

# **EITM Lectures**

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# Overview

- **Social Science Analysis**
- **Basic Building Blocks**
- **New Unified Theory**
- **Wage Inequality Model**

# Overview

- **Social Science Analysis**
- **Basic Building Blocks**
- **New Unified Theory**
- **Wage Inequality Model**

# First Principles -- 1

- **Objective**
  - **To accumulate reliable knowledge about behavioral and social phenomena**
- **Strategy**
  - **Develop framework**
  - **Theoretical analysis**
  - **Empirical analysis**

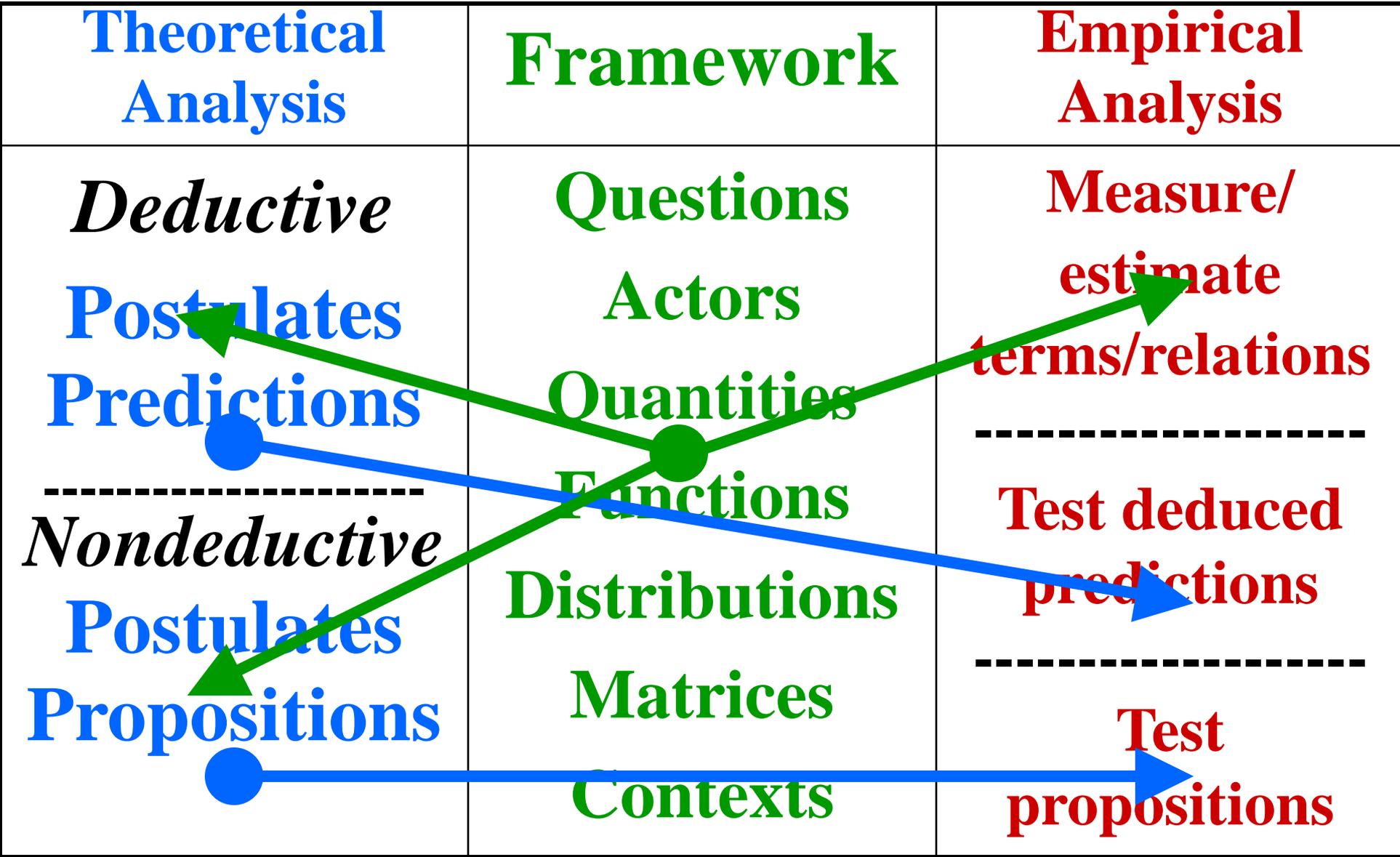
# In Other Words

- **Knowledge gained with the guiding hand of theory is more robust and reliable than knowledge obtained from**
  - **measurement without theory (Koopmans 1947)**
  - **inference without theory (Wolpin 2013)**

# Social Science Analysis

<b>Theoretical Analysis</b>	<b>Framework</b>	<b>Empirical Analysis</b>
<i>Deductive</i> <b>Postulates</b> <b>Predictions</b> -----	<b>Questions</b> <b>Actors</b> <b>Quantities</b> <b>Functions</b>	<b>Measure/estimate</b> <b>terms/relations</b> -----
<i>Nondeductive</i> <b>Postulates</b> <b>Propositions</b>	<b>Distributions</b> <b>Matrices</b> <b>Contexts</b>	<b>Test deduced predictions</b> ----- <b>Test propositions</b>

# Social Science Analysis



# **Fundamental Questions**

- 1. What do individuals and collectivities think is just, and why?**
- 2. How do ideas of justice shape determination of actual situations?**
- 3. What is the magnitude of the perceived injustice associated with given departures from perfect justice?**
- 4. What are the behavioral and social consequences of perceived injustice?**

# Justice Evaluation Function

$$J = \theta \ln \left( \frac{A}{C} \right)$$

# Justice Evaluation Function

- where  $\theta$  is the Signature Constant
  - whose sign indicates observer framing
    - positive for goods
    - negative for bads
  - whose absolute magnitude indicates observer expressiveness

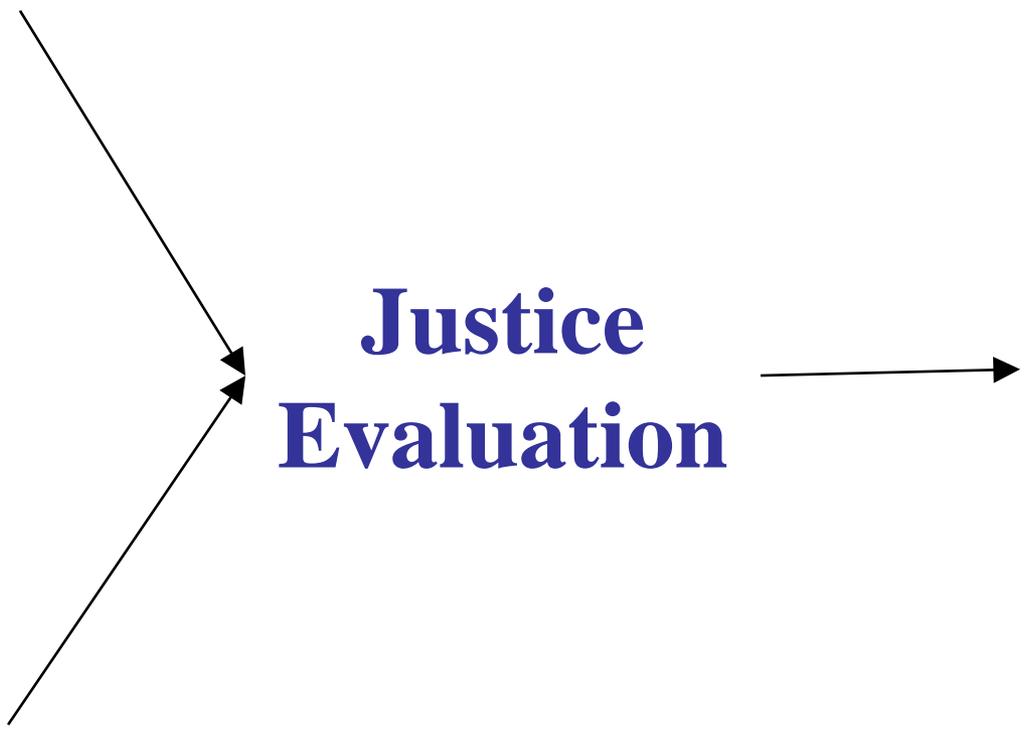
# The World of Distributive Justice

**Actual  
Reward**

**Just  
Reward**

**Justice  
Evaluation**

**Reactions  
to  
Injustice**



# Status Function

$$S = \ln \left( \frac{1}{1-r} \right)$$

# **First Principles -- 2**

- **All observed phenomena are the joint product of the operation of several forces (Newton's insight)**
- **Fundamental Drivers**
- **Basic (or MidLevel) Drivers**

# Fundamental Drivers of Human Behavior

- **To know the causes of things**
- **To judge the goodness of things**
- **To be perfect**
- **To be free**

# Remarks about the Four Fundamental Drivers

- **Ascribed to humans**
- **Ascribed to deities**
- **Appear in discourse between humans and deities**
- **Appear in both**
  - **what humans pray for**
  - **what human renounce in spirit of sacrifice**

# MidLevel Drivers of Human Behavior

- **Justice, self-esteem, and other comparison processes**
- **Status**
- **Power**
- **Identity**

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# **Basic Building Blocks**

- **What does a theory look like?**
- **Types of theories**
- **Models and theories**
- **Theoretical unification**
- **Probability distributions**

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# **What Does a Theory Look Like?**

- **What does a theory look like?**
  - **two parts**
    - **assumptions**
    - **testable propositions**



# **Basic Building Blocks**

- **What does a theory look like?**
- **Types of theories**
- **Models and theories**
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# Assumptions

- **Two kinds of assumptions**
  1. **guesses about the nature of the world (Newton; Popper) – called **postulates****
  2. **known to be true, or subject to human control**

# Testable Propositions

- **Two kinds of propositions**
  1. **deduced from assumptions (classical) – called **predictions****
  2. **constructed by combining terms from assumptions and observables (Toulmin)**

# Gold-Standard Theory - 1

- **Hypothetico-deductive theory**  
(invented by Newton)
- **Postulates** are “genuine guesses about the structure of the world”  
(Popper)
- **Predictions** display the “marvellous deductive unfolding” of the theory  
(Popper)

# Gold-Standard Theory - 2

- Goal is a theory with
  - minimum of **postulates**
  - maximum of **testable predictions**, including **novel predictions**
- **Postulates**' fruitfulness is evident in the “**derivations** far afield from its original domain” which “permit an increasingly broad and diversified basis for **testing** the **theory**” (Danto)

# **Nondeductive Theories**

- **Hierarchical (identified by Toulmin)**
  - **testable propositions constructed by linking postulates with observable terms**

# Summary of Theory Types

- **Deductive**
  - **gold-standard** hypothetico-deductive theory in which assumptions are guesses (Newton)
  - assumptions are true or subject to human control
- **Nondeductive**
  - hierarchical (Toulmin)
- **Hybrid deductive/nondeductive**

# Testing Theoretical Predictions

- **New explicit tests, including experiments**
- **Tests not designed to test the theory**
- **Predictions consistent with known facts**
- **Predictions consistent with conjectures**
- **Novel predictions – no tests yet**

**Theory Is**  
**the Social Scientist's**  
**Best Friend**

# How **Theory** Shows Its Friendship

- **Suggests questions to study**
- **Identifies factors producing outcomes**
- **Provides new ways to measure variables**
- **Guides choice of statistical procedures**
- **Guides interpretation of results**
- **Provides interpretation of non-recurring or rare events**
- **Yields fundamental constants**

# **Theory Guides Interpretation of Non-Recurring or Rare Events**

- **invention of mendicant institutions in 12<sup>th</sup> century was a response to switch from valuing attributes (birth, nobility, rank) to valuing possessions (wealth)**
- **invention of mystery novel in 19<sup>th</sup> century the same**

# Some Predictions for Fundamental Constants

- Critical inequality level occurs when Atkinson's inequality equals  $1-(2/e)$ , or approx **.264**
  - about when Gini's inequality equals **.42**
  - switches between cardinal and ordinal goods
- Societal mainstream lies in the region between  $J = -1$  and  $J = +1$ 
  - relative ratios/ranks between  $1/e$  and  $e$ , or approx between **.368** and **2.72**
  - ordinal-good societies have no “top”
  - cardinal-good societies can have neither “top” nor “bottom”

# Hypothesis Tests

- **one-tailed**
  - **prior theoretical reasoning, AND**
  - **effects predicted by all theories are in the same direction**
- **two-tailed**
  - **no prior theoretical reasoning, OR**
  - **prior theoretical reasoning AND opposite effects predicted**

**Theory Is**  
**the Social Scientist's**  
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# **Basic Building Blocks**

- **What does a theory look like?**
- **Types of theories**
- **Models and theories**
- **Theoretical unification**
- **Probability distributions**

# **Models and Theories - 1**

- 1. model derived from a theory**
  - applied theoretical model**
  - theory-derived description of a class of phenomena**
- 2. Ad hoc model**

# Models and Theories - 2

- Ad hoc models can become linked to theories
- A model can become the **postulate** of a theory
- A model can become the **prediction** of a theory

# Model Becomes Postulate

- **Justice evaluation model**
  - model of the process by which an observer judges the fairness or unfairness of the actual reward received by a rewardee (1978)
  - became a theory in 1980 when its fruitfulness as a **postulate** became apparent
- **Status model**
  - model of the process of giving and receiving status (1979)
  - became a theory in 2001 when its fruitfulness as a **postulate** became apparent

# Justice Evaluation Function

$$J = \theta \ln \left( \frac{A}{C} \right)$$

# **Distributive Justice: Still Only a Model**

- Could be used to measure justice evaluations**
- Could be tested**
- But theoretically could do little more than look good**
- Like the rose in The Little Prince**

# Distributive Justice: Becoming a Theory

- One day the caretaker noticed that the justice evaluation function could serve as a **postulate** and that **predictions** could be derived from it
- In time it yielded an abundance of **predictions** for many domains

# Model Becomes **Prediction**

- **Kepler's laws of planetary motion**
  - **model of planetary motion**
  - **derived by Newton fifty years later from his laws of motion and universal gravitation**

# **Put Differently – Two Stages**

- **Kepler stage**
  - **discovering empirical regularities**
- **Newton stage**
  - **discovering fundamental principles**
- **Source. Koopmans (1947)**

# **Basic Building Blocks**

- **What does a theory look like?**
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# Theoretical Unification

- Goal of scientific work is to understand **more and more** by **less and less**
- Theoretical unification plays large part

# **Theoretical Unification – of What?**

- Different theories of the same field of phenomena**
- Theories of different fields of phenomena**
- In both, unification may be of entire theories or of elements of theories**

# Theoretical Unification – How?

- Linking **postulates** from two or more theories
- Linking **predictions** from two or more theories
- Linking **postulates** from one or more theories to **predictions** from different theories

# **Theoretical Unification – Metaphysics**

- **Theoretical unification is usually a surprise**

# **Basic Building Blocks**

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# Choose Modeling Distributions

- **Work with mathematically-specified, continuous univariate two-parameter distributions**
  - **location parameter**
  - **second parameter  $c$ , which has been proposed as a general inequality parameter (Jasso and Kotz, *Sociological Methods and Research*, 2008)**

# Three Special Distributions

- **Three distributions widely used to model size distributions in the social sciences**
  - **lognormal**
  - **Pareto**
  - **power-function**

Table 1

### Three Continuous Univariate Distributions and Associated Functional Characteristics

Variate	Cumulative Distribution Function	Probability Density Function	Quantile Function
Lognormal $x > 0, c > 0$	$F_N \left\{ \frac{[\ln(\frac{x}{\mu}) + \frac{c^2}{2}]}{c} \right\}$	$\frac{1}{xc\sqrt{2\pi}} \exp \left\{ -\frac{[\ln(\frac{x}{\mu}) + \frac{c^2}{2}]^2}{2c^2} \right\}$	$\mu \exp \left[ c Q_N(\alpha) - \frac{c^2}{2} \right]$
Pareto $x > \frac{\mu(c-1)}{c}, c > 1$	$1 - \left[ \frac{\mu(c-1)}{cx} \right]^c$	$\left[ \frac{\mu(c-1)}{c} \right]^c cx^{-c-1}$	$\frac{\mu(c-1)}{c(1-\alpha)^{1/c}}$
Power function $0 < x < \frac{\mu(c+1)}{c}, c > 0$	$\left[ \frac{xc}{\mu(c+1)} \right]^c$	$\left[ \frac{c}{\mu(c+1)} \right]^c cx^{c-1}$	$\frac{\mu(c+1)\alpha^{1/c}}{c}$

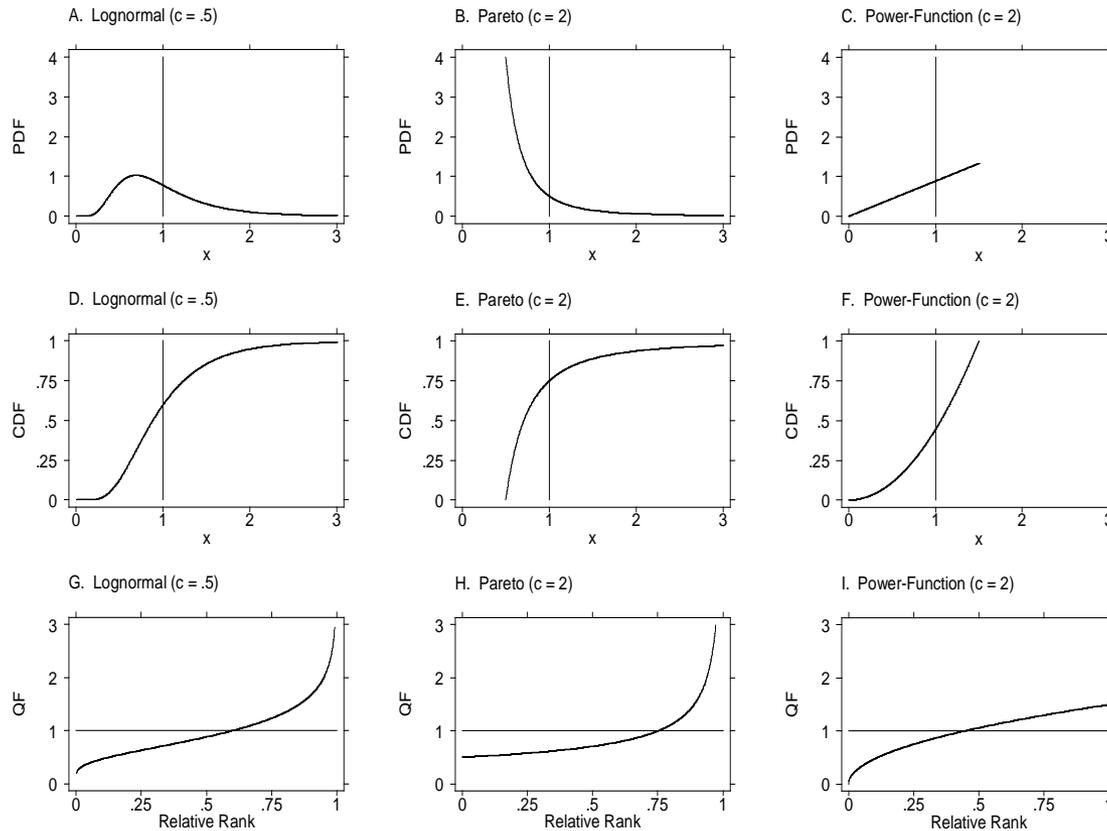
Note: For all variates,  $x > 0$ ; other restrictions are as indicated. The expressions  $F_N(\cdot)$  and  $Q_N(\cdot)$  denote the cumulative distribution function and the quantile function, respectively, of the standard normal variate:

$$F_N(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^x e^{-\frac{t^2}{2}} dt,$$

$$Q_N(\alpha) = \sqrt{2} \operatorname{erf}^{-1}(2\alpha - 1),$$

where erf denotes the error function. Inequality is a decreasing function of  $c$  for the Pareto and power-function variates and an increasing function of  $c$  for the lognormal distribution.

# Figure 1. PDF, CDF, and QF in the Lognormal, Pareto, and Power-Function



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# **A New Unified Theory of Sociobehavioral Forces**

**A place for everything,  
and everything in its place.**

**-- Samuel Smiles, 1875**

# The **NUT** Is Founded on Classical Insights

- **Plato (*Republic*):** “Governments vary as the dispositions of men vary. . . . There must be as many of one as of the other. . . . If the constitutions of States are five, the dispositions of individual minds will also be five.”
- **Aristotle (*Politics*):** “Different men seek after happiness in different ways and by different means, and so make for themselves different modes of life and forms of government.”

# New Unified Theory -- I

- **Attempt to integrate theories of five sociobehavioral processes (*ESR* 2008)**
  - **comparison (including justice, self-esteem, & reference-dependent processes)**
  - **status**
  - **power**
  - **identity**
  - **happiness (partially)**

# Requirements for Integration

- **Highly developed theories**
  - great precision and clarity
  - example: ratio & difference conceptions of the justice evaluation function
- **Similarity in the internal core of the theories**
  - in all of them, a quantitative characteristic generates an outcome

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# Properties of the Justice Evaluation Function

- **Original three noticed (*AJS* 1978)**
  - Mapping onto justice evaluation scale
  - Integrates rival ratio-difference views
  - Deficiency is felt more keenly than comparable excess
- **Theorem and proof (*SM* 1990)**
  - Scale-invariance (homogeneity of degree zero)
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- **Two more properties (*SMR* 1996)**
  - Symmetry
  - Limiting form of difference between two power functions
- **New -- Links loss aversion and the Golden Number**

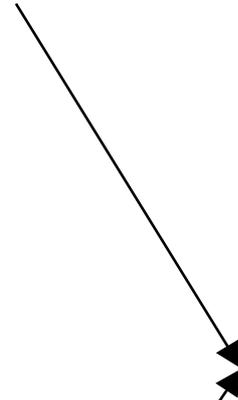
# The World of Distributive Justice

**Actual  
Reward**

**Just  
Reward**

**Justice  
Evaluation**

**Reactions  
to  
Injustice**



# Fundamental Justice Matrices

$$A' = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \ddot{y} & a_{1R} \\ a_{21} & a_{22} & a_{23} & \ddot{y} & a_{2R} \\ a_{31} & a_{32} & a_{33} & \ddot{y} & a_{3R} \\ ! & ! & ! & " & ! \\ a_{NI} & a_{N2} & a_{N3} & \ddot{y} & a_{NR} \end{bmatrix}$$

$$C' = \begin{bmatrix} c_{11} & c_{12} & c_{13} & \ddot{y} & c_{1R} \\ c_{21} & c_{22} & c_{23} & \ddot{y} & c_{2R} \\ c_{31} & c_{32} & c_{33} & \ddot{y} & c_{3R} \\ ! & ! & ! & " & ! \\ c_{NI} & c_{N2} & c_{N3} & \ddot{y} & c_{NR} \end{bmatrix}$$

$$\ln \frac{A}{C}$$

$$\begin{bmatrix} \ln \frac{a_{.1}}{c_{11}} & \ln \frac{a_{.2}}{c_{12}} & \ln \frac{a_{.3}}{c_{13}} & \ddot{y} & \ln \frac{a_{.R}}{c_{1R}} \\ \ln \frac{a_{.1}}{c_{21}} & \ln \frac{a_{.2}}{c_{22}} & \ln \frac{a_{.3}}{c_{23}} & \ddot{y} & \ln \frac{a_{.R}}{c_{2R}} \\ \ln \frac{a_{.1}}{c_{31}} & \ln \frac{a_{.2}}{c_{32}} & \ln \frac{a_{.3}}{c_{33}} & \ddot{y} & \ln \frac{a_{.R}}{c_{3R}} \\ ! & ! & ! & " & ! \\ \ln \frac{a_{.1}}{c_{NI}} & \ln \frac{a_{.2}}{c_{N2}} & \ln \frac{a_{.3}}{c_{N3}} & \ddot{y} & \ln \frac{a_{.R}}{c_{NR}} \end{bmatrix}$$

# Justice Index JI1

$$E(J) = E \left[ \ln \left( \frac{A}{C} \right) \right]$$

# **Four Techniques of Theoretical Derivation**

- **Micromodel**
- **Macromodel**
- **Matrixmodel**
- **Mesomodel**

# **Some Predictions of JusticeTheory**

- Gain from theft greater when stealing from a fellow group member rather than an outsider; this premium is greater in poor groups.**
- Parents will spend more of their toy budget at an annual giftgiving occasion than at birthdays.**
- Veterans of wars fought away from home are more vulnerable to posttraumatic stress than veterans of wars fought on home soil.**
- Gifts are more valuable in the giver's presence.**
- Blind are less susceptible to eating disorders.**

# **More Predictions of Justice Theory**

- **Loss aversion and deficiency aversion**
- **Inequality aversion**
- **Conditions for endowment effect**
- **Conditions for migration from top, bottom, or both**
- **Effect of inequality on vocations to the religious life**
- **Differential loyalties to self, subgroup, and group**
- **Effect of subgroup split on social conflict**
- **Effect of inequality on social conflict**

# Some **Predictions** About **Theft**

- **A thief will prefer to steal from a fellow group member rather than from an outsider, but victim prefers outsider thief.**
- **Thief's preference for insider theft and victim's for outsider theft are stronger in poor groups than in rich groups.**
- **In outsider theft, there are natural affinities between (i) thief and members of victim's group, and (ii) victim and members of thief's group.**
- **Society loses when rich steal from poor.**

# **A Thing's Value Changes**

- A gift is more valuable to the receiver when the giver is present.**
- A thief's gain from theft is greater when stealing from a fellow group member.**
- The gain or loss from having a gift stolen depends on whether the giver and the thief are from inside or outside the group.**
- In an experiment, if a thing is given by the experimenter and lost to a fellow participant, the loss from theft exceeds the gain from the gift.**

# Some Predictions on Conversation

- Topics raised signal valued goods
  - Ex. hereditary monarch discussing horse bloodlines
- Number of interruptions in a group depends on
  - Number of potential valued goods
  - **Inequality** in the distribution of cardinal goods
  - Intercorrelations among valued goods
- Homogeneous groups have fewer interruptions
- Interruptions are group-specific; a given actor may interrupt repeatedly in one group, never in another
- Courtesy is lower in heterogeneous groups, and thus in urban settings

# **Some Predictions Related to War**

- **In wartime, the favorite leisure-time activity of soldiers is playing games of chance.**
- **Giftgiving increases in wartime.**
- **Posttraumatic stress is greater among veterans of wars fought away from home than among veterans of wars fought on home soil.**
- **In epochs when husbands predecease their wives, fathers are mourned more than mothers.**
- **Love increases during mobilization and decreases during demobilization.**

# Fundamental Constants

## Arising from the Sense of Justice

- Critical **inequality** level occurs when Atkinson's **inequality** equals  $1-(2/e)$ , or approx **.264**
  - about when Gini's **inequality** equals **.42**
  - switches between cardinal and ordinal goods
- Societal mainstream lies in the region between  $J = -1$  and  $J = +1$ 
  - relative ratios/ranks between  $1/e$  and  $e$ , or approx between **.368** and **2.72**
  - ordinal-good societies have no “top”
  - cardinal-good societies can have neither “top” nor “bottom”

# Inequality as Switching Constant when **Justice** is the Force

- Critical **inequality** level occurs
  - when Atkinson's **inequality** equals  $1-(2/e)$ , or approx **.264**
  - when Theil's **MLD** equals  $\ln(e/2)$ , or approx **.307**
  - about when Gini's **inequality** equals **.42**
- May govern switch between cardinal and ordinal goods
- Based on guardian model

# **Some Interpretations of Non-Recurring Events**

- **invention of mendicant institutions in 12<sup>th</sup> century was a response to switch from valuing attributes (birth, nobility, rank) to valuing possessions (wealth)**
- **invention of mystery novel in 19<sup>th</sup> century the same**
- **In Mariel emigration, Cuba used a punish-via-bad strategy against U.S.**

# **New Unified Theory -- 2**

- **Identity is a combination of three elements**
  - **PSO (justice, status, power)**
  - **quantitative characteristic**
  - **qualitative characteristic**
- **Person is a collection of identities**
- **Society is a collection of persons**

# Quantitative Characteristics

- **Cardinal**

- **wealth**
- **land**
- **animals**

- **Ordinal**

- **beauty**
- **intelligence**
- **skills of all kinds**

# Goods and Bads

- In the eyes of an observer, a thing is a **good** if and only if **more is preferred to less**.
- In the eyes of an observer, a thing is a **bad** if and only if **less is preferred to more**.

# Qualitative Characteristics

- **Sex**
- **Race**
- **Ethnicity**
- **Language**
- **Nativity**
- **Religion**

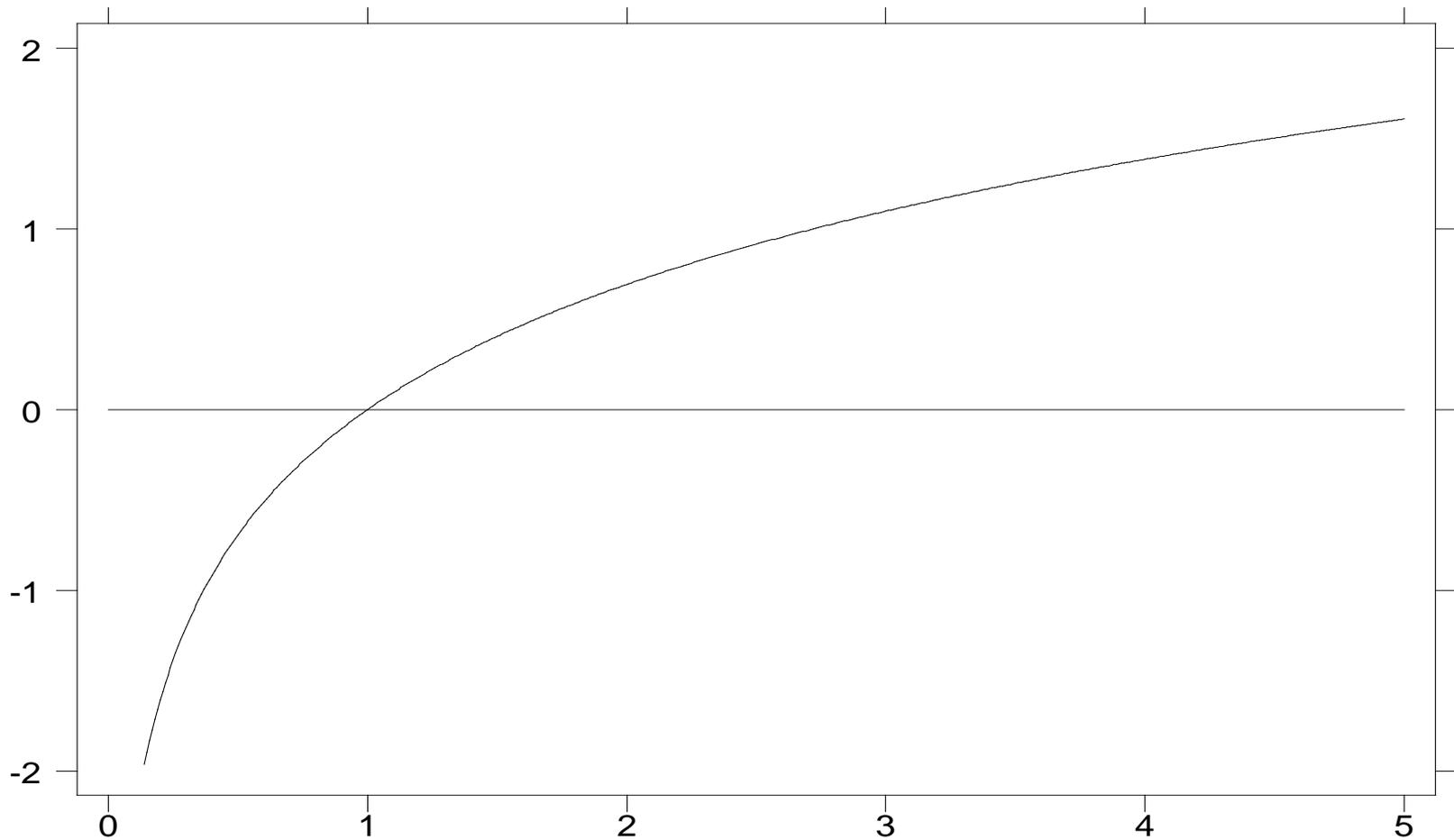
# **Sociobehavioral Forces**

- **Primordial sociobehavioral outcomes (PSO)**
- **Generated by quantitative characteristics**
- **In groups formed by categories of qualitative characteristics**

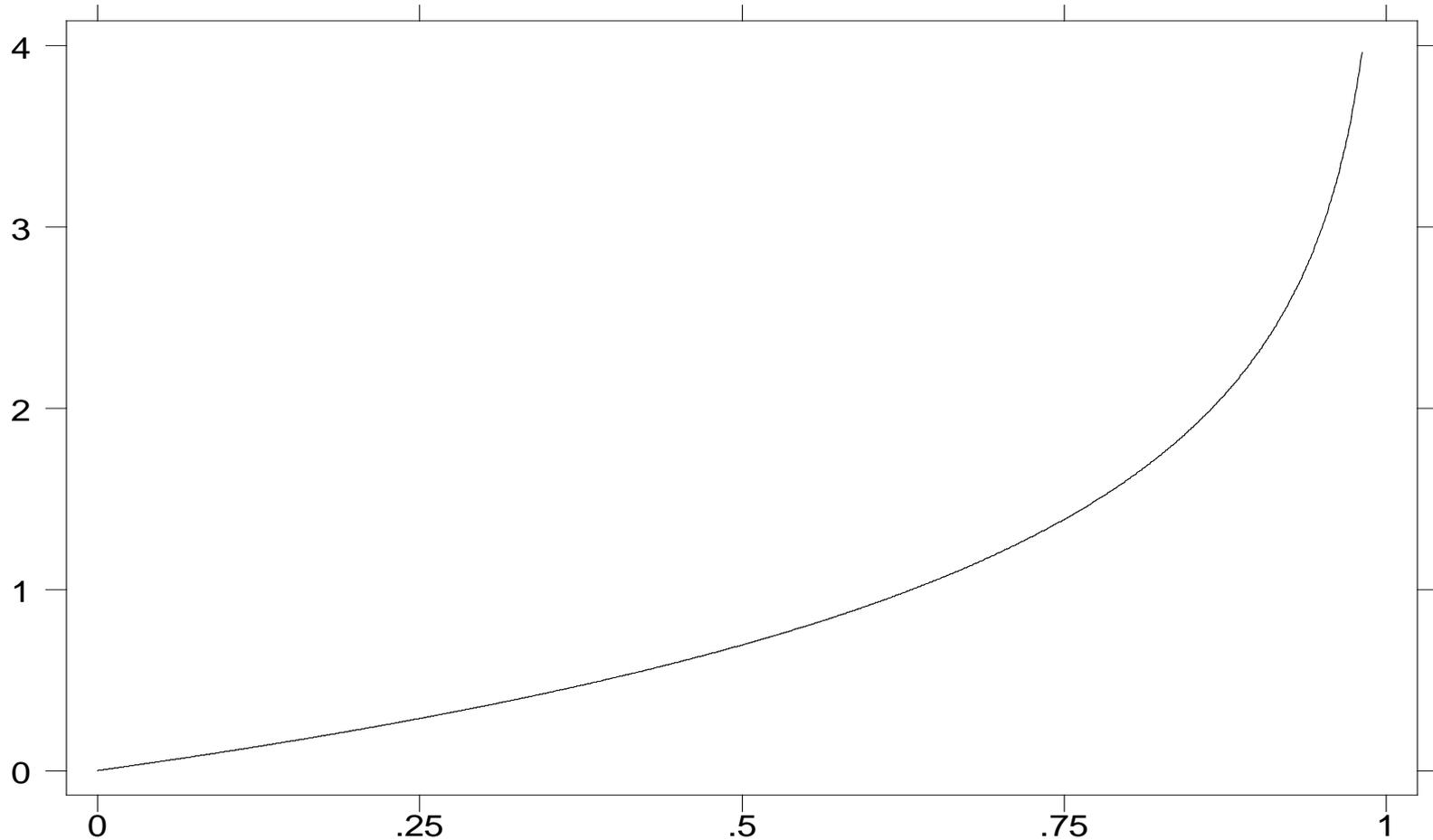
# Key Idea of the **NUT**

- **There are three basic sociobehavioral forces, each with a distinctive mathematical form (idea of 3 forces based on Homans)**
  - **In nature there are three possible rates of change: increasing, decreasing, constant**
  - **What distinguishes the forces is the rate of change**
    - **comparison** decreasing
    - **status** increasing
    - **power** constant

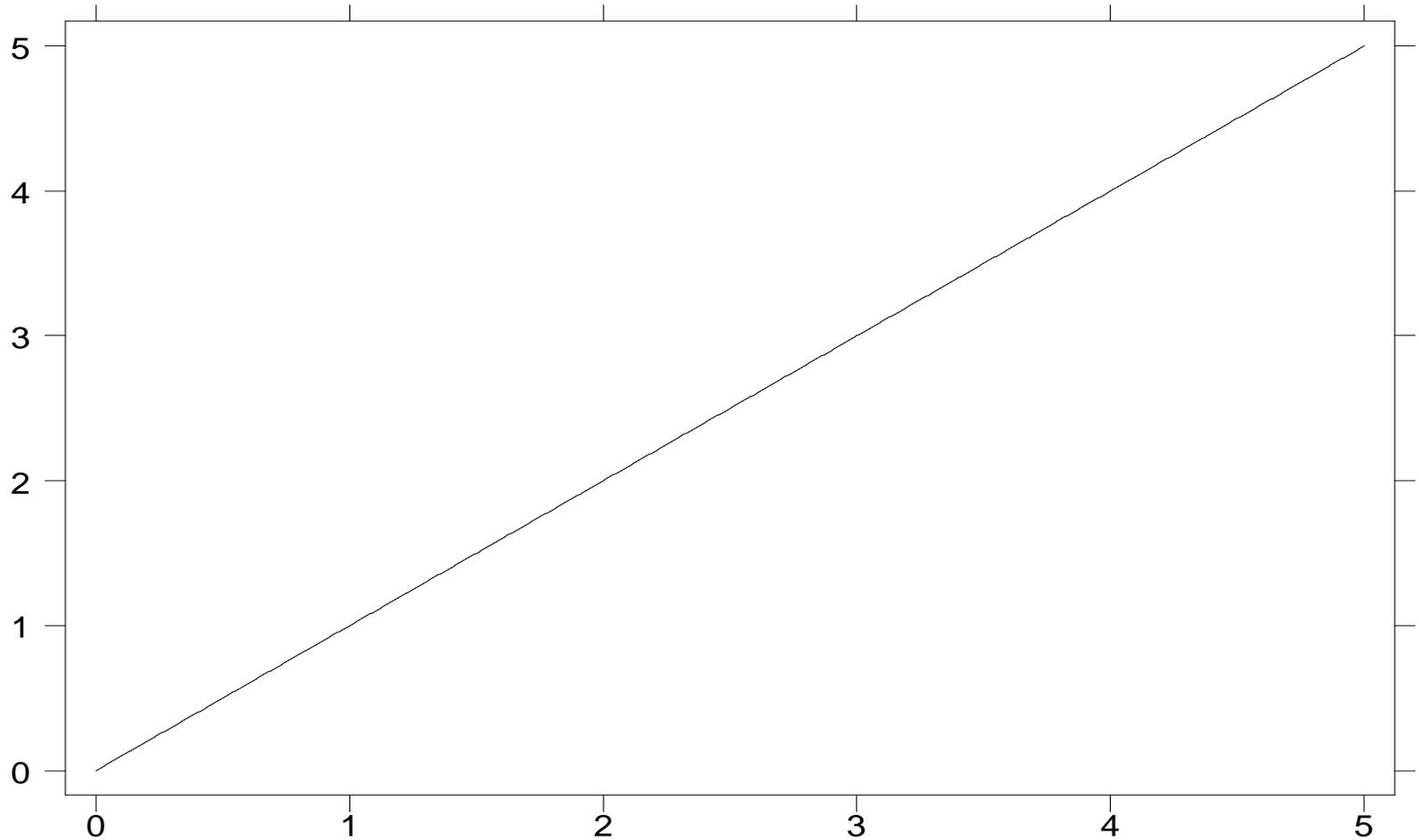
# Z Increases at a Decreasing Rate



# Z Increases at an Increasing Rate



# Z Increases at a Constant Rate



# Specific Functions for Three Sociobehavioral Forces

- **Comparison**

- log-ratio form proposed by Jasso (*AJS* 1978); proof that it is only form that satisfies both scale-invariance and additivity (Jasso, *SM* 1990); also satisfies loss aversion (*AJS* 1978) and symmetry (*SMR* 1996)

- **Status**

- convexity property (Goode 1978); specific form proposed by Sørensen (*AJS* 1979) for occupations and adopted for individuals by Jasso (*ASR* 2001)

- **Power**

- no work on functional form (Webster 2006)
- must be linear (Jasso, *ESR* 2008)

# Justice Evaluation Function

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# Properties of the Justice Evaluation Function

- **Original three noticed (*AJS* 1978)**
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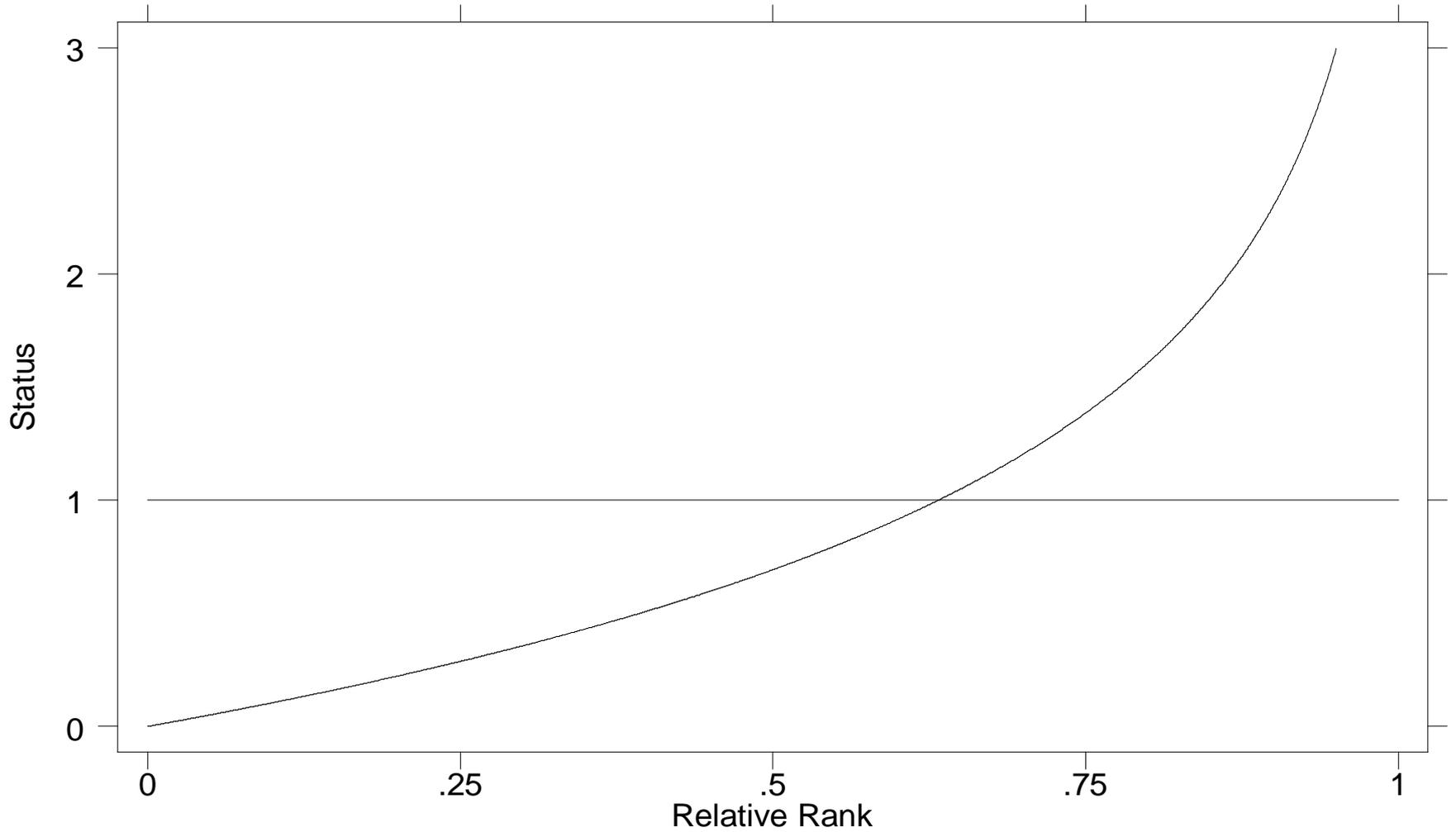
# Status Function

$$S = \ln \left( \frac{1}{1-r} \right)$$

# History and Properties of the **Status Function**

- **Proposed by Sørensen (*AJS* 1979)**
- **Satisfies convexity condition discussed by Goode (1978)**
- **Status increases at an increasing rate with personal quantitative characteristic**
- **Status distribution is negative exponential**

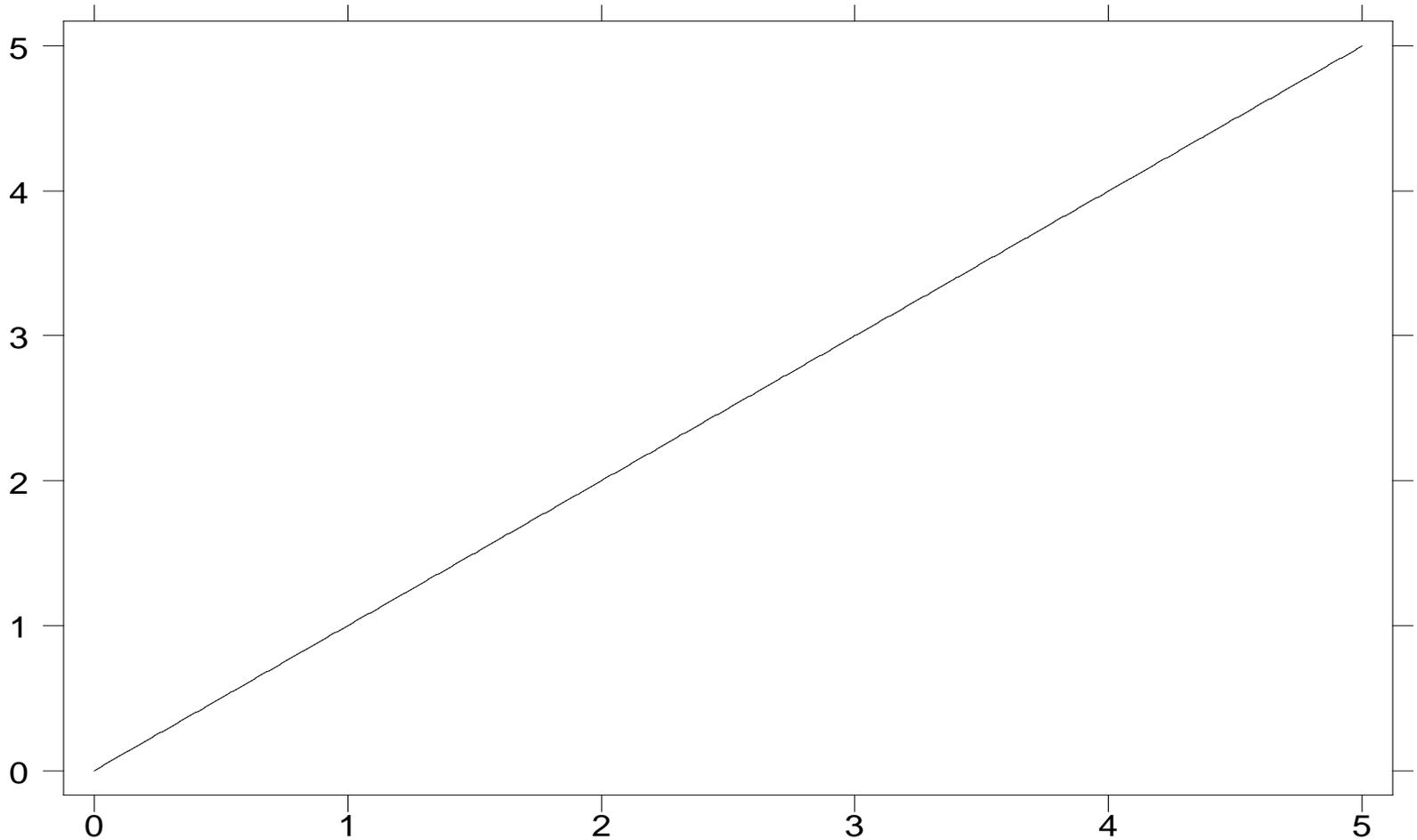
# Status Function



# Power Function

$$P = a + bX$$

# Power Function



# Carriers of Identity, Carriers of Happiness

- Using Rayo and Becker's (2007) evocative words, we might say that there are three carriers of identity, three carriers of happiness
  - justice
  - status
  - power

# Five Types of Societies in the **NUT**

- The **new unified theory** gives rise to five types of societies (evokes Plato)
  - justice-materialistic
  - justice-nonmaterialistic
  - status
  - power-materialistic
  - power-nonmaterialistic

# Subgroups in the **NUT**

- The **NUT** yields two kinds of subgroups
  - pre-existing subgroups
    - formed by categories of qualitative characteristics, such as race, sex, or nativity
  - emergent subgroups
    - arise via operation of basic sociobehavioral forces
      - Ex. underrewarded, fairly rewarded, overrewarded
      - Ex. Selfistas, Groupistas, Subgroupistas
      - Ex. mainstream, underworld, overworld

# New Unified Theory – 3

- **Personality** arises from personal configuration of PSO's and quantitative and qualitative characteristics in the identities
- **Culture** arises from societal configuration of PSO's and quantitative and qualitative characteristics in the identities

# **New Unified Theory -- 4**

- **Personality** and **culture** are styles of persons and groups
  - highlight element of trio
  - highlight particular realization of element of trio
  - examples
    - jock culture; nerd culture; tennis-obsessed
    - race-conscious; Catholic country
    - status-hungry; power-driven
    - “as a [.....]”

# **New Unified Theory – 5 Parsimonious and Fruitful**

- **It has a minimum of assumptions, and yields a maximum of predictions**
  - **a handful of assumptions, possibly less than five**
  - **hundreds of predictions, for a wide variety of phenomena at all levels of analysis, including some novel predictions**

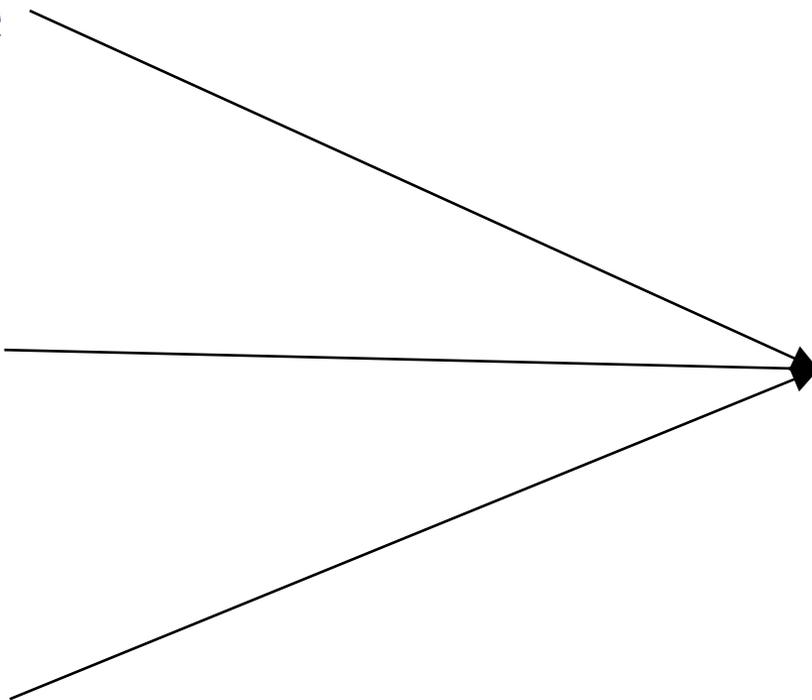
# New Unified Theory of Sociobehavioral Forces

**Justice**

**Status**

**Power**

**All  
Domains of  
Behavior**



```
graph LR; Justice --> Behavior; Status --> Behavior; Power --> Behavior;
```

The diagram consists of three text labels on the left: 'Justice' in blue, 'Status' in red, and 'Power' in green. Three black arrows originate from the right side of each label and converge on a single black arrowhead pointing to the text 'All Domains of Behavior' on the right. The text 'All Domains of Behavior' is in orange and is arranged in three lines.

# Some Predictions for Coups

- Who leads the coup? Highest-ranking always in **status** society, sometimes in **power** society, never in **justice** society
- Coups more prevalent in small states
- Enslaving Caesar always maximizes gain
- So why kill Caesar? To achieve **equal** gains, which can only happen in a **justice** society
- Thus, states where coups kill Caesar must be **justice** societies
- And **equality** is a major objective

# Are You Closer to the Neighbor Above or Below?

- **Justice Society**

- closer to the neighbor above

- **Status Society**

- closer to the neighbor below

- **Power Society**

- equally close to both neighbor above and neighbor below

# **Inequality**

## **and Multiple Goods**

- **Inequality in the PSO declines if multiple goods are valued and they are**
  - **negatively associated (dates to Berger, Cohen, and Zelditch 1966)**
  - **independent**

# Happiness and the **NUT**

- **Happiness produced by individual's PSO profile**
- **Assess effects on happiness of**
  - **changes in valued goods and in their distribution**
  - **changes in groups and subgroups**
  - **changes in dominant PSOs**

# Four Forms of Inequality: Example – Wage, Status, Nativity

Inequality in  $X$

Inequality in  $S$

Personal  
Inequality

wage inequality

status inequality

Subgroup  
Inequality

nativity wage gap

nativity status gap

# **Some Results – 1**

## **Personal & Subgroup Inequality**

- **General inequality parameter  $c$**
- **Link between overall inequality and subgroup inequality**
- **Source**
  - **Jasso and Kotz, *SMR* 2008**

# **Example:**

## **Gender Inequality**

- As overall inequality increases, so does gender inequality**
- As gender inequality increases, so does overall inequality**

# **Some Results – 2**

## **Two Worlds of Inequality**

- Inequality obeys different rules in the good and the PSO**
- Inequality may be larger or smaller in cardinal good than in the PSO it generates**
  - Ex. wealth inequality may be larger or smaller than inequality in the status it generates**

# In the Case of One Cardinal Good

- **Justice**

- $J$  can be equal, hence can have less inequality than  $X$

- **Status**

- $X$  can have more or less inequality

- **Power**

- inequality depends on sign of  $a$

# Status Example

- **Status distribution has a Gini of .5**
- **Distribution of ordinal good has a Gini of  $1/3$**
- **Distribution of cardinal good can have a Gini of any magnitude**
- **Thus, if  $X$  is ordinal, there is more inequality in status than in the ordinal good which generates it**
- **If  $X$  is cardinal, it can have more or less inequality than status**

# **Link between Income Variance and Happiness Variance**

- **Multiform**
- **Can be zero**
- **Can be linear**
- **Can be concave**
- **Can be convex**
- **Therefore, challenging empirically**

# **Some Predictions on Marriage**

- **The effect of employment, unemployment, retirement on marital cohesiveness depends on the spouses' earnings ratio.**
- **Shifts that strengthen the marital bond increase the well-being of one spouse, decreasing the other's.**
- **In societies where husbands earn more than their wives, divorce rates increase with husbands' mean earnings and wives' earnings inequality and decrease with wives' mean earnings and husbands' earnings inequality.**

# Effects on Divorce Rates of Husbands' and Wives' Inequality

$$X_H > X_W$$

$$X_W > X_H$$

Wives' Inequality	increases	decreases
Husbands' Inequality	decreases	increases

# **Modeling Polarization**

- **Begin with a group or population**
- **The group has a subgroup structure generated by a personal qualitative characteristic such as race or sex**
- **Two types of polarization**
  - **subgroups internally homogeneous**
  - **subgroups internally heterogeneous**

# Modeling Polarization cont'd

- **Subgroup internally homogeneous**
  - each person attaches to the subgroup, thinks and acts exclusively as a member of the subgroup
  - relations between subgroups a function of distance between the subgroups
- **Subgroup internally heterogeneous**
  - some persons attach to the subgroup, others not
  - new subgroups emerge, consisting of individuals attached to their subgroup plus one mixed subgroup

# Modeling Polarization cont'd

- **New vocabulary**
  - **Pre-existing subgroups – based on personal qualitative characteristics**
  - **Emergent subgroups – based on sociobehavioral attachments**

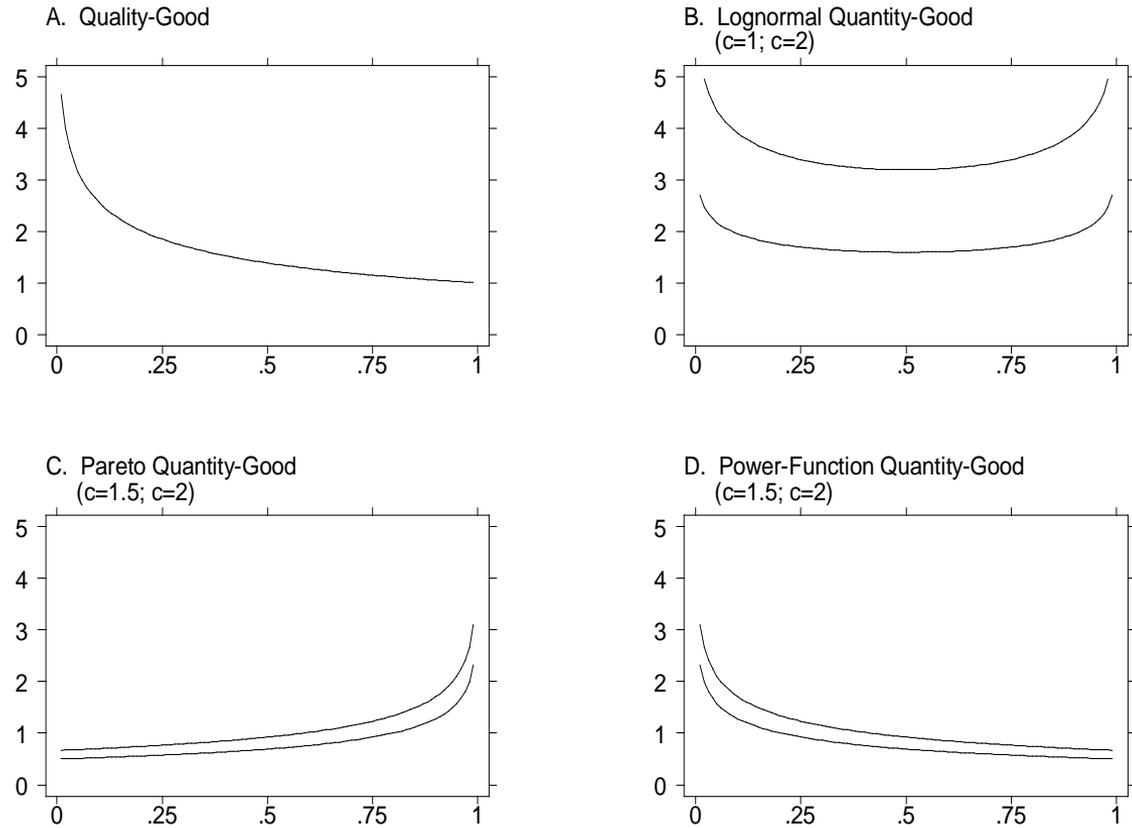
# **Modeling Polarization cont'd**

- **Example – racial segregation**
  - **Two pre-existing subgroups, blacks and whites**
  - **First polarization model – everyone attaches to their own racial subgroup, and relations between the races vary with distance between the subgroups**
  - **Second polarization model – some blacks identify as black, some whites identify as white, and some blacks and whites are color-blind – generating three emergent subgroups (e.g., choosing to live in all-black, all-white, and mixed neighborhoods)**

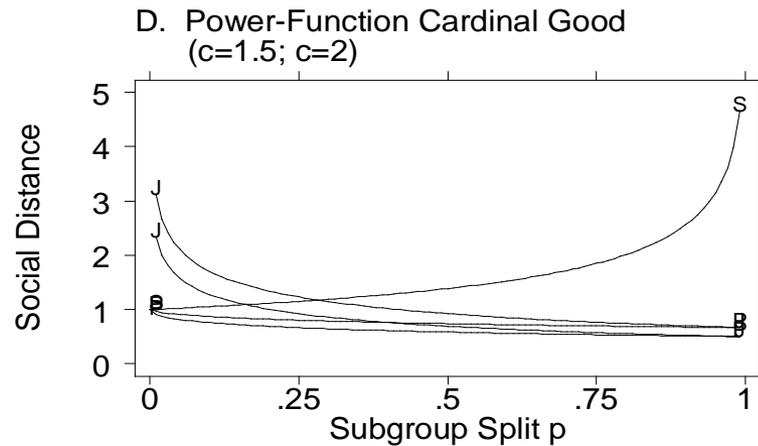
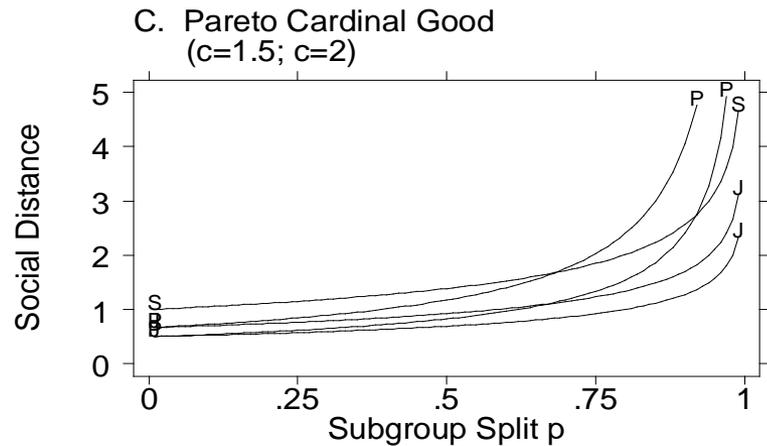
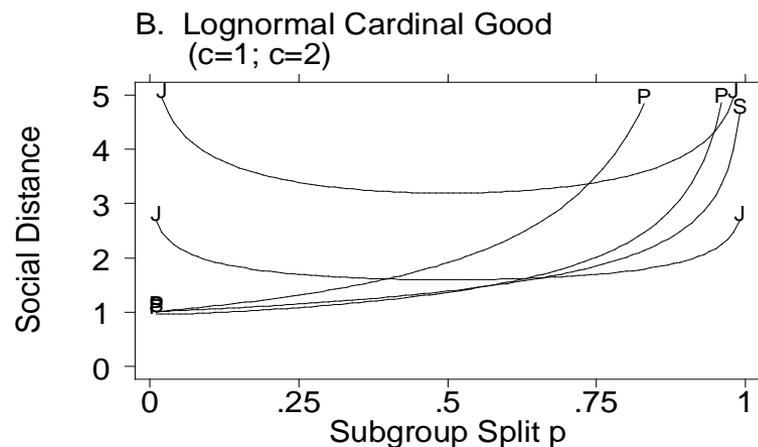
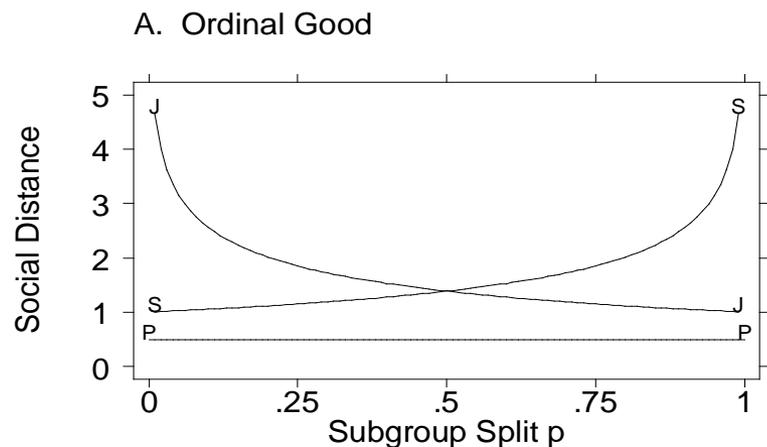
# **First Type of Polarization**

- In nonmaterialistic societies, polarization is a decreasing function of the relative size of the disadvantaged group.**
- In materialistic societies, the direction of the effect of subgroup size depends on the shape of the income distribution.**
- In materialistic societies, polarization is an increasing function of inequality in the distribution of the valued material goods.**

# Fig 2. How Polarization of the First Type Varies with Proportion in Bottom Subgroup and Inequality



# Fig 2. How Polarization of the First Type Varies with Proportion in Bottom Subgroup and Inequality



# Profiling

- **Profiling is the categorical ignoring personal quantitative characteristics and noticing only personal qualitative characteristics**
- **Same results as social distance**
- **Wolf-in-sheep's-clothes profiling**
- **Intensity of profiling**

# **Wolf-in-Sheep's-Clothes Profiling -- 1**

- NY Times story: third-grade teacher in a school with Hispanic children would like to see more Hispanic characters in the reading books so she can say to a child, "This book reminds me of you."**
- Why not, "Pippi Longstocking reminds me of you"? Or Peter Rabbit?**

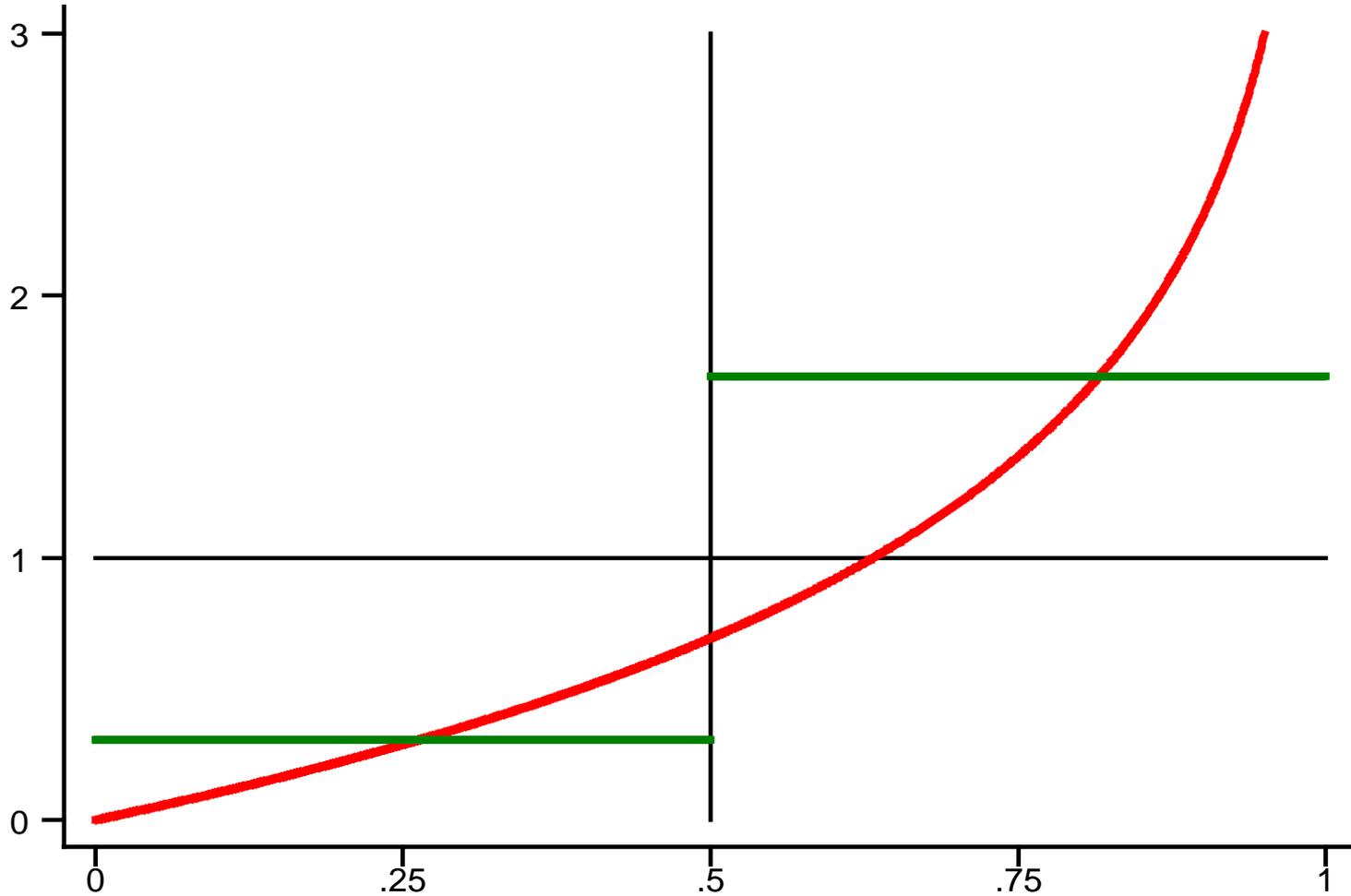
# **Wolf-in-Sheep's-Clothes Profiling -- 2**

- Teacher is blind to all the child's quantitative characteristics and all but one qualitative characteristic**
- Teacher is in effect discriminating and noticing only the child's ethnicity**
- The child has been profiled**

# Second Type of Polarization

- Individuals seek to enhance their identity and maximize their happiness, comparing their own  $Z$  with the average for their subgroup
- If the personal  $Z$  is less than the subgroup average  $Z$ , the person attaches and orients to the subgroup, but if the personal  $Z$  exceeds the subgroup average  $Z$ , the person becomes blind to subgroup

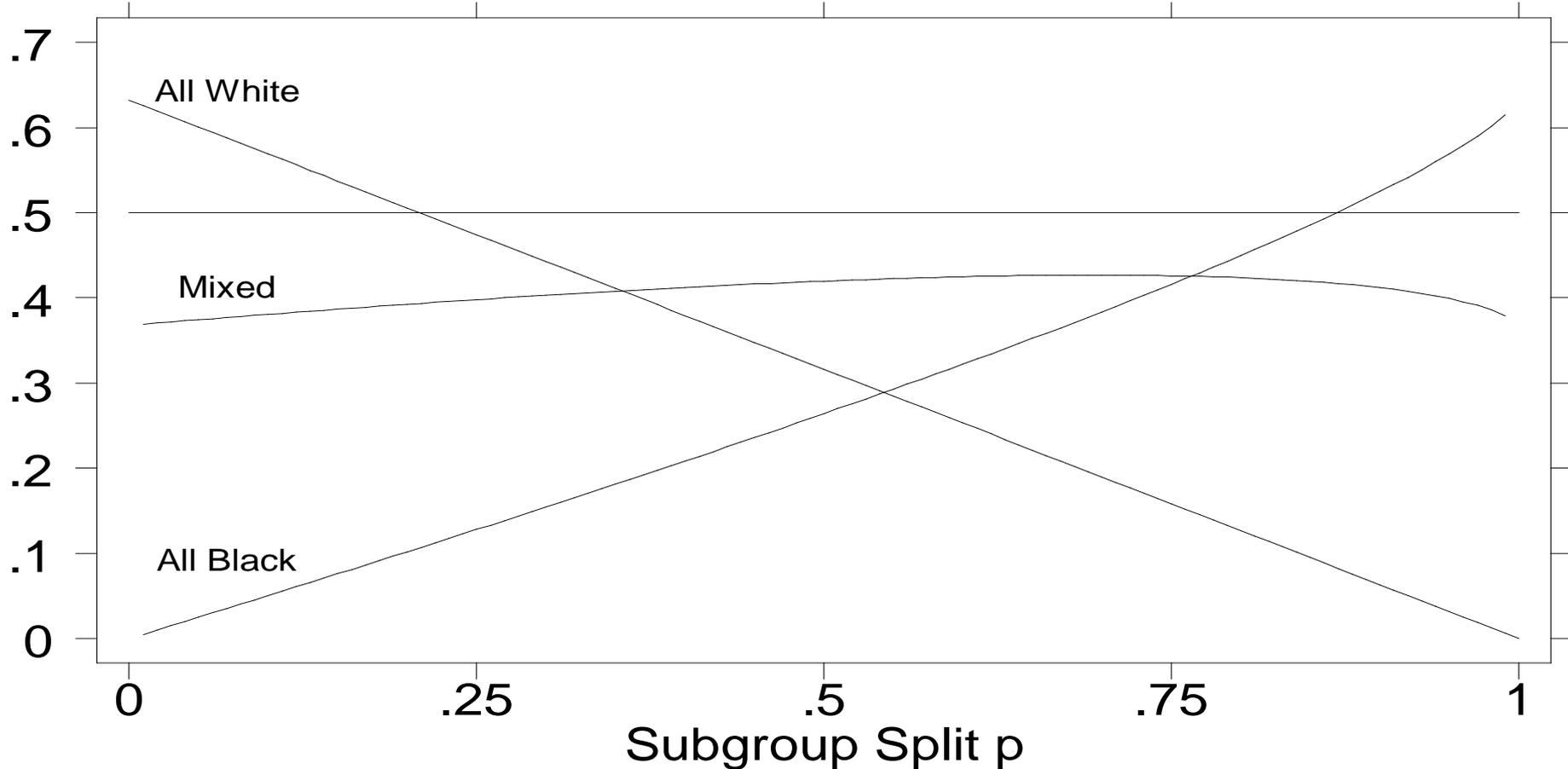
# Figure 4. Personal and Subgroup $Z$



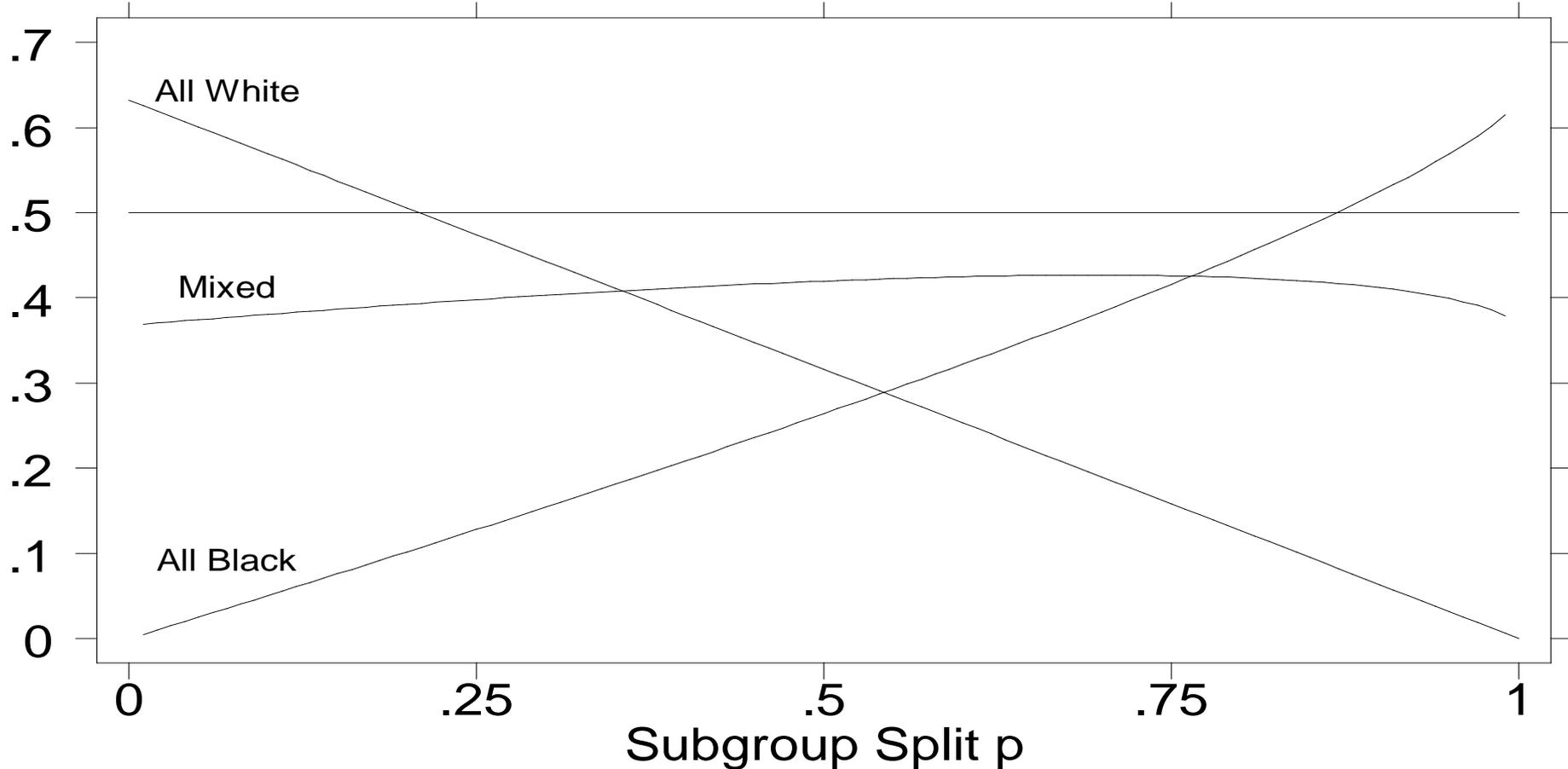
# Early Results

- **Early results in two-subgroup case**
  - **higher-ranking from each subgroup are Selfistas (Integrationists)**
  - **lower-ranking from each subgroup are Subgroupistas (Segregationists)**
  - **proportions Selfistas and Subgroupistas depend on subgroup relative size, valued goods, distributional form of cardinal goods, and sociobehavioral force**

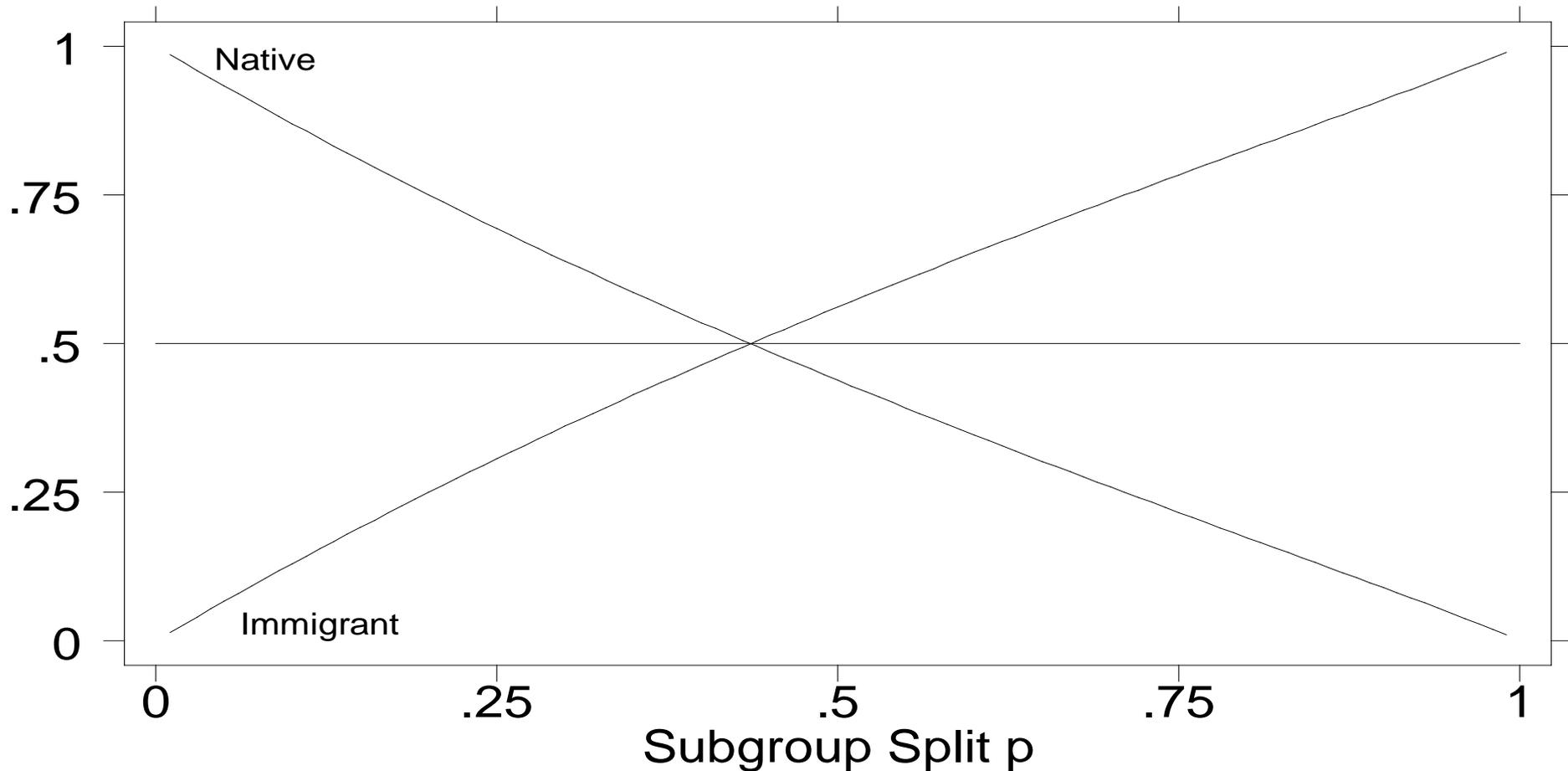
# Residential Segregation in a **Justice**-Pareto Society



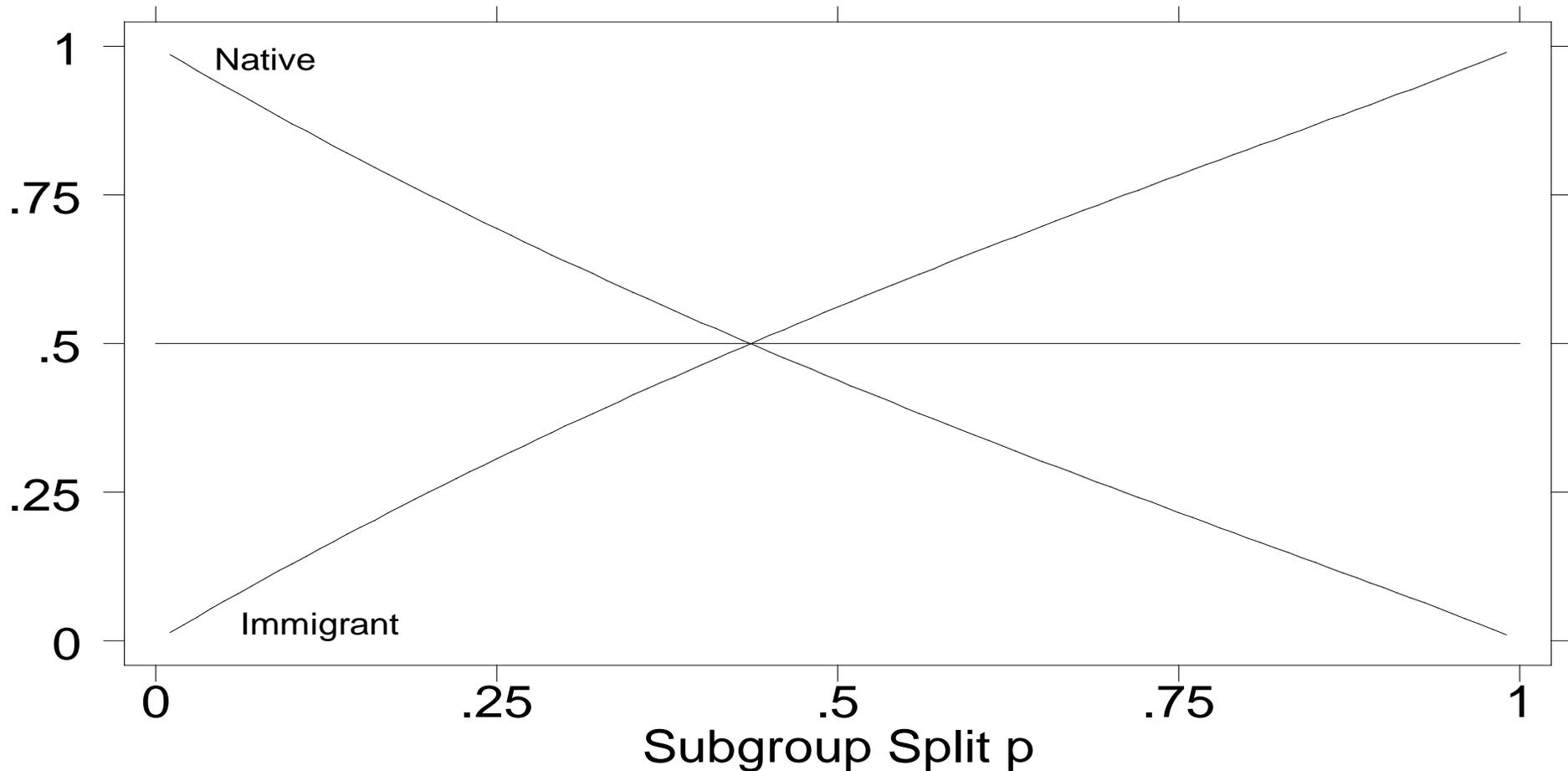
# Residential Segregation in a **Status** Society



# NB & FB in Mixed Neighborhood in a **Justice**-Pareto Society



# NB & FB in Mixed Neighborhood in a **Status** Society



# Testing Theoretical Predictions: Evidence

- **New explicit tests**
  - Marital cohesiveness
- **Tests not designed to test the theory**
  - Response to gains concave and to losses convex
  - Vocations across countries
- **Predictions consistent with known facts**
  - Parental giftgiving and Christmas
  - Vietnam veterans' posttraumatic stress
- **Predictions consistent with conjectures**
  - Giftgiving in courtship and marriage
- **Novel predictions – no tests yet**
  - Eating disorders and blindness

# Overview

- **Social Science Analysis**
- **Basic Building Blocks**
- **New Unified Theory**
- **Wage Inequality Model**

# **Wage Inequality Model**

- **Wage-Setting Model**
- **Two Main Analytic Results**
- **Illustrations – Theoretical, Empirical, Numerical**
- **Designing an Experiment**
- **Two Kinds of Mechanisms**

# Overview

- **Wage-Setting Model**
- **Two Main Analytic Results**
- **Illustrations – Theoretical, Empirical, Numerical**
- **Designing an Experiment**
- **Two Kinds of Mechanisms**

# Wage-Setting Model

- $N$  wage-setters
- Wage-setters may be persons or parties
- $R$  workers
- Each wage-setter recommends a wage for each worker
- Worker's wage will be the average of the recommended amounts
- Thus, final wage distribution is the average of the recommended wage dists

# Wage Matrix: *N* Wage-Setters and *R* Workers

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1R} \\ \vdots & \ddots & \vdots \\ x_{N1} & \cdots & x_{NR} \end{bmatrix}$$

# Wage-Setting Model

- Worker's wage will be the average of the recommended amounts

$$y_r = \sum_{i=1}^N w_{ir} x_{ir}$$

# Wage-Setting Model

- **Final wage distribution is weighted average of recommended wage dists**

$$Y = w_1 X_1 + w_2 X_2 + \dots + w_N X_N$$

# Wage Inequality Model

- Wage-Setting Model
- **Two Main Analytic Results**
- Illustrations – Theoretical, Empirical, Numerical
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# Two Main Analytic Results

- **As the covariances among the wage-setters' recommended wage distributions  $X_i$  move from positive to zero to negative, the variance in the final wage distribution  $Y$  declines**
- **If the wage-setters' recommended wage distributions  $X_i$  are independent, the variance in the final wage distribution  $Y$  declines as the number of wage-setters increases**

# Variance of Final Wage Distribution: $N$ Wage-Setters

$$\mathit{Var}(Y) = \sum_{i=1}^N w_i^2 [\mathit{Var}(X_i)] + 2 \sum_{i=1}^N \sum_{k>i}^N w_i w_k \mathit{Cov}(X_i, X_k)$$

**Variance of  
Final Wage Distribution:  
 $N$  Wage-Setters,  
Identical and Equally-Weighted**

$$Var(Y) = \frac{Var(X)}{N} + \frac{2}{N^2} \sum \sum Cov(X_i, X_k)$$

**Variance of  
Final Wage Distribution:  
*N* Wage-Setters,  
Identical, Independent,  
and Equally-Weighted**

$$\mathit{Var}(Y) = \frac{\mathit{Var}(X)}{N}$$

## **Footnote:**

### **As $N$ Increases, Variance Declines**

- **This powerful result provides the foundation for the shrinking standard error of the sample mean as the sample size increases**

# Variance of Final Wage Distribution: 2 Wage-Setters

$$\mathit{Var}(Y) = w_1^2 \mathit{Var}(X_1) + w_2^2 \mathit{Var}(X_2) + 2w_1w_2 \mathit{Cov}(X_1, X_2)$$

**Variance of  
Final Wage Distribution:  
2 Wage-Setters,  
Identical, Equally-Weighted**

$$\mathit{Var}(Y) = \frac{\mathit{Var}(X)}{2} + \frac{\mathit{Cov}(X_1, X_2)}{2}$$

**Variance of  
Final Wage Distribution:  
2 Wage-Setters,  
Identical, Equally-Weighted**

$$\mathit{Var}(Y) = \frac{[\mathit{Var}(X)][1 + \rho]}{2}$$

# Three Polar Types of Association

- **Perfect Positive.** Workers' relative ranks identical across all  $X_i$
- **Independent.** All the marginal distributions are independent
- **Perfect Negative.** Ranking in one distribution is exactly the reverse of ranking in the other distribution

# Variance in the Wage Distribution

## 2 Wage-Setters, Identical Dists

Association between  $X_1$  and  $X_2$

**Perfect  
Positive**

**Independent**

**Perfect  
Negative**

$Var(X)$

$$\frac{Var(X)}{2}$$

$$\frac{[Var(X)][1 + \rho]}{2}$$

# Two Main Analytic Results

- **As the covariances among the wage-setters' recommended wage distributions  $X_i$  move from positive to negative, the variance in the final wage distribution  $Y$  declines**
- **If the wage-setters' recommended wage distributions  $X_i$  are independent, the variance in the final wage distribution  $Y$  declines as the number of wage-setters increases**

# Other Analytic Results

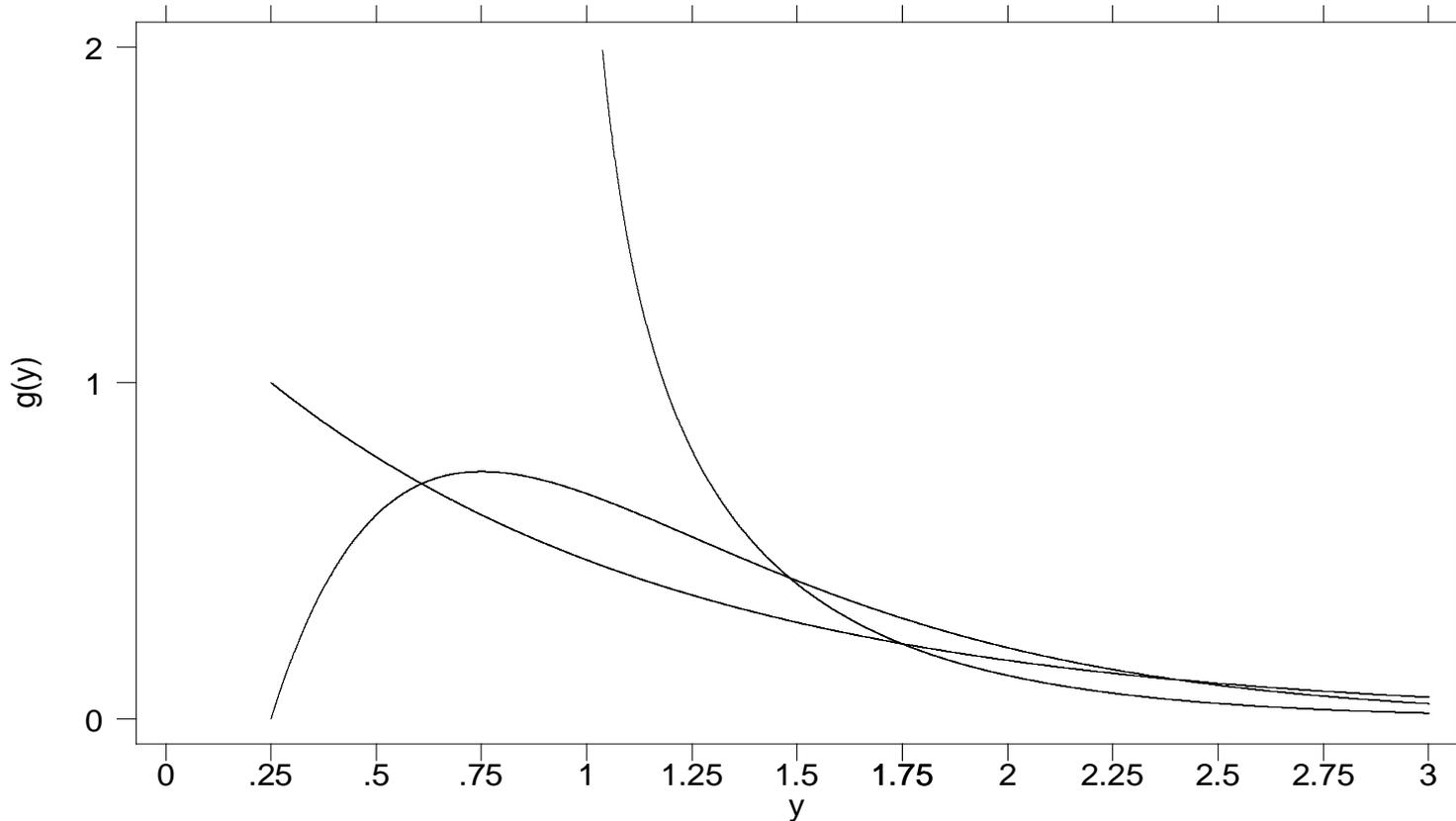
- **Given 2 wage-setters and recommended wage distributions  $X_i$  that are either**
  - **independent with equal finite variances**
  - **identical with finite variances and perfectly negatively associated**
- **the variance in the final wage distribution  $Y$  is minimized when the 2 wage-setters are equally-weighted**

# **Wage Inequality Model**

- **Wage-Setting Model**
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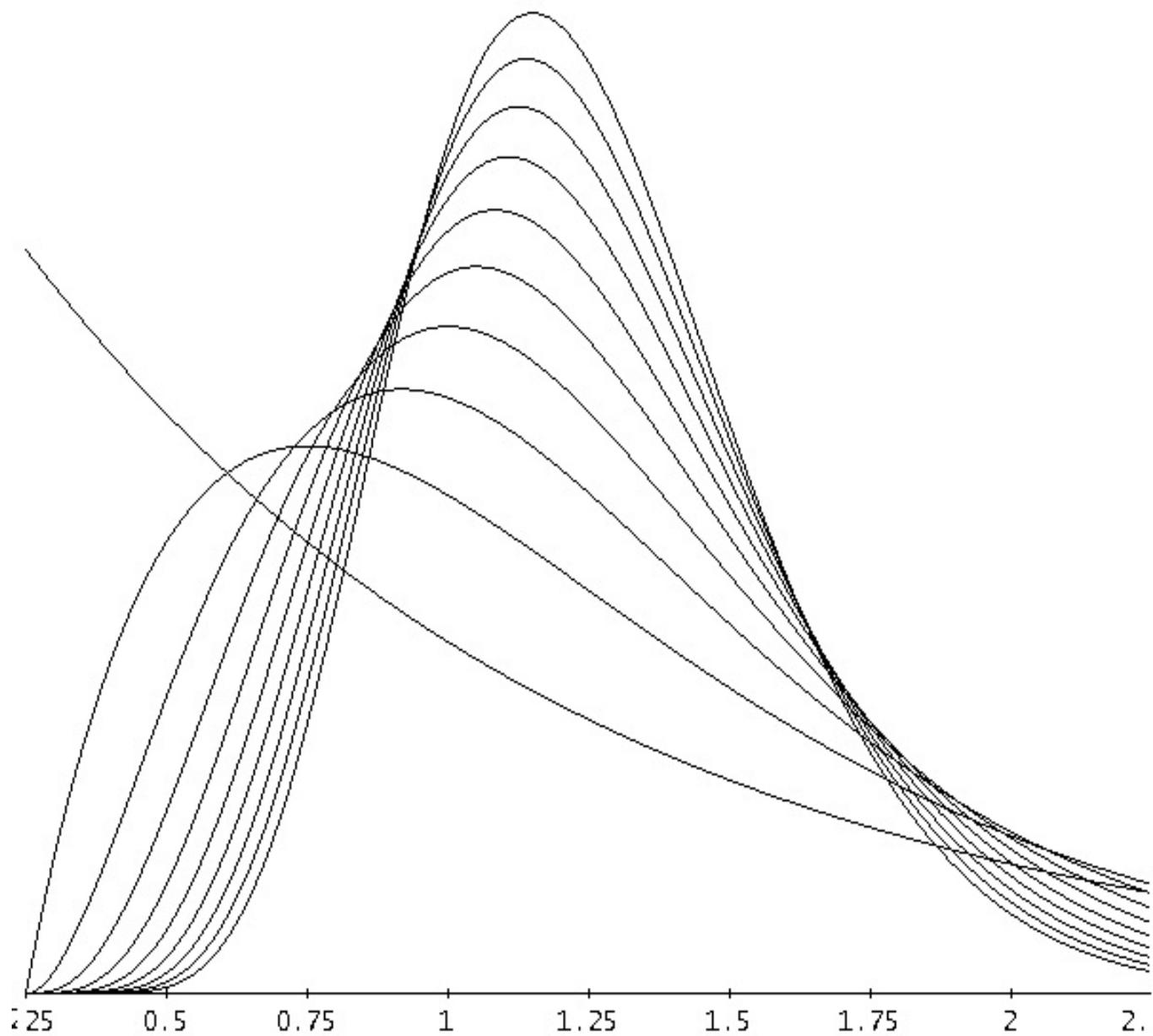


# PDF of Shifted Exponential, Shifted Erlang, and Shifted Ring(2)-Exponential



# How Inequality Declines: 2 Wage-Setters, Identical Dists

<b>Inequality Measure</b>	<b>Shifted Exponential</b>	<b>Shifted Erlang</b>	<b>Shifted Ring(2)-Exponential</b>
<b>Variance</b>	<b>1</b>	<b>.5</b>	<b>.178</b>
<b>Gini</b>	<b>.4</b>	<b>.3</b>	<b>.154</b>



# How Inequality Declines: 2, 6, 10 Independent Wage-Setters

<b>Inequality Measure</b>	<b>2 Wage-Setters</b>	<b>6 Wage-Setters</b>	<b>10 Wage-Setters</b>
<b>Variance</b>	<b>.5</b>	<b>.167</b>	<b>.1</b>
<b>Gini</b>	<b>.3</b>	<b>.181</b>	<b>.141</b>

# Illustration with Just Rewards

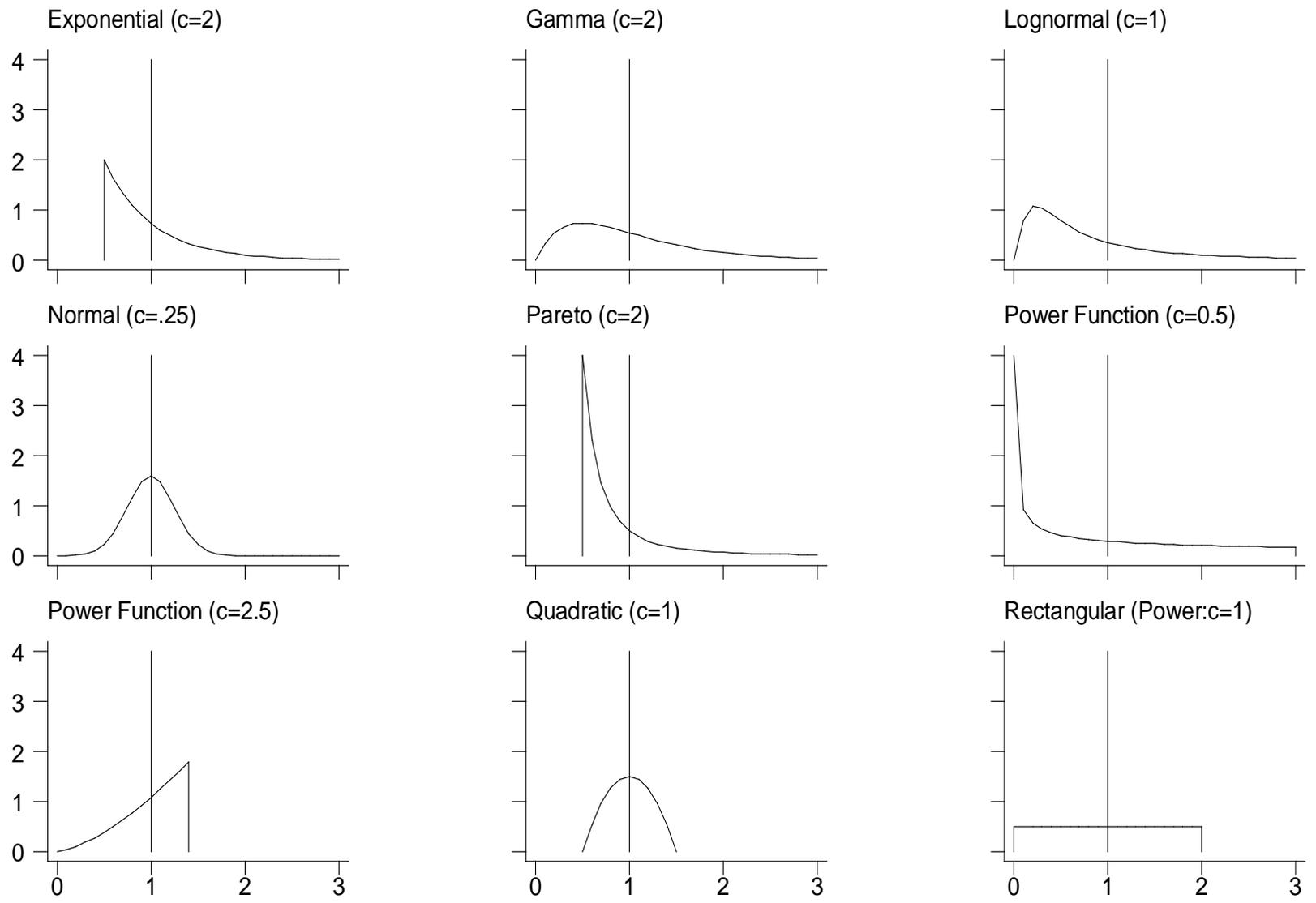
- **Just earnings for 20 fictitious workers in the eyes of 23 respondents**
- **253 covariances in the 23 just earnings distributions**
- **Pervasive individualism – 50 covariances negative**
- **Final earnings distribution (average of 23 amounts) has smaller variance than 21 of the 23 distributions**
- **Consistent with Hatfield's Principle: Equity is in the eye of the beholder**

# **Four Small Distributions Based on Classical Variates**

- **Dist A. Based on the shifted exponential**
- **Dist B. Based on the lognormal**
- **Dist C. Based on the Pareto**
- **Dist D. Based on the quadratic**

(Expected Value = 1)

Probability Density Function



x  
Figure 1. PDF in Several Variate Families

# Four Small Distributions

Distribution A	Distribution B	Distribution C	Distribution D
25	5	50	50
29	30	51	64
33	38	52	70
37	44	54	74
42	50	55	79
47	55	57	83
52	60	59	86
57	66	62	90
63	71	64	93
70	77	67	97
77	83	70	100
85	90	74	103
94	97	79	107
104	105	84	110
115	114	91	114
129	125	100	117
146	139	111	121
167	156	129	126
198	181	158	130
244	226	223	136
286	288	410	150

# Summary Measures in Four Distributions of Size 21

Measure	Distribution A	Distribution B	Distribution C	Distribution D
Mean	100	100	100	100
Median	77	83	70	100
Variance	5256.6	4661.9	6830.7	645.6
Gini	.394	.372	.348	.149

# Approximating Polar Types of Association

- **Perfect Positive.** Second distribution same as the original
- **Independence.** Generate a nearly independent distribution by applying a random-number generator to the original
- **Perfect Negative.** Generate reverse distribution

# Nearly Independent & Reverse Distributions

Orig	Ind	Rev									
25	25	286	5	44	288	50	79	410	50	107	150
29	94	244	30	181	226	51	52	223	64	126	136
33	42	198	38	50	181	52	84	158	70	121	130
37	63	167	44	66	156	54	50	129	74	103	126
42	146	146	50	30	149	55	55	111	79	83	121
47	47	129	55	139	125	57	67	100	83	97	117
52	129	115	60	226	114	59	62	91	86	64	114
57	52	104	66	77	105	62	158	84	90	136	110
63	33	94	71	288	97	64	57	79	93	90	107
70	244	85	77	114	90	67	54	74	97	114	103
77	115	77	83	5	83	70	64	70	100	86	100
85	198	70	90	60	77	74	51	67	103	50	197
94	70	63	97	83	71	79	70	64	107	130	93
104	77	57	105	125	66	84	59	62	110	74	90
115	104	52	114	71	60	91	223	59	114	150	86
129	286	47	125	55	55	100	410	57	117	79	83
146	37	42	139	156	50	111	74	55	121	110	79
167	167	37	156	90	44	129	111	54	126	117	74
198	57	33	181	97	38	158	91	52	130	70	70
244	85	29	226	38	30	223	100	51	136	100	64
286	29	25	288	105	5	410	129	50	150	93	50

# Nearly Independent & Reverse Distributions

Orig	Ind	Rev									
25	25	286	5	44	288	50	79	410	50	107	150
29	94	244	30	181	226	51	52	223	64	126	136
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37	63	167	44	66	156	54	50	129	74	103	126
42	146	146	50	30	149	55	55	100	79	83	121
...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...
146	37	42	139	156	50	111	74	55	121	110	79
167	167	37	156	90	44	129	111	54	126	117	74
198	57	33	181	97	38	158	91	52	130	70	70
244	85	29	226	38	30	223	100	51	136	100	64
286	29	25	288	105	5	410	129	50	150	93	50

# Correlations in Pairs of Distributions

Distribution	Perfect Positive	Independent	Perfect Negative
A shifted exp	1	-.0287	-.744
B lognormal	1	-.0908	-.819
C Pareto	1	.171	-.338
D quadratic	1	-.145	-1

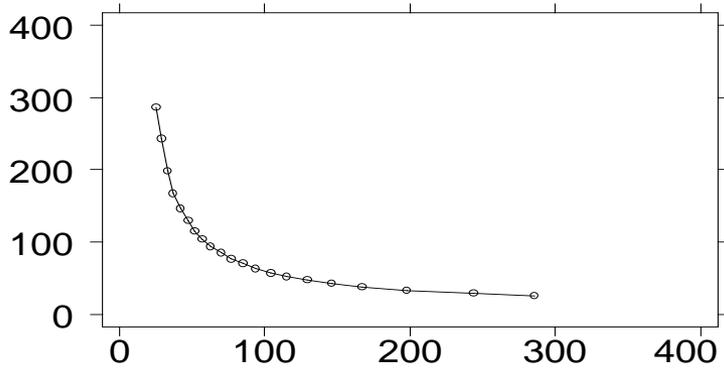
# Footnote:

## Association & Correlation

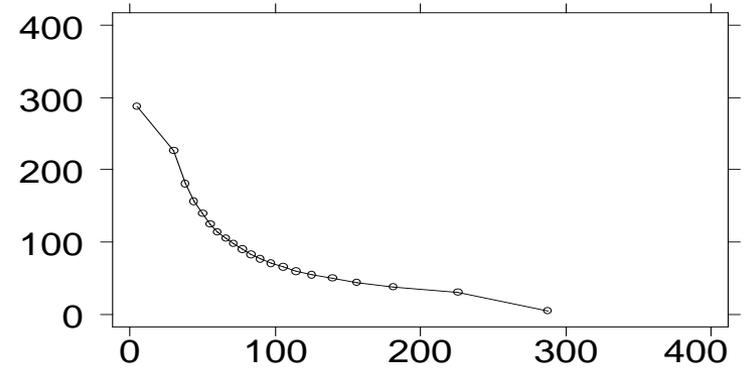
- Only in one of the four distributions – the symmetric Distribution D based on the quadratic -- does the case of perfect negative association attain a correlation of -1.
- Illustrates the fact that the correlation measures only linear dependence

# Perfect Negative Association in Four Small Distributions

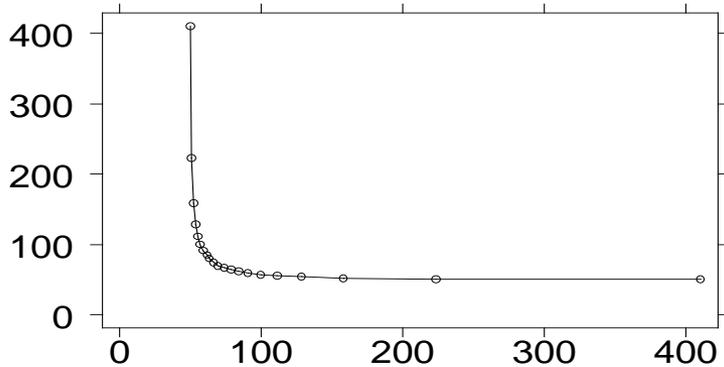
A. Based on the Shifted Exponential  
(corr =  $-.744$ )



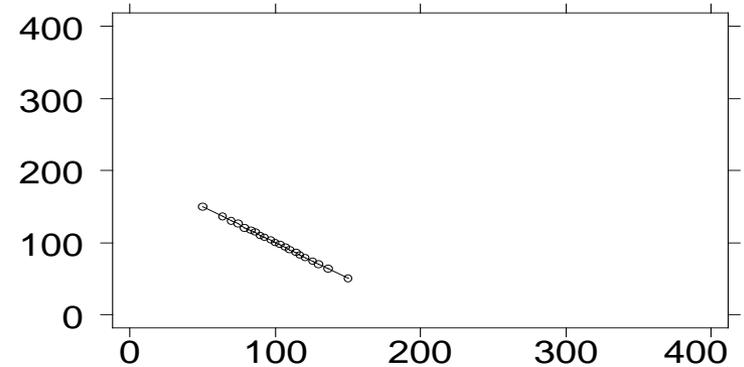
B. Based on the Lognormal  
(corr =  $-.819$ )



C. Based on the Pareto  
(corr =  $-.338$ )



D. Based on the Quadratic  
(corr =  $-1$ )



# **Wage Inequality Model**

- **Wage-Setting Model**
- **Two Main Analytic Results**
- **Illustrations – Theoretical, Empirical, Numerical**
- **Designing an Experiment**
- **Two Kinds of Mechanisms**

# **To Reduce Inequality: Two Levers**

- Promote independence of mind and diversity of thought**
- Increase number of decisionmakers**

# **To Increase Inequality: Two Levers**

- Eliminate independence of mind and diversity of thought**
- Decrease number of decisionmakers**

# **Understanding the Behavior Embedded in the Two Levers**

- What behavioral and situational factors generate independence of mind and diversity of thought?**
- What behavioral and situational factors determine the number of decisionmakers?**

# **Developing Experimental Treatments**

- Prior acquaintance among decisionmakers**
- Recommendation is solitary or in a group**
- Recommendation is public or anonymous**
- Decisionmakers discuss their recommendations, before and/or after making initial recommendation, or not**
- Constraints on recommendation – fixed mean, fixed pay schedule**

# **Wage Inequality Model**

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# Thinking about Mechanisms

- **There may be two kinds of mechanisms**
  - formal – mathematical/statistical
  - behavioral
- **Require distinct approaches & methods**
- **In the case of wage-setters and inequality**
  - formal mechanism identifies the operation of independence of mind and the number of decisionmakers
  - empirical analysis necessary to find determinants and correlates of independence of mind and number of decisionmakers

# **Wage Inequality Model**

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# Overview

- **Social Science Analysis**
- **Basic Building Blocks**
- **New Unified Theory**
- **Wage Inequality Model**

# **EITM Lectures**

**Guillermina Jasso**  
**New York University**

**University of Houston**  
**Hobby Center for Public Policy**  
**17 June 2014**