Development Given Geography, Climate, and Genes

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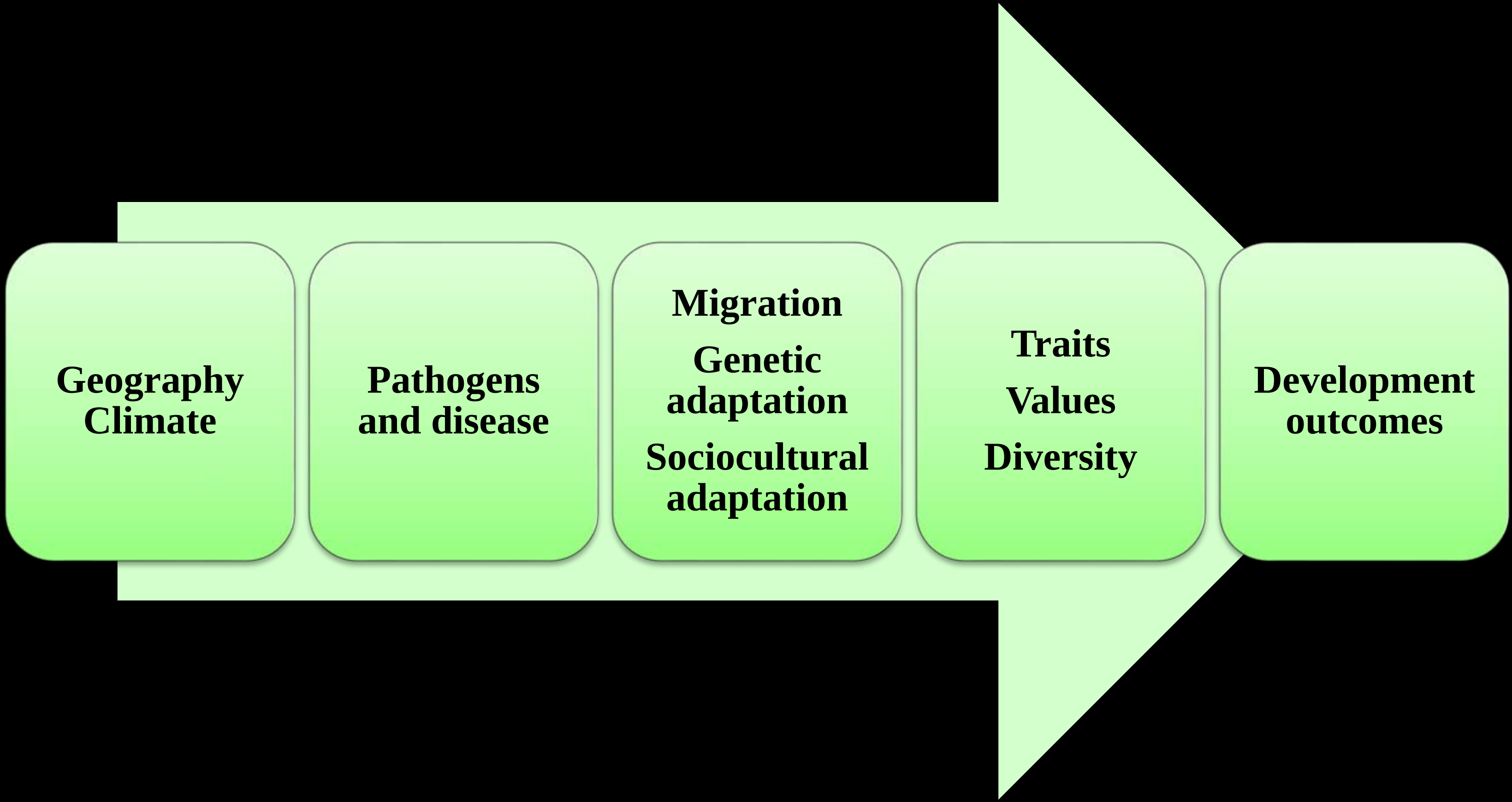
Overview

1. A proposed causal chain
2. Figuring out what causes what
3. Findings
4. Interpretations and implications

A Proposed Causal Chain



From Geography and Climate to Disease

- Many variables explored
- We add a new variable: UV exposure
  - "Faster evolution" hypothesis (Wright et al. 2003)
  - One implication: more pathogens (Keesing et al. 2010)

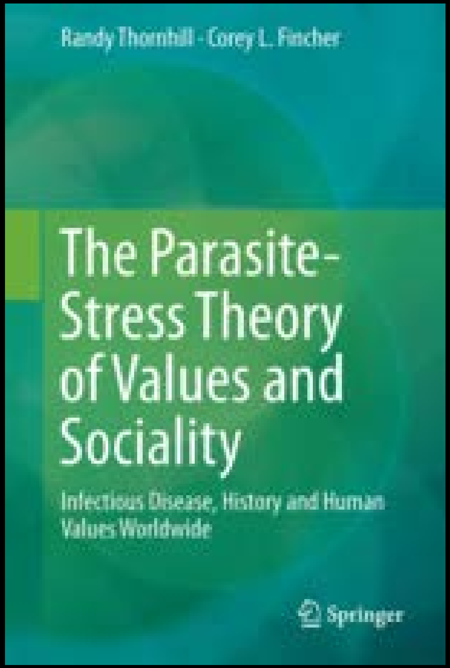
From Disease to Adaptation

1. Migration
2. Genetic adaptation
3. Social and cultural adaptation

(Thornhill & Fincher 2014):

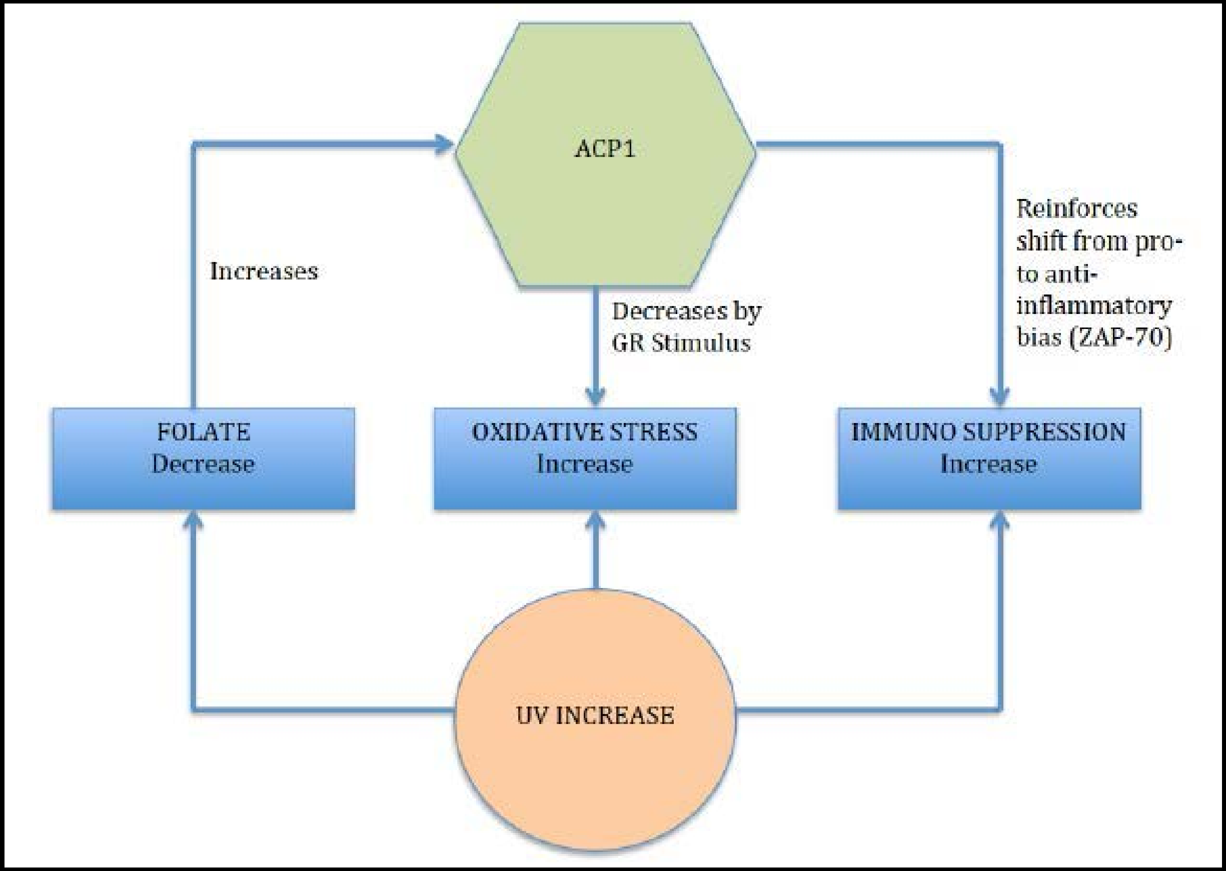
- The "behavioral immune system"

(Murray and Schaller 2016)



An Example of Genetic Adaptation:

Acid phosphotase controlled by locus 1



From Migration and Adaptation to Behavioral Attributes

- Migration
- Genetic adaptations
- Behavioral immune systems

- Traits
- Values
- Diversity

An Example: Diversity

- Ashraf & Galor 2013
- Migration leads to lower levels of genetic diversity, the farther the group is from Africa
- Effects on development
- Optimal genetic diversity?

From Behavioral Attributes to Development Outcomes

- Traits
- Values
- Diversity

- Productivity
- Governance
- Fertility
- Health outcomes
- Happiness

Example: Traits and Values to Development

- Individualism and economic development (Gorodnichenko & Gerard 2015)
- Individualism and governance (Kyriacou 2015)
- Local adaptations within Africa important for development (Michalopoulos & Papaioannou 2013)

What Causes What?

- Concepts and measures are contestable
- Contemporary data (even then, partial), so we can't examine a huge historical time series
- Causality may go in both directions (e.g., co-evolution)
- Students of cross-country econometric studies: what else is new?

So What Can We Do?

- Examine patterns
  - Use theory, especially from individual-level data
  - Consider instrumental variables
- Look for exceptions that may provide clues
- Ponder how policies might take advantage of deep roots

Our Novelties

- Country frequencies for several genetic markers plus heterozygotic diversity
- Ultraviolet exposure as an instrument
- Many econometric checks
- Go beyond statistical significance to interpretations and implications

Our Statistical Findings

- ACP1 frequencies are predictive of country differences in many development outcomes
- Instrument: UV exposure
- Other predictors: the kitchen sink
- The combined effects of deep roots: a large percentage of variance explained

ln GNIpc 2014	(1) OLS	(5) IV	(6) IV
Frequency of *ACP1**B allele	-7.69*** (0.91)	-9.07*** (1.71)	-4.95*** (1.62)
Predicted genetic diversity (ancestry adjusted)		13.67 (126.67)	186.50* (109.050
Predicted genetic diversity squared (ancestry adjusted)		-13.09 (90.17)	-139.51* (78.64)
Log Neolithic transition timing (ancestry adjusted)		-0.17 (0.33)	0.49* (0.27)
Log precipitation		-0.31** (0.14)	-0.27** (0.12)
Log percentage of arable land		-0.21** (0.10)	-0.20** (0.10)
Land suitable for agriculture		-0.22 (0.51)	-0.30 (0.39)
Log Mean distance to nearest waterway		-0.31*** (0.08)	-0.18** (0.08)
Log life expectancy in 1940			1.91*** (0.38)
Sub-Saharan Africa dummy variable		-0.45 (0.49)	0.41 (0.42)
Constant	14.74*** (0.68)	15.70 (42.30)	-58.83 (36.98)
Number of countries	115	105	61
Adjusted R^2	0.38	0.57	0.76

Other Outcomes

1. Governance (e.g. rights, corruption, GCI)
2. Fertility
3. Disability-adjusted life years
4. Self-reported happiness

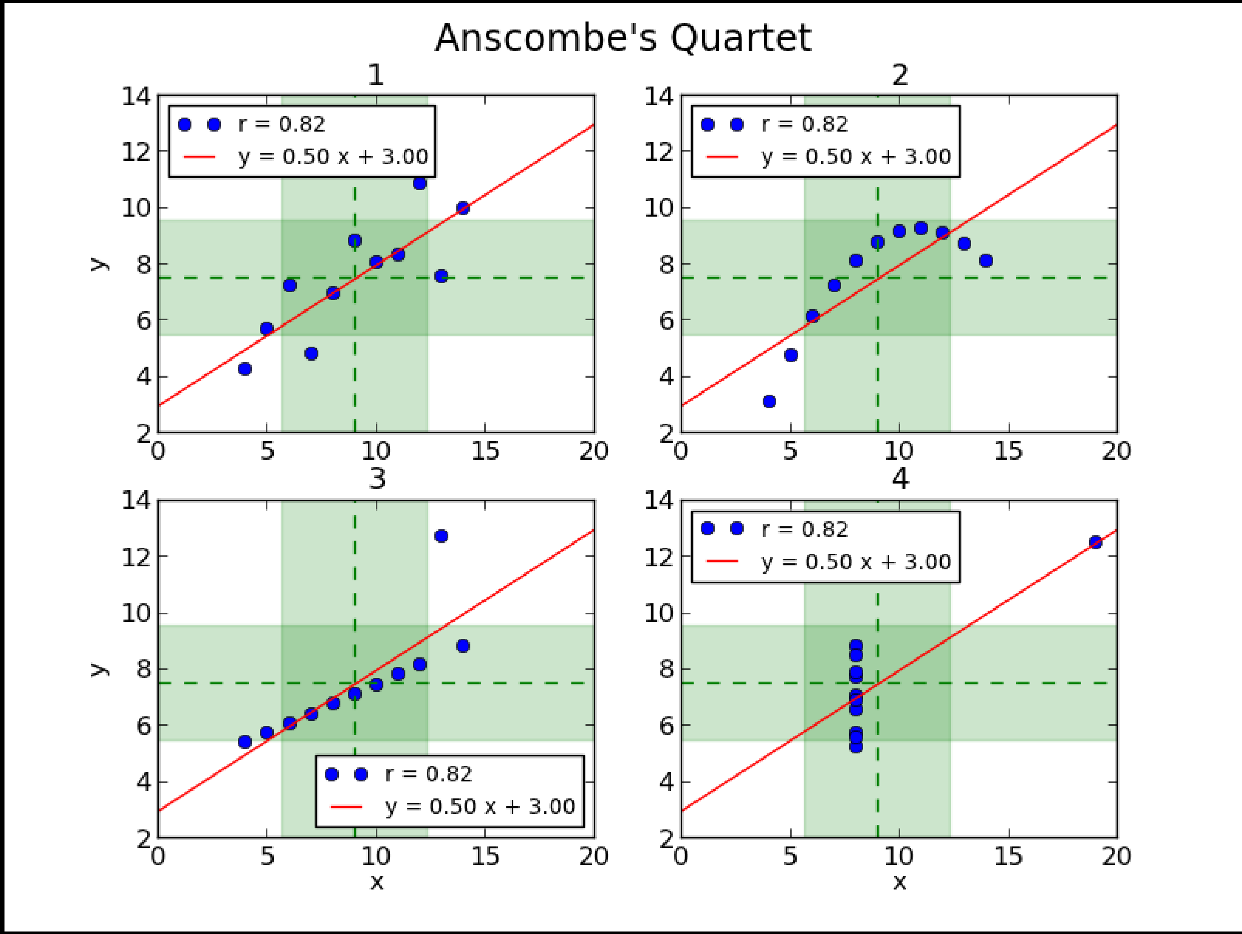
In every case:

- APC1 is highly significant
- R^2 is surprisingly high

What Do Such Findings Entail?

- Will become a more and more important question
- Think of the generalization: what if variables beyond our control have a high R^2 for outcomes we care about?

Reminders about R^2



What If Well-Behaved?

1. R^2 can be large, yet entire distributions can improve over time
2. Functional relationships may evolve
3. Adaptive policies can take advantage of different settings
4. Exceptions to the patterns may inspire and teach the rest

1. Distributions Shift

- 1970: Geography, climate, and genes explained over half the variation in GDP pc. Ditto for 2014. Yet average incomes ⇧ from $6451 to $15,415
- Height: Heritability > 0.8. And yet, from 1850 to 1980 average height ⇧ 11 cm. Hatton (2014) cites better health care, housing, nutrition, social services.

2. Functional Relationships Evolve

- Beyond Hatton’s list, rural education, good-government movements, social networks, technological change, and contraception
- Global flows of goods, services, and finance ⇧ by factor of 1.5 from 1990 to 2012 and could triple again in the next decade (Manyika et al 2014)
- Future explanatory power of deep roots may change radically

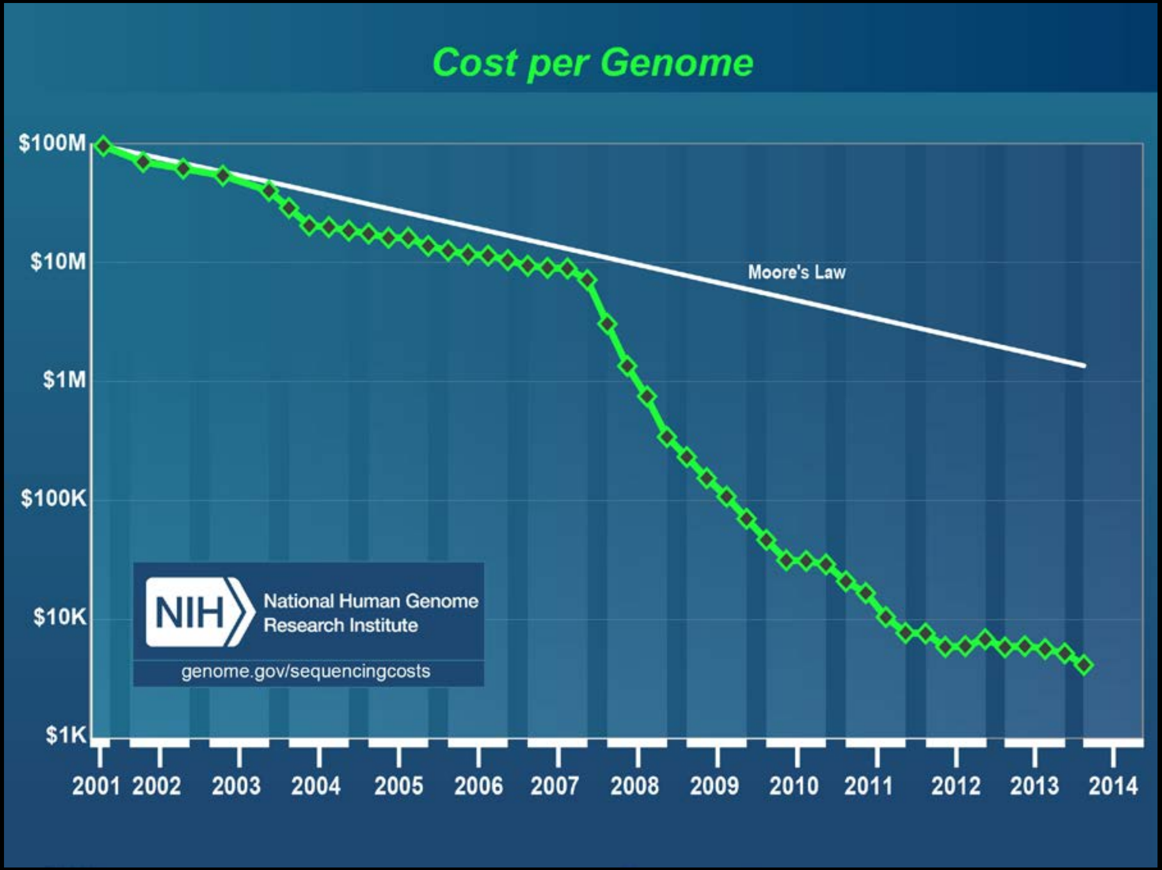
3. Adapting Policies

- The analogy of soil science

4. *Learning from Exceptions*

- Fertility: our deep roots explain 72 percent of the variation in national fertility rates
- Ghana: reduced mean fertility per woman from 6.4 in late 1980s to 4.0 in 2008.
- Can we identify and learn from exceptional performers?

Genetic Data Will Become More and More Prevalent



Genetic Data Will Become More and More Prevalent

- Genome-wide association studies will lead to more and more genetic data about individuals, groups, countries, and regions
- Fatalism and other maladies lurk
- We need to prepare ourselves methodologically
- And perhaps practically as well