

Molecular Genetics, Risk Aversion, Return Perceptions, and Stock Market Participation

Rick Sias

University of Arizona

Laura Starks

University of Texas
University

Harry Turtle

Colorado State

ABFER

May 2019

Understanding behavior

- Why do we make the choices we do?

- Our common environment?

- Culture, schools, parents?

- Our unique environment?

- Things that happen to me alone

- Genetics?

Our “nurture”
(life experience)



Interaction

Our “nature”

It is not “nature” *versus* “nurture” that determines our choices.

It is nature *plus* nurture.

The question is the influence of each.

What percent of the following traits do you expect to derive from genetic endowments?

According to
genetic research

- Eye color
- Height
- School achievement
- Spatial ability (e.g., navigation)
- General intelligence



How much do genetic influences affect individuals' behavior with regard to their financial perceptions and choices?

Understanding behavior with regard to perceptions and financial choices

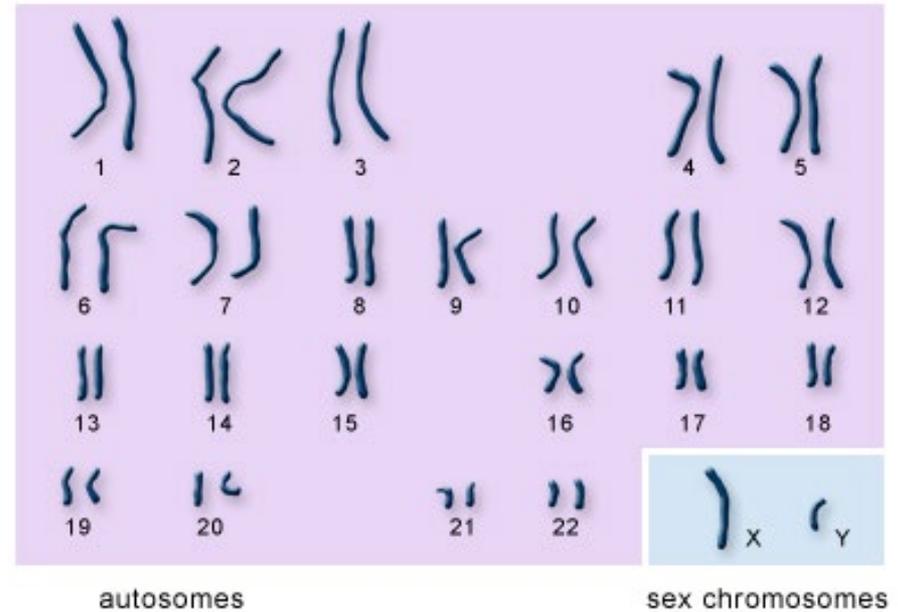
- Individuals' perceptions and financial choices
 - Choice to participate in the equity markets
 - Risk aversion
 - Expectations of return distributions
- How much derives from genetic endowment and how much from the environment?

Understanding behavior from the influence of genetics

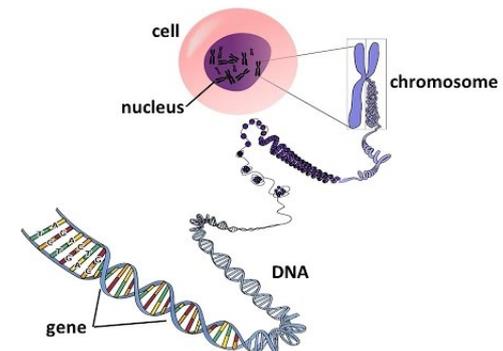
- Evolution of genetics research in the last decade
 - From twin studies to molecular genetics
 - Twin studies → *how much* (for your population, given assumptions)
 - Molecular genetics → *how and why* for broad characteristics that are polygenic in nature and not well understood

Molecular genetics

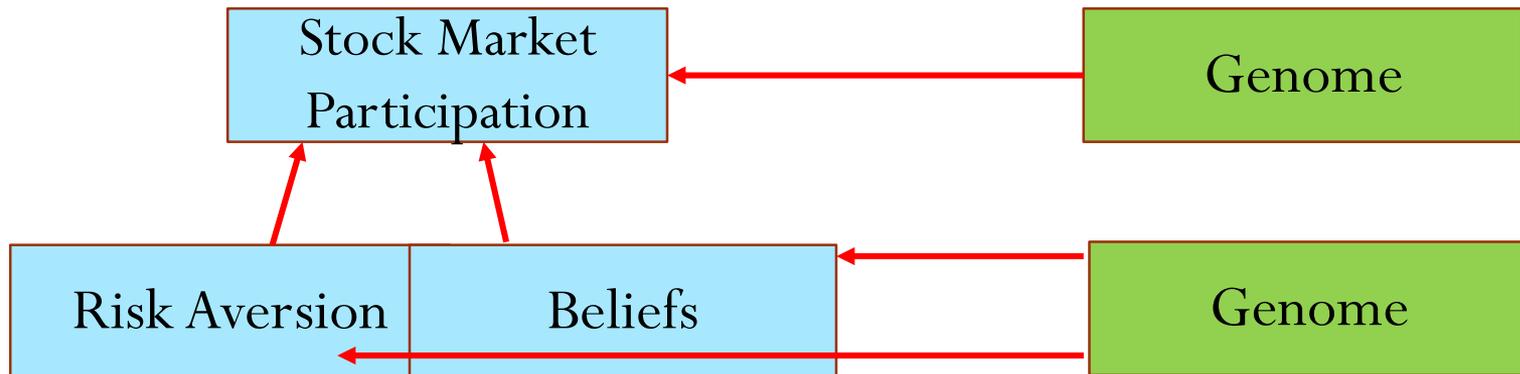
- Genome – genetic information needed to build and maintain a human
- Contained in 23 pairs of chromosomes within every cell in your body
- Each chromosome is one long DNA molecule
- Genes are the parts of the DNA that “code” for protein
 - 99% of DNA is non-coding



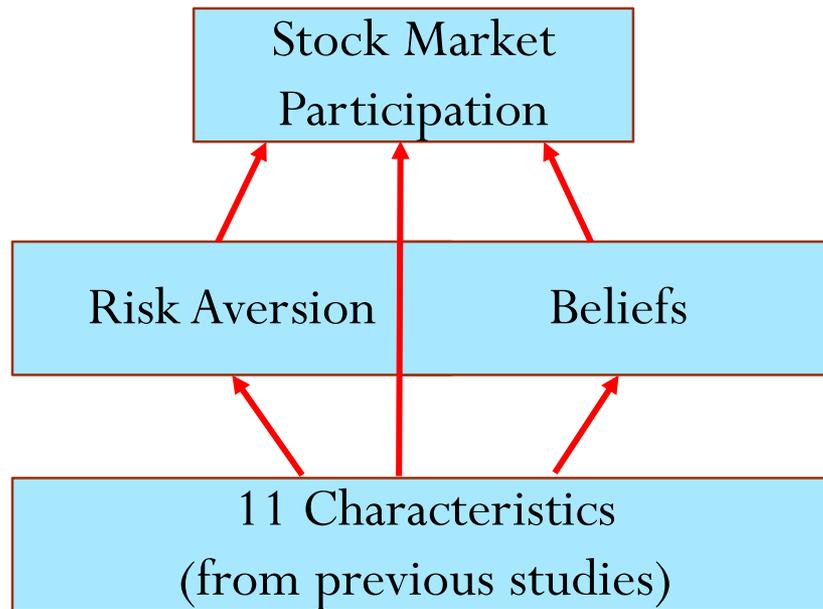
U.S. National Library of Medicine



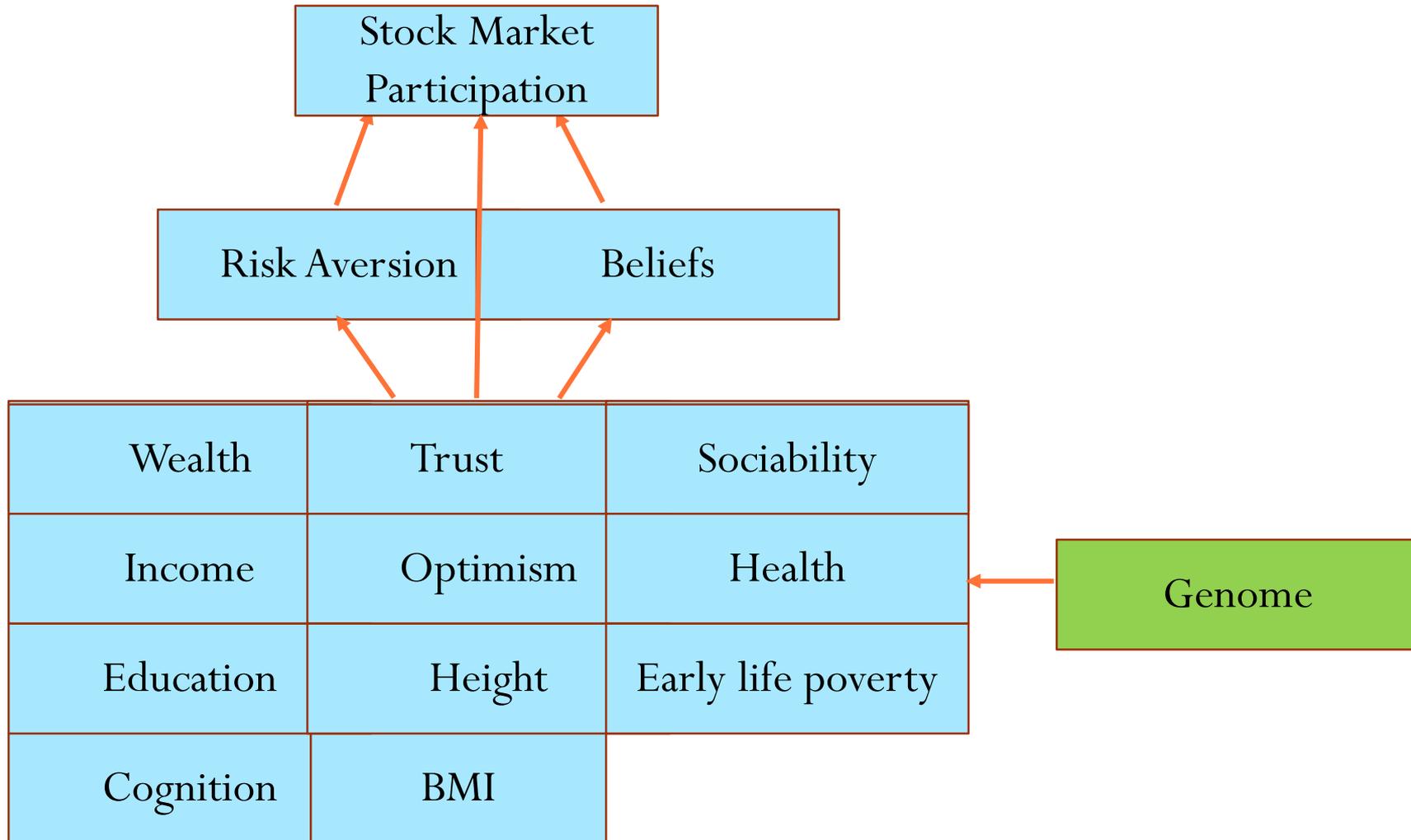
Motivation for our study



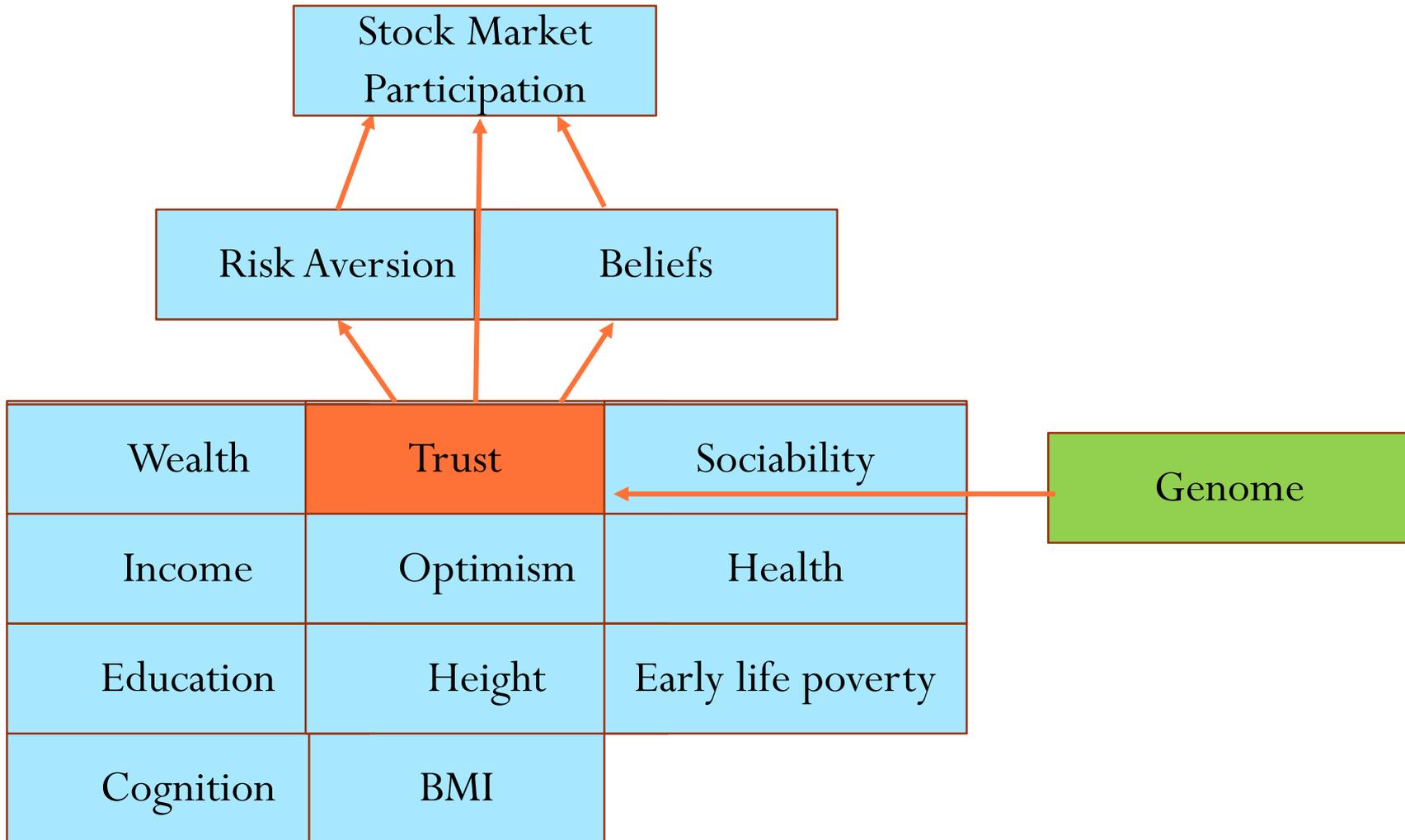
Motivation



Motivation



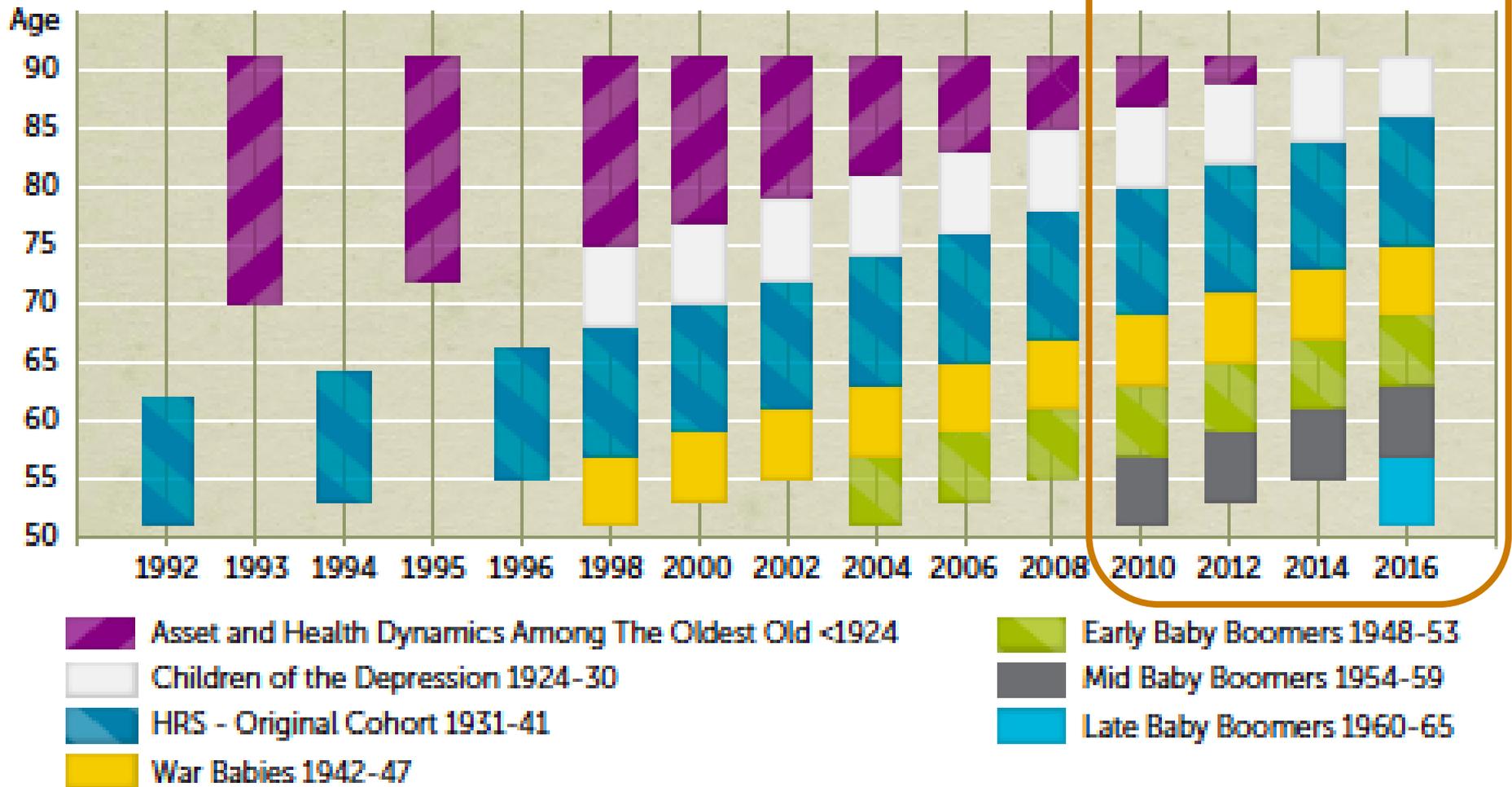
Motivation



Data

- U.S. Health and Retirement Study (SSA and NIA)
 - Every two years (1992-2016)
 - Adults ages 50-80
 - Many questions around topics including work, investments, etc.
- Delivered in waves over time
 - New respondents added
 - New questions developed

FIGURE A-4 Longitudinal cohort design of the HRS



Our sample: 5,560 individuals and
12,633 individual-year observations

Data

- U.S. Health and Retirement Study (SSA and NIA)
 - Every two years (1992-2016)
 - Adults ages 50-80
 - Many questions around topics including work, investments, etc.
- Delivered in waves over time
 - New respondents added
 - New questions developed
 - **Genetic sample collection began in 2006**

Primary variable to capture genetic influence

- A polygenic score (PGS) aggregates millions of individual loci across the human genome and weights them by the strength of their association to produce a single quantitative measure of genetic risk. (HRS Survey)

The goal of a PGS is provide an index to predict a particular trait

- PGS for a variety of phenotypes have been constructed for HRS respondents who provided salivary DNA. PGS for each phenotype are based on a single, replicated genome-wide association study (GWAS). (HRS Survey)

Data

- Genetics

- Educational Attainment PGS
- General Cognition PGS
- Neuroticism PGS
- Depressive Symptoms PGS

- Myocardial Infarction PGS
- Coronary Artery Disease PGS
- BMI PGS
- Height PGS

- Outcomes

- Participate in equity market
- % Equity held
- Self-rated risk aversion
- $P(R_M > 0\%)$
- $P(R_M > 20\%)$
- $P(R_M < -20\%)$

- Traditional investor characteristic variables

- Wealth
- Income
- Education
- Cognition
- Trust
- Sociability
- Optimism
- Early life poverty
- Height
- BMI
- Health

- Controls

- Gender
- Age
- HRS Wave
- Retired
- Married
- Genetic PCs

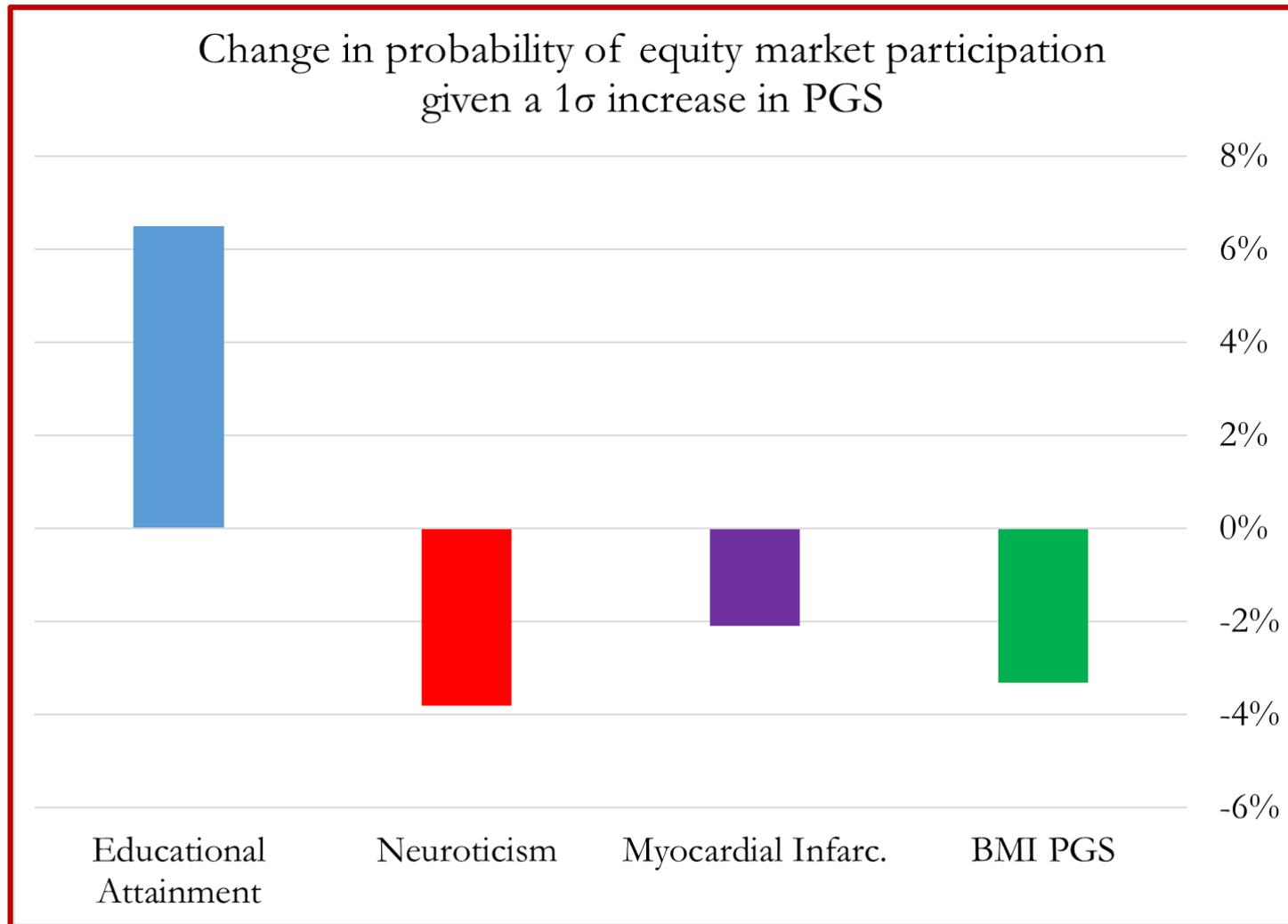
Genetics and stock market participation

- Q1 - Do genetic endowments help explain variation in stock market participation?



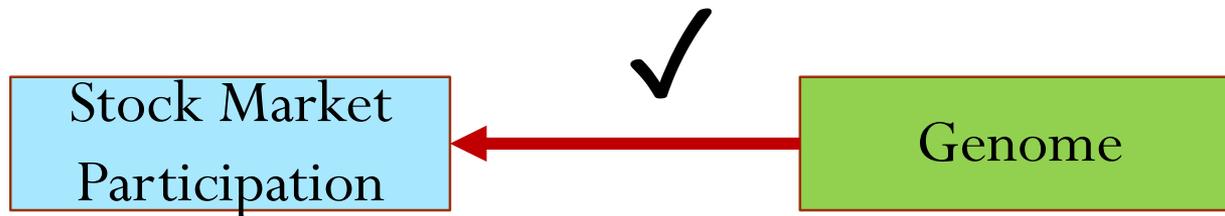
➔ Regress stock market participation on each PGS with controls included

Genetics and likelihood of holding any stock



Genetics and stock market participation

- Q1 - Do genetic endowments help explain variation in stock market participation?



➔ Yes, substantial predictability

Why?

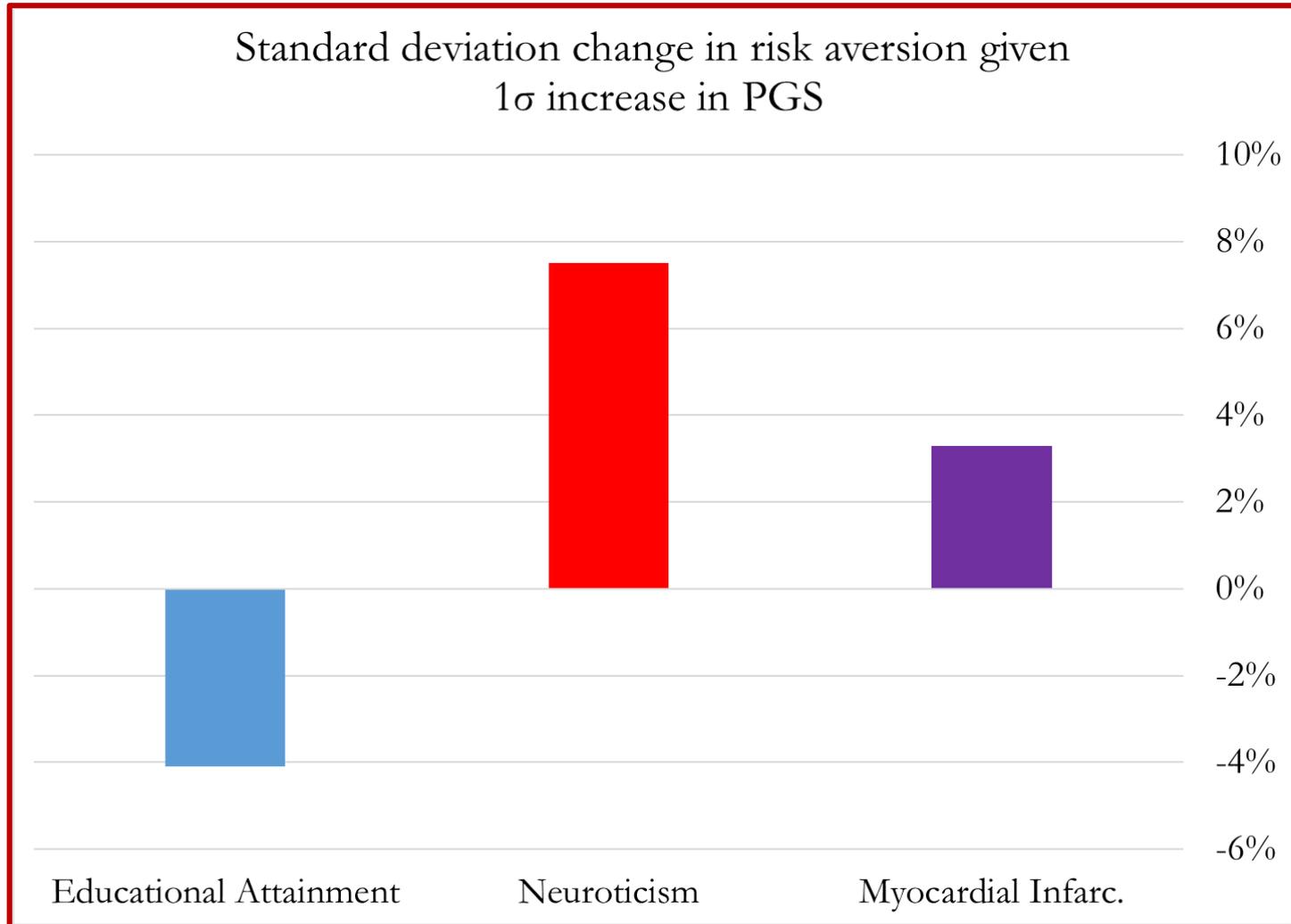
Why? Do genetics explain risk aversion and beliefs?

- Q2 - Do genetic endowments help explain variation in risk aversion and in beliefs regarding stock returns?

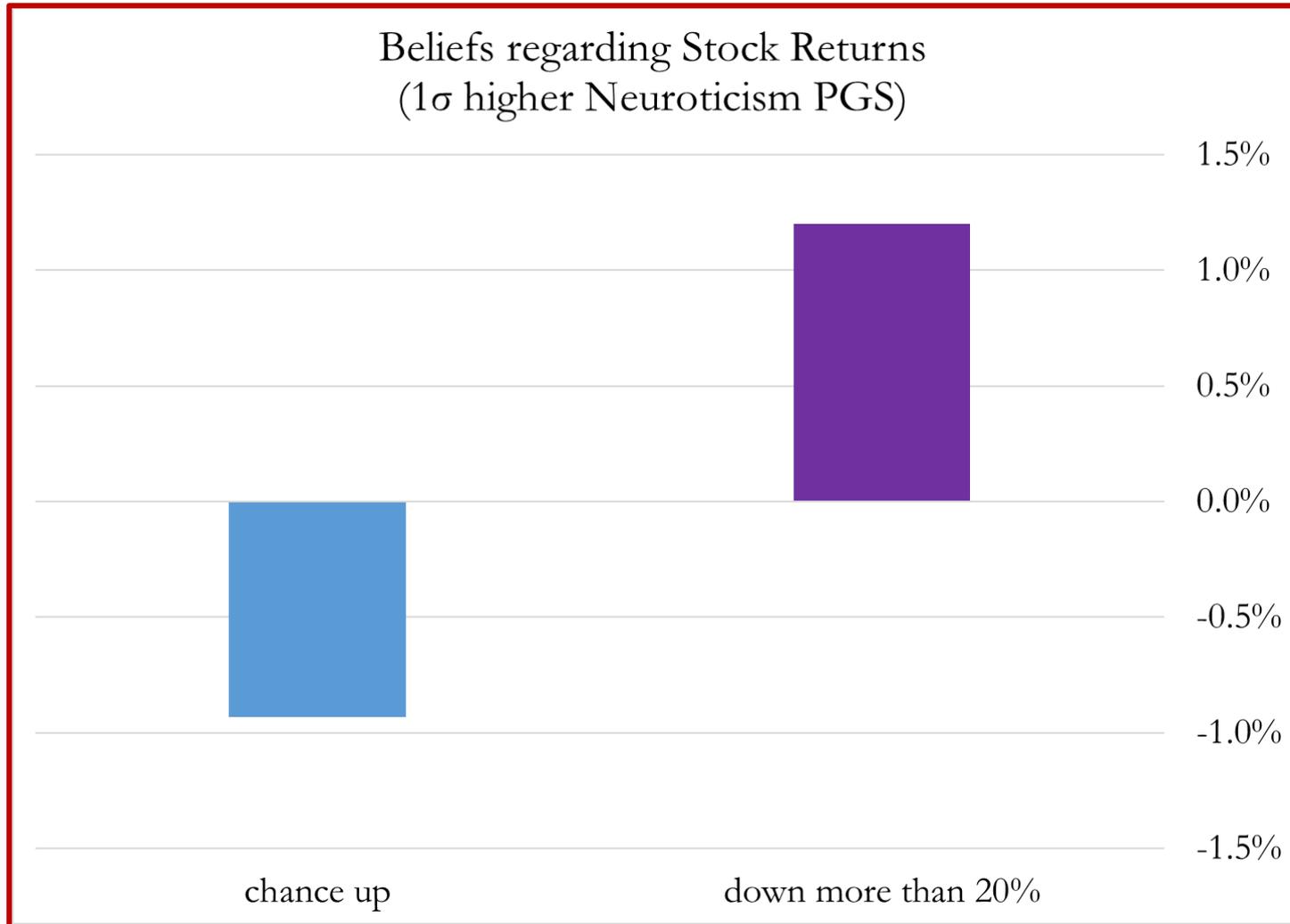


- Regress risk aversion and beliefs on controls and each PGS

Genetics and risk aversion

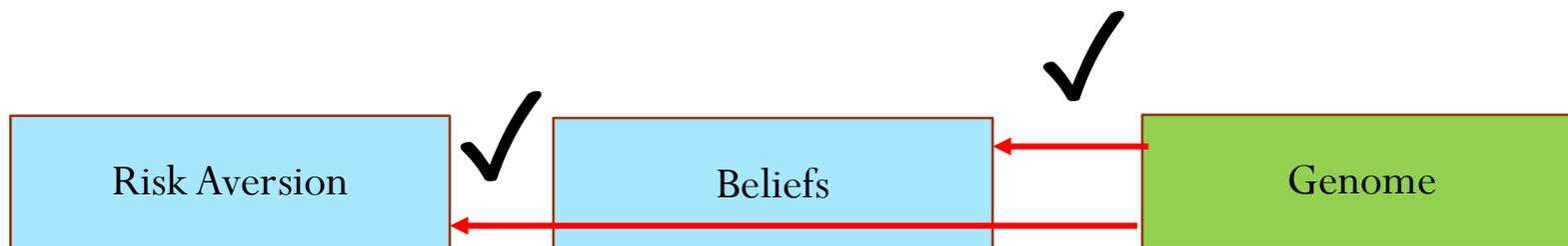


Genetics and beliefs regarding stock returns



Do genetics explain risk aversion and beliefs

- Q2 - Do genetic endowments help explain variation in risk aversion, and beliefs regarding stock returns?

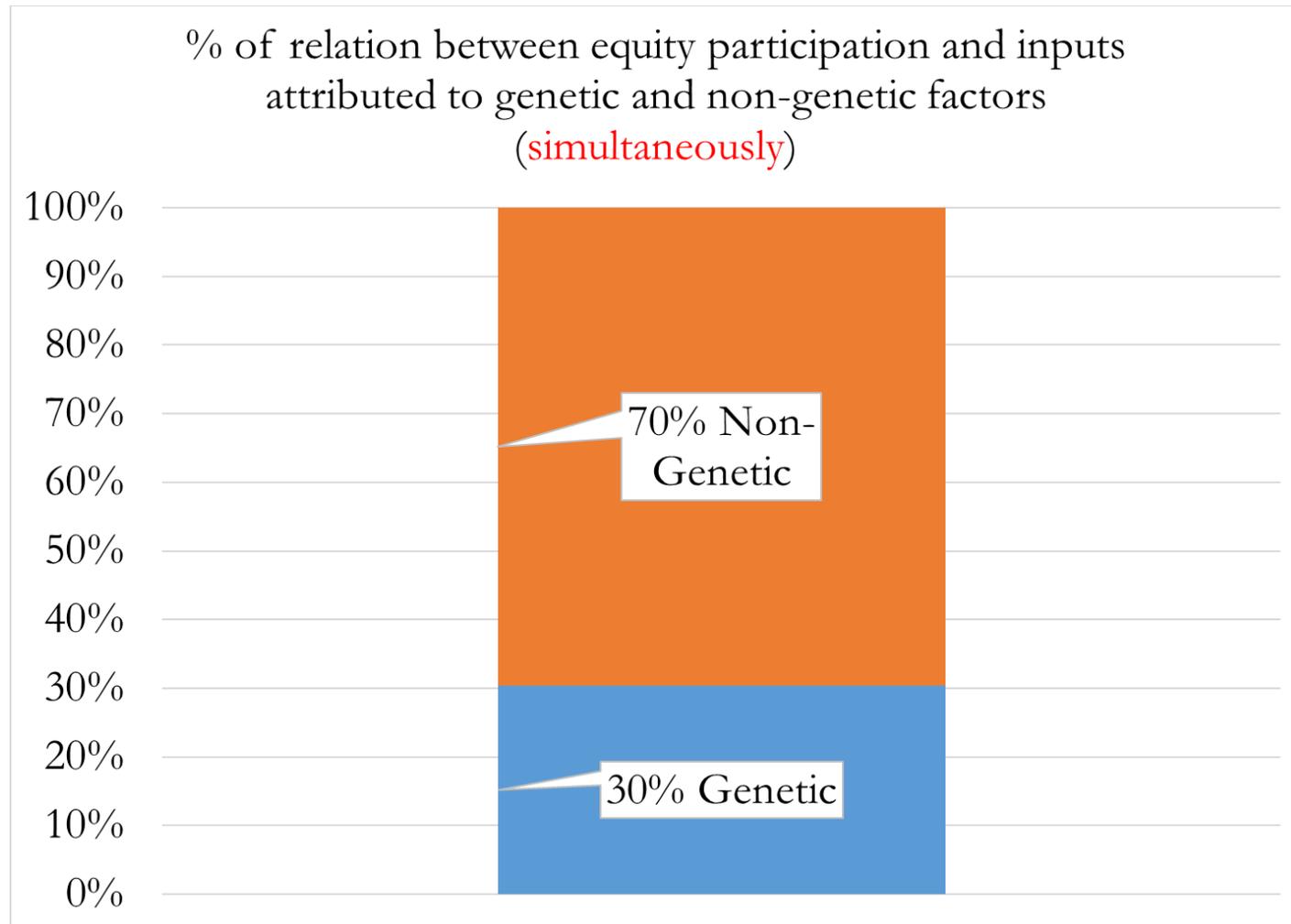


- Yes, PGSs impact both risk aversion and beliefs

Genetics, holding stocks, risk aversion, and beliefs

- Q3 – How much of the relation between stock market participation and risk aversion/beliefs can be explained by the 8 genetic components?
 - Step 1: Remove variation in participation, risk aversion, and beliefs related to control variables (e.g., age, gender, married, retired, HRS waves, & genetic PCs)
 - “Orthogonalized” participation, risk aversion, beliefs
 - Step 2: Regress orthogonalized risk aversion (or beliefs) on the 8 PGSs
 - fitted value is “genetic component”
 - residual is “non-genetic component”
 - Step 3: Regress orthogonalized participation on genetic and non-genetic components and partition R^2

Stock market participation, risk aversion, and beliefs



Traditional explanatory variables and genetics

- Q3 – Can genetics help explain the relation between risk aversion, beliefs, and stock market participation? And, if so, how much?

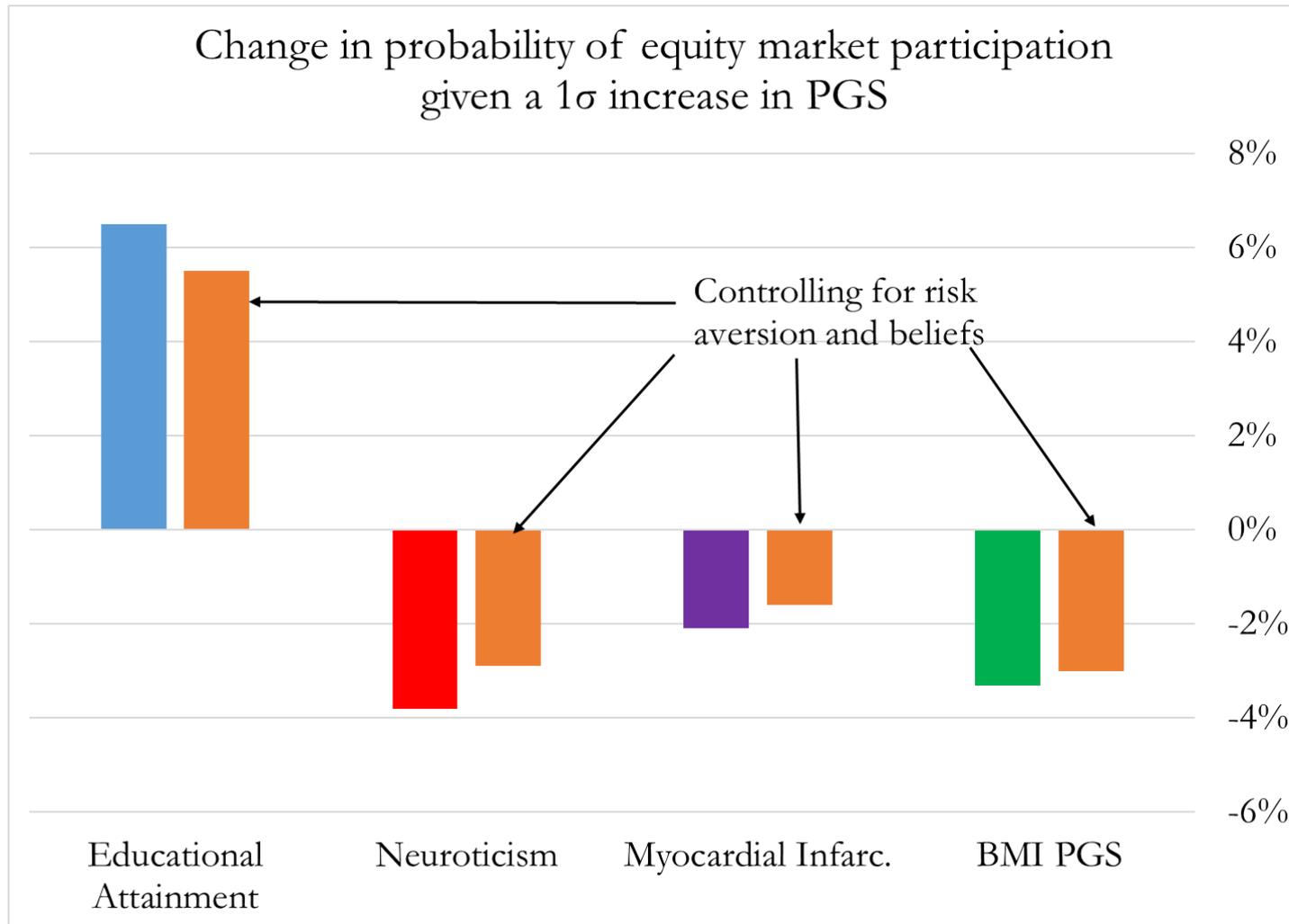
✓ Yes

- Best estimate:
 - 30% due to these eight genetic endowments
 - 70% not explained by these eight non-genetic endowments

Genetics, holding stocks, risk aversion, and beliefs

- Q4 – Can genetics impact on risk aversion and beliefs fully explain the relation between genetics and stock market participation?
 - Perhaps PGS better capture risk aversion and beliefs?
 - Other factors (that are captured by the PGSs) impact stock market participation
- Regress stock market participation on controls, risk aversion, beliefs, and each PGS individually

Genetics and likelihood of holding any stock



Genetics, holding stocks, risk aversion, and beliefs

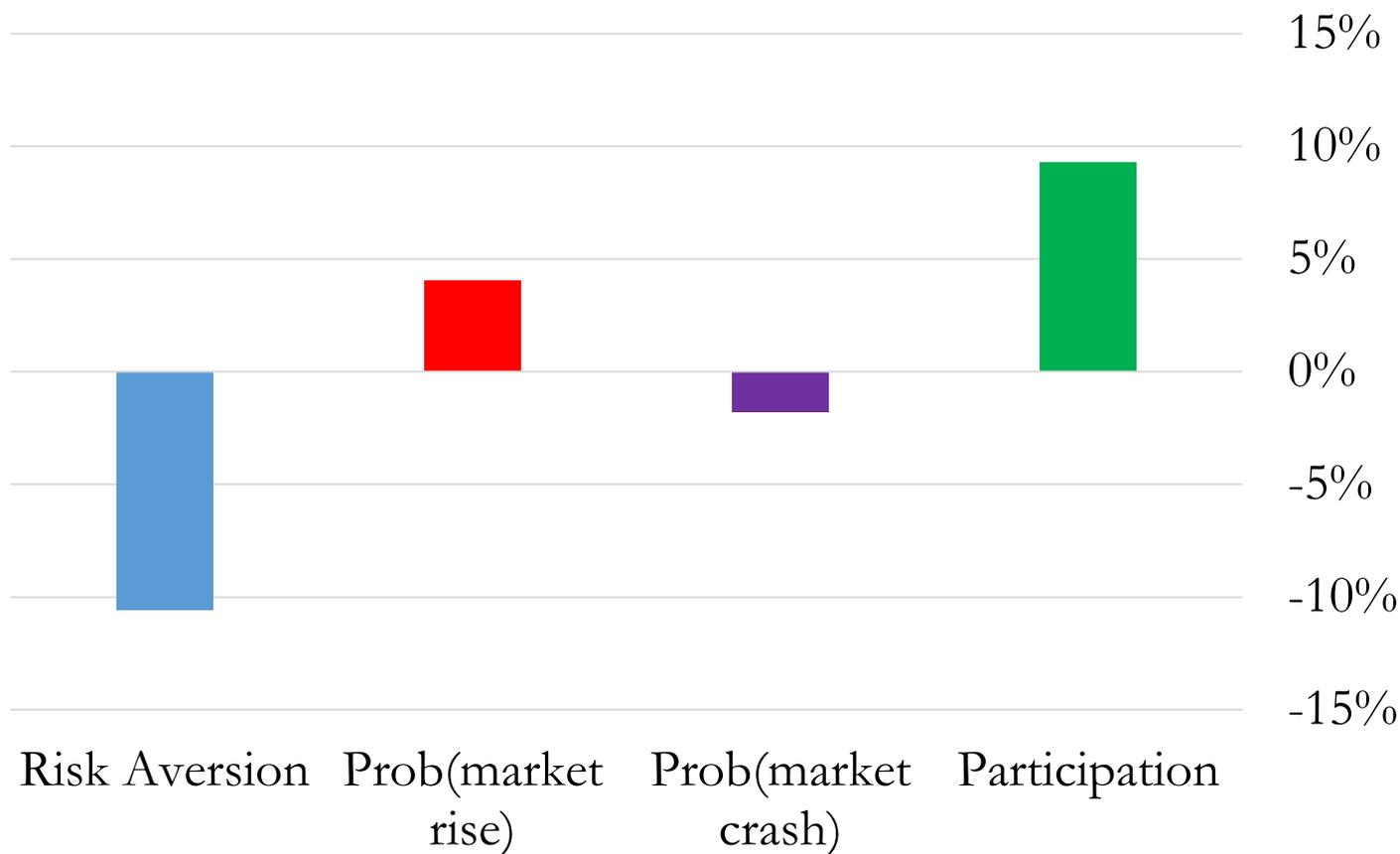
- Q4 – Can genetics impact on risk aversion and beliefs fully explain the relation between genetics and stock market participation?
 - No
 - The PGS may better capture risk aversion and beliefs
 - Other factors (related to PGSs) impact stock market participation
 - ➔ Look at traditional investor characteristic variables (e.g., trust) and PGSs

Investor characteristics from previous literature and genetics

- Q5 – Can genetics help explain the relation between investor characteristics and stock market participation, risk aversion, and beliefs?
- Step 1: Confirm relation between investor characteristics (e.g., trust) and stock market participation

Economic outcomes and investor characteristics, trust, without genetics

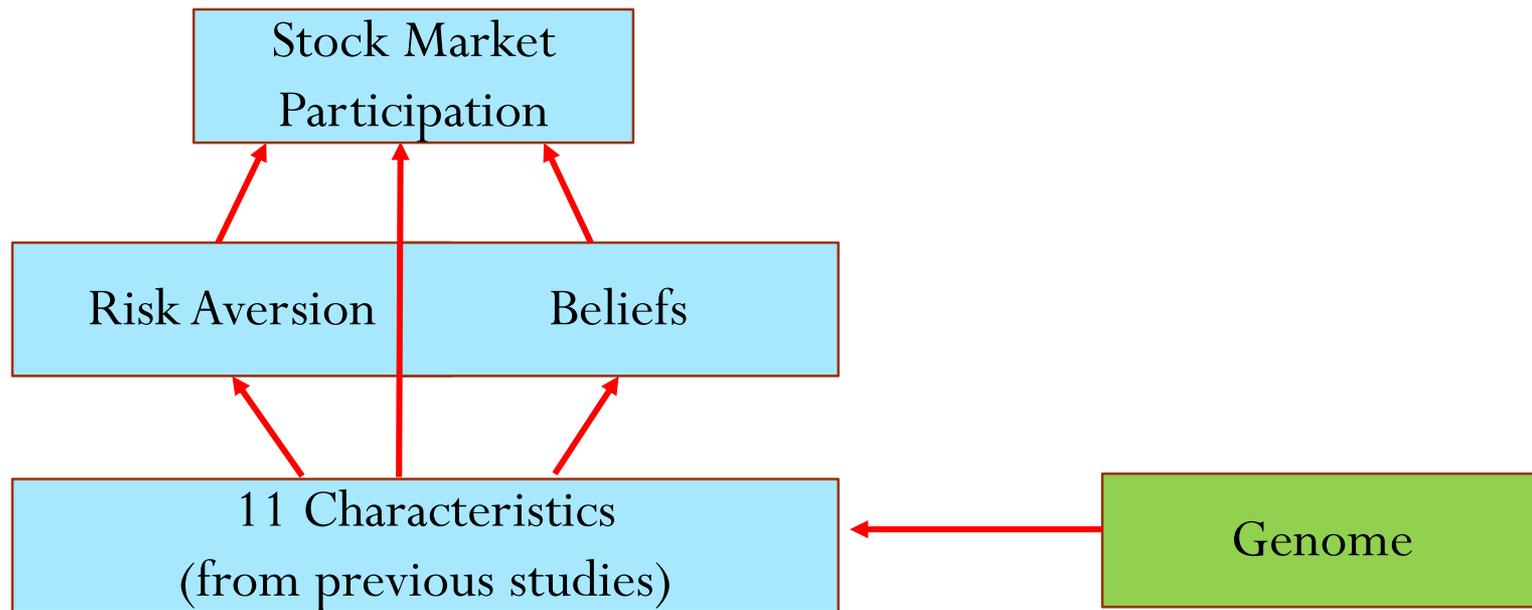
Impact of 1 σ higher Trust (phenotype)
(includes control variables)



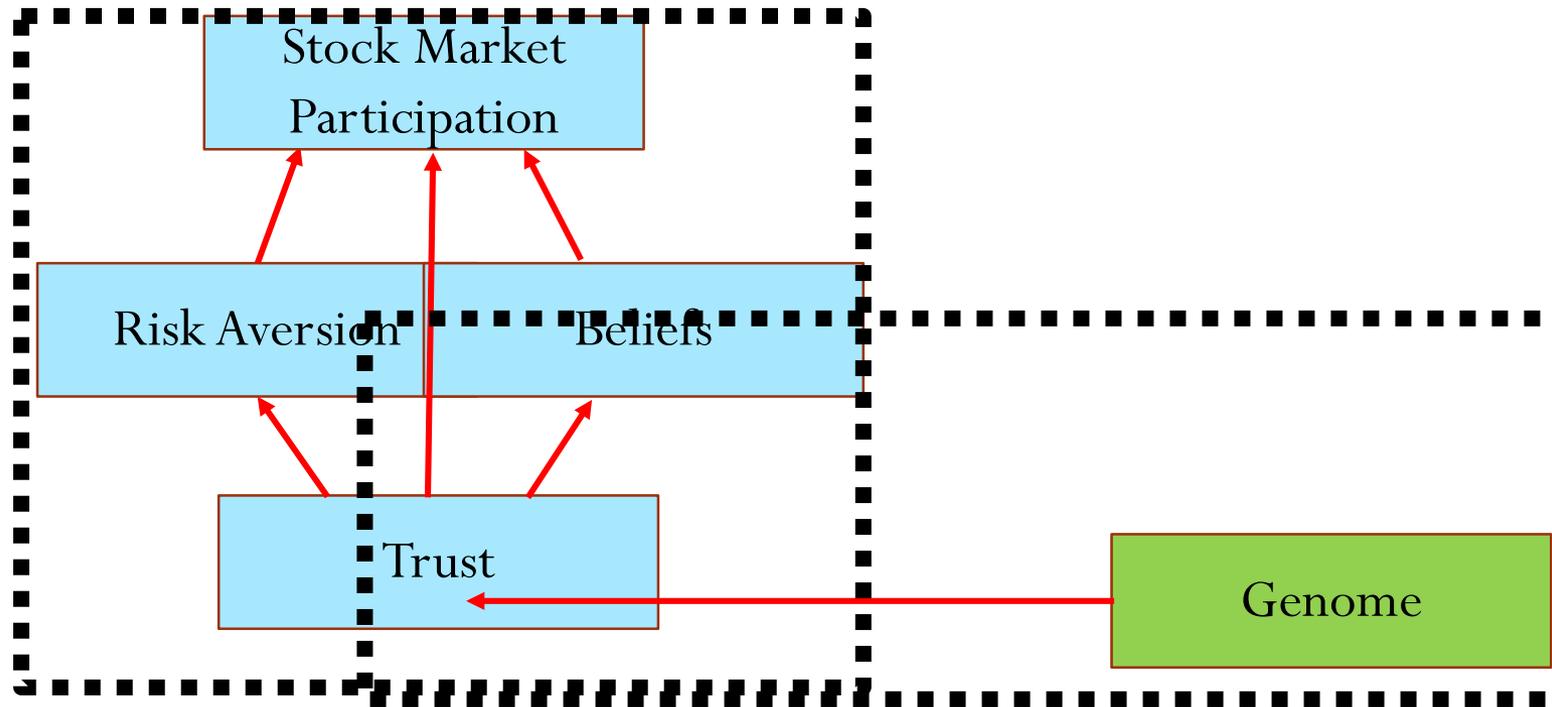
Investor characteristics from the extant literature and genetics

- Q5 – Can genetics help explain the relation between investor characteristics and stock market participation, risk aversion, and beliefs?
 - Step 1: Confirm relation between investor characteristics (e.g., trust) and stock market participation
 - ✓
 - Higher trust → lower risk aversion, more bullish beliefs, and greater equity market participation
 - Step 2: Examine if genetics help to explain variation in investor characteristics (e.g., trust)

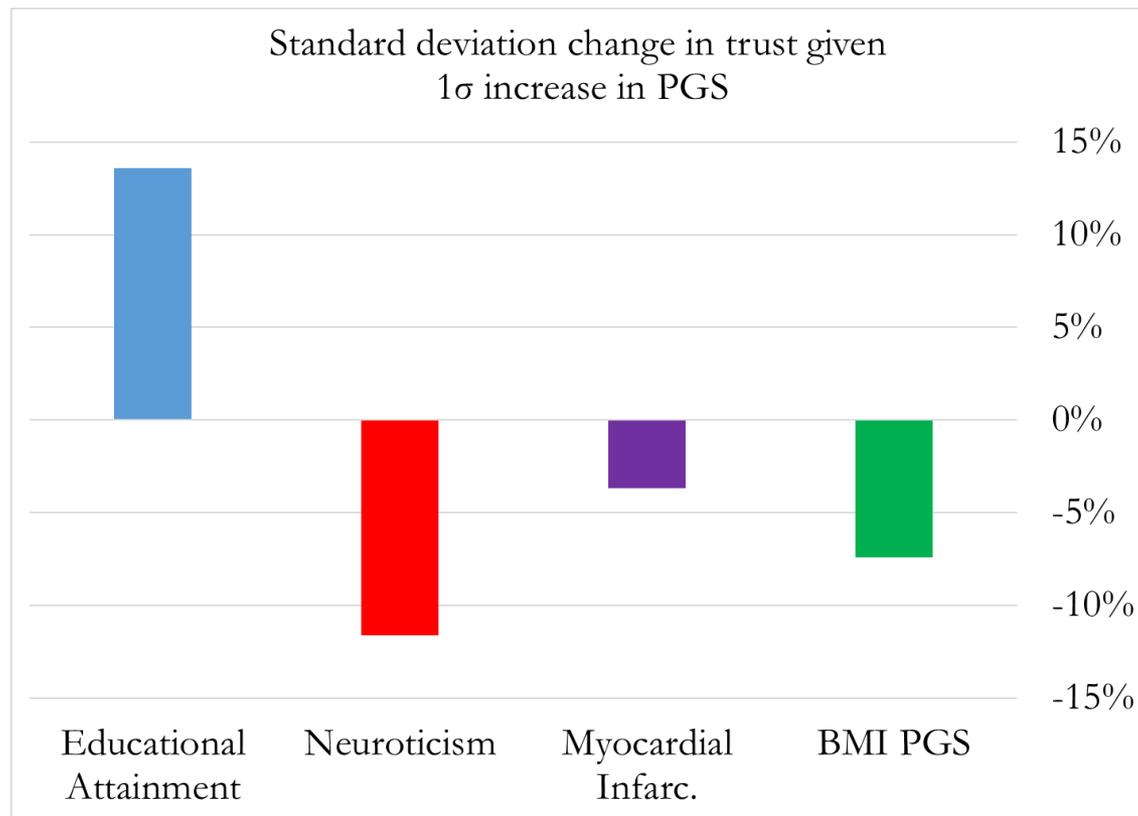
Does it occur because the genome influences the 11 characteristics?



Example: Does it occur because the genome influences trust?



Genetics and trust



Investor characteristics from the extant literature and genetics

- Q5 – Can genetics help explain the traditional relation between investor characteristics and stock market participation, risk aversion, and beliefs?

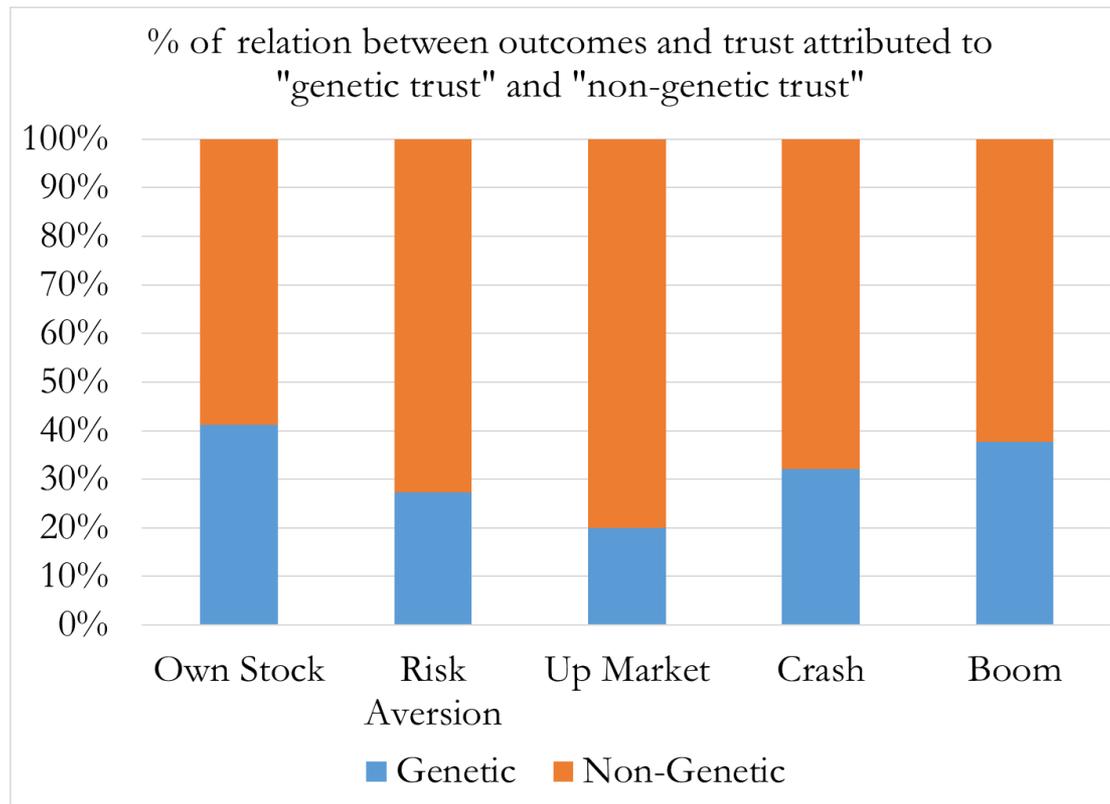
✓ Yes

- PGS → trust
- Trust → risk aversion, beliefs and participation

Investor characteristics and genetics

- Q6 – How much of the relation between outcomes and investor characteristics is due to genetic vs non-genetic variation in characteristics?
 - Step 1: Remove variation in outcomes and characteristics attributed to the control variables: “Orthogonalized” participation, risk aversion, beliefs, trust
 - Step 2: Regress orthogonalized trust on the eight PGSs
 - fitted value is “genetic component”
 - residual is “non-genetic component”
 - Step 3: Regress orthogonalized participation on genetic and non-genetic components of trust and partition R^2

Genetics and trust



Investor characteristics and genetics

- Q6 – Can genetics help explain the relation between investor characteristics and stock market participation, risk aversion, and beliefs? And if so, how much?

✓ Yes

- Across the 11 characteristics ~
 - Equity participation: 38% genetic/62% non-genetic
 - Risk aversion: 20% genetic/80% non-genetic
 - Beliefs: 46% genetic/54% non-genetic

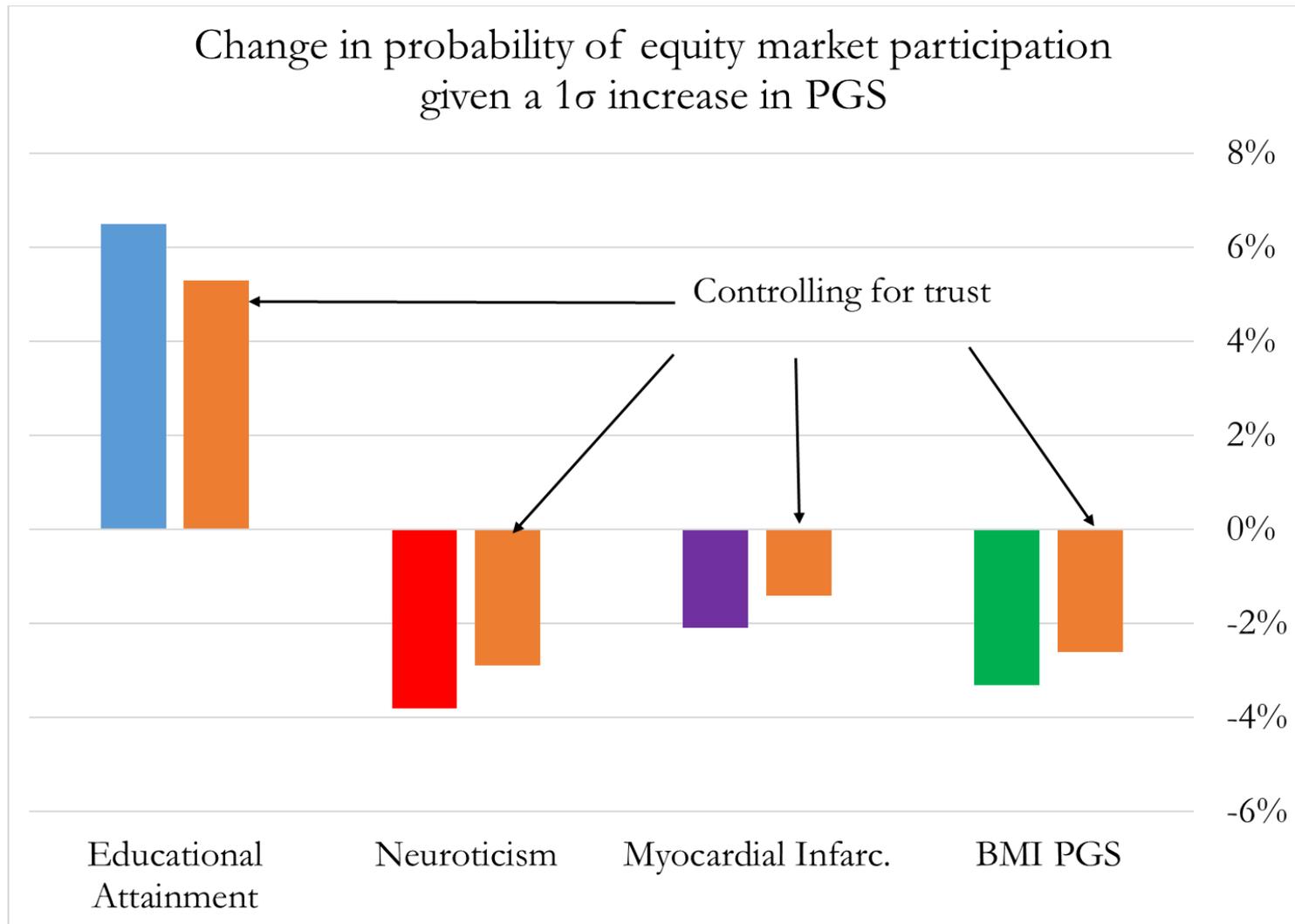
- | | | |
|-------------|----------------------|----------|
| ○ Wealth | ○ Trust | ○ Height |
| ○ Income | ○ Sociability | ○ BMI |
| ○ Education | ○ Optimism | ○ Health |
| ○ Cognition | ○ Early life poverty | |

*11 characteristics
from previous
research*

Investor characteristics and genetics

- Q7 – Which investor characteristics are channels for the PGSs?
 - Does Neuroticism PGS impact stock market participation through its impact on trust?
 - Regress participation on controls, PGS, and trust to examine
 - Does realized trust subsume the predictability due to the Neuroticism PGS?

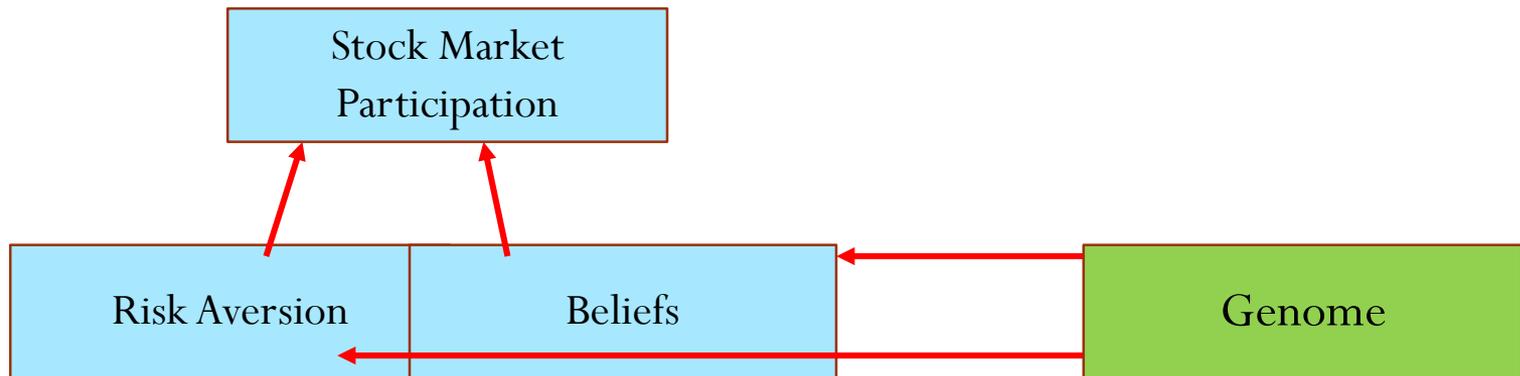
Genetics and likelihood of holding any stock



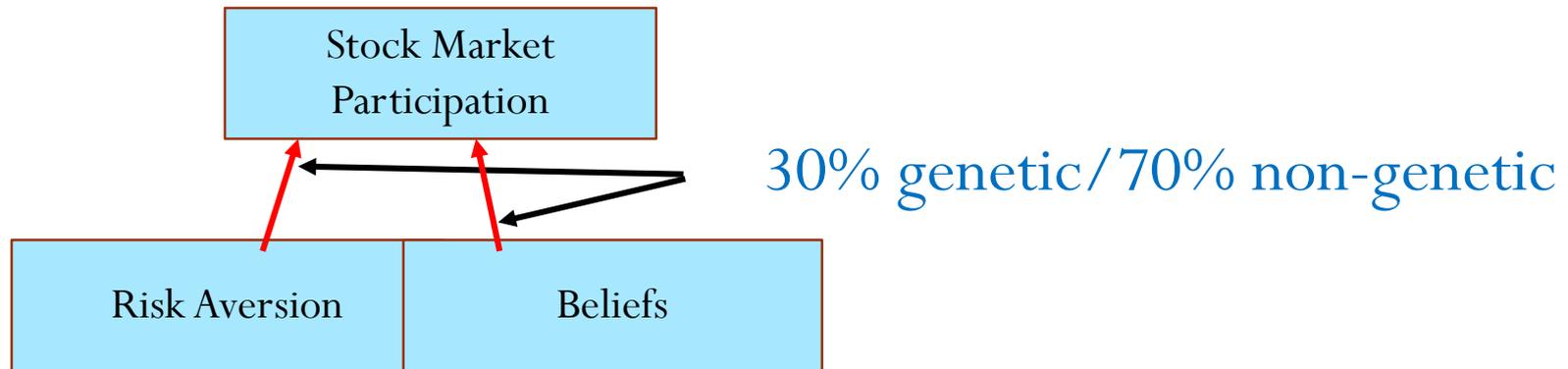
Investor characteristics and genetics

- Q7 – Which investor characteristics are channels for the PGSs?
 - For some PGSs, we identify specific channels:
 - Height PGS no longer predicts participation after controlling for realized height
 - For other PGSs, channels remain unidentified:
 - Neuroticism PGS predicts participation when we include any of the 11 investor characteristics (e.g., wealth, trust, optimism

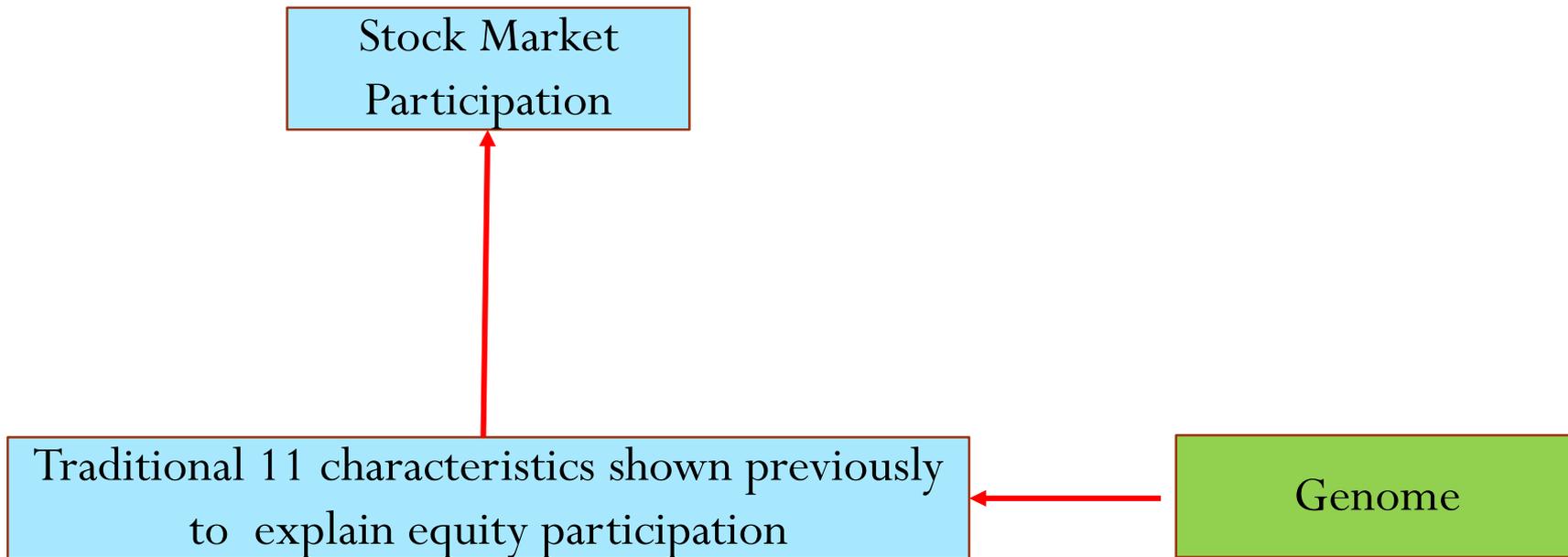
Summing up...



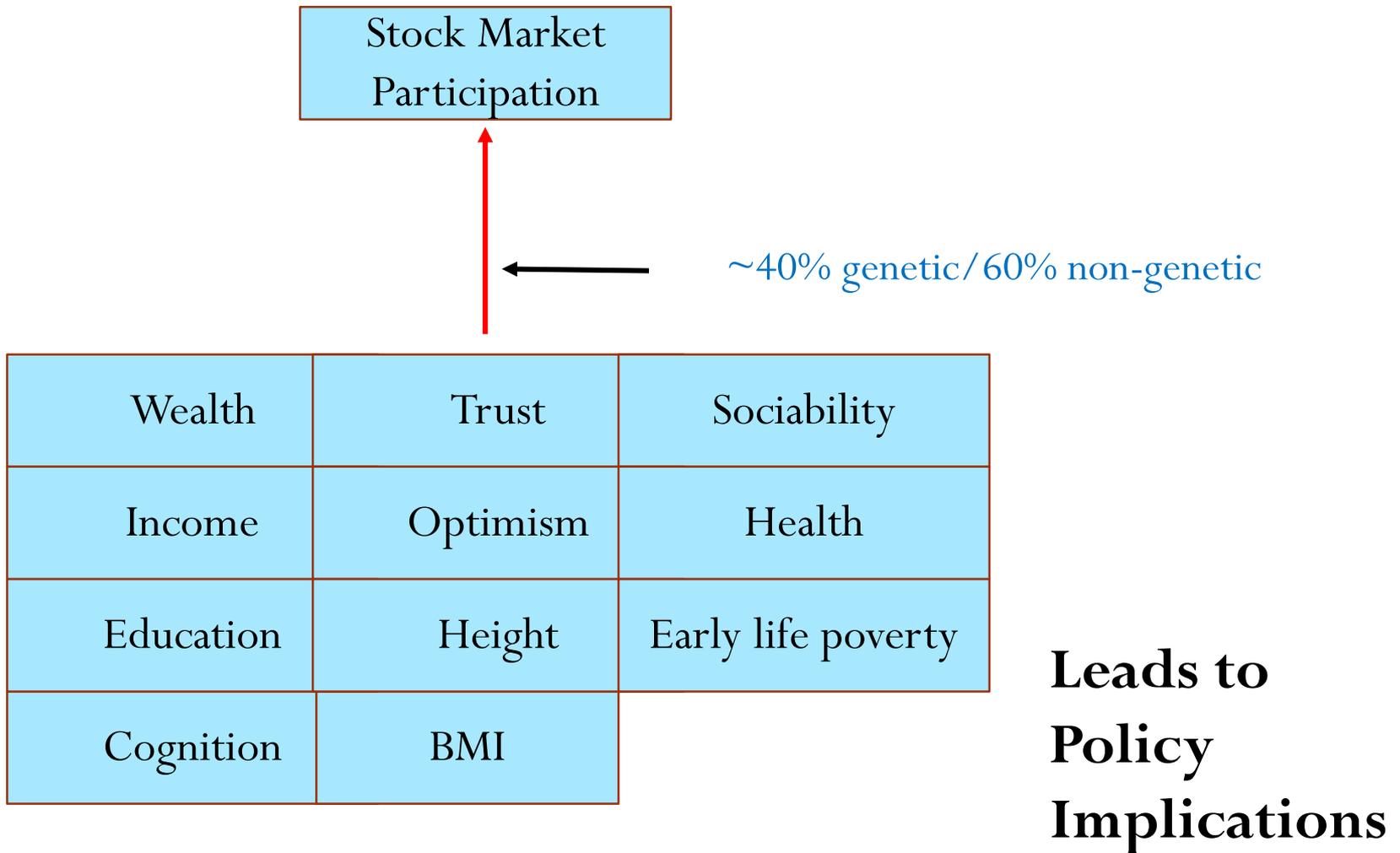
Summing up...



Summing up...



Summing up and conclusions





Thank
you!

