THE PRICE ELASTICITY OF THE DEMAND FOR WATER IN UTAH

AN ECONOMIST'S VIEW

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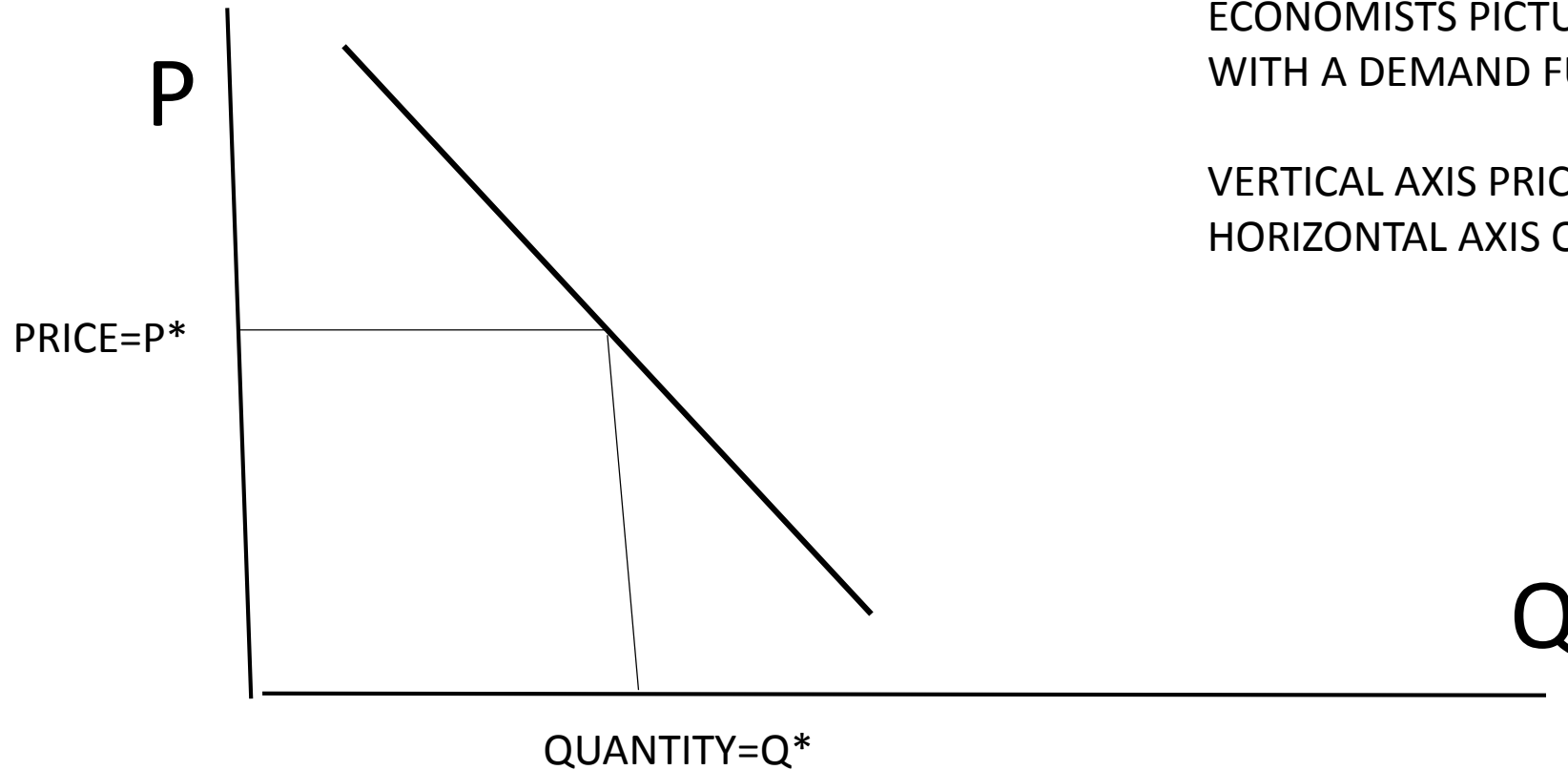Department of Economics, University of Utah

PRICES MATTER

A BASIC IDEA IN ECONOMICS IS THAT **PRICES MATTER**

WHEN PRICES INCREASE QUANTITY DEMANDED DECREASES
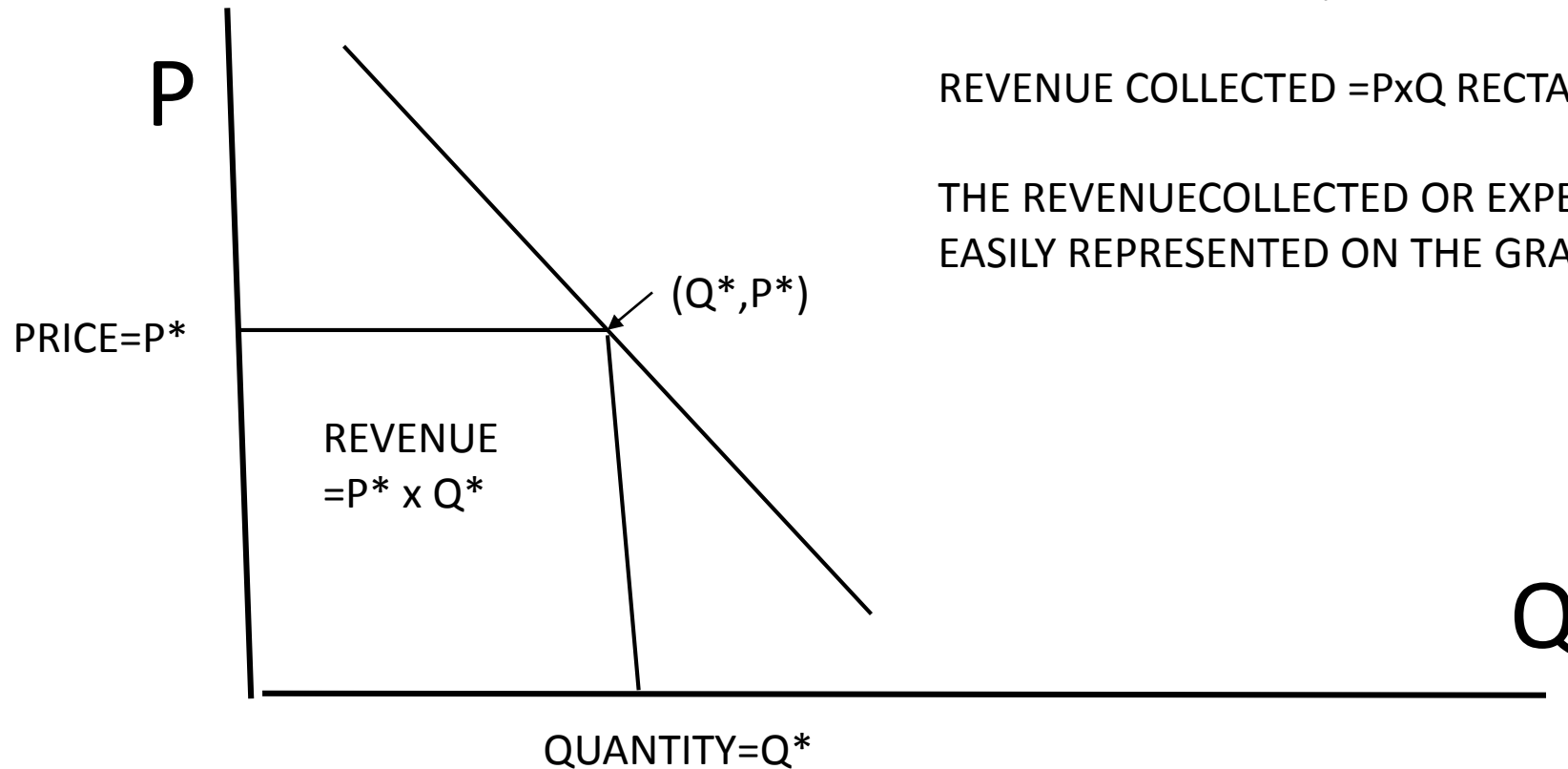WHEN PRICES DECREASE QUANTITY DEMANDED INCREASES

DEMAND FUNCTION

P

PRICE=P*

QUANTITY=Q*

Q

ECONOMISTS PICTURE THESE IDEAS
WITH A DEMAND FUNCTION

VERTICAL AXIS PRICE, P
HORIZONTAL AXIS QUANTITY, Q

DEMAND FUNCTION
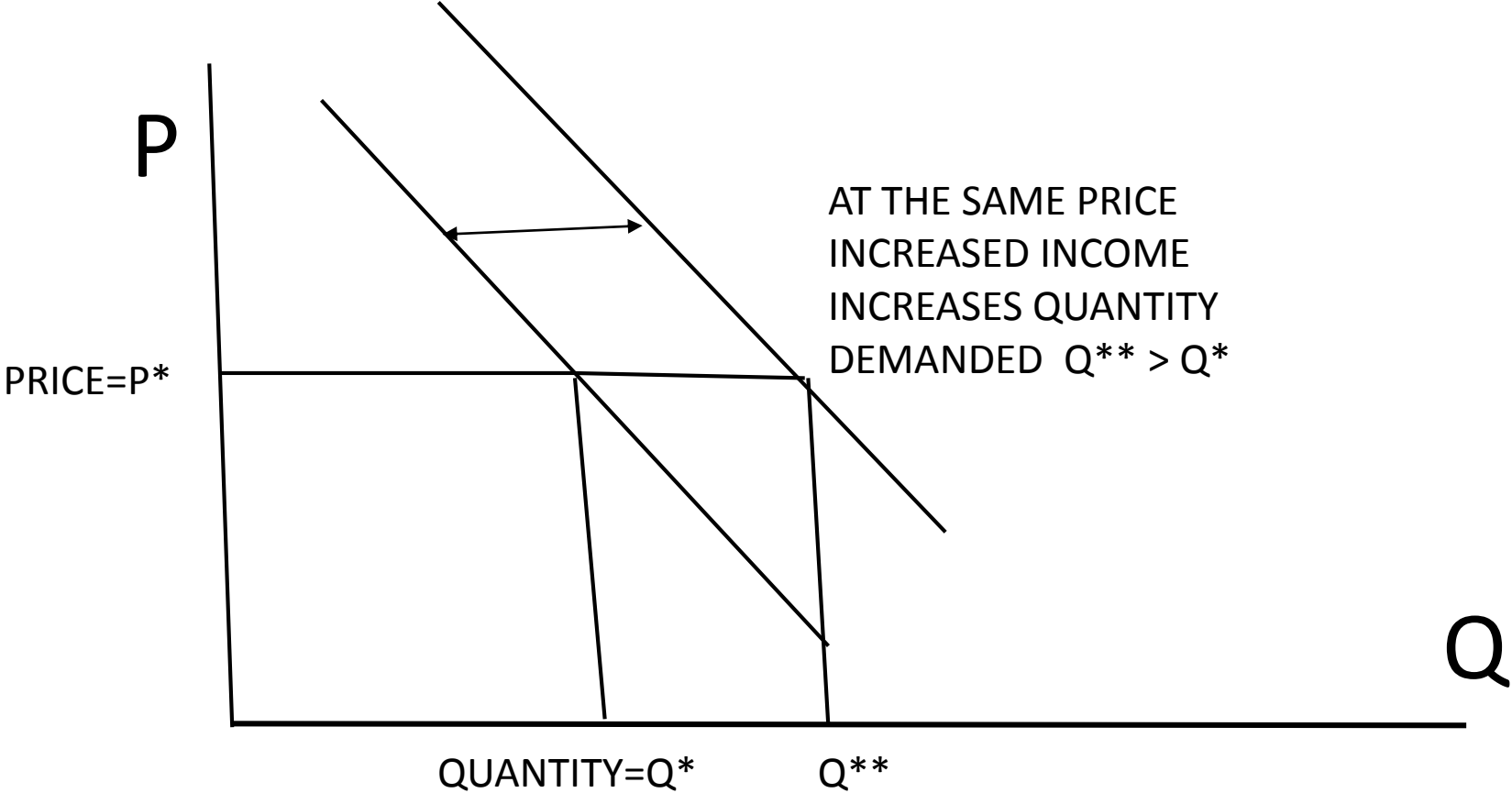
LINE SLOPES DOWN (NEGATIVE SLOPE)

REVENUE COLLECTED =PxQ RECTANGULAR AREA

THE REVENUECOLLECTED OR EXPENDITURE IS ALSO EASILY REPRESENTED ON THE GRAPH

P

PRICE=P*

(Q*,P*)

REVENUE
=P* x Q*

Q

QUANTITY=Q*

DEMAND FUNCTION WITH INCOME ADDED

P

AT THE SAME PRICE
INCREASED INCOME
INCREASES QUANTITY
DEMANDED Q** > Q*

PRICE=P*

Q

QUANTITY=Q*   Q**

ELASTICITY

- THE WORD ELASTICITY SOUNDS STRANGE TO NON-ECONOMISTS, BUT IT IS IMPORTANT IN MANY POLICY APPLICATIONS
- MEASURE OF THE RESPONSIVENESS OF ONE VARIABLE TO ANOTHER
- PRICE ELASTICITY OF DEMAND MEASURES THE RESPONSIVENESS OF QUANTITY DEMANDED TO CHANGES IN PRICE
- FIRST I DEFINE THIS TERM
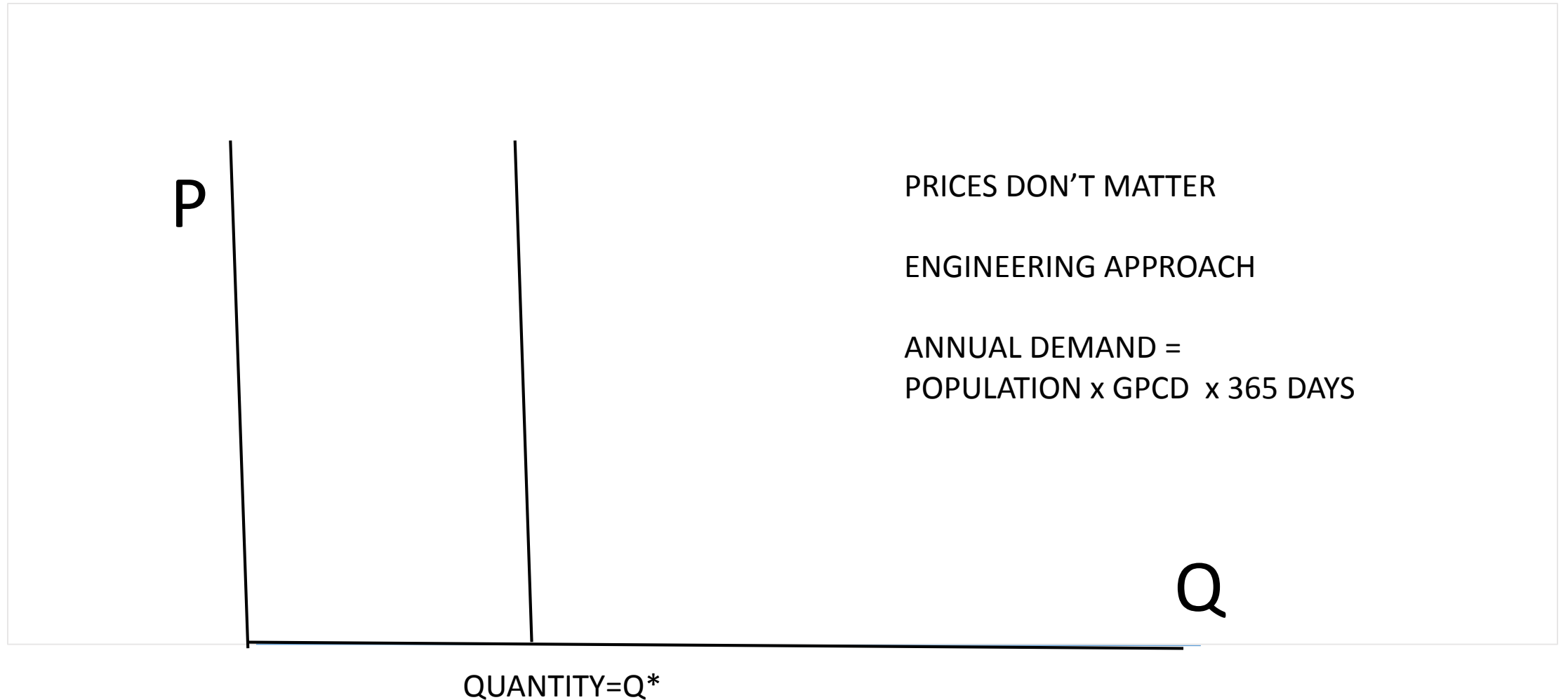- THEN I WILL CLARIFY THE MEANING THROUGH EXAMPLES

DEFINITION

- PRICE ELASTICITY = $\dfrac{(\% \text{ CHANGE IN QUANTITY})}{(\% \text{ CHANGE IN PRICE})}$

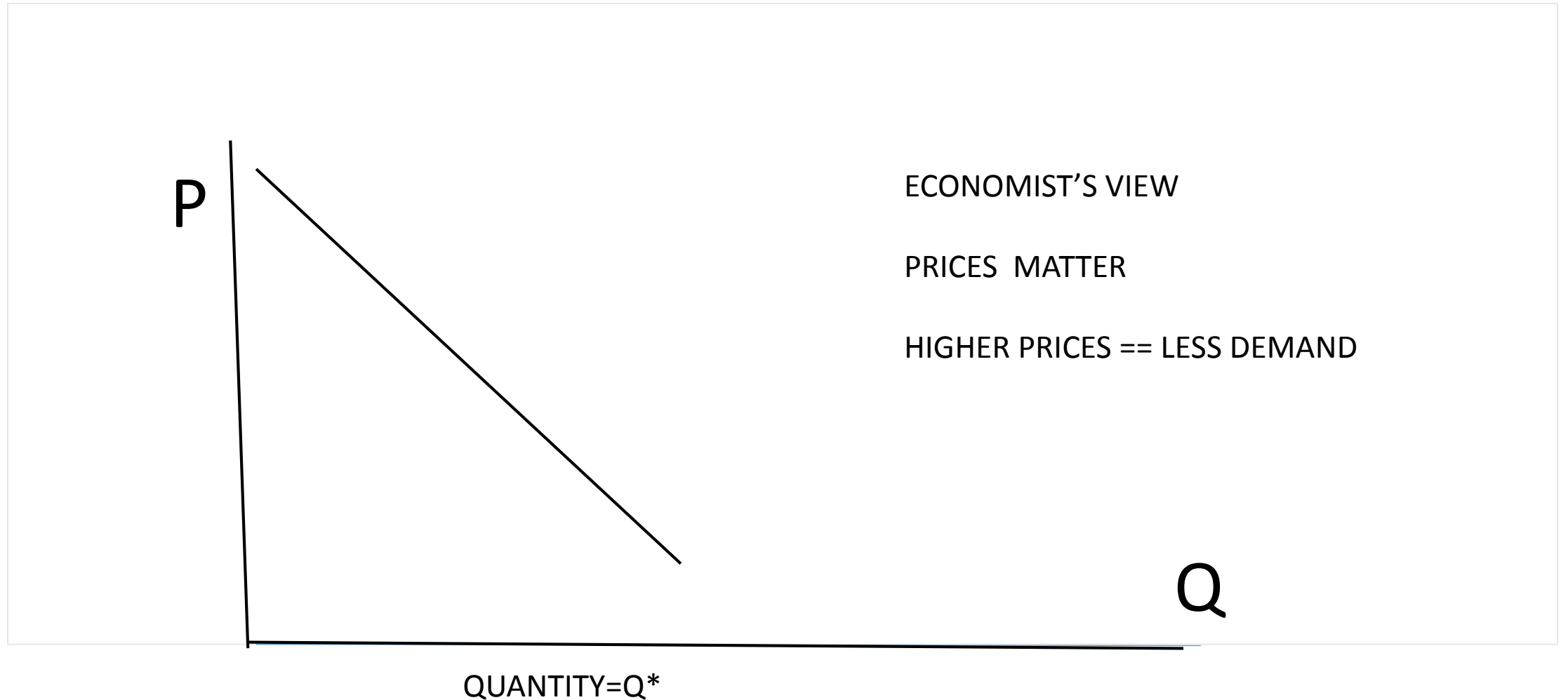NOTE SINCE DEFINITION IS IN PERCENT, IT DOES NOT DEPEND ON UNITS OF MEASUREMENT (AF, CCF, 1000 GALLONS)

REAL PRICES USED. INFLATION NOT A FACTOR

EASY COMPARISON AMONG STUDIES
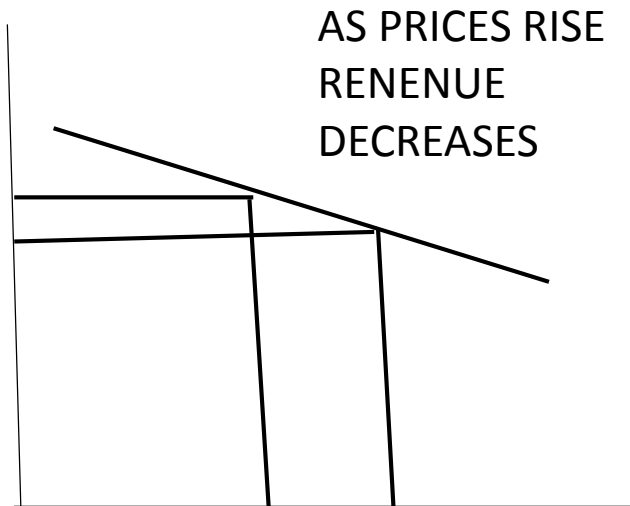
ZERO PRICE ELASTICITY

P

PRICES DON'T MATTER

ENGINEERING APPROACH

ANNUAL DEMAND =
POPULATION x GPCD x 365 DAYS

Q

QUANTITY=Q*

NEGATIVE PRICE ELASTICITY

P

ECONOMIST'S VIEW

PRICES MATTER

HIGHER PRICES == LESS DEMAND

Q

QUANTITY=Q*

MAGNITUDE OF PRICE ELASTICITY

ELASTIC DEMAND
- |ELASTICITY |>1

AS PRICES RISE
RENENUE
DECREASES

INELASTIC DEMAND
- |ELASTICITY |<1

P

AS PRICES RISE
REVENUE
INCREASES

Q
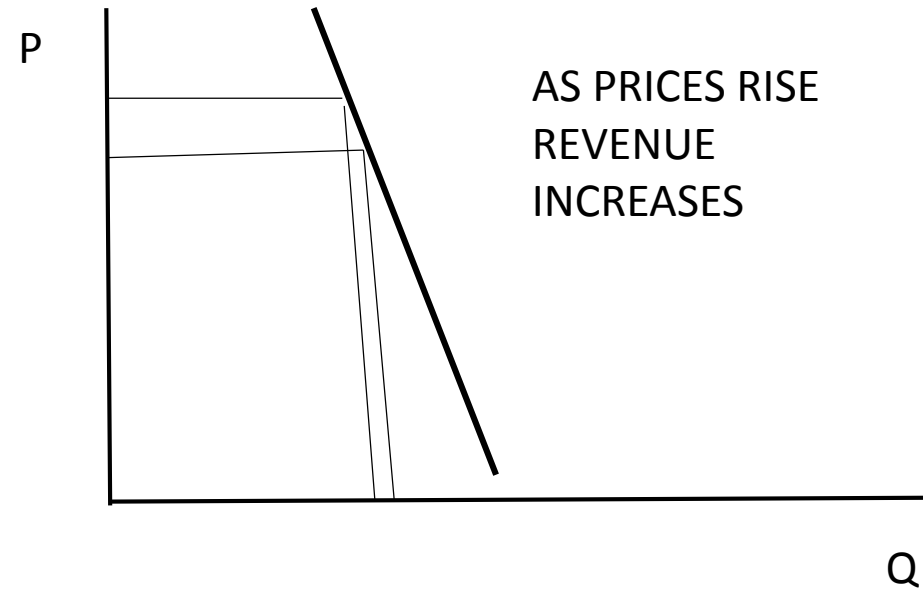
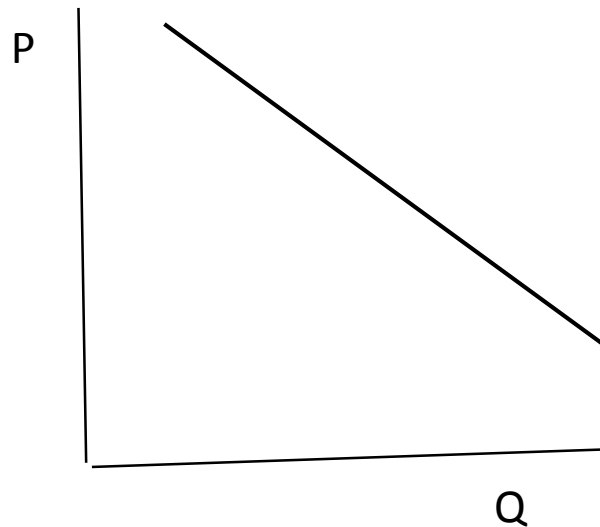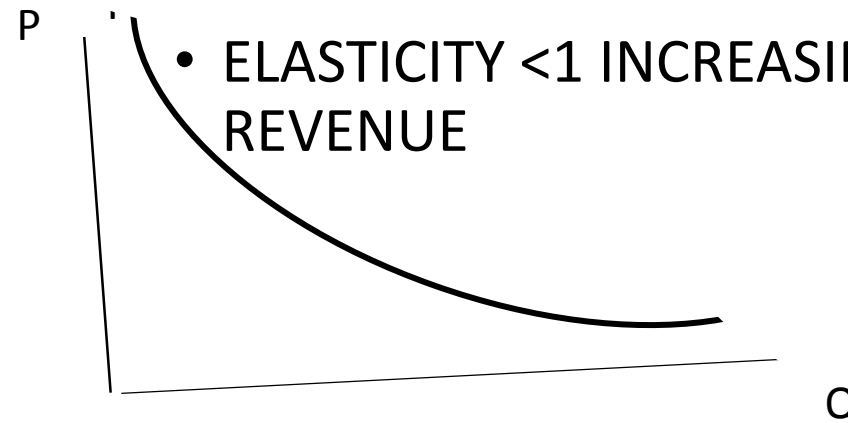# EFFECT OF FUNCTIONAL FORM ON ELASTICITY

LINEAR DEMAND

- ELASTICITY VARIES
- EVALUATED AT MEAN

CONSTANT ELASTICITY

- DEMAND FUNCTIONS WITH CONSTANT ELASTICITY EXIST
  - LOGARITHMIC FUNCTION
  - ELASTICITY =1 CONSTANT REVENUE
  - ELASTICITY <1 INCREASING REVENUE

P

Q

P

Q

What does economics say about water demand

- Price elasticity will be negative
- Price elasticity will be small. Demand will be inelastic with respect to price
- Income elasticity will be positive
- Income elasticity will be small. Demand will be inelastic with respect to income

WHAT WOULD ECONOMICS SAY ABOUT THE ELASTICITY OF WATER EMPIRICALLY

- META-ANALYSIS
- CASE STUDIES

META-ANALYSIS

- 2002 STUDY   314 CASES
  - PRICE ELASTICITY
    - MEAN -0.41
    - MEDIAN -0.35
  - INCOME ELASTICITY
    - MEAN .43
    - MEDIAN .24
- 1997 STUDY   124 CASES
  - PRICE ELASTICITY
    - 90% BETWEEN 0 AND -0.74
    - MEAN -0.51

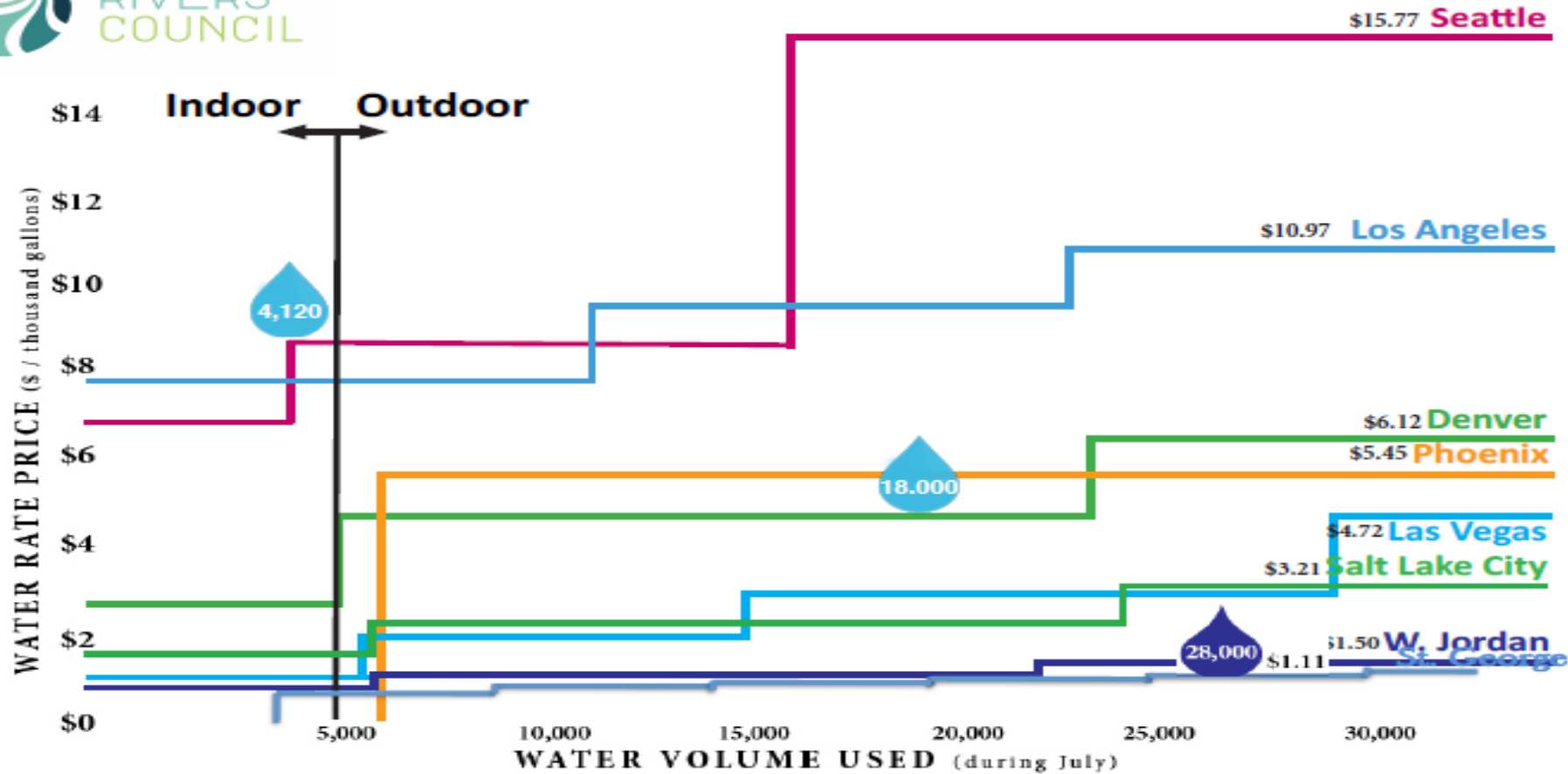- VALUES CONSISTENT WITH PRIORS, BUT WHY THE VARIATION

DIFFERENCES AMONG STUDIES

- PRICE VARIABLE
- INDIVIDUAL / AGGREGATE
- SEASONAL / ANNUAL
- LONG RUN / SHORT RUN
- INCLUDE INCOME
- INCLUDE RAINFALL
- LOCATION (SOUTHWEST U.S)

INCREASING BLOCK RATES

Water Prices in Western Cities

UTAH RIVERS COUNCIL

Indoor | Outdoor

$15.77 Seattle
$10.97 Los Angeles
$6.12 Denver
$5.45 Phoenix
$4.72 Las Vegas
$3.21 Salt Lake City
$1.50 W. Jordan
$1.11 St. George

4,120
18,000
28,000

WATER RATE PRICE ($ / thousand gallons)

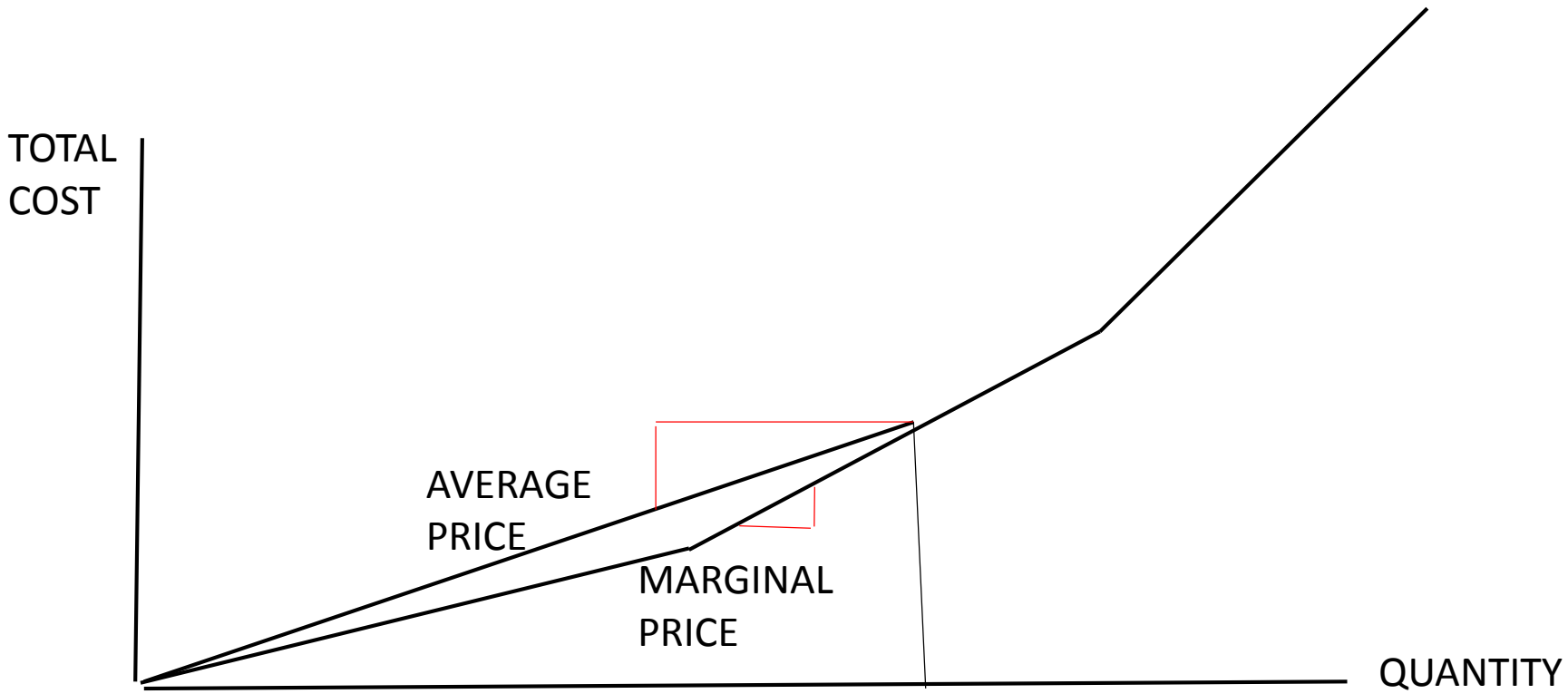WATER VOLUME USED (during July)

Updated 6/14/17

HOW DO YOU DEFINE THE PRICE OF WATER
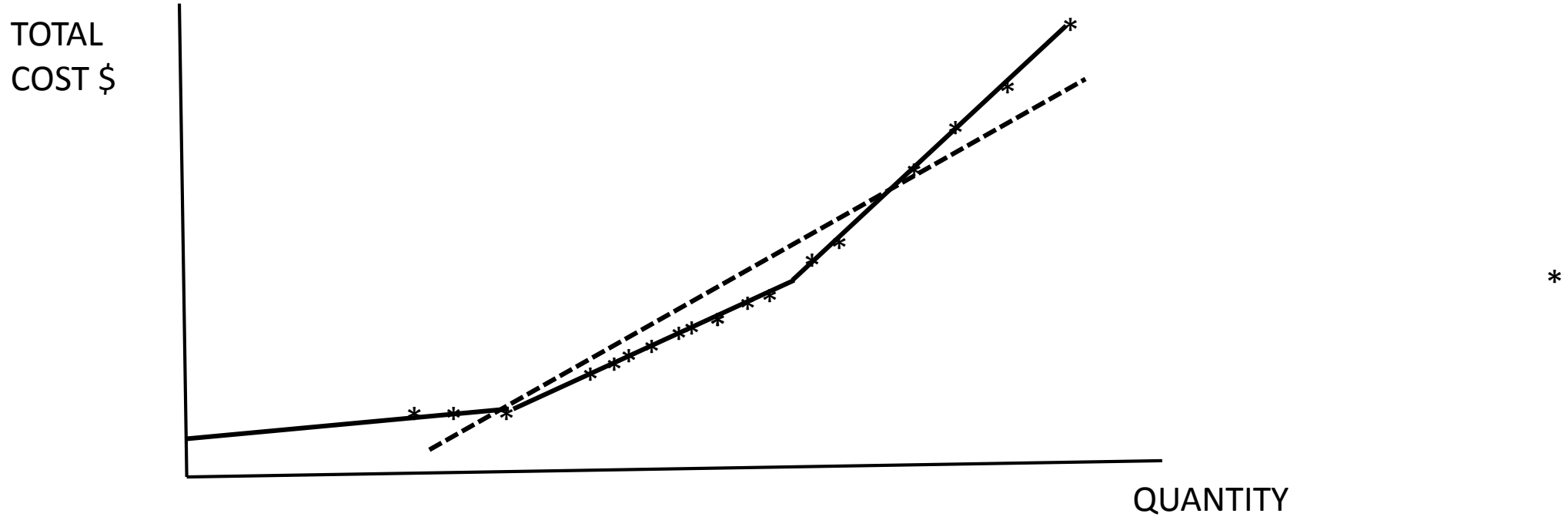
- 6 WAYS TO DEFINE PRICE
    - AVERAGE PRICE (AP)
    - MARGINAL PRICE (MP)
    - SHIN PRICE (SHIN)
    - TOTAL REVENUE (BILLINGS)
    - INSTRUMENTAL VARIABLES (IV)
    - DISCRETE – CONTINUOUS CHOICE (DUC)

Average Price (AP), Marginal Price (MP)

Total Cost - Billings

- PRICE ELASTICITY

SHIN PRICE

- SHIN PRICE$=(MP)^a \left(\dfrac{AP}{MP}\right)^b$
- IF b=0   SHIN PRICE =MP,
- IF a=b   SHIN PRICE =AP

IV, DCC

- TAKE INTO CONSIDERATION THE SIMULTANAITY OF PRICE AND QUANTITY
- ONE CHOICE WHICH BLOCK OF THE RATE SCHEDULE
- SECOND GIVEN THE CHOSEN BLOCK WHAT IS THE DEMAND
- REQUIRES INDIVIDUAL CUSTOMER DATA
- EMPERICALLY CUSTOMERS DO BUNCH AROUND BLOCK DEMARCATIONS

RECENT STUDIES

Author	Year	Location	Price Elasticity	
COLE	2009	SLC	-0.485	
CUWCD	1995	UTAH	-0.592	
ERICKSON	1991	UTAH	-0.54	
Baerenklau, Schwabe, Dinar	2014	EASTERN MUNICIPAL WATER DISTRICT, CA	-0.69	
Baerenklau, Schwabe, Dinar	2014	SOUTHERN CA	-0.76	
Yoo, Simonit,Kinzig ,Perrings	2014	Phoenix	-0.661	
Klaiber, Smith,Kaminsky, Strong	2014	Phoenix	-0.565	
Hewitt&Hanemann	2000	Demon TX	-1.586	
Olmstead,Hanemann, & Stavins	2006	Urban US/Canada	-0.33	
Renwick&Archibald	1997	CA	-0.33	
Taylor,Mckean, Young	2004	CO	-0.416	
Olmstead	2009	Urban US/Canada	-0.61	
Cavanagh,Hanemann,Stavins	2002	Urban US/Canada	-0.49	
			-0.536468182	mean without outlier
			-0.619396154	mean total sample

SUMMARY

- PRICES MATTER
- -.4 > ELASTICITY > -0.6