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

<table>
<thead>
<tr>
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<th>Framework</th>
<th>Empirical Analysis</th>
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<tr>
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- Deductive: Postulates → Predictions → Framework → Empirical Analysis
- Nondeductive: Postulates → Propositions → Framework → Empirical 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
Overview

• Social Science Analysis
• Basic Building Blocks
• New Unified Theory
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Basic Building Blocks

• What does a theory look like?
• Types of theories
• Models and theories
• Theoretical unification
• Probability distributions
Basic Building Blocks

• What does a theory look like?
• Types of theories
• Models and theories
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• Probability distributions
What Does a Theory Look Like?

• What does a theory look like?
  – two parts
    • assumptions
    • testable propositions
<table>
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Figure 12.2. The Structure of a Theory
Basic Building Blocks

• What does a theory look like?

• Types of theories

• Models and theories

• Theoretical unification

• Probability distributions
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 12th century was a response to switch from valuing attributes (birth, nobility, rank) to valuing possessions (wealth)

• invention of mystery novel in 19th century the same
Some Predictions for Fundamental Constants

• Critical inequality level occurs when Atkinson’s inequality equals \(1 - \frac{2}{e}\), 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 \(\frac{1}{e}\) 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 Best Friend
Basic Building Blocks

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

• What does a theory look like?

• Types of theories

• Models and theories

• Theoretical unification

• Probability distributions
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

<table>
<thead>
<tr>
<th>Variate</th>
<th>Cumulative Distribution Function</th>
<th>Probability Density Function</th>
<th>Quantile Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lognormal</td>
<td>( F_N \left{ \frac{\ln(x) + \frac{c^2}{2}}{c} \right} )</td>
<td>( \frac{1}{xc\sqrt{2\pi}} \exp \left{ -\left[ \frac{\ln(x) + \frac{c^2}{2}}{2c^2} \right]^2 \right} )</td>
<td>( \mu \exp \left[ cQ_N(\alpha) - \frac{c^2}{2} \right] )</td>
</tr>
<tr>
<td>( x &gt; 0, c &gt; 0 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pareto</td>
<td>( 1 - \left[ \frac{\mu(c-1)}{cx} \right]^c )</td>
<td>( \left[ \frac{\mu(c-1)}{c} \right]^c cx^{-c-1} )</td>
<td>( \frac{\mu(c-1)}{c(1-\alpha)^{1/c}} )</td>
</tr>
<tr>
<td>( x &gt; \frac{\mu(c-1)}{c}, c &gt; 1 )</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Power function</td>
<td>( \left[ \frac{xc}{\mu(c+1)} \right]^c )</td>
<td>( \left[ \frac{c}{\mu(c+1)} \right]^c cx^{c-1} )</td>
<td>( \frac{\mu(c+1)x^{1/c}}{c} )</td>
</tr>
<tr>
<td>( 0 &lt; x &lt; \frac{\mu(c+1)}{c}, c &gt; 0 )</td>
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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:

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

\[
Q_N(\alpha) = \sqrt{2} \ \text{erf}^{-1}(2\alpha - 1),
\]

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

A. Lognormal (c = .5)

B. Pareto (c = 2)

C. Power-Function (c = 2)

D. Lognormal (c = .5)

E. Pareto (c = 2)

F. Power-Function (c = 2)

G. Lognormal (c = .5)

H. Pareto (c = 2)

I. Power-Function (c = 2)
Overview

• Social Science Analysis
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• **New Unified Theory**
• Wage Inequality Model
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
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
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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)
  – Additivity (zero second-order mixed partial derivative)

• 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

\[ A' = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \ddots & a_{1R} \\ a_{21} & a_{22} & a_{23} & \ddots & a_{2R} \\ a_{31} & a_{32} & a_{33} & \ddots & a_{3R} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{N1} & a_{N2} & a_{N3} & \ddots & a_{NR} \end{bmatrix} \]

\[ C' = \begin{bmatrix} c_{11} & c_{12} & c_{13} & \ddots & c_{1R} \\ c_{21} & c_{22} & c_{23} & \ddots & c_{2R} \\ c_{31} & c_{32} & c_{33} & \ddots & c_{3R} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ c_{N1} & c_{N2} & c_{N3} & \ddots & c_{NR} \end{bmatrix} \]

\[ \ln \frac{A'}{C'} = \begin{bmatrix} \ln \frac{a_{11}}{c_{11}} & \ln \frac{a_{12}}{c_{12}} & \ln \frac{a_{13}}{c_{13}} & \ddots & \ln \frac{a_{1R}}{c_{1R}} \\ \ln \frac{a_{21}}{c_{21}} & \ln \frac{a_{22}}{c_{22}} & \ln \frac{a_{23}}{c_{23}} & \ddots & \ln \frac{a_{2R}}{c_{2R}} \\ \ln \frac{a_{31}}{c_{31}} & \ln \frac{a_{32}}{c_{32}} & \ln \frac{a_{33}}{c_{33}} & \ddots & \ln \frac{a_{3R}}{c_{3R}} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \ln \frac{a_{N1}}{c_{N1}} & \ln \frac{a_{N2}}{c_{N2}} & \ln \frac{a_{N3}}{c_{N3}} & \ddots & \ln \frac{a_{NR}}{c_{NR}} \end{bmatrix} \]
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 Justice Theory

• 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 $1 - \left(\frac{2}{e}\right)$, or approx .264
  - when Theil’s MLD equals $\ln\left(\frac{e}{2}\right)$, 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\textsuperscript{th} century was a response to switch from valuing attributes (birth, nobility, rank) to valuing possessions (wealth)

• invention of mystery novel in 19\textsuperscript{th} 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

\[ J = \theta \ln \left( \frac{A}{C} \right) \]
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)
  – Additivity (zero second-order mixed partial derivative)

• Two more properties (SMR 1996)
  – Symmetry
  – Limiting form of difference between two power functions

• New -- Links loss aversion and the Golden Number
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

Graph showing the relationship between status and relative rank.
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
• **Personality** arises from personal configuration of PSOs and quantitative and qualitative characteristics in the identities

• **Culture** arises from societal configuration of PSOs 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
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

<table>
<thead>
<tr>
<th></th>
<th>Inequality in $X$</th>
<th>Inequality in $S$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Inequality</strong></td>
<td>wage inequality</td>
<td>status inequality</td>
</tr>
<tr>
<td><strong>Subgroup Inequality</strong></td>
<td>nativity wage gap</td>
<td>nativity status gap</td>
</tr>
</tbody>
</table>
Some Results – 1

Personal & Subgroup Inequality

• General inequality parameter $c$

• Link between overall inequality and subgroup inequality

• Source
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

<table>
<thead>
<tr>
<th>Wives’ Inequality</th>
<th>$X_H &gt; X_W$</th>
<th>$X_W &gt; X_H$</th>
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</thead>
<tbody>
<tr>
<td>increases</td>
<td>decreases</td>
<td>increases</td>
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<tr>
<td>decreases</td>
<td>increases</td>
<td>decreases</td>
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</table>
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

A. Quality-Good

B. Lognormal Quantity-Good
   \(c=1; c=2\)

C. Pareto Quantity-Good
   \(c=1.5; c=2\)

D. Power-Function Quantity-Good
   \(c=1.5; c=2\)
Fig 2. How Polarization of the First Type Varies with Proportion in Bottom Subgroup and Inequality

A. Ordinal Good

B. Lognormal Cardinal Good
\(c=1; c=2\)

C. Pareto Cardinal Good
\(c=1.5; c=2\)

D. Power-Function Cardinal Good
\(c=1.5; c=2\)
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?
• 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

Graph showing the relationship between Subgroup Split $p$ and the proportion of each subgroup. The graph compares 'All White', 'Mixed', and 'All Black' categories.
NB & FB in Mixed Neighborhood in a Justice-Pareto Society

![Graph showing the distribution of Native and Immigrant subgroups across a mixed neighborhood split. The x-axis represents the subgroups split, ranging from 0 to 1, and the y-axis represents the proportion.]
NB & FB in Mixed Neighborhood in a Status Society

![Graph showing the relationship between Subgroup Split p and Native vs. Immigrant categories.]
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

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

\[ Y = w_1 X_1 + w_2 X_2 + ... + w_N X_N \]
Wage Inequality Model

• Wage-Setting Model

• Two Main Analytic Results

• Illustrations – Theoretical, Empirical, Numerical

• Designing an Experiment

• Two Kinds of Mechanisms
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

\[
Var(Y) = \sum_{i=1}^{N} w_i^2 [Var(X_i)] + 2 \sum_{i=1}^{N} \sum_{k>i} w_i w_k Cov(X_i, X_k)
\]
Variance of Final Wage Distribution: \( N \) Wage-Setters, Identical and Equally-Weighted

\[
\text{Var}(Y) = \frac{\text{Var}(X)}{N} + \frac{2}{N^2} \sum\sum \text{Cov}(X_i, X_k)
\]
Variance of Final Wage Distribution: 

$N$ Wage-Setters, Identical, Independent, and Equally-Weighted

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

\[ \text{Var}(Y) = w_1^2 \text{Var}(X_1) + w_2^2 \text{Var}(X_2) + 2w_1 w_2 \text{Cov}(X_1, X_2) \]
Variance of Final Wage Distribution: 2 Wage-Setters, Identical, Equally-Weighted

\[ \text{Var}(Y) = \frac{\text{Var}(X)}{2} + \frac{\text{Cov}(X_1, X_2)}{2} \]
Variance of Final Wage Distribution: 2 Wage-Setters, Identical, Equally-Weighted

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

<table>
<thead>
<tr>
<th>Association between $X_1$ and $X_2$</th>
<th>Perfect Positive</th>
<th>Independent</th>
<th>Perfect Negative</th>
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<tbody>
<tr>
<td>$Var(X)$</td>
<td>$\frac{Var(X)}{2}$</td>
<td>$\frac{[Var(X)][1 + \rho]}{2}$</td>
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</tr>
</tbody>
</table>
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
- Two Main Analytic Results
- Illustrations – Theoretical, Empirical, Numerical
- Designing an Experiment
- Two Kinds of Mechanisms
### Prototypical Distributions of Income

<table>
<thead>
<tr>
<th>Infimum</th>
<th>Has supremum</th>
<th>No supremum</th>
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<tbody>
<tr>
<td>&gt; 0</td>
<td>quadratic</td>
<td>Pareto</td>
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<td>shifted exponential</td>
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<td>= 0</td>
<td>power-function</td>
<td>lognormal</td>
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</table>
PDF of Shifted Exponential, Shifted Erlang, and Shifted Ring(2)-Exponential
## How Inequality Declines: 2 Wage-Setters, Identical Dists

<table>
<thead>
<tr>
<th>Inequality Measure</th>
<th>Shifted Exponential</th>
<th>Shifted Erlang</th>
<th>Shifted Ring(2)-Exponential</th>
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<tbody>
<tr>
<td>Variance</td>
<td>1</td>
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<td>Gini</td>
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<td>.3</td>
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</table>
# How Inequality Declines: 2, 6, 10 Independent Wage-Setters

<table>
<thead>
<tr>
<th>Inequality Measure</th>
<th>2 Wage-Setters</th>
<th>6 Wage-Setters</th>
<th>10 Wage-Setters</th>
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<tr>
<td>Variance</td>
<td>.5</td>
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<td>.1</td>
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<tr>
<td>Gini</td>
<td>.3</td>
<td>.181</td>
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</table>
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
Figure 1. PDF in Several Variate Families
# Four Small Distributions

<table>
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<tr>
<th>Distribution A</th>
<th>Distribution B</th>
<th>Distribution C</th>
<th>Distribution D</th>
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### Summary Measures in Four Distributions of Size 21

<table>
<thead>
<tr>
<th>Measure</th>
<th>Distribution A</th>
<th>Distribution B</th>
<th>Distribution C</th>
<th>Distribution D</th>
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<tbody>
<tr>
<td>Mean</td>
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<td>Median</td>
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<tr>
<td>Variance</td>
<td>5256.6</td>
<td>4661.9</td>
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<tr>
<td>Gini</td>
<td>.394</td>
<td>.372</td>
<td>.348</td>
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</table>
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

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<th>Ind</th>
<th>Rev</th>
<th>Orig</th>
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## Correlations in Pairs of Distributions

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<td>-.744</td>
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<td>B lognormal</td>
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<td>-.0908</td>
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<td>C Pareto</td>
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<td>D quadratic</td>
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<td>-.145</td>
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• 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

• Wage-Setting Model
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• Illustrations – Theoretical, Empirical, Numerical
• Designing an Experiment
• Two Kinds of Mechanisms
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