTLY THE
NUMBER OF APPLES WE'D
LIKE TO BUY!



...AND BECAUSE ANY OTHER MARKET PRICE DOESN'T MAKE SENSE IN A WORLD
FULL OF **OPTIMIZING INDIVIDUALS**.



ANY MARKET PRICE OTHER THAN
THE EQUILIBRIUM PRICE WILL CREATE
INDIVIDUAL INCENTIVES THAT PULL
THE PRICE TOWARD THE EQUILIBRIUM!



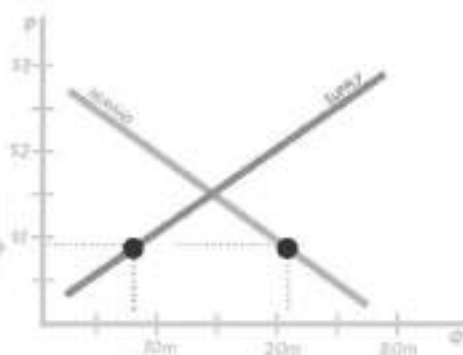
LET'S LOOK
AT THIS MORE
CLOSELY...



AT ANY MARKET PRICE BELOW THE EQUILIBRIUM, INDIVIDUAL INCENTIVES WILL DRIVE THE PRICE UP!



FOR EXAMPLE, IF THE MARKET PRICE WERE DOWN HERE...



... THEN SELLERS WOULD WANT TO SELL THIS AMOUNT...



... AND BUYERS WOULD WANT TO BUY THIS AMOUNT.

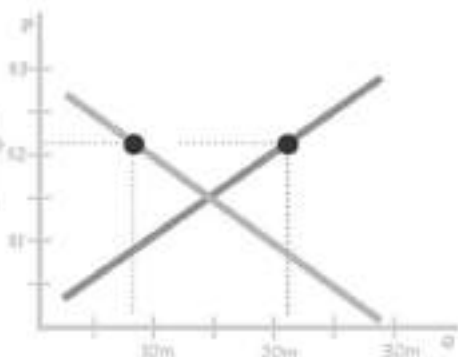


THIS IMBALANCE WOULD GIVE SELLERS AN INCENTIVE TO RAISE THEIR PRICES, AND GIVE SOME BUYERS AN INCENTIVE TO OFFER MORE MONEY.



AT ANY MARKET PRICE **ABOVE** THE EQUILIBRIUM, **INDIVIDUAL INCENTIVES WILL DRIVE THE PRICE DOWN!**

FOR EXAMPLE, IF THE MARKET PRICE WERE UP HERE...



... THEN BUYERS WOULD WANT TO **BUY** THIS AMOUNT...

... AND SELLERS WOULD WANT TO **SELL** THIS AMOUNT.



THIS **IMBALANCE** WOULD GIVE SELLERS AN INCENTIVE TO LOWER THEIR PRICES, AND GIVE BUYERS AN INCENTIVE TO BARGAIN.



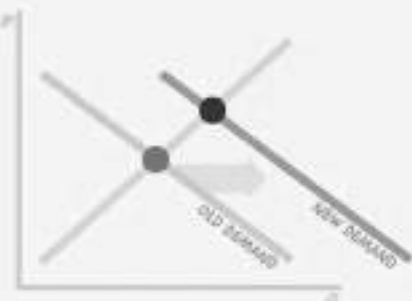
ONLY AT THE **MARKET EQUILIBRIUM PRICE** IS THE AMOUNT THAT SELLERS WANT TO SELL EQUAL TO THE AMOUNT THAT BUYERS WANT TO BUY!

SINCE THE MARKET EQUILIBRIUM PRICE OCCURS AT THE INTERSECTION OF THE CURVES, ANY **CHANGE** IN THAT EQUILIBRIUM PRICE **MUST** COME FROM **CHANGES IN THE CURVES!**



1. DEMAND CAN INCREASE.

THIS MIGHT HAPPEN IF LOTS OF BUYERS WANT TO TRY A NEW APPLE PIE RECIPE!



This pushes the demand curve **to the right...**

...and that pushes the equilibrium price and quantity **up**.



2. DEMAND CAN DECREASE.

APPLE PIE IS SO LAST YEAR...

...THIS IS THE YEAR OF THE PEAR TART!



This pushes the demand curve **to the left...**

...and that pushes the equilibrium price and quantity **down**.



3. SUPPLY CAN INCREASE.

THIS MIGHT HAPPEN
IF THERE'S A BUMPER
CROP OF APPLES!



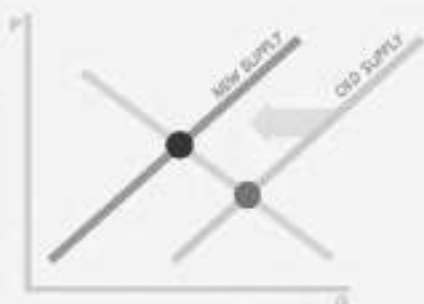
This pushes the
supply curve **to**
the right...

...and that pushes the
equilibrium price **down**
and the quantity **up**.



4. SUPPLY CAN DECREASE.

THIS MIGHT
HAPPEN IF THERE'S
A CROP FAILURE.



This pushes the
supply curve **to**
the left...

...and that pushes the
equilibrium price **up**
and the quantity **down**.



THESE ARE THE BASICS OF SUPPLY AND DEMAND!

AS WE MOVE ON,
REMEMBER THIS.



SUPPLY AND DEMAND WORKS LIKE A
SEESAW, WITH THE MARKET
EQUILIBRIUM PRICE AS THE
BALANCE POINT.

THE AMOUNT THAT
SELLERS WANT TO SELL
AT THE MARKET
EQUILIBRIUM
PRICE...

... **ALWAYS
EQUALS** ...

THE AMOUNT THAT
BUYERS WANT TO BUY
AT THE MARKET
EQUILIBRIUM
PRICE!



CHAPTER 12

TAXES

WE'RE GOING
TO BUILD A NEW
BRIDGE!



AND WE'RE GOING TO
HAVE TO RAISE TAXES
TO PAY FOR IT.



**NOBODY *WANTS* TO PAY TAXES,
BUT AS OLIVER WENDELL HOLMES SAID:**

"TAXES ARE
WHAT WE PAY
FOR CIVILIZED
SOCIETY."

**IN THIS CHAPTER WE'RE GOING TO SEE *EXACTLY*
HOW TAXES AFFECT COMPETITIVE MARKETS.**

SOMEBODY BETTER
CATCH THIS!



BY STUDYING THE EFFECT OF TAXES ON SUPPLY AND DEMAND,
WE'LL BE SKIPPING OVER THE **ART** OF TAXATION,...

"THE ART OF TAXATION CONSISTS
IN SO PLUCKING THE GOOSE AS
TO OBTAIN THE LARGEST POSSIBLE
AMOUNT OF FEATHERS...

...WITH THE SMALLEST
POSSIBLE AMOUNT
OF HISSING!"



...AND FOCUSING INSTEAD ON THE **SCIENCE** OF TAXATION,



HOW DOES A TAX ON
GOOSE FEATHERS...

...AFFECT THE
MARKET FOR
PILLOWS?



IN PARTICULAR, WE'RE GOING TO USE SUPPLY AND DEMAND CURVES
TO ANSWER A SCIENTIFIC QUESTION:

HOW DOES A TAX
ON SELLERS ...

...COMPARE WITH A
TAX ON BUYERS?



AS WE'RE ABOUT TO SEE, THE **LEGAL INCIDENCE** OF A TAX CAN BE DIFFERENT FROM THE **ECONOMIC INCIDENCE**.

THE **LEGAL INCIDENCE**—WHO DIRECTLY PAYS THE TAX—IS DETERMINED BY POLITICS...

SHOULD WE RAISE
TAXES ON SELLERS
OR BUYERS?

BUYERS!
SELLERS!



...BUT THE **ECONOMIC INCIDENCE**—THE ULTIMATE BURDEN OF THE TAX—IS DETERMINED
BY **SUPPLY AND DEMAND**.

AS AN EXAMPLE, LET'S
LOOK AT HOW A TAX
OF \$0.60 PER GALLON
AFFECTS THE MARKET
FOR GASOLINE.



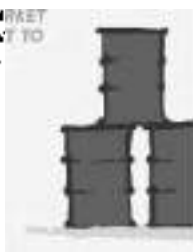
IF WE LEVY A \$0.60 TAX ON THE **SELLERS**, THEN SUPPLY WILL DECREASE, WHICH MEANS THE **SUPPLY** CURVE SHIFTS TO THE LEFT.



SELLERS NOW HAVE TO PAY THE TAX OUT OF WHAT THEY GET FROM THE BUYERS.



SO AT ANY MARKET PRICE WE'LL WANT TO SELL LESS.



ALTERNATELY, IF WE LEVY A \$0.60 TAX ON THE **BUYERS**, THEN DEMAND WILL DECREASE, WHICH MEANS THE **DEMAND** CURVE SHIFTS TO THE LEFT.



THE MARKET PRICE IS WHAT THE BUYER PAYS THE SELLER, SO BUYERS NOW HAVE TO PAY THE TAX ON TOP OF THAT.

SO AT ANY MARKET PRICE WE'LL WANT TO BUY LESS.



EITHER WAY, THOUGH, THE ONLY WAY WE CAN DETERMINE THE NEW MARKET EQUILIBRIUM PRICE IS BY COMBINING SUPPLY AND DEMAND.

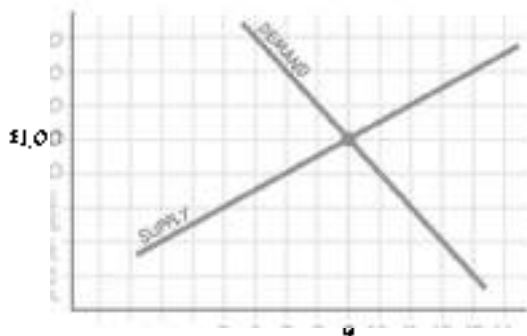
A \$0.60 TAX WILL NOT NECESSARILY RESULT IN A \$0.60 CHANGE IN THE PRICE OF GASOLINE!

REALLY?

LET'S SEE HOW IT WORKS IN GREATER DETAIL...



CONSIDER THESE SUPPLY AND DEMAND CURVES, WHICH DESCRIBE A HYPOTHETICAL MARKET FOR GASOLINE.



NOW LET'S SEE WHAT HAPPENS WHEN THERE'S A TAX OF \$0.60 PER GALLON ON THE SELLERS.

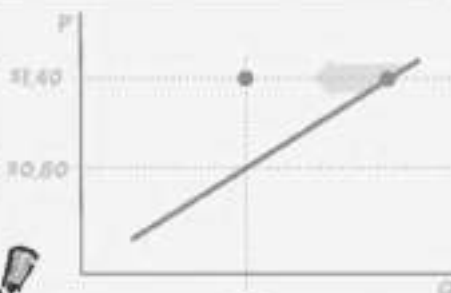
EVERY TIME YOU SELL A GALLON YOU HAVE TO PAY \$0.60 TO THE GOVERNMENT!



WHEN SELLERS ADJUST TO THE TAX, THEIR SUPPLY CURVES **SHIFT TO THE LEFT**, WHICH MEANS THAT AT **ANY** MARKET PRICE THEY'D WANT TO SELL LESS.

FOR EXAMPLE, IF THE MARKET PRICE WERE \$1.40...

...SELLERS WOULD GET TO KEEP ONLY \$0.80 AFTER TAXES...



...SO AT A PRICE OF \$1.40 WITH A \$0.60 TAX THEY'D WANT TO SELL THE **SAME QUANTITY** THEY WANTED TO SELL AT A PRICE OF \$0.80 WITHOUT THE TAX.

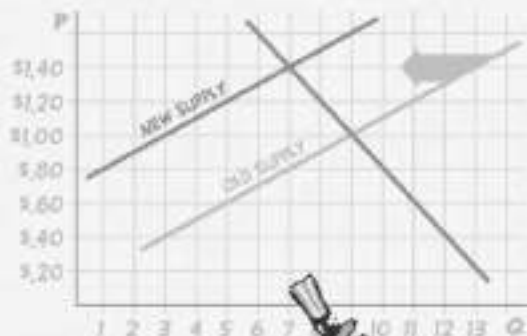


SO WE CAN CALCULATE EXACTLY HOW THE MARKET SUPPLY CURVE SHIFTS.

HOWEVER MUCH THEY'D
PREVIOUSLY WANTED TO SELL
IF THE MARKET PRICE WERE
\$X PER GALLON ...

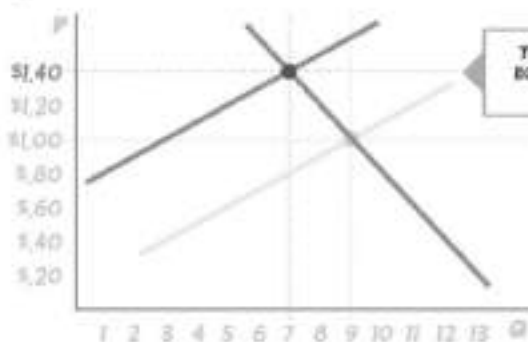
... THEY WOULD NOW WANT
TO SELL IF THE MARKET
PRICE WERE $\$(X + 0.60)$
PER GALLON ...

... BECAUSE THEN
AFTER THE TAX WE'D
STILL GET TO KEEP
\$X PER GALLON!



AS FOR THE DEMAND
CURVE, IT DOESN'T
CHANGE BECAUSE
THE TAX IS ON THE
SELLERS.

**BUT WHEN WE LOOK AT THE NEW MARKET EQUILIBRIUM PRICE,
WE SEE THAT IT CHANGES BY LESS THAN THE AMOUNT OF THE TAX!**



THE NEW MARKET
EQUILIBRIUM PRICE
IS \$1.40.

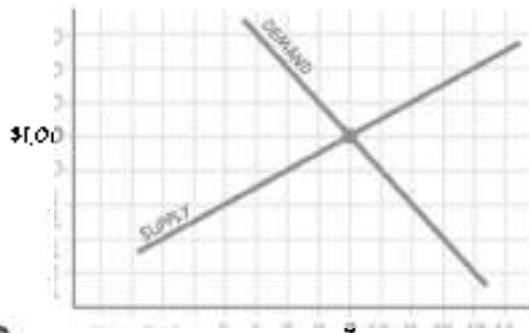
SO A \$0.60 TAX
CAUSES THE MARKET
EQUILIBRIUM PRICE TO
INCREASE BY \$0.40.

EVEN THOUGH THE TAX IS
ON THE SELLERS, MARKET
FORCES PUSH SOME OF
THE TAX BURDEN
ONTO THE BUYERS!



WHAT WOULD CHANGE IF WE PUT THE TAX ON THE **BUYERS** INSTEAD OF THE SELLERS? LET'S FIND OUT BY LOOKING AT THE SAME MARKET FOR GASOLINE.

AGAIN, WE START OUT WITH A MARKET EQUILIBRIUM PRICE OF \$1.00 PER GALLON.



NOW LET'S SEE WHAT HAPPENS WHEN THERE'S A TAX OF \$0.60 PER GALLON ON THE BUYERS.



WHEN BUYERS ADJUST TO THE TAX, THEIR DEMAND CURVES **SHIFT TO THE LEFT**, WHICH MEANS THAT AT **ANY** MARKET PRICE THEY'D WANT TO BUY LESS.

FOR EXAMPLE, IF THE MARKET PRICE WERE \$0.80...

...BUYERS WOULD HAVE TO PAY \$1.40 AFTER TAXES...



...SO AT A PRICE OF \$0.80 WITH A \$0.60 TAX, THEY'D WANT TO BUY THE **SAME QUANTITY** THEY WANTED TO BUY AT A PRICE OF \$1.40 WITHOUT THE TAX.



SO WE CAN CALCULATE EXACTLY HOW THE MARKET DEMAND CURVE SHIFTS,

HOWEVER MUCH THEY'D
PREVIOUSLY WANTED TO BUY
IF THE MARKET PRICE WERE
\$X PER GALLON...

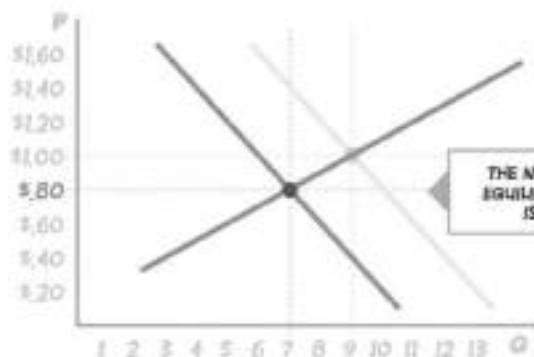
... THEY WOULD NOW WANT
TO BUY IF THE MARKET
PRICE WERE $\$(X - \$0.60)$
PER GALLON...

... BECAUSE THEN
AFTER THE TAX WE'D
STILL BE PAYING
\$X PER GALLON!



AS FOR THE SUPPLY
CURVE, IT DOESN'T
CHANGE BECAUSE
THE TAX IS ON THE
BUYERS.

**BUT AGAIN, WHEN WE LOOK AT THE NEW MARKET EQUILIBRIUM PRICE,
WE SEE THAT IT CHANGES BY LESS THAN THE AMOUNT OF THE TAX!**



THE NEW MARKET
EQUILIBRIUM PRICE
IS \$0.80.

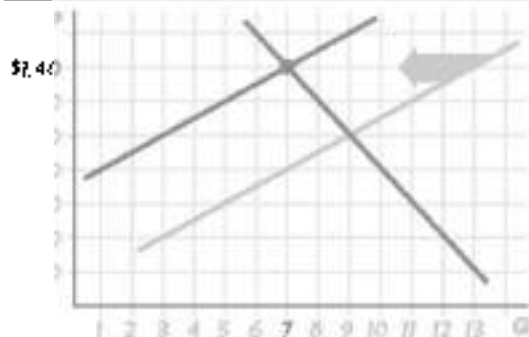
SO A \$0.60 TAX
CAUSES THE MARKET
EQUILIBRIUM PRICE TO
FALL BY \$0.20.

EVEN THOUGH THE
TAX IS ON THE BUYERS,
MARKET FORCES PUSH
SOME OF THE TAX
BURDEN ONTO
THE SELLERS!



LET'S SUMMARIZE!

WITH THE TAX ON THE SELLERS, THE SUPPLY CURVE SHIFTS TO THE LEFT LIKE THIS:

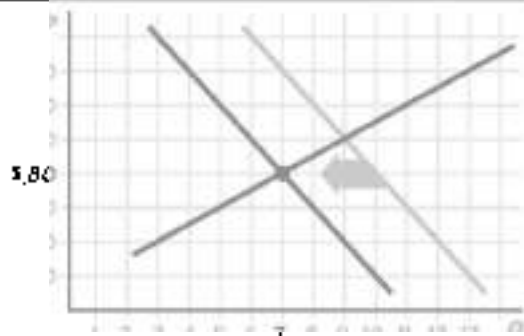


BUYERS PAY
\$1.40 PER
GALLON.

AND SELLERS GET **\$1.40** PER
GALLON, BUT AFTER THE
\$0.60 TAX, THEY TAKE HOME
\$0.80 PER GALLON.



AND WITH THE TAX ON THE BUYERS, THE
DEMAND CURVE SHIFTS TO THE LEFT LIKE THIS:



BUYERS PAY \$0.60 TO
THE SELLERS PLUS \$0.60
FOR TAX, FOR A TOTAL OF
\$1.40 PER GALLON.

AND SELLERS TAKE
HOME **\$0.80** PER
GALLON.



WAIT A
MINUTE!

**EITHER WAY,
I PAY \$1.40
PER GALLON!**

**AND I
TAKE HOME
\$0.80 PER
GALLON!**



THAT'S
RIGHT!

IT DOESN'T
MATTER IF THE TAX
IS ON THE BUYERS OR
THE SELLERS.

EITHER WAY, THE
ECONOMIC
OUTCOME IS THE
SAME!



THIS IS CALLED **TAX EQUIVALENCE**.

POLITICIANS AND VOTERS
DECIDE WHETHER TO
TAX THE BUYERS OR
THE SELLERS...

...BUT SUPPLY AND
DEMAND DETERMINES
WHERE THE BURDEN
ACTUALLY FALLS.



NOTE THAT TAX EQUIVALENCE DOES **NOT** MEAN THAT
THE BUYERS AND SELLERS SHARE THE TAX BURDEN **EQUALLY**.

BEFORE THE TAX I PAID
\$1.00 PER GALLON,
AND NOW I PAY \$1.40.

BEFORE THE TAX I GOT
\$1.00 PER GALLON, AND
NOW I GET ONLY \$0.60

SO \$0.40 OF THE TAX IS
COMING FROM THE BUYERS
BUT ONLY \$0.20 IS COMING
FROM THE SELLERS!



FOR A REAL-LIFE EXAMPLE OF TAX EQUIVALENCE LET'S LOOK AT THE **PAYROLL TAX** THAT FUNDS SOCIAL SECURITY...

POliticians DECIDED THAT THE SOCIAL SECURITY TAX SHOULD BE
DIVIDED EQUALLY BETWEEN EMPLOYEES AND EMPLOYERS.



THE ECONOMIC BURDEN WOULD BE THE SAME EVEN
IF THE WHOLE TAX WERE ON THE EMPLOYERS...

...OR IF THE WHOLE TAX WERE
ON THE EMPLOYEES.

10% TAX MORE
IN WAGES

BUT I'D MAKE
UP FOR IT BY
PAYING LESS IN
WAGES!

10% TAX MORE
IN WAGES

BUT I'D MAKE
UP FOR IT BY
GETTING A HIGHER
SALARY!



SO THEN WHAT
DETERMINES WHO
ULTIMATELY PAYS
THE TAX?

YEAH, WHAT
ACTUALLY
DETERMINES
THE ECONOMIC
BURDEN?

ELASTICITIES!

THAT'S COMING UP
IN CHAPTER 14.



CHAPTER 13

MARGINS

MAX FORTUNE
COOKIE SAYS:

HARD WORK WILL GET
RICHLY REWARDED

... AT THE
MARGIN!

HA HA
HA HA!

MARL SAYS THE JOINERY OF
A THOUSAND MILES BEGINS
WITH A SINGLE STEP

... AT THE
MARGIN!



RECALL FROM PAGE 20 THAT **MARGINAL ANALYSIS** INVOLVES
COMPARING SIMILAR CHOICES.

I AM PLANNING TO SPEND
120 MINUTES FISHING, BUT **MAYBE**
I SHOULD SPEND A FEW MORE?



COMPARING SIMILAR CHOICES IS USEFUL ANY TIME WE STUDY **INDIVIDUAL OPTIMIZATION**,
BUT IT IS ESPECIALLY USEFUL WHEN WE LOOK AT:

BUYERS...

I'M BUYING 7
ORANGES!

ARE YOU SURE YOU
DON'T WANT TO BUY
ONE MORE OR
ONE LESS?



YES, I'M
SURE!



...AND SELLERS.

I'M GOING TO SELL 200
BOXES OF ORANGES!

ARE YOU SURE YOU
DON'T WANT TO SELL
ONE MORE OR
ONE LESS?



YES, I'M SURE
NOW GET OUT
OF MY STORE!



THIS TYPE OF MARGINAL ANALYSIS IS ALSO CALLED **THINKING AT THE MARGIN.**

ECONOMISTS DON'T SAY THAT OPTIMIZING INDIVIDUALS
ACTUALLY DO THINK AT THE MARGIN,...

I THINK I'LL
BUY AN
ORANGE

I THINK I'LL
BUY ANOTHER
ORANGE

I THINK I'LL
BUY ANOTHER
ORANGE

NBODY
ACTUALLY MAKES
DECISIONS LIKE
THIS!



... BUT RATHER THAT OPTIMIZING INDIVIDUALS
ACT **AS IF** THEY THINK AT THE MARGIN!

IF BUYING 7 ORANGES IS
OPTIMAL FOR YOU, THEN YOU
CAN'T DO BETTER BY BUYING
6 ORANGES OR 8 ORANGES.

SECURITY!

I SUPPOSE YOU'RE RIGHT,
BUT WILL YOU PLEASE
MIND YOUR OWN
BUSINESS?



A GOOD ANALOGY IS THE WAY POOL SHARKS ACT **AS IF** THEY UNDERSTAND PHYSICS
EVEN IF THEY'VE NEVER STUDIED NEWTON.

FORCE EQUALS MASS TIMES
ACCELERATION, SO THE
8 BALL IS GOING INTO THE
CORNER POCKET!



JUST AS WE CAN LEARN ABOUT POOL SHARKS BY STUDYING PHYSICS,
WE CAN LEARN ABOUT OPTIMIZING INDIVIDUALS BY STUDYING **MARGINAL ANALYSIS**.

IN THIS CHAPTER WE'RE GOING TO SEE
HOW **THINKING AT THE MARGIN**
REVOLUTIONIZES OUR UNDERSTANDING
OF **SUPPLY AND DEMAND**.

DID YOU SAY
REVOLUTIONIZE?
TELL ME MORE!



JUST AS SOME PICTURES CAN BE SEEN IN TWO ENTIRELY DIFFERENT WAYS...

I SEE NOTHING
REVOLUTIONARY
ABOUT THIS, CHE...

...IT'S JUST
A PICTURE OF
A VASE.



LOOK AGAIN,
FOOL...

...IT'S ALSO A
PICTURE OF TWO
FACES!



... **SUPPLY AND DEMAND CURVES CAN BE SEEN IN TWO ENTIRELY DIFFERENT WAYS!**

**SUPPLY CURVES CAN ALSO BE SEEN AS
MARGINAL COST CURVES.**

**AND DEMAND CURVES CAN ALSO BE SEEN AS
MARGINAL BENEFIT CURVES.**

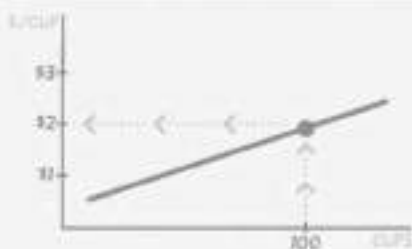
WHOA?



WAIT UNTIL THE
OTHER COMRADES
HEAR ABOUT THIS!



AN INDIVIDUAL
MARGINAL COST CURVE
TELLS US THE **EXTRA COST**
FOR ONE PARTICULAR SELLER OF
PRODUCING **ONE MORE UNIT**.



PRODUCING 99 CUPS OF COFFEE
HAD HIGHER COSTS \$2.00 AND
PRODUCING 100 CUPS OF COFFEE
COSTS \$2.50...

SO MY
MARGINAL COST
FOR THE 100TH CUP
IS \$2.

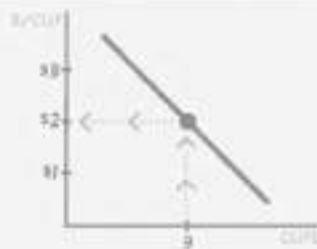


COMBINE ALL THE SELLERS AND YOU GET A
MARKET MARGINAL COST CURVE.



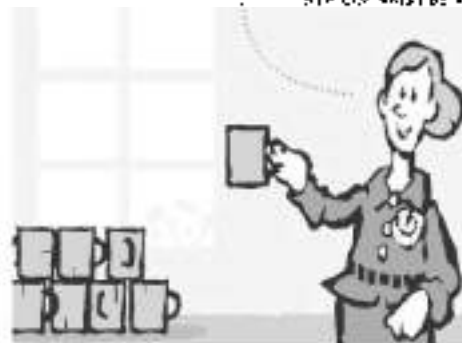
WHAT'S THE MINIMUM
AMOUNT IT WOULD COST
US TO PRODUCE ONE
MORE CUP OF COFFEE?

AN INDIVIDUAL
MARGINAL BENEFIT CURVE
TELLS US THE **EXTRA BENEFIT**
FOR ONE PARTICULAR BUYER OF
CONSUMING **ONE MORE UNIT**.



TO BE WILLING TO PAY UP
TO \$2 FOR 9 CUPS OF
COFFEE PER WEEK AND UP
TO \$2.20 FOR 10 CUPS...

...SO MY **MARGINAL
BENEFIT** FROM THE
9TH CUP WOULD BE \$2.



COMBINE ALL THE BUYERS AND YOU GET A
MARKET MARGINAL BENEFIT CURVE.

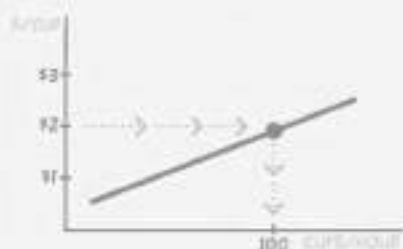


WHAT'S THE MAXIMUM
AMOUNT WE'D BE WILLING
TO PAY FOR ONE MORE CUP
OF COFFEE?



TO SEE HOW MARGINAL COST CURVES RELATE TO SUPPLY CURVES,
LET'S LOOK AT **ERNESTO'S COFFEE BUSINESS**.

IT TURNS OUT THAT **EVERY POINT** ON ERNESTO'S SUPPLY CURVE...



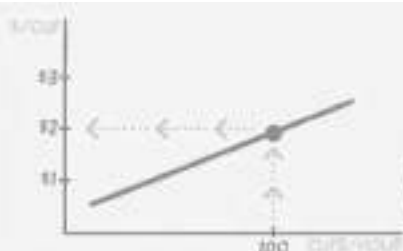
MY SUPPLY CURVE SAYS
THAT IF THE MARKET PRICE
WERE \$2 PER CUP...



...I'D MAXIMIZE MY PROFIT
BY SELLING 100 CUPS OF
COFFEE PER HOUR.



...IS ALSO A POINT ON HIS MARGINAL COST CURVE!



THE MARGINAL COST
OF PRODUCING THE
100TH CUP IS \$2.



THAT'S THE DIFFERENCE IN
MY TOTAL COSTS BETWEEN
PRODUCING 99 CUPS...

...AND PRODUCING
100 CUPS!



THIS IS TRUE BECAUSE ERNESTO WANTS TO
MAXIMIZE HIS PROFIT.

ERNESTO'S SUPPLY CURVE SAYS THAT IF THE MARKET PRICE WERE \$2 PER CUP,
HE'D MAXIMIZE HIS PROFIT BY SELLING 100 CUPS.

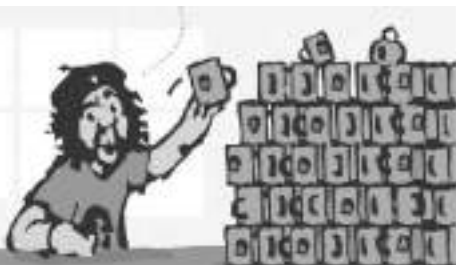
BUT IF THE 100TH CUP COST
MORE THAN \$2 TO PRODUCE...

...I COULD MAKE MORE PROFIT BY
SELLING FEWER THAN 100 CUPS
AT A MARKET PRICE OF \$2 PER CUP.



AND IF THE 100TH CUP COST
LESS THAN \$2 TO PRODUCE...

...I COULD MAKE MORE PROFIT BY
SELLING MORE THAN 100 CUPS
AT A MARKET PRICE OF \$2 PER CUP.

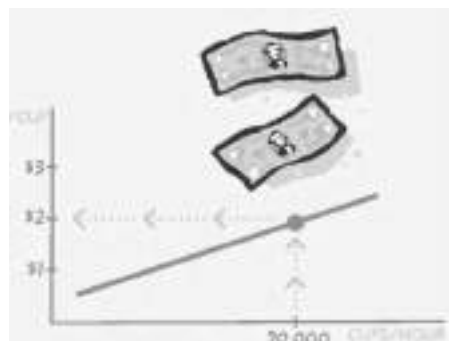
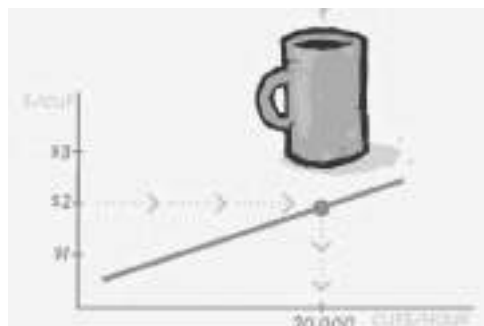


SINCE HE'S PROFIT-MAXIMIZING, HIS COST OF PRODUCING THE 100TH CUP **MUST BE \$2.**

IF WE LOOK AT ERNESTO AND ALL THE OTHER COFFEE SELLERS TOGETHER, WE CAN SEE THAT **EVERY POINT ON THE MARKET SUPPLY CURVE IS ALSO A POINT ON THE MARKET MARGINAL COST CURVE**.

IF THE MARKET SUPPLY CURVE SAYS THAT AT A PRICE OF \$2 ALL THE SELLERS TOGETHER WANT TO SELL 20,000 CUPS OF COFFEE PER HOUR ...

... THEN THE MARKET MARGINAL COST OF PRODUCING THE 20,000TH CUP MUST BE \$2.



AGAIN, THE REASON IS **PROFIT MAXIMIZATION**.

IF THE 20,000TH CUP COST **MORE** THAN \$2 TO PRODUCE ...

... AT LEAST ONE OF US COULD MAKE MORE PROFIT BY **SELLING FEWER CUPS** AT A MARKET PRICE OF \$2!

AND IF THE 20,000TH CUP COST **LESS** THAN \$2 TO PRODUCE ...

... AT LEAST ONE OF US COULD MAKE MORE PROFIT BY **SELLING MORE CUPS** AT A MARKET PRICE OF \$2!



ALL THESE LOGICAL ARGUMENTS CAN BE BACKED UP WITH **ROCK-SOLID MATHEMATICS** ...

... BUT WE'D NEED TO DO SOME CALCULUS.

Facing market price p , a firm in a competitive market chooses quantity q to maximize profit π :

$$\pi = pq - C(q)$$

$$\frac{d\pi}{dq} = 0 \Rightarrow p = C'(q)$$

So either $q=0$ or the firm produces until marginal cost equals the market price!

BUYERS ARE **OPTIMIZING INDIVIDUALS** JUST LIKE SELLERS, SO FOR AN EXAMPLE ON THE DEMAND SIDE LET'S LOOK AT **EVITA'S COFFEE-PURCHASING PREFERENCES**.

IT TURNS OUT THAT **EVERY POINT** ON EVITA'S DEMAND CURVE...



MY DEMAND CURVE SAYS THAT IF THE MARKET PRICE WERE \$2 MY OPTIMAL CHOICE WOULD BE TO BUY 9 CUPS OF COFFEE PER WEEK.



...IS ALSO A POINT ON HER MARGINAL BENEFIT CURVE!



MY MARGINAL BENEFIT CURVE SAYS THAT IF I'VE BOUGHT 8 CUPS OF COFFEE THIS WEEK...

...THEN MY MAXIMUM WILLINGNESS TO PAY FOR A 9TH CUP IS \$2.



THE MATH HERE IS EVEN TRICKIER THAN ON THE SUPPLY SIDE, **JOHN HICKS** SHARED THE NOBEL PRIZE IN 1972 FOR FIGURING IT OUT.

IT'S ACTUALLY QUITE COMPLICATED.

CONGRATULATIONS, YOU WIN THE NOBEL PRIZE!



THE MATH MAY BE COMPLICATED, BUT THE INTUITIVE EXPLANATION IS PRETTY EASY: EVITA IS AN OPTIMIZING INDIVIDUAL!

MY DEMAND CURVE SAYS THAT IF THE MARKET PRICE WERE ABOVE \$2 PER CUP, I'D ONLY WANT TO BUY 8 CUPS...



... BUT IF THE MARKET PRICE WERE EXACTLY \$2 PER CUP, I'D WANT TO BUY 9 CUPS...

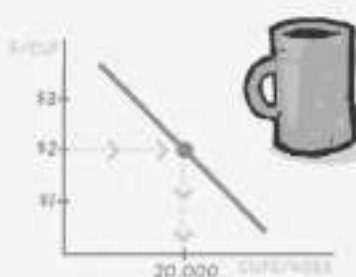


SO MY MAXIMUM WILLINGNESS TO PAY FOR A 9TH CUP MUST BE EXACT \$2!

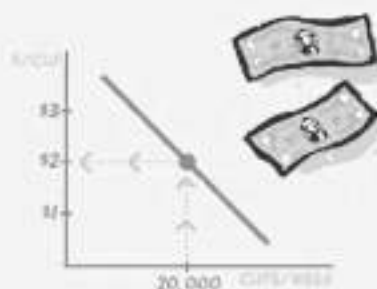


IF WE LOOK AT EVITA AND ALL THE OTHER COFFEE BUYERS TOGETHER, WE CAN SEE THAT **EVERY POINT ON THE MARKET DEMAND CURVE IS ALSO A POINT ON THE MARKET MARGINAL BENEFIT CURVE.**

IF THE MARKET DEMAND CURVE SAYS THAT AT A PRICE OF \$2 ALL THE BUYERS TOGETHER WANT TO BUY 20,000 CUPS PER WEEK...



... THEN THE MARKET MARGINAL BENEFIT OF CONSUMING THE 20,000TH CUP MUST BE \$2.



AGAIN, THE INTUITIVE REASON IS **INDIVIDUAL OPTIMIZATION.**

IF OUR MAXIMUM WILLINGNESS TO PAY FOR THE 20,000TH CUP IS LESS THAN \$2...

... AT LEAST ONE OF US WOULD BE BETTER OFF BUYING LESS AT A MARKET PRICE OF \$2.

AND IF OUR MAXIMUM WILLINGNESS TO PAY FOR THE 20,000TH CUP IS MORE THAN \$2...

... AT LEAST ONE OF US WOULD BE BETTER OFF BUYING MORE AT A MARKET PRICE OF \$2.



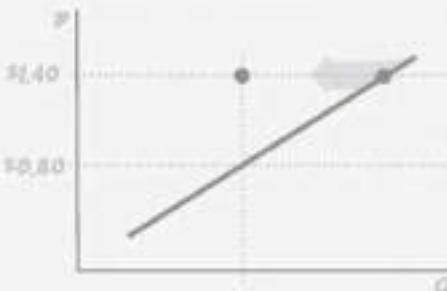
TO SEE HOW THIS **RENOVATIONIZES** HOW WE THINK ABOUT SUPPLY AND DEMAND, LET'S LOOK AGAIN AT TAXES ON THE **SELLERS**.



WE KNOW FROM THE PREVIOUS CHAPTER THAT A TAX OF \$0.60 PER GALLON ON THE SELLERS **SHIFTS EACH SELLER'S SUPPLY CURVE TO THE LEFT...**

FOR EXAMPLE,
IF THE MARKET
PRICE WERE \$1.40 ...

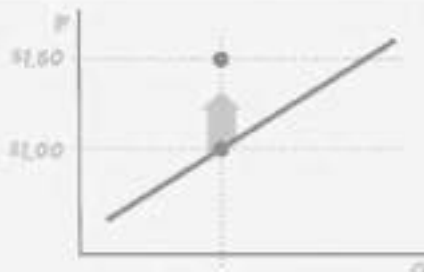
... SELLERS WOULD GET
TO KEEP ONLY \$0.80
AFTER TAXES ...



... SO AT A PRICE OF \$1.40 WITH A \$0.60
TAX THEY'D WANT TO SELL THE **SAME
QUANTITY** THEY WANTED TO SELL AT
A PRICE OF \$0.80 WITHOUT THE TAX.



... BUT IF WE THINK AT THE MARGIN, WE CAN INTERPRET THIS AS
EACH SELLER'S MARGINAL COST CURVE SHIFTING UP BY \$0.60!



THE MARGINAL COST OF PRODUCING
THIS GALLON USED TO BE \$1.00, BUT NOW
IT'S \$1.60 BECAUSE OF THE TAX!

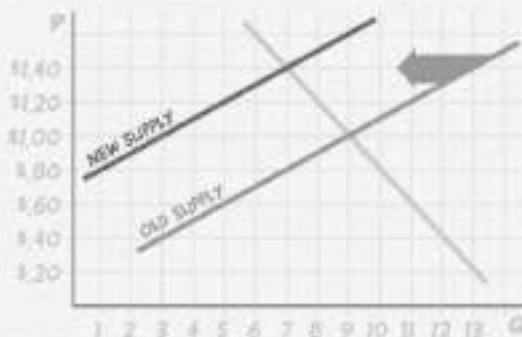


THE SAME THING IS TRUE WHEN WE LOOK AT ALL THE SELLERS TOGETHER.

WHEN THERE'S A \$0.60 TAX ON THE SELLERS,
THE MARKET SUPPLY CURVE **SHIFTS LEFT**...

HOWEVER MUCH WE
PREVIOUSLY WANTED TO SELL
AT $9X$ PER GALLON, ...

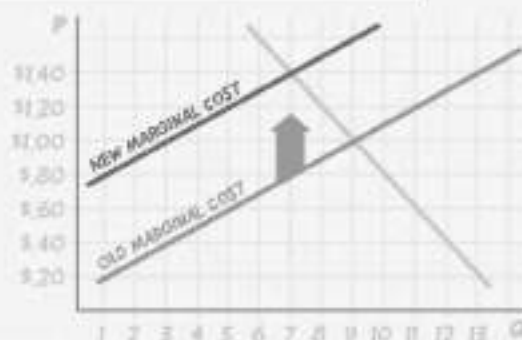
... WE NOW WANT TO
SELL AT $9(X + 0.60)$
PER GALLON.



... BUT FROM THE MARGINAL PERSPECTIVE WE SEE THAT
THE MARKET MARGINAL COST CURVE **SHIFTS UP** BY \$0.60.

BECAUSE OF THE TAX, IT
COSTS US \$0.60 MORE
TO PRODUCE AND SELL
EACH GALLON, ...

... SO THE MARKET
MARGINAL COST CURVE
GOES UP BY \$0.60.



IT'S THE SAME STORY, WITH **TWO DIFFERENT EXPLANATIONS!**

WE NOW HAVE TWO
SEPARATE TOOLS TO
EVALUATE THE SHIFT!



AND NOW LET'S LOOK
AGAIN AT HOW TAXES
AFFECT BUYERS.

EVERY TIME YOU BUY A GALLON
THE GOVERNMENT WILL NOW
CHARGE YOU AN EXTRA \$0.60
ON TOP OF WHAT YOU PAY
THE SELLERS!

BAH, THE TRUE
REVOLUTIONARY
NEVER PAYS
TAXES!



WE KNOW FROM THE PREVIOUS CHAPTER THAT A TAX OF \$0.60 PER GALLON ON THE BUYERS
SHIFTS EACH BUYER'S DEMAND CURVE TO THE LEFT...

FOR EXAMPLE, IF THE
MARKET PRICE WERE
\$0.80...

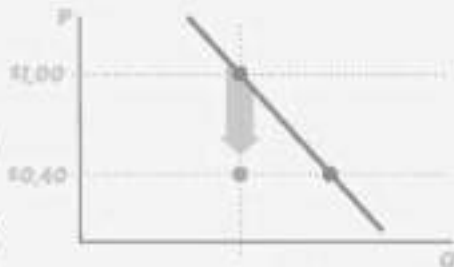
... BUYERS WOULD HAVE
TO PAY \$1.40
AFTER TAXES...



... SO AT A PRICE OF \$0.80 WITH A \$0.60
TAX, THEY'D WANT TO BUY THE **SAME
QUANTITY** THEY WANTED TO BUY AT A
PRICE OF \$1.40 WITHOUT THE TAX.

... BUT IF WE THINK AT THE MARGIN, WE CAN INTERPRET THIS AS
EACH BUYER'S MARGINAL BENEFIT CURVE SHIFTING DOWN BY \$0.60!

BECAUSE OF THE \$0.60 TAX, THE
MAXIMUM I'M WILLING TO PAY
THE SELLER FOR EACH GALLON
GOES DOWN BY \$0.60!



THE MARGINAL BENEFIT OF BUYING
THIS GALLON USED TO BE \$1.00, BUT NOW
IT'S \$0.40 BECAUSE OF THE TAX!

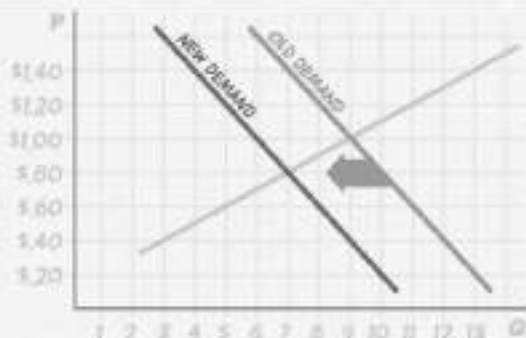


THE SAME THING IS TRUE WHEN WE LOOK AT ALL THE BUYERS TOGETHER.

WHEN THERE'S A \$0.60 TAX ON THE BUYERS, THE MARKET DEMAND CURVE SHIFTS LEFT...

HOWEVER MUCH WE PREVIOUSLY WANTED TO BUY AT \$X PER GALLON, ...

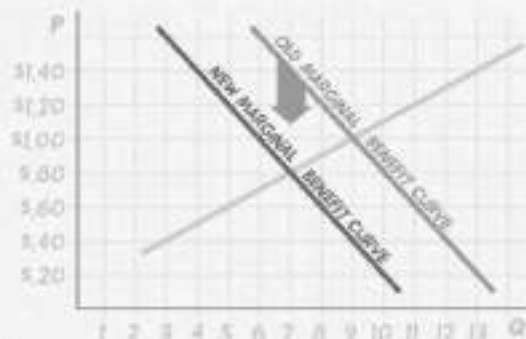
... WE NOW WANT TO BUY AT $3(X - 0.60)$ PER GALLON.



... BUT FROM THE MARGINAL PERSPECTIVE, WE SEE THAT THE MARKET MARGINAL BENEFIT CURVE SHIFTS DOWN BY \$0.60.

WE HAVE TO PAY \$0.60 IN TAX FOR EACH GALLON WE BUY ...

... SO THE MARKET MARGINAL BENEFIT OF CONSUMING EACH GALLON GOES DOWN BY \$0.60.



IT'S THE SAME STORY, WITH **TWO DIFFERENT EXPLANATIONS!**

DON'T YOU JUST LOVE ECONOMICS?



I THOUGHT I TOLD YOU TO GET OUT OF MY STORE!



IN SUMMARY, THE CURVES THAT
PROVIDE THE FOUNDATION OF
COMPETITIVE MARKETS...

...HAVE TWO
TOTALLY SEPARATE
INTERPRETATIONS!

YOU CAN THINK OF THEM AS
SUPPLY AND DEMAND CURVES...

...OR YOU CAN THINK OF THEM AS
**MARGINAL COST AND
MARGINAL BENEFIT CURVES,**

HOW MANY MUGS DO
SELLERS WANT TO SELL OR
BUYERS WANT TO BUY AT
A GIVEN MARKET PRICE?

WHAT'S THE EXTRA COST
OR EXTRA BENEFIT OF
ONE MORE?

IF YOU STUDY MORE ECONOMICS, YOU'LL DO LOTS MORE
THINKING AT THE MARGIN!

THIS YEAR YOU WILL
LEARN MANY
THINGS

... **AT THE
MARGIN!**

**HA HA
HA HA!**

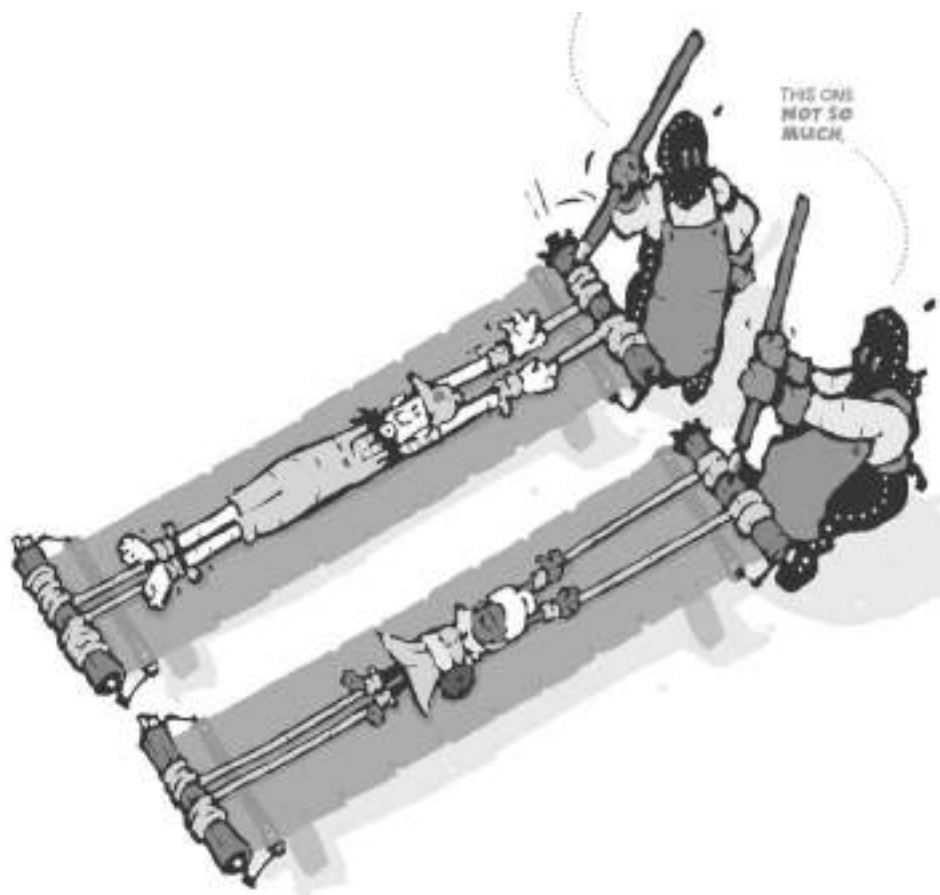


CHAPTER 14

ELASTICITY

THIS ONE
IS VERY
FLEXIBLE!

THIS ONE
NOT SO
MUCH.



ELASTICITY MEASURES HOW CHANGES IN ONE VARIABLE AFFECT A DIFFERENT VARIABLE.

THERE ARE MANY TYPES OF ELASTICITIES, LIKE THE **WEALTH ELASTICITY OF CONSUMPTION**...

... WHICH MEASURES HOW A CHANGE IN **WEALTH** AFFECTS **CONSUMPTION**.



AND THE **INCOME ELASTICITY OF DEMAND**...

... WHICH MEASURES HOW A CHANGE IN **INCOME** AFFECTS **DEMAND** FOR SOME PRODUCT.



AND **CROSS-PRICE ELASTICITY**...

... WHICH MEASURES HOW A CHANGE IN THE **PRICE OF ONE PRODUCT** AFFECTS **DEMAND FOR A DIFFERENT PRODUCT**.



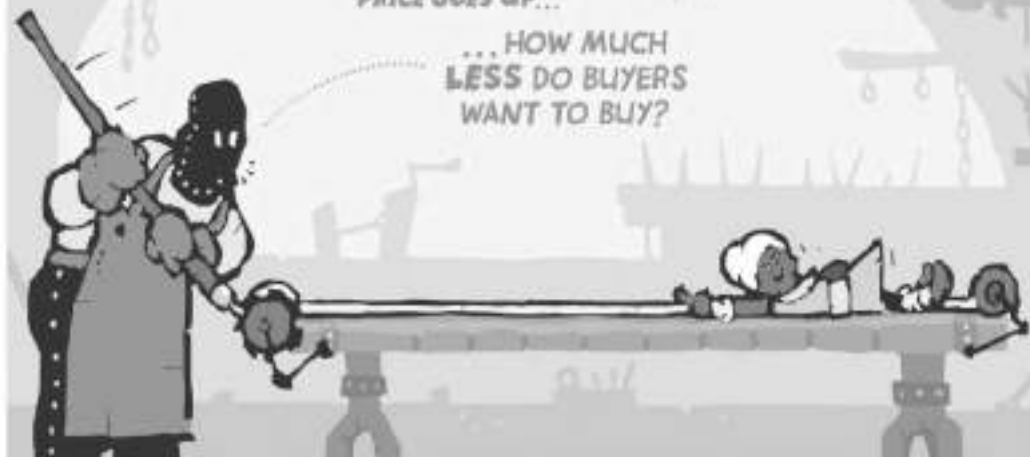
BUT WE'RE GOING TO FOCUS ON TWO OTHERS:

THE **PRICE ELASTICITY OF DEMAND**...

... WHICH MEASURES HOW A CHANGE IN THE **PRICE** OF SOME PRODUCT AFFECTS **DEMAND** FOR THAT SAME PRODUCT,

IF THE MARKET PRICE GOES UP...

... HOW MUCH **LESS** DO BUYERS WANT TO BUY?



AND THE **PRICE ELASTICITY OF SUPPLY**...

... WHICH MEASURES HOW A CHANGE IN THE **PRICE** OF SOME PRODUCT AFFECTS **SUPPLY** FOR THAT SAME PRODUCT,

IF THE MARKET PRICE GOES UP...

... HOW MUCH **MORE** DO SELLERS WANT TO SELL?



**ONE REASON PRICE ELASTICITIES ARE IMPORTANT IS THAT THEY HELP EXPLAIN
HOW PRICES CHANGE AS A RESULT OF TAXES.**

REMEMBER ON PAGE 153,
WHEN SELLERS HAD TO PAY
LESS OF THE TAX...

I PAY ONLY
\$0.20 OF THE
\$0.60 TAX!



...WHILE BUYERS HAD TO
PAY MORE OF IT?

I HAVE TO PAY
\$0.40 OF THE
\$0.60 TAX!



THAT'S BECAUSE SELLERS WERE
MORE ELASTIC THAN BUYERS.



IF SUPPLY IS MORE ELASTIC THAN DEMAND,
THEN SELLERS ARE MORE RESPONSIVE
TO PRICE CHANGES THAN BUYERS...

...BUT IF DEMAND IS MORE ELASTIC THAN SUPPLY,
THEN BUYERS ARE MORE RESPONSIVE
TO PRICE CHANGES THAN SELLERS.

IN THIS CASE,
BUYERS WILL PAY
MORE OF THE TAX.



IN THIS CASE,
SELLERS WILL PAY
MORE OF THE TAX.



BY THIS POINT YOU SHOULD KNOW WHY ALL THIS IS TRUE: SUPPLY AND DEMAND!

RECALL THAT THE MARKET EQUILIBRIUM PRICE IS DETERMINED BY
A **BALANCE** BETWEEN SUPPLY AND DEMAND,

THE AMOUNT THAT
SELLERS WANT TO SELL
AT THAT PRICE

... **ALWAYS
EQUALS...**

THE AMOUNT THAT
BUYERS WANT TO BUY
AT THAT PRICE!



SO THE **TAX BURDENS** HAVE TO BE CAREFULLY BALANCED BETWEEN BUYERS AND SELLERS...

IF YOU PUT THE
TAX BURDEN ON US WE'LL
**CUT BACK ON
HOW MUCH
WE SELL!**

IF YOU PUT THE
TAX BURDEN ON US WE'LL
**CUT BACK ON
HOW MUCH
WE BUY!**



... AND IN ORDER TO MAINTAIN THAT BALANCE,
THE LESS ELASTIC SIDE BEARS MORE OF THE TAX BURDEN!

IN OUR GAS TAX EXAMPLE, BUYERS
HAD TO BEAR **TWICE** AS MUCH
OF THE TAX BURDEN...

... BECAUSE SELLERS
WERE **TWICE** AS
ELASTIC!

SO HOW DO WE
KNOW THAT?

WHAT'S THE FORMAL
DEFINITION OF
ELASTICITY?



**THE PRICE ELASTICITY OF DEMAND
MEASURES THE PERCENTAGE CHANGE IN DEMAND
PRODUCED BY A 1% INCREASE IN PRICE,**

HOW MUCH
LESS WILL
YOU BUY?

DEMAND ELASTICITIES
ARE ALWAYS NEGATIVE
BECAUSE HIGHER PRICES
MAKE BUYERS WANT TO
BUY LESS.

If demand decreases by
more than 1%, we say that
DEMAND IS ELASTIC.

If demand decreases
between 0 and 1%, we say that
DEMAND IS INELASTIC.

FOR EXAMPLE, AT CURRENT PRICES THE DEMAND
FOR FRESH TOMATOES IS **ELASTIC**, ABOUT -4 .

IF THE PRICE OF FRESH TOMATOES GOES
UP 1%, BUYERS WILL BUY 4% LESS!

WE CAN ALWAYS USE
CANNED TOMATOES, OR
JUST DO WITHOUT.

IN CONTRAST, AT CURRENT PRICES THE DEMAND
FOR COFFEE IS **INELASTIC**, ABOUT -0.25 .

IF THE PRICE OF COFFEE GOES UP 1%,
BUYERS WILL BUY ONLY 0.25% LESS.

WE DON'T REALLY CARE
ABOUT TOMATOES,
BUT WE NEED
OUR COFFEE!

THE PRICE ELASTICITY OF SUPPLY MEASURES THE PERCENTAGE CHANGE IN SUPPLY PRODUCED BY A 1% INCREASE IN PRICE,

SUPPLY ELASTICITIES
ARE ALWAYS POSITIVE
BECAUSE HIGHER PRICES MAKE
SELLERS WANT TO
SELL MORE.

HOW MUCH
MORE WILL
YOU SELL?

if supply increases
between 0 and 1%, we say that
SUPPLY IS INELASTIC.

if supply increases by
more than 1%, we say that
SUPPLY IS ELASTIC.

0

1

2

3

IT'S IMPORTANT TO NOTE THAT ELASTICITIES ARE
ALWAYS MEASURED AT A PARTICULAR POINT...

Such as this
point...



...or this point.

SEE THE GLOSSARY OF
ECONOMIC CONCEPTS
FOR THE MEAN FORMULAE.

... BECAUSE ELASTICITIES CAN BE DIFFERENT AT DIFFERENT PRICES!

MY PRICE SENSITIVITY IS
A LOT LESS AT A MARKET
PRICE OF \$2 PER GALLON...



... THAN AT A
MARKET PRICE OF
\$5 PER GALLON.



**ELASTICITIES
ARE ALSO DIFFERENT
OVER TIME.**



HAVING MORE TIME GIVES
BUYERS AND SELLERS MORE
WAYS TO BE FLEXIBLE!

SUPPLY AND DEMAND ARE ALWAYS **MORE ELASTIC IN THE LONG RUN** THAN IN THE SHORT RUN.

FOR EXAMPLE, AT A PRICE OF \$4 PER GALLON, DEMAND FOR
GASOLINE IS **INELASTIC IN THE SHORT RUN**...

I DON'T HAVE MUCH
CHOICE, I HAVE TO
GET TO WORK.



... BUT **MORE ELASTIC
IN THE LONG RUN.**

EVENTUALLY I DECIDED
TO BUY A SMALLER CAR,
AND I MOVED CLOSER
TO MY WORKPLACE!



SIMILARLY, THE SUPPLY OF GASOLINE IS
RELATIVELY **INELASTIC IN THE SHORT RUN**...

IT'S GOING TO TAKE
MONTHS TO DRILL
MORE OIL WELLS.



... BUT **MORE ELASTIC
IN THE LONG RUN.**

NOW WE'RE
TALKING!



IN FACT, FOR MANY PRODUCTS, SUPPLY IN THE LONG RUN
IS **PERFECTLY ELASTIC!**

A GOOD EXAMPLE
IS THE SUPPLY
OF SOUVENIR
T-SHIRTS!

A PERFECTLY ELASTIC LONG-RUN SUPPLY
CURVE IS **PERFECTLY FLAT**.



IT MEANS
SUPPLIERS ARE
PERFECTLY
FLEXIBLE.



THE EASIEST WAY TO UNDERSTAND PERFECTLY ELASTIC LONG-RUN SUPPLY CURVES
IS BY THINKING AT THE MARGIN.

THE PRODUCERS' COST IS THE SAME
FOR THE 100TH SHIRT...

...OR THE
1,000,000TH SHIRT!



SO THE MARKET MARGINAL
COST CURVE IS FLAT!

BUT YOU CAN ALSO THINK ABOUT **MARKET SUPPLY CURVES**,
IN WHICH CASE PERFECT ELASTICITY MEANS THREE THINGS:

- 1.** AT ANY MARKET PRICE **BELOW \$3**,
SUPPLY WOULD **PLUMMET TO ZERO**.

IN THE LONG RUN,
NOBODY WANTS TO
SELL T-SHIRTS IF THE
PRICE IS BELOW \$3

YOU CAN MAKE MORE
MONEY SELLING OTHER
STUFF, LIKE HATS OR
MUGS OR CAMERAS!

- 2.** AT ANY MARKET PRICE **ABOVE \$3**,
SUPPLY WOULD **SHOOT UP TOWARD INFINITY**.

IN THE LONG RUN,
EVERYBODY WANTS TO
SELL T-SHIRTS IF THE
PRICE IS ABOVE \$3.

YOU CAN MAKE
MORE MONEY SELLING
T-SHIRTS THAN YOU CAN
SELLING ANYTHING ELSE!

- 3.** AT A MARKET PRICE OF **PRECISELY \$3**, SELLERS ARE WILLING TO
SELL ANY NUMBER OF T-SHIRTS, FROM 100 TO 1,000,000.

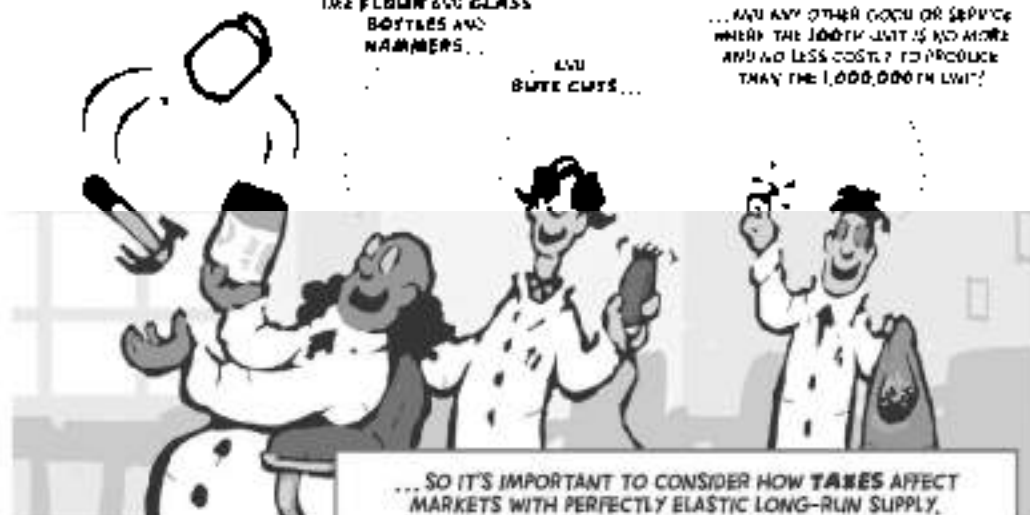
I'M HAPPY SELLING T-SHIRTS,
BUT I'D BE EQUALLY HAPPY
SELLING HATS OR CAMERAS OR
MUGS OR CANDLES OR...

MANY GOODS AND SERVICES HAVE PERFECTLY ELASTIC LONG-RUN SUPPLY...

LIKE FLOUR AND GLASS
BOYTES AND
HAMMERS...

AND
BUTE CUTS...

...AND ANY OTHER GOOD OR SERVICE
WHERE THE JOINTLY COST IS NO MORE
AND NO LESS COSTLY TO PRODUCE
THAN THE 1,000,000TH UNIT!



... SO IT'S IMPORTANT TO CONSIDER HOW **TAXES** AFFECT
MARKETS WITH PERFECTLY ELASTIC LONG-RUN SUPPLY,

FOR AN EXAMPLE, LET'S SEE WHAT HAPPENS IF THERE'S A \$1 TAX ON THE **BUYERS** OF T-SHIRTS,



WE LEARNED ON PAGE 150
THAT IF THE TAX IS ON THE
BUYERS, DEMAND WILL
DECREASE,

AS THE GRAPH SHOWS, A TAX ON THE **BUYERS** DOESN'T
CHANGE THE MARKET EQUILIBRIUM PRICE...

... WHICH MEANS THAT **BUYERS** BEAR
THE ENTIRE TAX BURDEN!

I PAY \$3 TO THE
SELLER, PLUS THE
\$1 TAX, FOR A TOTAL
OF \$4 PER SHIRT.

I STILL GET
\$3 PER SHIRT.

SUPPLY IS SO ELASTIC
THAT YOU CAN'T PUSH
ANY OF THE TAX
BURDEN ONTO HIM!



WE KNOW FROM **TAX EQUIVALENCE** THAT THE END RESULT WILL BE THE SAME IF THE TAX IS PLACED ON THE **SELLERS**.

BUT IT'S EASY TO SEE THIS BY JUST LOOKING AT THINGS FROM THE **SELLERS' PERSPECTIVE**. IF THERE'S A \$1 TAX ON THE SELLERS OF T-SHIRTS,



IN THE LONG RUN, SELLERS **WILL STOP SELLING T-SHIRTS** IF THEY END UP WITH LESS THAN \$3 AFTER PAYING THE TAX...



... SO IN THE LONG RUN IT'S **IMPOSSIBLE** FOR THE SELLERS TO BEAR ANY OF THE TAX BURDEN!



THE \$1 TAX ON THE SELLERS RAISES THE MARKET MARGINAL COST CURVE BY \$1, SO THE NEW MARKET PRICE IS \$4,

WHICH MEANS I PAY \$4 PER T-SHIRT...

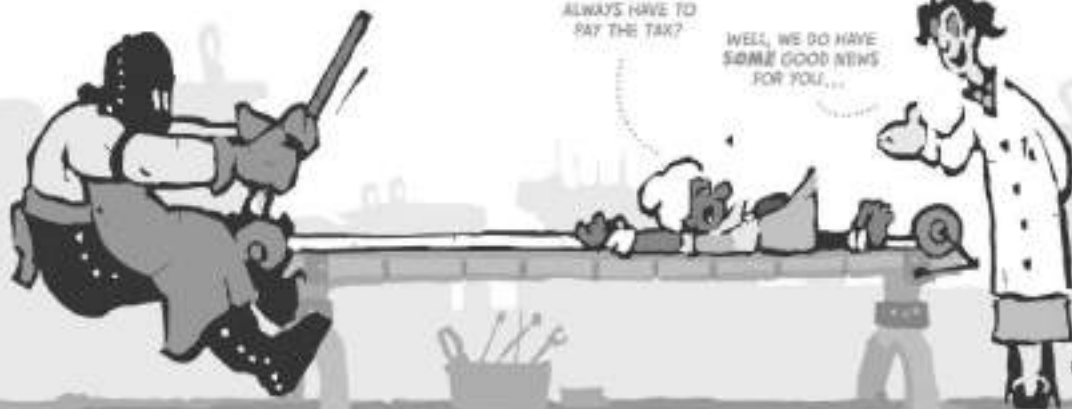
... AND I TAKE HOME \$3 AFTER PAYING THE TAX.



IN SUMMARY: WITH A PERFECTLY ELASTIC LONG-RUN SUPPLY CURVE, **THE BUYERS BEAR THE ENTIRE TAX BURDEN!**

THAT'S NOT FAIR!
I'M ALWAYS HAVE TO PAY THE TAX?

WELL, WE DO HAVE SOME GOOD NEWS FOR YOU...



IT MAY NOT SEEM FAIR THAT **BUYERS** BEAR THE ENTIRE BURDEN OF TAXES FOR MANY PRODUCTS.

WE HATE ECONOMICS!

BUT THE **REASON** BUYERS HAVE TO BEAR THE ENTIRE TAX BURDEN...

...IS THAT **COMPETITION** IS SQUEEZING SELLERS SO HARD THAT **THE SELLERS CAN'T BE SQUEEZED ANY MORE!**

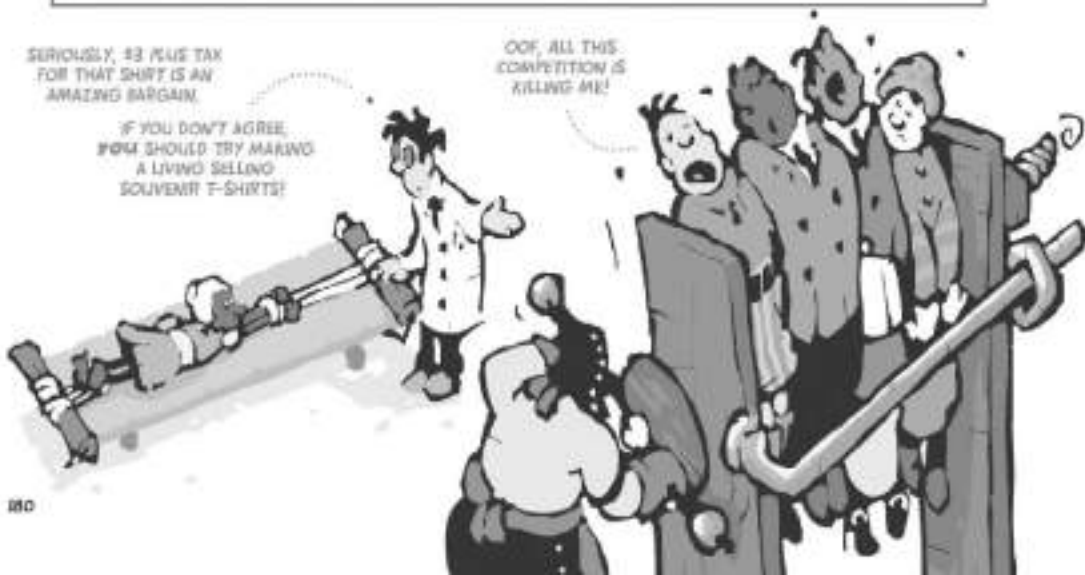
WE HATE ECONOMICS TOO!

SO EVEN THOUGH BUYERS OFTEN BEAR THE ENTIRE TAX BURDEN IN THE LONG RUN, THEY'RE STILL **GETTING A GREAT DEAL IN COMPETITIVE MARKETS!**

SERIOUSLY, 43 PLUS TAX FOR THAT SHIRT IS AN AMAZING BARGAIN.

IF YOU DON'T AGREE, YOU SHOULD TRY MAKING A LIVING SELLING SOUVENIR T-SHIRTS!

OOH, ALL THIS COMPETITION IS KILLING ME!



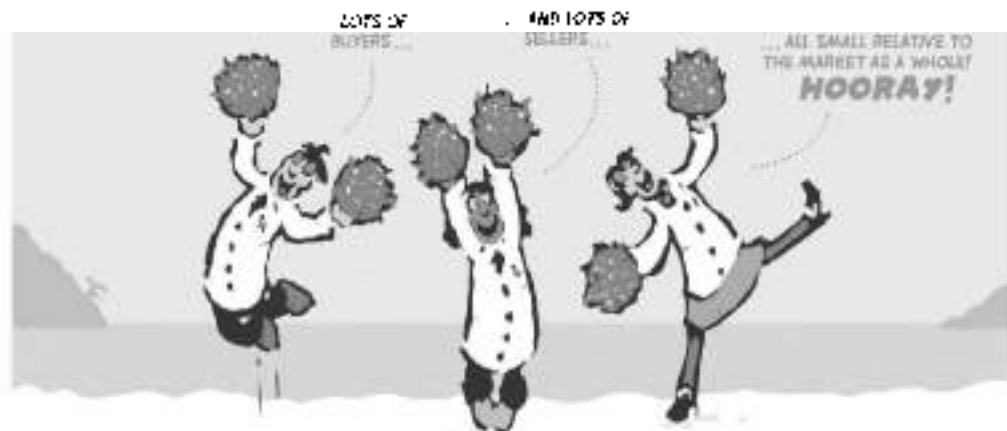
CHAPTER 15

THE BIG PICTURE

ECONOMISTS SEE THE WORLD
DIFFERENTLY.



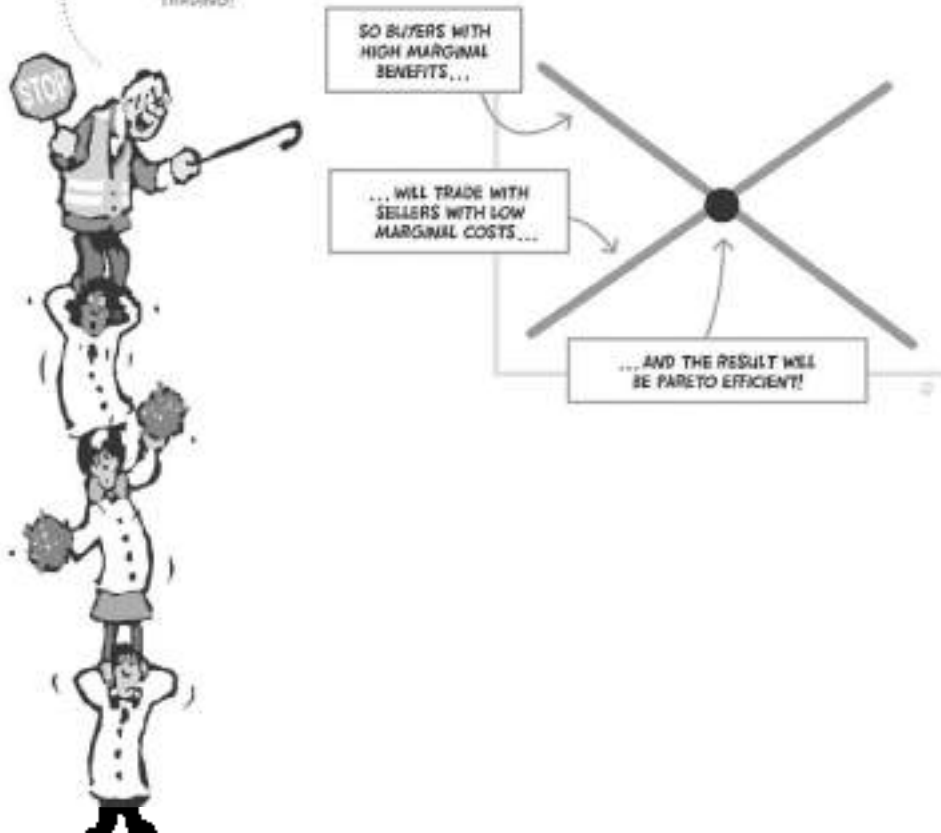
THE ECONOMIC WORLDVIEW IS STRONGLY INFLUENCED BY ONE SIMPLE IDEA:
COMPETITIVE MARKETS ARE GREAT!



THE BENEFITS OF COMPETITIVE MARKETS CAN BE SEEN FROM THE **COASE THEOREM**,

IF THERE'S NOTHING
TO STOP PEOPLE FROM
TRADING...

... THEN NOTHING WILL
STOP PEOPLE FROM
TRADING!



MORE FORMALLY, ECONOMISTS OFTEN RESPOND TO THE **BIG QUESTION** BY TALKING ABOUT A RESULT CALLED **THE INVISIBLE HAND THEOREM**.

UNDER WHAT CIRCUMSTANCES DOES INDIVIDUAL OPTIMIZATION LEAD TO OUTCOMES THAT ARE GOOD FOR THE GROUP AS A WHOLE?

IN A PERFECT WORLD, **COMPETITIVE MARKETS** WILL LEAD TO A PARETO EFFICIENT OUTCOME!



OF COURSE, THE WORLD WE LIVE IN IS **NOT PERFECT**...

... BUT ECONOMISTS STILL THINK ABOUT COMPETITIVE MARKETS THE SAME WAY THAT REGULAR PEOPLE THINK ABOUT PUPPIES,

IT'S SO ADORABLE!

BUT HOW DO WE TAKE CARE OF IT?

HERE ARE A FEW GOOD RULES:

RULE #1: UNDERSTAND THE MARKET'S LIMITATIONS

RULE #2: PROTECT COMPETITION

RULE #3: GIVE THE MARKET SECOND CHANCES



RULE #1: UNDERSTAND THE MARKET'S LIMITATIONS.

HEEL!



JUST LIKE YOU CAN HAVE A **PARETO EFFICIENT** OUTCOME WHERE ONE KID GETS ALL THE CAKE...



... YOU CAN HAVE COMPETITIVE MARKETS THAT LEAD TO OUTCOMES THAT **ARE PARETO EFFICIENT** BUT ARE **NOT** WHAT MOST PEOPLE WOULD CONSIDER TO BE **GOOD**.



BUT HERE TOO ECONOMISTS SEE THE WORLD **DIFFERENTLY**.

WHEN ADDRESSING INEQUALITY, ECONOMISTS
TEND TO FAVOR POLICIES THAT **MINIMIZE
INTERVENTION** IN WELL-FUNCTIONING
COMPETITIVE MARKETS...

SOMETHING TELLS ME
YOU SHOULD BE REALLY
CAREFUL ABOUT WHERE
YOU DROP THAT.



...AND **MAXIMIZE
INDIVIDUAL CHOICE.**

INSTEAD OF DIRECTLY GIVING
POOR PEOPLE GOODS AND
SERVICES WE SHOULD JUST
GIVE THEM **MONEY**.

THAT LEAVES AS MANY
CHOICES AS POSSIBLE UP
TO EACH INDIVIDUAL....

...AND WHO'S BETTER
AT OPTIMIZING THAN
THE INDIVIDUAL?



GIVING STARVING PEOPLE **MONEY** INSTEAD OF **FOOD** MAY SOUND ODD, BUT HISTORY
SHOWS THAT MANY FAMINES WEREN'T CAUSED BY LACK OF FOOD BUT BY LACK OF **MONEY**.

RESEARCH BY **AMARTYA SEN**, WHO
WON THE 1998 NOBEL PRIZE, SHOWED
THAT SOME FAMINE-STRIKEN AREAS
ACTUALLY **EXPORTED** FOOD,

LACK OF **MONEY** IS
THE ROOT OF ALL EVIL.

CONGRATULATIONS,
YOU WON THE
NOBEL PRIZE!



RULE #2: PROTECT COMPETITION.



MARKETS NEED REFEREES...

HEY, NO COLLUDING, NO
PRICE FIXING, AND NO
HITTING BELOW THE BELT!



... BECAUSE COMPANIES HAVE AN INCENTIVE TO FIX PRICES OR FORM CARTELS OR OTHERWISE ENGAGE IN **ANTI-COMPETITIVE BEHAVIOR**.

PSS!

IF WE BOTH
CHARGE HIGH
PRICES

... THEN WE'LL
BOTH MAKE
MORE MONEY!

WE LEARNED THAT
ON PAGE 102!



IN THE 19TH CENTURY, CARTELS WERE KNOWN AS **TRUSTS**, WHICH IS WHY POLICIES TO PROTECT COMPETITION ARE CALLED **ANTITRUST** POLICIES.



AND IN CASES WHERE COMPETITION IS LIMITED OR IMPOSSIBLE, GOVERNMENTS CAN WORK TO **LIMIT** THE EXTENT OF DAMAGE TO CONSUMERS.



RULE #3: GIVE THE MARKET SECOND CHANCES.



SOMETIMES COMPETITIVE MARKETS CREATE BIG MESSSES, LIKE **POLLUTION**.



ECONOMISTS THINK OF POLLUTION AS AN **EXTERNAL COST**,
MEANING A COST IMPOSED ON A THIRD PARTY.



THESE EXTERNAL COSTS ARE AT THE HEART OF THE TRAGEDY OF THE COMMONS.

OPTIMIZING BEHAVIOUR
OF INDIVIDUALS ..

-COUGH-
-COUGH-

CAN PRODUCE AN
OUTCOME ..

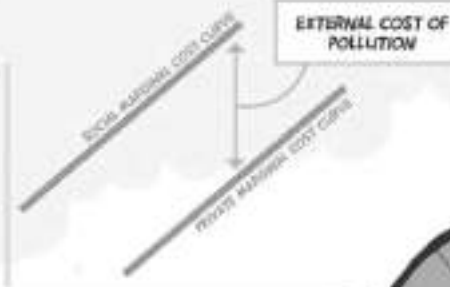
-COUGH-
-COUGH-

THAT IS BEST FOR
EVERYONE

-COUGH-
-COUGH-



FROM THE PERSPECTIVE OF SUPPLY AND DEMAND, THE PROBLEM IS THAT EXTERNAL COSTS
CREATE A **GAP** BETWEEN **PRIVATE** MARGINAL COSTS AND **SOCIAL** MARGINAL COSTS.



IF I DON'T HAVE TO BEAR THE
FULL COST OF MY ACTIONS,
OF COURSE I'M GOING TO
POLLUTE A LOT!



WHEN YOU LOOK AT THE PROBLEM THIS WAY, IT'S EASY TO SEE THAT THE SOLUTION PROPOSED
BY ECONOMISTS IS TO USE **MARKET FORCES** TO CORRECT **MARKET FAILURE**.



THE WAY TO
GET PEOPLE TO
POLLUTE LESS,...

...IS TO MAKE
POLLUTING
EXPENSIVE!

WOW, NOW THAT'S
AN IDEA WORTHY OF A
NOMEL PRIZE!



ONE WAY TO MAKE POLLUTING EXPENSIVE IS TO IMPOSE A CARBON TAX OR OTHER TYPE OF POLLUTION TAX.

ANYONE WHO WANTS TO
SELL FOSSIL FUELS HAS
TO PAY A CARBON TAX!

A PROPERLY DESIGNED POLLUTION TAX CAN **CLOSE THE GAP** BETWEEN
PRIVATE MARGINAL COSTS AND **SOCIAL MARGINAL COSTS**.

↑
SOCIAL MARGINAL COST CURVE

↑
PRIVATE MARGINAL COST CURVE

BY INCREASING PRIVATE
MARGINAL COSTS...

...THE POLLUTION TAX
INTERNALIZES THE
EXTERNAL COSTS!

IT SOUNDS LIKE **MAGIC**, BUT DON'T FORGET WHAT WE LEARNED ABOUT TAXES:

MARKET FORCES WILL PUSH
STANDARD COSTS OF THE TAX
BURDEN FROM SELLERS
ONTO BUYERS...

... WHICH MEANS WE'LL
ALL HAVE TO PAY
HIGHER PRICES FOR
THINGS LIKE GASOLINE!

WE CAN GET
CLEAN AIR...

... BUT WE CAN'T
GET A FREE
LUNCH!

JUST A HALF A
TANK, PLEASE.

AN ALTERNATIVE TO A POLLUTION TAX IS
A SYSTEM THAT INVOLVES A **CAP...**



THE SPECIAL BONUS OF
POLLUTION TAXES IS
THAT THEY **GENERATE
REVENUE...**



CAP-AND-TRADE CAN
ALSO GENERATE
REVENUE...

... IF YOU USE AN
AUCTION TO
SELL THE PERMITS!



...AND WE CAN USE THIS REVENUE TO
LOWER EXISTING TAXES.

LOWER TAXES ON
WORKING!



LOWER TAXES ON
SAVING!



LOWER TAXES ON
INVESTING!



WHY TAX GOODS
WHEN WE CAN
TAX BADS?



THE WAY ECONOMISTS SEE THE WORLD,
TAXES AND POLLUTION ARE TWO UNFORTUNATE REALITIES
THAT GO GREAT TOGETHER!

IN THIS CASE, TWO
WRONGS REALLY
DO MAKE A RIGHT!



ISN'T THE WORLD
HEAVENLY?



CHAPTER 16

CONCLUSION



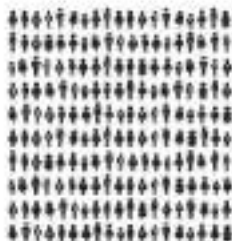
THIS BOOK HAS FOCUSED
ON THE **OPTIMIZING**
INDIVIDUAL...



...AND STRATEGIC
INTERACTIONS
BETWEEN A **FEW**
INDIVIDUALS...



...AND COMPETITIVE
MARKET INTERACTIONS
BETWEEN **LOTS OF**
INDIVIDUALS.



AND ALL ALONG WE'VE BEEN ASKING
ONE BIG QUESTION:

**UNDER WHAT
CIRCUMSTANCES
DOES INDIVIDUAL
OPTIMIZATION LEAD TO
OUTCOMES THAT ARE
GOOD FOR THE
GROUP AS A
WHOLE?**

IN OTHER
WORDS:

WHEN I DO
WHAT'S GOOD
FOR ME,

... ARE YOU DO
WHAT'S GOOD
FOR YOU ...

... AND EVERYONE ELSE
DOES WHAT'S GOOD FOR
THEMSELVES ...

WHEN ARE THE
RESULTS GOOD FOR
ALL OF US?



WHY DO WE GET
STUCK HERE?
TWO THINGS: 1. TOO MANY
PARADOXES
2. TOO MANY
PARADOXES

HOW CAN
WE KNOW WHEN
WE'VE GOTTEN
STUCK?



BUT WHERE DO WE GO FROM HERE?

TO SEE WHAT
ECONOMICS IS GOING
IN THE FUTURE...

LET'S FIRST
LOOK BACK AT
WHAT IT'S
BEEN!



IN THE 18TH AND 19TH CENTURIES, MICROECONOMICS WAS FOCUSED
ALMOST ENTIRELY ON COMPETITIVE MARKETS...

I'LL SELL YOU A
SAUSAGE FOR
2 FARTINGS!

I'LL SELL YOU A
SAUSAGE FOR
2 FARTINGS!

GEE THANKS
FOR THE LOW
PRICES!

DON'T THANK ME
I'M JUST TRYING TO
MAXIMISE MY
PROFIT!



... AND EARLY ECONOMISTS LIKE ADAM SMITH NOTICED THAT
INDIVIDUAL SELF-INTEREST CAN PROMOTE THE COMMON GOOD.

"IT IS NOT FROM THE BENEVOLENCE
OF THE BUTCHER, THE BREWER, OR THE
BAKER THAT WE EXPECT OUR DINNER,
BUT FROM THEIR REGARD TO THEIR
OWN INTEREST..."

IT'S LIKE THEY'RE LED
BY AN INVISIBLE
HAND!



THE DISCOVERIES OF THESE ECONOMISTS SUGGESTED THAT
A WORLD FULL OF **SELFISH INDIVIDUALS** COULD BE **HEAVENLY!**



THESE LESSONS FROM COMPETITIVE MARKETS MADE
ECONOMISTS **OPTIMISTIC** ABOUT **THE BIG QUESTION**.

YOU MIGHT THINK THAT A
DECENTRALIZED ECONOMY GUIDED
BY INDIVIDUAL SELF-INTEREST
WOULD LEAD TO **CHAOS, WAR**
AND **DISASTER**.

...BUT TO BE
PERFECTLY HONEST,
WE THINK IT'S THE
BEST OPTION.

...IT IS A
BEACH!



BY THE MIDDLE OF THE 20TH CENTURY, ECONOMISTS LIKE KENNETH ARROW AND GERARD DEBREU HAD FIGURED OUT PRETTY MUCH EVERYTHING ABOUT **COMPETING MARKETS**.



BUT THEN ECONOMISTS AND MATHEMATICIANS STARTED LOOKING MORE CLOSELY AT **STRATEGIC INTERACTIONS**, AND **GAME THEORY** WAS BORN.



GAME THEORISTS UNCOVERED MANY SITUATIONS WHERE INDIVIDUAL SELF-INTEREST **DOES NOT** LEAD TO GOOD OUTCOMES FOR THE GROUP AS A WHOLE.



EARLIER ECONOMISTS HAD KNOWN THAT THERE WERE CERTAIN **MARKET FAILURES** THAT COULD LEAD TO PARETO INEFFICIENT OUTCOMES.

THE INVISIBLE HAND CAN BREAK DOWN IF THERE'S A **MONOPOLY** INSTEAD OF PERFECT COMPETITION...

8 PAIRINGS FOR A SAUSAGE?

BUT THAT'S ROBBERY!

I PREFER TO THINK OF IT AS PROFIT MAXIMISATION!



...OR IF THERE'S A **TRAGEDY OF THE COMMONS**, SUCH AS POLLUTION OR OVERTISHING.

THE INVISIBLE HAND IS PROVIDING US WITH INVISIBLE FISH.



BUT GAME THEORISTS DISCOVERED **NEW** COMPLEXITIES RELATED TO ISSUES LIKE **ASYMMETRIC INFORMATION**...

THEY KNOW THE CAR THEY'RE SELLING IS A PANDA OR A LEMON.

ALL I DON'T KNOW

...AND THEY KNOW THAT I DON'T KNOW

...AND IF A... GOES DOWNHILL FROM HERE!



...AND THESE COMPLEXITIES MADE ECONOMISTS LIKE **JOSEPH STIGLITZ**, WHO SHARED THE 2001 NOBEL PRIZE, MUCH LESS OPTIMISTIC ABOUT THE BIG QUESTION.

SOMETIMES THE INVISIBLE HAND IS INVISIBLE BECAUSE IT'S NOT THERE.

CONGRATULATIONS, YOU WIN THE NOBEL PRIZE!



THEN, AT THE **END OF THE 20TH CENTURY**, THE BIG QUESTION IN MICROECONOMICS...

...WAS JOINED BY AN **EVEN MORE FUNDAMENTAL QUESTION**:

UNDER WHAT CIRCUMSTANCES DO INDIVIDUALS ACT LIKE OPTIMIZING INDIVIDUALS ANYWAY?

UNDER WHAT CIRCUMSTANCES DO PEOPLE REALLY ACT LIKE OPTIMIZING INDIVIDUALS ANYWAY?



THIS NEW QUESTION LIES AT THE INTERSECTION OF ECONOMICS AND PSYCHOLOGY, WHICH EXPLAINS WHY A **PSYCHOLOGIST, DANIEL KAHNEMAN**, SHARED THE 2002 NOBEL PRIZE IN ECONOMICS.



HUMAN BEINGS ARE NOT ALWAYS RATIONAL.

CONGRATULATIONS, YOU WIN THE NOBEL PRIZE!



THIS NEW FIELD OF **BEHAVIORAL ECONOMICS** IS YIELDING VALUABLE INSIGHTS ABOUT **IRRATIONAL HUMAN BEHAVIOR**.

I KNOW I SHOULD SAVE FOR MY RETIREMENT, BUT I JUST CAN'T REDUCE MY CURRENT CONSUMPTION!

I HAD THAT SAME PROBLEM, BUT NOW I'VE COMMITTED TO SAVING PART OF MY FUTURE SALARY INCREASES...

...IT'S CALLED **SAVE MORE LATER!**



BUT ALL THIS DOESN'T MEAN THAT
THE **OPTIMIZING INDIVIDUAL**
MODEL IS DEAD!

OKAY, SO I'M NOT
ALWAYS RATIONAL.

BUT MOST OF THE TIME
I DO ALL RIGHT: I LOOK
AT MY OPTIONS AND PICK
THE BEST ONE!

ON THE CONTRARY, THE **OPTIMIZING INDIVIDUAL** MODEL IS STILL INCREDIBLY
HELPFUL FOR UNDERSTANDING **MARKETPLACE BEHAVIOR...**

PROFIT
MAXIMIZATION...

...IS ALL ABOUT THINKING AT THE
MARRRRRH-GIN!

... AND IT CAN EVEN HELP US UNDERSTAND **NON-MARKET SITUATIONS**
LIKE CRIME AND ADDICTION AND PERSONAL RELATIONSHIPS!

LET'S MAXIMIZE THE
PRESENT VALUE OF OUR
JOINT UTILITY FUNCTION!

I LOVE IT WHEN YOU
TALK ECONOMICS
TO ME!

THESE UNEXPECTED APPLICATIONS
OF THE **OPTIMIZING INDIVIDUAL**
MODEL WON **GARY BECKER** THE
NOBEL PRIZE IN 1992.

SOMETIMES
CRIME DOES
PAY.

CONGRATULATIONS,
YOU WIN THE
NOBEL PRIZE!

AS WE CONTINUE INTO THE 21ST CENTURY,
THE BIG QUESTION IN MICROECONOMICS
STILL LOOMS LARGE:

UNDER WHAT
CIRCUMSTANCES
DOES **INDIVIDUAL**
OPTIMIZATION LEAD TO
OUTCOMES THAT ARE
GOOD FOR THE
GROUP AS A
WHOLE?



AS WE'VE SEEN, THERE'S NO SIMPLE ANSWER TO THIS QUESTION,
BUT ECONOMISTS DO HAVE A LOT TO SAY ABOUT IT...

IF YOU THINK FREE MARKETS
NEVER WORK, YOU NEED TO
TAKE AN ECONOMICS CLASS!

AND IF YOU THINK FREE
MARKETS ALWAYS WORK,
YOU NEED TO TAKE ANOTHER
ECONOMICS CLASS!



... AND ECONOMIC INSIGHTS CAN HELP US BETTER UNDERSTAND
KEY ISSUES IN THE YEARS AHEAD.

WHAT SHOULD WE
DO ABOUT CLIMATE
CHANGE?

FREE TRADE?

TAX POLICY?

THE
MINIMUM
WAGE?

HEALTH
INSURANCE?



AS WE CAN SEE FROM DISCUSSIONS ABOUT HEALTH CARE, ECONOMISTS
DON'T ALWAYS AGREE ABOUT EVERYTHING...

ON THE ONE HAND,
FREE MARKETS DON'T WORK
PERFECTLY. PROBLEMS LIKE
ADVERSE SELECTION MEAN
THAT YOU'RE NOT GOING
TO GET A PARETO EFFICIENT
OUTCOME FROM FREE-MARKET
COMPETITION. AND IN A
SINGLE-PAYER SYSTEM THE
GOVERNMENT COULD BRING
DOWN DRUG PRICES BY USING
ITS MONOPOLY POWER AS
THE ONLY BUYER THAT'S
WILLING TO PAY FOR THE
MEDICINE.

... ON THE OTHER HAND,
GOVERNMENT PROGRAMS
DON'T ALWAYS WORK PERFECTLY
EITHER. THERE'S SOMETHING
TO BE SAID FOR RELYING ON
THE FISCAL DISCIPLINE THAT
COMES FROM FREE-MARKET
COMPETITION, AND DRUG
COMPANIES WILL HAVE LESS
INCENTIVE TO INVEST IN R&D
IF THE GOVERNMENT IS GOING
TO LIMIT THEIR PROFITS.

DOES ANYONE KNOW
WHERE I CAN FIND A
**ONE-HANDED
ECONOMIST?**



... BUT ECONOMISTS **HAVE** FIGURED OUT **CREATIVE AND POWERFUL
SOLUTIONS** TO SOME OF OUR MOST DAUNTING PROBLEMS.

CLIMATE CHANGE IS
A CLASSIC TRAGEDY
OF THE COMMONS
SITUATION.

BUT WE CAN HARNESS
MARKET FORCES
TO SAVE THE
ENVIRONMENT...

... BY MAKING
**POLLUTING
EXPENSIVE!**



THERE'S PLENTY MORE **YOU** CAN LEARN ABOUT ALL THESE ISSUES!
AND WHEN YOU'VE HAD ENOUGH OF **MICROECONOMICS**, THERE'S ALWAYS...

MACROECONOMICS!

THAT'S WHAT OUR
NEXT BOOM IS GOING
TO BE ABOUT...

...JUST AS SOON AS
WE FIGURE IT OUT
OURSELVES!





GLOSSARY



ADVERSE SELECTION

A SITUATION IN WHICH ASYMMETRIC INFORMATION (SELLERS KNOW SOMETHING BUYERS DON'T OR VICE-VERSA) CAUSES PROBLEMS WITH TRADE, AS IN THE USED CAR MARKET OR THE MARKET FOR HEALTH INSURANCE: 48–52

ANNUITY

A STREAM OF ANNUAL PAYMENTS FOR A CERTAIN NUMBER OF YEARS: 34

ASYMMETRIC INFORMATION

SEE ADVERSE SELECTION.

AUCTIONS

A TRADING METHOD THAT IS USED TO SELL EVERYTHING FROM ELECTRICITY TO EBAY COLLECTIBLES: 103–16



BEHAVIORAL ECONOMICS

A NEW FIELD THAT COMBINES ECONOMICS AND PSYCHOLOGY: 200

CAKE CUTTING

A FAIR-DIVISION GAME THAT GENERALIZES DIVORCE SETTLEMENTS, ALLOCATIONS OF FISHING PERMITS, AND MANY OTHER SITUATIONS: 67–78 AND PARETO EFFICIENCY: 85, 88

CAP-AND-TRADE AND CARBON TAXES

TWO TYPES OF ECONOMIC POLICIES THAT CAN BE USED TO REDUCE CARBON EMISSIONS BY MAKING POLLUTING EXPENSIVE: SIMILAR METHODS HAVE BEEN USED TO REDUCE OVERFISHING: 190–92 AND COASE THEOREM: 100





COASE THEOREM

THE WORLD'S MOST FAMOUS TAUTOLOGY. THE COASE THEOREM SAYS THAT IF THERE IS NOTHING TO STOP PEOPLE FROM TRADING, NOTHING WILL STOP PEOPLE FROM TRADING, AND SO THEY WILL CONTINUE TRADING UNTIL THEY REACH A PARETO EFFICIENT OUTCOME. 60

AND PARETO EFFICIENCY? 87

AND TRAGEDY OF THE COMMONS? 100

AND COMPETITIVE MARKETS? 182

COMPARATIVE ADVANTAGE

THE IDEA THAT TWO INDIVIDUALS (OR TWO COUNTRIES!) CAN BOTH GAIN FROM TRADE EVEN IF ONE OF THEM IS BETTER THAN THE OTHER AT EVERYTHING? 56–58

COMPETITIVE MARKETS

MARKETS WITH LOTS OF BUYERS AND LOTS OF SELLERS, EACH ONE SMALL RELATIVE TO THE MARKET AS A WHOLE 118–24

AND LAW OF ONE PRICE? 130

AND COASE THEOREM? 182

AND PUPPIES? 183–89

AND LOW PRICES? 196



DECISION THEORY

THE STUDY OF INDIVIDUAL OPTIMIZATION; COMPARE WITH GAME THEORY AND PRICE THEORY. 8

DECISION TREE

A VISUAL REPRESENTATION OF THE CHOICES FACING AN INDIVIDUAL 17

DEMAND CURVE

A CURVE DESCRIBING HOW MANY UNITS OF SOME PRODUCT ONE OR MORE BUYERS WANT TO BUY AT DIFFERENT MARKET PRICES 134–35

SHIFTS IN? 140

RELATION TO MARGINAL BENEFIT CURVE? 162–63

DIVERSIFICATION

THE IDEA THAT YOU SHOULDN'T PUT ALL YOUR EGGS IN ONE BASKET? 47

WITH INDEX FUNDS? 63

DOMINANT STRATEGY

A STRATEGY (SUCH AS CONFESSING IN THE PRISONERS' DILEMMA) THAT GENERATES THE BEST OUTCOME FOR A PLAYER REGARDLESS OF THE OTHER PLAYERS' STRATEGIES. 94

NOT ALL GAMES HAVE THEM? 101

AND AUCTIONS? 110–11

EFFICIENT MARKET HYPOTHESIS

THE THEORY THAT AN INDIVIDUAL INVESTOR CAN'T CONSISTENTLY BEAT THE MARKET? 63





ELASTICITY

A FORMULA FOR MEASURING THE CHANGE IN ONE VARIABLE PRODUCED BY A CHANGE IN A DIFFERENT VARIABLE. THE X ELASTICITY OF Y MEASURES THE PERCENTAGE CHANGE IN Y PRODUCED BY A 1% INCREASE IN X: 169-80

A PERFECTLY ELASTIC LONG-RUN SUPPLY CURVE MEANS THAT THE LONG-RUN COST OF PRODUCING THE 1 MILLIONTH UNIT IS THE SAME AS THE MARGINAL COST OF PRODUCING THE 100TH UNIT: 176-79

THE FORMULA FOR ELASTICITY INVOLVES CALCULUS, BUT THERE ARE TWO ALGEBRAIC APPROXIMATIONS. ACCORDING TO ONE OF THESE APPROXIMATIONS, YOU CAN CALCULATE (SAY) THE PRICE ELASTICITY OF DEMAND AT POINT A (WITH PRICE P_A AND QUANTITY Q_A) BY PICKING A NEARBY POINT B ON THE DEMAND CURVE (WITH PRICE P_B AND QUANTITY Q_B) AND CALCULATING:

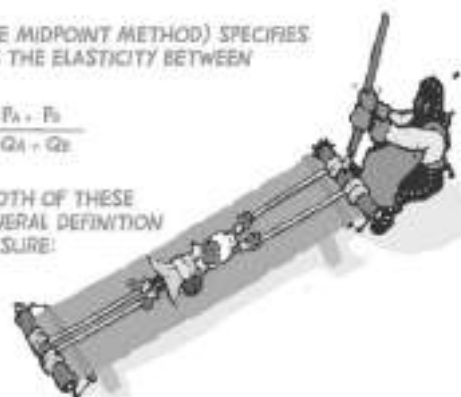
$$\text{ELASTICITY}_A = \frac{Q_B - Q_A}{P_B - P_A} \times \frac{P_A}{Q_A}$$

THE OTHER APPROXIMATION (CALLED THE MIDPOINT METHOD) SPECIFIES TWO POINTS (A AND B) AND CALCULATES THE ELASTICITY BETWEEN THEM AS:

$$\text{ELASTICITY}_{AB} = \frac{Q_B - Q_A}{P_B - P_A} \times \frac{P_A + P_B}{Q_A + Q_B}$$

ALTHOUGH IT MAY NOT LOOK LIKE IT, BOTH OF THESE CALCULATIONS MATCH UP WITH THE GENERAL DEFINITION OF ELASTICITY BECAUSE THEY BOTH MEASURE:

% CHANGE IN Q
% CHANGE IN P



EVOLUTIONARY GAME THEORY

THE APPLICATION OF GAME THEORY TO EVOLUTION: 70

EXPECTED VALUE

A MATHEMATICAL MEASURE OF THE "AVERAGE" OUTCOME OF A RISKY SITUATION: 42-43
AND LAW OF LARGE NUMBERS: 46

THE FORMULA IS

$$\text{EXPECTED VALUE} = \sum_{\text{OUTCOMES}} \text{PROBABILITY (i)} \times \text{VALUE (i)}$$

THE GREEK LETTER Σ ("SIGMA") IS THE MATHEMATICAL NOTATION FOR SUMMATION. E.G.,

$$\sum_{i=1,2,3} i^2 = 1^2 + 2^2 + 3^2 = 14$$



EXTERNAL COST OR EXTERNALITY

A COST INCURRED BY A THIRD PARTY, AS WITH POLLUTION: 188–89

FAIR BET

A BET WITH AN EXPECTED VALUE OF ZERO: 42

GAME THEORY

THE STUDY OF STRATEGIC INTERACTIONS BETWEEN TWO OR MORE INDIVIDUALS: 67–71

CONTRAST WITH PRICE THEORY: 117–18, 125

**INFLATION**

A GENERAL INCREASE IN PRICES OVER TIME: 30

INTEREST RATE

THE RATE A BANK CHARGES YOU TO BORROW MONEY, OR THE RATE A BANK PAYS YOU TO SAVE MONEY: 31

AND COMPOUND INTEREST: 33

INVISIBLE HAND

ADAM SMITH'S METAPHOR FOR HOW INDIVIDUAL SELF-INTEREST CAN LEAD TO GOOD OUTCOMES FOR THE GROUP AS A WHOLE: 13

CONTRAST WITH TRAGEDY OF THE COMMONS: 12–14, 198–99

AND COASE THEOREM: 61–62

INVISIBLE HAND THEOREM: 183

AND COMPETITION: 196

IS IT REALLY THERE?: 198–99

LAW OF LARGE NUMBERS

A MATHEMATICAL THEOREM THAT SAYS REPEATING A BET A LARGE NUMBER OF TIMES IS LIKELY TO PRODUCE AN AVERAGE OUTCOME CLOSE TO THE EXPECTED VALUE: 46–47

LAW OF ONE PRICE

AN IDEA IN ECONOMIC THEORY WHICH SAYS THAT A COMMODITY THAT IS EASY TO TRADE WILL SELL FOR APPROXIMATELY THE SAME PRICE ALL OVER THE WORLD: 62

MARGINAL ANALYSIS

THE IDEA THAT IF AN INDIVIDUAL IS OPTIMIZING, HE OR SHE CANNOT DO BETTER BY MAKING SMALL CHANGES, SUCH AS BUYING OR SELLING ONE MORE OR ONE LESS: 20–21

AND PRICING DECISIONS: 25–26





MARGINAL BENEFIT AND MARGINAL COST CURVES

CURVES THAT DESCRIBE THE EXTRA COST FOR SELLERS TO PRODUCE ONE MORE UNIT, OR THE MAXIMUM WILLINGNESS BY BUYERS TO PAY TO CONSUME ONE MORE UNIT: 158-68
AND PERFECTLY ELASTIC LONG-RUN SUPPLY: 177
AND THE COASE THEOREM: 182
AND POLLUTION: 189-90



MARKET EQUILIBRIUM PRICE

THE PRICE AT WHICH THE SUPPLY AND DEMAND CURVES INTERSECT. AT THIS PRICE, THE AMOUNT THAT BUYERS WANT TO BUY IS EQUAL TO THE AMOUNT THAT SELLERS WANT TO SELL: 136-39
AND SEESAW: 142



MARKET FAILURE

A SITUATION IN WHICH INDIVIDUAL OPTIMIZATION DOES NOT LEAD TO A PARETO EFFICIENT OUTCOME FOR THE GROUP AS A WHOLE AS WITH POLLUTION OR OVERFISHING: 188-89, 199



MARKET POWER

THE ABILITY OF A SINGLE BUYER OR SELLER TO AFFECT A MARKET BECAUSE OF ITS SIZE; CONTRAST WITH PRICE-TAKER: 120
AND ANTITRUST POLICY: 187



MONOPOLY AND MONOPSONY

A MARKET WITH ONLY ONE SELLER (**MONOPOLY**) OR ONLY ONE BUYER (**MONOPSONY**). THESE ARE THE MOST EXTREME FORMS OF MARKET POWER: 120
MONOPOLY PRICING: 199



PARETO

THREE TERMS NAMED AFTER ITALIAN ECONOMIST VILFREDO PARETO. ONE OUTCOME IS A **PARETO IMPROVEMENT** OVER ANOTHER IF SWITCHING MAKES AT LEAST ONE PERSON BETTER OFF AND MAKES NOBODY WORSE OFF. ANY PARTICULAR OUTCOME IS EITHER **PARETO INEFFICIENT** OR **PARETO EFFICIENT** DEPENDING ON WHETHER THERE IS OR IS NOT ANY **PARETO IMPROVEMENT** OVER IT, I.E., ON WHETHER THERE IS OR IS NOT ANOTHER OUTCOME THAT MAKES AT LEAST ONE PERSON BETTER OFF WITHOUT MAKING ANYBODY WORSE OFF: 80-86

AND COASE THEOREM: 87

AND PRISONERS' DILEMMA: 95-96

AND COMPETITIVE MARKETS: 183-84



PAYOFF MATRIX

A VISUAL REPRESENTATION OF SIMULTANEOUS-MOVE GAMES: 90

PRESENT VALUE

THE AMOUNT OF MONEY YOU NEED TO PUT IN THE BANK TODAY IN ORDER TO FINANCE ONE OR MORE FUTURE PAYMENTS: 32

PRICE ELASTICITY

SEE ELASTICITY.



PRICE-TAKER

A BUYER OR SELLER THAT IS SMALL RELATIVE TO THE MARKET AS A WHOLE AND THEREFORE TAKES THE MARKET PRICE AS GIVEN: 124

PRICE THEORY

THE STUDY OF COMPETITIVE MARKET INTERACTIONS: 118
CONTRAST WITH GAME THEORY: 117-18, 125

PRISONERS' DILEMMA

A TWO PERSON GAME IN WHICH EACH PLAYER HAS A DOMINANT STRATEGY AND THOSE DOMINANT STRATEGIES PRODUCE A PARETO INEFFICIENT OUTCOME: 92-96
AND TRAGEDY OF THE COMMONS: 97
AND COASE THEOREM: 100

RISE

A SITUATION FEATURING UNCERTAIN OUTCOMES, AS WITH A COIN FLIP: 40-41

SIMULTANEOUS-MOVE GAME

A GAME IN WHICH PLAYERS MOVE AT THE SAME TIME: 89-102

SMITH, ADAM

AUTHOR OF *THE WEALTH OF NATIONS* (1776). HE COINED THE "INVISIBLE HAND" METAPHOR: 13, 196

SUNK COST

AN ITEM THAT IS IN ALL THE PAYOFF BOXES IN A DECISION TREE: 18-19
AND RESEARCH AND DEVELOPMENT COSTS: 24, 26

SUPPLY CURVE

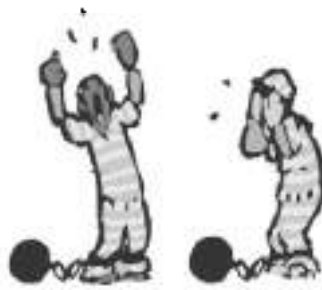
A CURVE DESCRIBING HOW MANY UNITS OF SOME GOOD ONE OR MORE SELLERS WANT TO SELL AT DIFFERENT MARKET PRICES: 132-33
SHIFTS IN: 147
RELATION TO MARGINAL COST CURVE: 160-61

SUPPLY AND DEMAND

THE IDEA THAT PRICES IN COMPETITIVE MARKETS ARE DETERMINED BY THE INTERSECTION OF THE MARKET SUPPLY CURVE AND THE MARKET DEMAND CURVE: 131
AS SEESAW: 142, 173
AND MARGINAL COST AND MARGINAL BENEFIT CURVES: 158, 168

TAXES

A FAVORITE SUBJECT OF STUDY FOR ECONOMISTS: 143-54
ECONOMIC INCIDENCE V. LEGAL INCIDENCE: 146, 154, 172-73
TAX EQUIVALENCE: 152-54
AND MARGINS: 164-67
AND ELASTICITY: 172-73
AND POLLUTION: 190-92





TRADE

EXCHANGE BETWEEN WILLING PARTIES 54–61
AND PARETO EFFICIENCY 87–88

TRAGEDY OF THE COMMONS

A GENERALIZATION OF THE PRISONERS' DILEMMA, WITH DOMINANT STRATEGIES LEADING TO PARETO INEFFICIENT OUTCOMES, AS IN TRAFFIC CONGESTION, OVERFISHING, OR POLLUTION 97–100
CONTRAST WITH INVISIBLE HAND 11–14, 196–99
AND EXTERNAL COSTS 109

UTILITY

A CONSTRUCT THAT IS SIMILAR TO HAPPINESS; ECONOMISTS ASSUME THAT INDIVIDUALS MAXIMIZE UTILITY JUST AS FIRMS MAXIMIZE PROFIT 201

VARIANCE

A MATHEMATICAL MEASUREMENT OF RISK 44–45

WIDGET

A MYSTERIOUS COMMODITY FOUND ONLY IN ECONOMICS BOOKS 9





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—N. GREGORY MANKIEW, PROFESSOR OF ECONOMICS, HARVARD UNIVERSITY, AND AUTHOR OF *PRINCIPLES OF ECONOMICS*

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