Economics and Measurement

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Outline

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- These *strong* assumptions were needed because preference and attitudes, beliefs and subjective expectations were largely perceived as unmeasurable.
- Skepticism towards questions that pose *hypothetical* situations and evidence from *stated* rather than *actual* choices.

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  - Tobin (1959); Katona (1959) on buying intentions.
- Even at that time some researchers tried out and justified alternative measures;
  - Juster (1966) on buying intentions and purchasing probabilities;
  - Katona's work on the Michigan survey and consumer sentiment Katona (1974);
    - Curtin (2016) provides a nice survey;
  - Juster et al. (1964) hypothetical car loans to estimate the elasticity to maturity and interest rates.

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- Block and Marschak (1960) on RUM:
  - *''Our particular way of defining the class of basic observations and, correspondingly, of the directly testable conditions is to some extent arbitrary. Depending on the range of possible experiments and other observations, it may be preferable to define the class more narrowly [..] [or] more broadly. Following the practice of psychologists, we might admit the ranking, by the subject, of three or more objects as an observable fact, although the subject observed action consists in this case of a verbal statement. [..] We might even admit as observable the subject verbal statements of the relative intensity of his preferences''.*
- Stated preferences and conjoint analysis:
  - Luce (1956, 1959); Luce and Tukey (1964); Luce and Suppes (1965).

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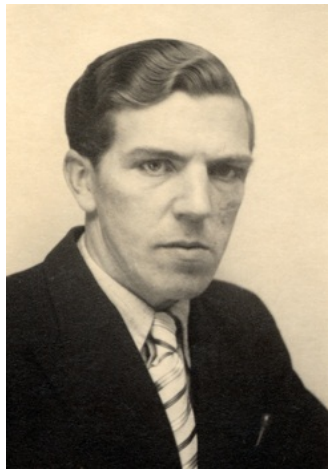
  Haavelmo (1958) presidential address is another important example:

I think most of us feel that if we could use *explicitly* such variables as, e.g., what people *think* prices or incomes are going to be, or variables expressing what people *think* the effects of their actions are going to be, we would be able to establish relations that could be more accurate and have more explanatory value. But because the statistics on such variables are not very far developed, we do not take the formulation of theories in terms of these variables seriously enough. It is my belief that if we can develop more explicit and a priori convincing economic models in terms of these variables, which are realities in the minds of people even if they are not in the current statistical yearbooks, then ways and means can and will eventually be found to obtain actual measurements of such data.



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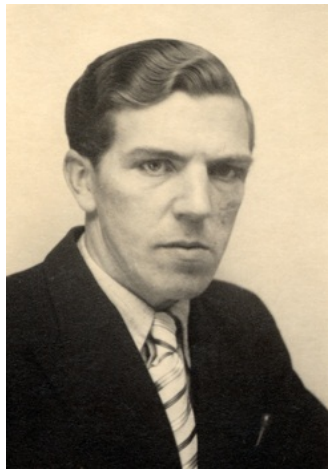

- ... but the consensus went towards an almost exclusive revealed preference approach.

Introduction

- ... with the possible exception of experimental economics.
- Experimental economists have been trying a variety of different methods to measure *preferences*, *beliefs* and *attitudes*;
- Lab work on various mechanisms to elicit primitives.
- More recently experiments have been brought to the field and collected together with observational data to measure:
  - preference for and attitudes towards redistribution and attitudes towards migrants;
  - bargaining and social preferences;
  - reciprocity in conflict areas;
  - willingness to compete.

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Things have been changing

- There are some interesting discussions about what we could and should measure:
  - Contributions in the vlume edited by Caplin and Schott (2008) and in particular the discussion between Gul and Pesendorfer for *mindless economics* v Camerer for *mindful economics*.
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- Researchers have been moving away from models that imply full rationality:
  - Robustness;
  - Non-rational beliefs;
  - Learning.
- .... and some innovative work has been done in terms of measurement.
  - Eliciting data on policy preferences;
  - Eliciting data on information.

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- Measurement of subjective expectations.
  - Data on subjective expectations may allow avoiding strong assumptions.
  - These data are being used to estimate models of retirement choices and education and occupation choices.
- Measurement of beliefs and perceptions.
- Measurement of attitudes.

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    - The relation between theory and measurement;
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- To make the relationship between theory and measurement explicit I will use a model, taken from my own work on modeling child development.
- An application:

  I will then present some new work, using new measures on the determinants of parental investment collected in Tanzania.

Outline

Measures and Economic Theory

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- Examples:
  - The work by Keynes and Stone, and the development of National Accounts Keynes (1936); Clark (1933); Kuznets et al. (1937); Kuznets (1941); Gilbert et al. (1949); Stone (1984).
  - Demand systems and price indexes Stone (1954); Christensen et al. (1975); Deaton and Muellbauer (1980).

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  - Demand systems and price indexes Stone (1954); Christensen et al. (1975); Deaton and Muellbauer (1980).
- In practice, what we often have are *markers* related to the *latent factors* that populate the theoretical models we use.

Measures and Economic Theory

- Goldberger (1972) started his Fischer-Schulz lecture with the following:

  "By structural equation models, I refer to stochastic models in which each equation represents a causal link, rather than a mere empirical association. The models arise in non-experimental situations and are characterized by simultaneity and/or errors in the variables. The errors in the variables may be due to measurement error in the narrow sense, or to the fact that measurable quantities **are not the same as the relevant theoretical quantities**. *Generally speaking the structural parameters do not coincide with coefficients of regressions among observable variables, but the model does impose constraints on those regression coefficients.*

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- We should be explicit about:
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  - what is observable and what is not, given the available data.
- This may induce the attempt to measure additional relevant variables.
- The possibility of measuring new factors can allow us to use more realistic models, subject to less stringent assumptions.

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Beyond standard measures

- A theoretical framework can be represented by:

$$F(\boldsymbol{\theta}; \boldsymbol{\phi}) = 0$$

  - $\boldsymbol{\theta}$ is a matrix of latent factors which are not necessarily observed.
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- The function F represents individual behaviour and interactions, that is the relevant economic model.
- The function F typically defines what are the latent factors of interest.
  - To introduce uncertainty and imperfect information, some factors are not necessarily observed by the model's agents.
- Richer and more realistic F functions typically require a richer set of factors and richer measurements to be brought to data.

Measuring what

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- The nature of the measurement system depends on the economic model F:
  - Cunha, Heckman, and Schennach (2010) use a flexible version for the estimation of the production function of human capital.
  - Goldberger (1972) uses the Permanent Income model as an example.
  - Griliches (1974) discusses the relationship between earnings, schooling and ability.
  - Production function with endogenous inputs:
    - Olley and Pakes (1992); Levinsohn and Petrin (2003); Ackerberg et al. (2015); Gandhi et al. (2020); Doraszelski and Jaumandreu (2013, 2018).

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- The available measures define what components of F can be related to data.

Measuring new concepts

- There is often a trade off between richer measures and stronger and less realistic assumptions.
- Examples about information:
  - Subjective expectations data:
  - direct measures of individual expectations;
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  - Assume full knowledge of relevant processes.

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  - Information available to agents and its quality Attanasio and Krutikova (2020).

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- Later in this talk, to stress the relationship between theory and measurement, I will use a model of child development and the accumulation of human capital, and new measures from Tanzania.

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- What factors are (imprecisely) observable and which are intrinsically not?

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- We then have to establish how to relate relevant latent factors to available measures.
- This approach is neither new nor exclusive to economics.
- Work on MIMIC and more generally factor models in economics, psychology, sociology, genetics:
  - Wright (1934);
  - Duncan (1966);
  - Goldberger (1971, 1972);
  - Griliches (1974);
  - Jöreskog and Goldberger (1975);
  - Chamberlain and Griliches (1975).

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An example of a measurement system

- A useful and recent example of the use of a factor model to analyse a structural relationship is the one proposed by Cunha, Heckman and Schennach (2010):

$$m_{i,t}^{jk} = \alpha_t^{j,k} + \beta_t^{j,k}\theta_{i,t}^{j} + \epsilon_{i,t}^{jk}, \qquad j = 1, ...J; \quad k = 1, ..., K.$$

  - $\theta_{i,t}^{j}$ is factor j for individual i at time t;
  - $m_{i,t}^{jk}$ is measure k for factor j;
  - $\epsilon_{i,t}^{jk}$ is an *additive* measurement error ;
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- **Assumptions**
  - At least 2 measures $m_{i,t}^{jk}$ per factor are available;
  - Measurement errors are independent across at least two measures;
  - Although non-parametric identification might be possible with enough measures, assumptions about the distribution of the factors θ are typically used.

An example of a measurement system

- A useful and recent example of the use of a factor model to analyse a structural relationship is the one proposed by Cunha, Heckman and Schennach (2010):

$$m_{i,t}^{jk} = \alpha_t^{j,k} + \beta_t^{j,k}\theta_{i,t}^{j} + \epsilon_{i,t}^{jk}, \qquad j = 1, ...J; \quad k = 1, ..., K.$$

  - $\theta_{i,t}^{j}$ is factor j for individual i at time t;
  - $m_{i,t}^{jk}$ is measure k for factor j;
  - $\epsilon_{i,t}^{jk}$ is an *additive* measurement error ;
  - $\alpha_t^{j,k}$ and $\beta_t^{j,k}$ are parameters representing the *discriminating* and *saliency* properties of a measurement item.

- **Assumptions**
  - At least 2 measures $m_{i,t}^{jk}$ per factor are available;
  - Measurement errors are independent across at least two measures;
  - Although non-parametric identification might be possible with enough measures, assumptions about the distribution of the factors θ are typically used.
  - In this example, each measure is determined by only one factor.
  - This is a *dedicated* system;
  - This assumption can be somewhat relaxed.

Outline

Theory and measurement strategies

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- Sufficient measurement allows identification of *causal links*;
- In a sense, the construction of an RCT could be interpreted as a measurement issue;
- To establish *causal links* between variables, it might be useful to collect information on drivers of a given variable which plausibly do not affect others.
  - Prices and other environmental factors;
  - Past events;
  - Changes exogenous to the outcome of interest but not to some of its determinants.

Outline

Existing measures and measurement systems

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- This is analogous to the scoring algorithms that are often used in psychometrics, where a set of (often binary) variables are converted into a *score*.
- Often available measures use pre-defined scoring algorithms.
  - Examples of child development measures:
    - Bayley Scales of Infant Development; Woodcock Johnson; MacArthur-Bates Communicative Development Inventories (MB-CDIs).
  - These scoring algorithms were constructed calibrating on obsolete samples and/or are over-simplified.

Existing measures and measurement systems

- Using predefined scoring algorithms in all contexts is not necessary and can be very misleading and inefficient.
  - Different measurement systems and scoring algorithms should be used.
    - adapting to the context and the nature of the items (continuous, discrete, binary).
  - We will see examples of this in our work in Tanzania.

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  - We will see examples of this in our work in Tanzania.
- Estimating an explicit measurement system from the individual available items also allows flexibility about functional form assumptions on the distribution of latent factors.

Outline

Scaling: the importance of anchoring

- We need to fix the metric for the unobserved factors:
  - Normalise at least one of α's and one of the β's per factor;
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- These normalisations define the scale and location of the unobservable factors;
  - e.g child development: height at 2 or wages at 22?
- The metric used to evaluate the unobserved latent factors is important:
  - Comparability across different contexts;
    - e.g. in measuring child development, comparing across different ages and measuring growth;
  - Evaluating the size of the impact achieved by certain interventions.

Scaling: the importance of anchoring

- Some of the normalisations are not innocuous:
  - Normalising $\beta_t^{jk} = 1, \ \forall t$ for a specific measure k is a very strong assumption.
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    - Agostinelli and Wiswall (2016) have some interesting work on this.
- The lack of longitudinal data covering long periods with the same measure is an additional problem.

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- The lack of longitudinal data covering long periods with the same measure is an additional problem.
- Issues when different items are available over different ages or different cohorts.
  - Link adjacent ages with similar items to establish bridges over the entire life cycle,
    - Attanasio et al. (2019) look at child development from age 6 to 72 months.

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- More generally, the economic model one uses should dictate and direct:
  - the type of measures collected;
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  - See Cunha and Heckman (2008), Todd and Wolpin (2003) and others.
- Several studies have looked at the production function of different dimensions of human capital.
  - Cunha, Heckman, and Schennach (2010), Attanasio, Meghir, and Nix (2020) and Attanasio, Cattan, Fitzsimons, Meghir, and Rubio-Codina (2020), Heckman, Pinto, and Savelyev (2013), Heckman, Liu, Lu, Zhou, et al. (2020) ... many others.

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- Some of the inputs of this production function are chosen by individual actors (parents, teachers), making it difficult to estimate their impact.
- Attanasio et al. (2020) specify a control function approach that could be valid regardless of assumption about parental beliefs.

The outstanding research questions and the measurements to get the answers

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- Here: simple sketch of a model:
  - it focuses on a number of factors important to understand parental choices and child development;
  - it defines how they can be related.

Child Development and its drivers

- Parents maximise an objective function:

$$U(\mathbf{c}, H, L) = \pi^w U^w(\mathbf{c}, H, L) + (1 - \pi^w) U^m(\mathbf{c}, H, L)$$

  - The utility function is not necessarily of the 'unitary' type;
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- Parents are subject to a budget constraint to finance consumption and parental investment X

$$\mathbf{q}'\mathbf{c} + pX = y$$

  - X is material parental investment; can be a vector;
  - $\mathbf{q}$ and p are vectors of prices;
  - y are available resources. In a more complex model could include access to credit.

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  - Multiple children;
  - Preferences might reflect gender biases.

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  - Parental beliefs about the process of child development: $g()$;
    - Expected returns to parental investment and its riskiness.
  - Decision making power: π^w;
- *Parental investment* and many of its drivers are not directly observables.
- Measures of these latent factors may allow the identification of richer models.

Outline

Data collection: Tanzania

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- We randomize who answers some of the questions:
  - the husband on his own;
  - the wife on her own;
  - the couple.

Outline

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- The use of a measurement system is particularly appropriate as it can:
  - Use efficiently existing measures;
  - Construct cheaper and more effective measures.
- One motivation of the Tanzania project was to improve existing measures of child development:
  - Several initiatives are being undertaken by different research teams with this goal:
    - D-Score, CREDI, WHO initiatives for children up to 36 months $\rightarrow$ GSED initiative;
    - MELQO project for older children and input quality.

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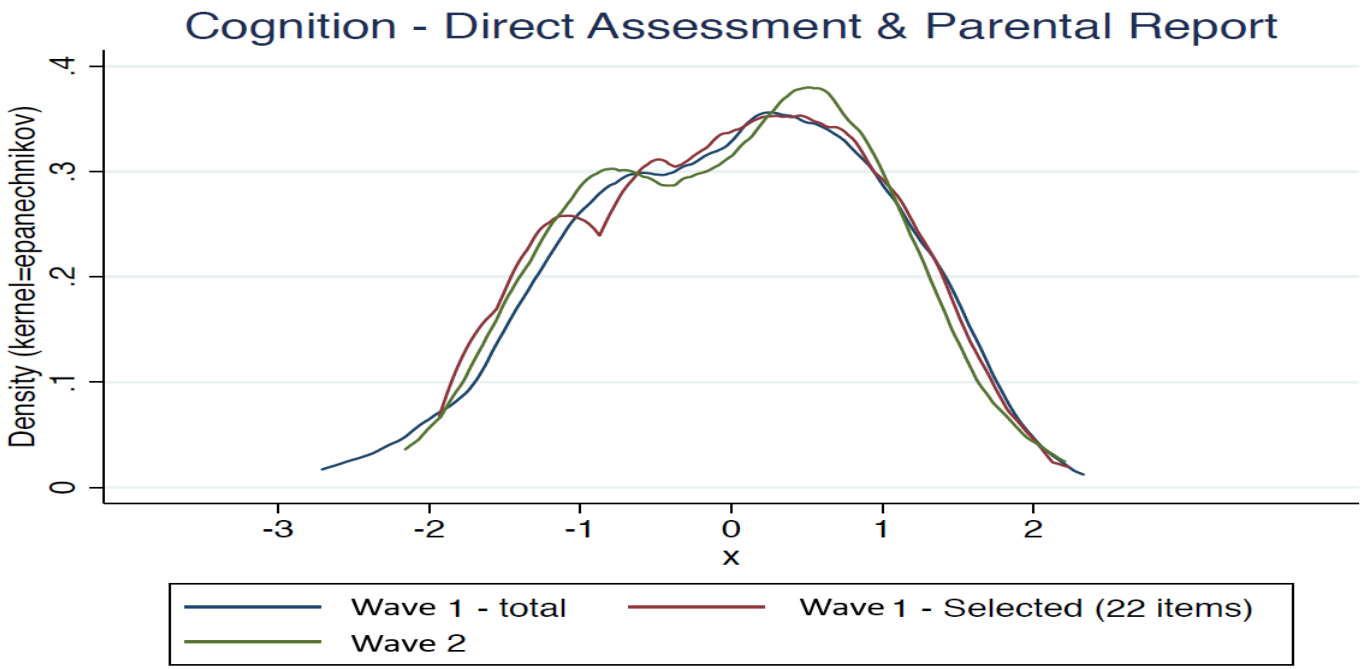
- In the second wave, we collect the reduced set of items to validate the new index in the new sample.
- The resulting tests are as informative as more traditional ones and much cheaper to implement.

Constructing a new test of cognitive development

- We plot the density of a cognitive development factor estimated on:
  - Complete cognition Bayley (91 items);
  - Selected items (15 items from Bayley and 7 from CREDI);
  - Selected items in the wave 2 new sample.

Wave 1 and Wave 2 Factor Comparison



- Correlation in baseline sample between extended and reduced measure = 0.961.

Outline

New measures

- In addition to traditional measures and constructs, in our Tanzania sample, we collect measures of important constructs that are less common.
- In particular, we collect measures that are markers of:
  - Bargaining power within the couple;
  - Beliefs about the return to parental investment;
  - Individual preferences for different allocations of resources.

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  - Here are 100 Denars that we will give to your husband, how much are you willing to pay to have them paid to you?
  - An additional hypothetical question with larger stakes.
- The results:
  - Considerable variability, linked to several observables;
  - Targeting the grant to wives shifted considerably the willingness to pay.

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Average willingness to pay
(out of 6,600 TSH)

wives	husbands	difference (p-value)
2,720	660	2,060 (< 0.0001)

- Considerable difference between husbands' and wives' willingness to pay.
- ...reflecting different bargaining position within the marriage.

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- The strategy consists in presenting mothers with *scenarios* in terms of initial conditions and investment and ask them to map these scenarios into child development outcomes.
- In addition to the Tanzania sample, we have also collected similar data on a longitudinal basis in India:
  - We have slightly modified the methodology;
  - We will be exploring new dimensions of beliefs;
  - The longitudinal dimension will allow us to study beliefs formation.

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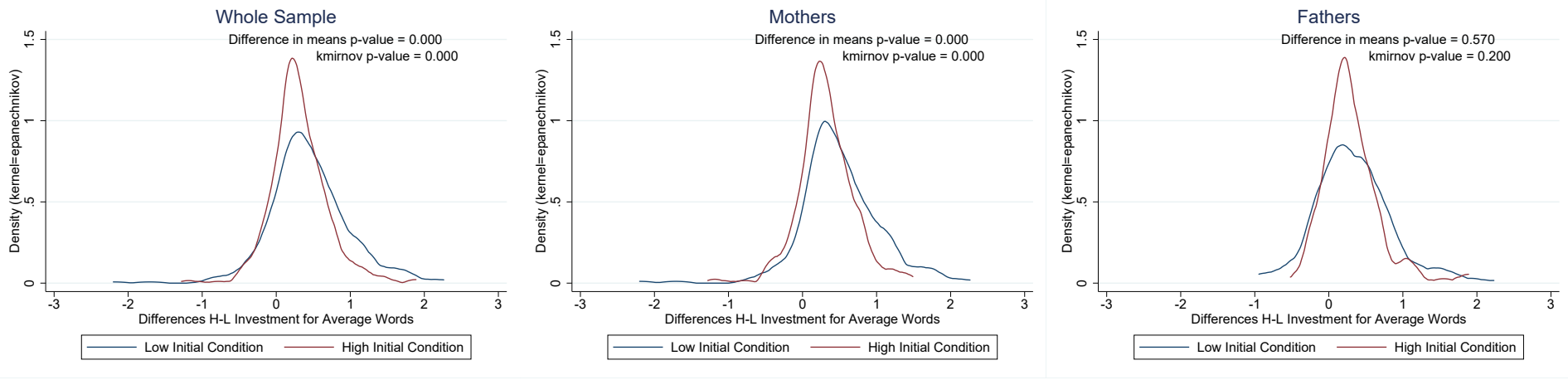
  - We randomise whether the beliefs questions are answered by the father or the mother.

Beliefs on returns to investment: language development



- Returns to investment are perceived to be higher

  for low initial conditions than for high initial conditions;
  difference in means:

  - for whole sample = 0.140 (p-value=0.000);
  - for mothers = 0.200 (p-value=0.000);
  - for fathers = 0.030 (p-value=0.570).

- The entire distribution seems to be different, with the low initial condition returns presenting more dispersion and shifted to the right.

Beliefs on returns to investment: language development

	Mothers	Fathers	difference (p-value)
Low Initial Condition	0.511	0.336	0.175
(easy words)	(0.034)	(0.046)	(0.003)
High Initial Condition	0.313	0.303	0.010
(easy and difficult words)	(0.024)	(0.035)	(0.808)
Number of observations	246	126	

Notes: The table shows the means for the returns to investment. Standard errors in parentheses.

- Mothers have a higher expected return to investment for low initial condition children than fathers: difference = 0.175 (p-value=0.000).
- No significant difference between fathers and mothers on expected returns for high initial condition children.

Beliefs on returns to investment: socio-emotional development

- We did a similar exercise to measure beliefs about the effect of parenting on socioemotional development.
- This type of belief has not been measured before.
- The results are similar to those about the beliefs about the effect of parenting on cognitive development and language.
- Returns to investment are perceived to be higher for low initial conditions than for high initial conditions;

Beliefs on socio emotional development

Measuring preferences with hypothetical scenarios

- In Tanzania, we also gathered information on husband and wives preferences using stated preferences:
  - We use a dictator allocation game to elicit data on parents preferences;
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    - across different commodities;
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References

- A paper very close to ours is Ameriks, Briggs, Caplin, Shapiro, and Tonetti (2020) using *Strategic Survey Questions (SSQs)*:

  "...if we want to develop direct measures of preferences, we need to develop survey instruments that allow respondents to provide us with information that identifies preference parameters not only in a language in which they are comfortable but also in a format that allows a precise mapping to structural parameters of interest" (pp. 2395-6).

Allocation module

- Respondents were asked to allocate a hypothetical amount, represented by a pile of beans, to different expenditure categories and household members.
- Allocation question is posed as:

  "We would now like to understand how you would prefer to spend 300,000 TSH, if we were to give this money to you. Use these 60 beans that each represents 5,000 TSH, and cardboard card with 3 different expenditure options (for mother, for father, for your child); for each question distribute the beans according to your preferences. Imagine that your child is 5 years old for this exercise. How much would you spend on .. (item) for .. (person)?"
- 6 possible categories/ items:
  - Clothing;
  - Food;
  - Learning materials such as books, notebooks, pens & pencils;
  - Health expenditures;
  - Transportation;
  - School expenditures.

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  - Food;
  - Learning materials such as books, notebooks, pens & pencils;
  - Health expenditures;
  - Transportation;
  - School expenditures.
- As we randomize whether we interview the father, the mother or both, we have 3 different samples.

Expenditure allocations

	Mother decision (s.e.)	Father decision (s.e.)	diff (p-value)	Couple decision (s.e.)	diff (p-value)
To self	0.268	0.257	-0.01	0.250	-0.02
	(0.008)	(0.007)	(0.348)	(0.009)	(0.148)
To spouse	0.175	0.219	0.04	0.232	0.06
	(0.009)	(0.007)	(0.000)	(0.009)	(0.000)
To child	0.558	0.524	-0.03	0.518	-0.04
	(0.011)	(0.013)	(0.043)	(0.013)	(0.019)

Notes: This table shows the average share of expenditure to household members for the different subsamples.
The p-values refer to the test of difference between the mother and father subsample and the mother and couple subsamples.

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Main messages:

- Mothers allocate more than fathers to children;
- Mothers allocate less than fathers to spouse;
- 'Couple' decisions look more like fathers'.

Allocation to the child

	Mother decision (s.e.)	Father decision (s.e.)	diff (p-value)	Couple decision (s.e.)	diff (p-value)
Clothing	6.628	5.559	-1.07	5.493	-1.13
	(0.225)	(0.311)	(0.005)	(0.195)	(0.000)
Food	6.062	5.338	-0.72	4.401	-1.66
	(0.302)	(0.269)	(0.076)	(0.251)	(0.000)
School exp.	7.434	7.529	0.09	7.282	-0.15
	(0.353)	(0.573)	(0.886)	(0.456)	(0.791)
Learning mat.	5.503	5.213	-0.29	5.697	0.19
	(0.247)	(0.285)	(0.441)	(0.317)	(0.629)
Health exp.	5.159	5.213	0.05	5.761	0.60
	(0.207)	(0.252)	(0.866)	(0.232)	(0.054)
Transportation	2.683	2.603	-0.08	2.430	-0.25
	(0.182)	(0.202)	(0.769)	(0.199)	(0.349)

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Outline

Paremetrizing a simple model

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- A simple starting point is a Cobb Douglas specification (homothetic preferences). For individual i in household n:

$$\ln U_n^i = \sum_{j=1}^{q} \left(\alpha_n^{i,jw} \ln C_n^{jw} + \alpha_n^{i,jh} \ln C_n^{jh} \right) + \alpha_n^{i,k} \ln H_n^k, \quad i = \{h, w\}$$

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- The child's human capital is obtained by a production function which depends on some initial condition $H_n^{k,0}$ and parental investment $X_n = \left(\sum_j C_n^{jk} \right)$.

$$\ln H_n^k = \gamma_0 \ln H_n^{k,0} + \gamma \ln X_n$$

Specifying a simple model

- We normalise prices to 1 and do not consider savings, so that the budget constraint for family n is:

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  ... or a collective model with Pareto weights π_n and $1 - \pi_n$:

$$\ln U_n^F = \pi_n \ln U_n^w + (1 - \pi_n) \ln U_n^h.$$

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- with homothetic preferences the allocation answers identifies:
  - unitary model: α_n^{js} , $s = h, w, \forall j;$
  - collective model: $\alpha_n^{w,js}\pi_n + \alpha_n^{h,js}(1 - \pi_n), \quad s = h, w, \forall j.$

Estimating individual preferences from individually stated allocations

- Under homothetic preferences, individual allocation do not vary with income.

$$\ln \frac{C_n^{js}}{Y_n^i} = \ln \alpha_n^{i,js} = \ln \bar{\alpha}^{i,js} + \nu_n^{i,js}; \quad j = 1, ..., q; \quad s = w, h;$$

$$\ln \frac{X_n^i}{Y_n^i} = \ln \gamma_n + \ln \alpha_n^{i,k} = \ln \bar{\gamma} + \ln \bar{\alpha}^{i,k} + \nu_n^{i,k}; \quad i = w, h.$$

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  - see Dunbar et al. (2019) and Lechene et al. (2020).

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- Differences between estimates obtained the individual samples and the couple sample are deviations from the unitary model.

Individual homothetic preferences:

differences between husbands and wives on food and clothing;

	Wife Sample	Husband Sample	Couple Sample
Clothing wife	0.075	0.065	0.065
	(0.004)	(0.003)	(0.004)
Clothing husband	0.070	0.054	0.062
	(0.004)	(0.002)	(0.003)
Food wife	0.065	0.076	0.049
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Transportation wife	0.040	0.042	0.040
	(0.002)	(0.002)	(0.003)
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	(0.003)	(0.003)	(0.003)
Human Capital $+\gamma$	1.192	1.181	0.793
	(0.111)	(0.110)	(0.038)

Standard errors in parentheses. Source: Tz Pilot.

Individual homothetic preferences:

no difference in education or other expenditure shares.

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- However:
  - Couple sample:

$$\frac{C^b_{jw} + C^b_{jh} + \Delta(c_{jw} + c_{jh})}{Y + \Delta Y} = \pi(\alpha^w_{jw} + \alpha^w_{jh}) + (1 - \pi)(\alpha^h_{jw} + \alpha^h_{jh})$$

  - Wife sample:

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  - Husband sample:

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Combining allocation and expenditure data

	Stated allocations + Actual Expenditure		
	Wife Sample	Husband Sample	Couple Sample
Clothing	0.143	0.106	0.170
	(0.012)	(0.009)	(0.015)
Food	0.598	0.562	0.450
	(0.023)	(0.024)	(0.022)
Health	0.081	0.078	0.117
	(0.008)	(0.008)	(0.011)
Total education	0.034	0.060	0.043
	(0.003)	(0.006)	(0.005)
Human Capital $+\gamma$	0.931	1.081	0.816
	(0.085)	(0.105)	(0.061)

Standard errors in parentheses. Source: Tz Pilot.

Individual preferences: non-homotheticity

- Relaxing homotheticity, we can use a *piglog* system (such as Q-AIDS) to get:

$$\frac{C_n^{js}}{Y_n^i} = \alpha_n^{i,js} + \beta_1^j \ln Y_n + \beta_2^j (\ln Y_n)^2 = \bar{\alpha}^{i,js} + + \beta_1^j \ln Y_n + \beta_2^j (\ln Y_n)^2 + \nu_n^{i,js};$$

$$\frac{X_n^i}{Y_n^i} = \gamma_n \alpha_n^{i,k} + \beta_1^k \ln Y_n + \beta_2^k (\ln Y_n)^2 = \bar{\gamma}\bar{\alpha}^{i,k} + \beta_1^k \ln Y_n + \beta_2^k (\ln Y_n)^2 + \nu_n^{i,k};$$

$$j = 1, ..., q \quad i = w, h; \quad s = w, h;$$

- In this system, consistently with other papers in the literature, we let the intercept reflect deviations from the unitary model.
  - Attanasio and Lechene (2014) assume that the slopes of this system are independent of distribution factors and test restrictions on the intercepts.

Engel curves

VARIABLES	(1) Food	(2) Clothes	(3) Education	(4) Food	(5) Clothes	(6) Education
log. total expenditures	-0.098**	-0.031	0.116***	-0.060	-0.035	0.101***
	(0.042)	(0.030)	(0.018)	(0.043)	(0.030)	(0.019)
Father				-0.047**	-0.018	0.045***
				(0.024)	(0.016)	(0.010)
Couple				-0.064***	0.007	-0.002
				(0.023)	(0.016)	(0.010)
Constant	-2.952	0.547	-1.389***	1.384	0.624	-1.221***
	(3.384)	(0.364)	(0.218)	(0.539)	(0.370)	(0.236)
Observations	422	422	422	422	422	422
R-squared	0.034	0.036	0.099	0.082	0.041	0.123

Standard errors in parentheses. * p<0.01, ** p<0.05, * p<0.1.

All specification include control functions. Omitted category is Mother.

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Father				-0.047**	-0.018	0.045***
				(0.024)	(0.016)	(0.010)
Couple				-0.064***	0.007	-0.002
				(0.023)	(0.016)	(0.010)
Constant	-2.952	0.547	-1.389***	1.384	0.624	-1.221***
	(3.384)	(0.364)	(0.218)	(0.539)	(0.370)	(0.236)
Observations	422	422	422	422	422	422
R-squared	0.034	0.036	0.099	0.082	0.041	0.123

Standard errors in parentheses. * p<0.01, ** p<0.05, * p<0.1.

All specification include control functions. Omitted category is Mother.

Parental investment: a semi-structural approach

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- None of the variables in the 'parental investment' model are directly observable;
- ... but a measurement system can yield estimates of the relevant factors:
  - A parental investment factor from data on material and time investment;
  - *relative preference for children human capital* can be estimated as a factor derived from $\frac{\gamma\alpha_k^*}{\alpha_{jw}^i}$, $\frac{\gamma\alpha_k^*}{\alpha_{jh}^i}$ and $\frac{\gamma\alpha_k^*}{\alpha_{jk}^i}$ from the allocation modules;
  - π_n can be measured from the bargaining power game;
  - γ_n can be represented by a factor derived from the questions on *investment productivity*.

Modeling parental investment: whole sample

VARIABLES	(1) Parental inv.	(2) Parental inv.	(3) Parental inv.	(4) Parental inv.
Preferences	-0.261***	-0.256***	-0.231***	-0.220***
	(0.060)	(0.061)	(0.059)	(0.060)
Beliefs		0.067		0.103**
		(0.051)		(0.050)
log. total expenditures	1.147***	1.030***	0.964***	0.848***
	(0.261)	(0.261)	(0.259)	(0.259)
Father			0.423***	0.477***
			(0.155)	(0.155)
Couple			-0.255*	-0.180
			(0.148)	(0.152)
Constant	-14.157***	-12.650***	-12.008***	-10.580***
	(3.195)	(3.195)	(3.161)	(3.168)
Observations	376	376	376	376
R-squared	0.256	0.276	0.296	0.313

Standard errors in parentheses. * p<0.01, ** p<0.05, * p<0.1.

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Modeling parental investment: couple sample

VARIABLES	(1) Parental inv.	(2) Parental inv.	(3) Parental inv.
Preferences	-0.458***	-0.489***	-0.464***
	(0.108)	(0.103)	(0.105)
Barganing Power		0.641***	0.603**
		(0.241)	(0.243)
Beliefs			0.137
			(0.105)
log. total expenditures	0.937*	0.888*	0.850*
	(0.486)	(0.471)	(0.470)
Constant	-11.759*	-11.480**	-10.995*
	(5.952)	(5.798)	(5.795)
Observations	139	139	139
R-squared	0.238	0.320	0.328

Standard errors in parentheses. * p<0.01, ** p<0.05, * p<0.1.

All specifications include control functions and control for parents and child characteristics.

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- The availability of new measures will allow new ways of testing the models.
- We have learned much in this process both about the theory and measurement:
  - More structural use of the stated preference data;
  - New and more sophisticated measures;
  - Longitudinal data and changes in beliefs.

Outline

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Conclusions

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- What we can measure should be broad:
  - Tastes;
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  - Attitudes and norms.
- How and what we measure should be driven by theory and by the questions we ask.
- Much energy should be invested in using appropriately existing measures and constructing new measures.

References I

Ackerberg, D. A., K. Caves, and G. Frazer (2015). Identification properties of recent production function estimators. *Econometrica 83*(6), 2411–2451.

Agostinelli, F. and M. Wiswall (2016). Estimating the technology of children's skill formation. Technical report, National Bureau of Economic Research.

Alan, S. and S. Ertac (2019). Mitigating the gender gap in the willingness to compete: Evidence from a randomized field experiment. *Journal of the European Economic Association 17*(4), 1147–1185.

Alesina, A. and G.-M. Angeletos (2005). Fairness and redistribution. *American economic review 95*(4), 960–980.

Alesina, A., S. Stantcheva, and E. Teso (2018). Intergenerational mobility and preferences for redistribution. *American Economic Review 108*(2), 521–54.

References II

Almås, I., A. Armand, O. Attanasio, and P. Carneiro (2018). Measuring and changing control: Women's empowerment and targeted transfers. *The Economic Journal 128*(612), F609–F639.

Almås, I., O. Attanasio, P. Jervis, and C. Ringdal (2020). Targeted cash transfers and children's welfare: Should women be targeted? Technical report, NHH working paper.

Almås, I., L. Berge, K. Bjorvatn, V. Somville, and B. Tungodden (2020). Adverse selection into competition: Evidence from a large-scale field experiment in tanzania. *NHH Working paper*.

Almås, I., A. Cappelen, E. Sørensen, and B. Tungodden (2020). Fairness across the world: preferences and beliefs. Technical report, NHH working paper.

Almås, I., A. W. Cappelen, and B. Tungodden (2020). Cutthroat capitalism versus cuddly socialism: Are americans more meritocratic and efficiency-seeking than scandinavians? *Journal of Political Economy 128*(5), 1753–1788.

References III

Ameriks, J., J. Briggs, A. Caplin, M. Lee, M. D. Shapiro, and C. Tonetti (2020). Older americans would work longer if jobs were flexible. *American Economic Journal: Macroeconomics 12*(1), 174–209.

Ameriks, J., J. Briggs, A. Caplin, M. D. Shapiro, and C. Tonetti (2020). Long-term-care utility and late-in-life saving. *Journal of Political Economy 128*(6), 2375–2451.

Arcidiacono, P., V. J. Hotz, A. Maurel, and T. Romano (2017). Ex ante returns and occupational choice. *Unpublished manuscript*.

Attanasio, O., R. Bernal, M. Giannola, and M. Nores (2019). Child development in the early years: Parental investments and the changing dynamics of different dimensions. *Unpublished manuscript University College London, Rutgers University and Universidad de los Andes*.

References IV

Attanasio, O., T. Boneva, and C. Rauh (2019). Parental beliefs about returns to different types of investments in school children. Technical report, National Bureau of Economic Research.

Attanasio, O., S. Cattan, E. Fitzsimons, C. Meghir, and M. Rubio-Codina (2020). Estimating the production function for human capital: results from a randomized controlled trial in colombia. *American Economic Review 110*(1), 48–85.

Attanasio, O., F. Cunha, and P. Jervis (2019). Subjective parental beliefs. their measurement and role. Technical report, National Bureau of Economic Research.

Attanasio, O. and S. Krutikova (2020). Consumption insurance in networks with asymmetric information: Evidence from tanzania. *Journal of the European Economic Association*.

Attanasio, O., C. Meghir, and E. Nix (2020). Human capital development and parental investment in india. Technical report, Forthcoming, Review of Economic Studies.

References V

Attanasio, O. P. and K. M. Kaufmann (2014). Education choices and returns to schooling: Mothers' and youths' subjective expectations and their role by gender. *Journal of Development Economics 109*, 203–216.

Baranov, V., S. Bhalotra, P. Biroli, and J. Maselko (2020). Maternal depression, women's empowerment, and parental investment: Evidence from a randomized controlled trial. *American Economic Review 110*(3), 824–59.

Becker, A., B. Enke, and A. Falk (2020). Ancient origins of the global variation in economic preferences. In *AEA Papers and Proceedings*, Volume 110, pp. 319–23.

Ben-Akiva, M. E., D. McFadden, K. Train, et al. (2019). *Foundations of stated preference elicitation: Consumer behavior and choice-based conjoint analysis*. Now.

Bianchi, F., S. C. Ludvigson, and S. Ma (2020). Belief distortions and macroeconomic fluctuations. Technical report, National Bureau of Economic Research.

References VI

Blass, A. A., S. Lach, and C. F. Manski (2010). Using elicited choice probabilities to estimate random utility models: Preferences for electricity reliability. *International Economic Review 51*(2), 421–440.

Block, H. and J. Marschak (1960). Random orderings and stochastic theories of response, in "contributions to probability and statistics"(i. olkin, s. ghurye, w. hoeffding, w. madow, and h. mann, eds.).

Bobba, M. and V. Frisancho (2020). Self-perceptions about academic achievement.

Boneva, T. and C. Rauh (2018). Parental beliefs about returns to educational investments—the later the better? *Journal of the European Economic Association 16*(6), 1669–1711.

Cappelen, A., J. List, A. Samek, and B. Tungodden (2020). The effect of early-childhood education on social preferences. *Journal of Political Economy 128*(7), 000–000.

References VII

Cavatorta, E. and B. Groom (2020). Does deterrence change preferences? evidence from a natural experiment. *European Economic Review*, 103456.

Chamberlain, G. and Z. Griliches (1975). Unobservables with a variance-components structure: Ability, schooling, and the economic success of brothers. *International Economic Review*, 422–449.

Charness, G., U. Gneezy, and A. Imas (2013). Experimental methods: Eliciting risk preferences. *Journal of Economic Behavior & Organization 87*, 43–51.

Chen, X., L. P. Hansen, and P. G. Hansen (2020). Robust identification of investor beliefs. Technical report, National Bureau of Economic Research.

Christensen, L. R., D. W. Jorgenson, and L. J. Lau (1975). Transcendental logarithmic utility functions. *The American Economic Review 65*(3), 367–383.

Clark, A. J. (1933). The mode of action of drugs on cells.

References VIII

Cunha, F., I. Elo, and J. Culhane (2013). Eliciting maternal beliefs about the technology of skill formation. *NBER Working Paper 19144*.

Cunha, F. and J. H. Heckman (2008). Formulating, identifying and estimating the technology of cognitive and noncognitive skill formation. *The Journal of Human resources 43*(4), 738–782.

Cunha, F., J. J. Heckman, and S. M. Schennach (2010). Estimating the technology of cognitive and noncognitive skill formation. *Econometrica 78*(3), 883–931.

Curtin, R. (2016). George katona: a founder of behavioral economics. In *Routledge Handbook of Behavioral Economics*, pp. 30–47. Routledge.

Danz, D., L. Vesterlund, and A. J. Wilson (2020). Belief elicitation: Limiting truth telling with information on incentives. Technical report, National Bureau of Economic Research.

References IX

de Bresser, J. (2019). The role of heterogeneous expectations in life cycle models: Evaluating the accuracy of counterfactuals.

Deaton, A. and J. Muellbauer (1980). An almost ideal demand system. *The American economic review 70*(3), 312–326.

Delavande, A. and B. Zafar. Forthcoming."university choice: The role of expected earnings, non-pecuniary outcomes and financial constraints.". *Journal of Political Economy*.

Dizon-Ross, R. (2019). Parents' beliefs about their children's academic ability: Implications for educational investments. *American Economic Review 109*(8), 2728–65.

Dohmen, T., A. Falk, D. Huffman, and U. Sunde (2018). On the relationship between cognitive ability and risk preference. *Journal of Economic Perspectives 32*(2), 115–34.

References X

Doraszelski, U. and J. Jaumandreu (2013). R&d and productivity: Estimating endogenous productivity. *Review of Economic Studies 80*(4), 1338–1383.

Doraszelski, U. and J. Jaumandreu (2018). Measuring the bias of technological change. *Journal of Political Economy 126*(3), 1027–1084.

Dunbar, G. R., A. Lewbel, and K. Pendakur (2019). Identification of random resource shares in collective households without preference similarity restrictions. *Journal of Business & Economic Statistics*, 1–20.

Duncan, O. D. (1966). Path analysis: Sociological examples. *American journal of Sociology 72*(1), 1–16.

Falk, A., A. Becker, T. Dohmen, B. Enke, D. Huffman, and U. Sunde (2018). Global evidence on economic preferences. *The Quarterly Journal of Economics 133*(4), 1645–1692.

References XI

Falk, A. and J. Hermle (2018). Relationship of gender differences in preferences to economic development and gender equality. *Science 362*(6412).

Forsythe, R., J. L. Horowitz, N. E. Savin, and M. Sefton (1994). Fairness in simple bargaining experiments. *Games and Economic behavior 6*(3), 347–369.

Gandhi, A., S. Navarro, and D. A. Rivers (2020). On the identification of gross output production functions. *Journal of Political Economy 128*(8), 000–000.

Ghisolfi, S. (2020). Requiring contributions during bargaining increases inequality in outcomes. *Working paper*.

Giannola, M. (2020). Intrahousehold allocations, fertility and inequality. *Working paper*.

Gilbert, M., C. Clark, J. Stone, F. Perroux, D. Lieu, Evelpides, F. Divisia, Tinbergen, Kuznets, Smithies, et al. (1949). The measurement of national wealth: discussion. *Econometrica: Journal of the Econometric Society*, 255–272.

References XII

Giustinelli, P., C. F. Manski, and F. Molinari (2019). Precise or imprecise probabilities? evidence from survey response on late-onset dementia. Technical report, National Bureau of Economic Research.

Goldberger, A. S. (1971). Econometrics and psychometrics: A survey of communalities. *Psychometrika 36*(2), 83–107.

Goldberger, A. S. (1972). Structural equation methods in the social sciences. *Econometrica: Journal of the Econometric Society*, 979–1001.

Griliches, Z. (1974). Errors in variables and other unobservables. *Econometrica: Journal of the Econometric Society*, 971–998.

Haavelmo, T. (1958). The role of the econometrician in the advancement of economic theory. *Econometrica: Journal of the Econometric Society*, 351–357.

Hansen, L. P. and T. J. Sargent (1981). A note on wiener-kolmogorov prediction formulas for rational expectations models. *Economics Letters 8*(3), 255–260.

References XIII

Hausman, D. M. (1994). *The philosophy of economics: An anthology*. Cambridge University Press.

Hausman, J. (2012a). Contingent valuation: from dubious to hopeless. *Journal of Economic Perspectives 26*(4), 43–56.

Hausman, J. A. (2012b). *Contingent valuation: A critical assessment*. Elsevier.

Heckman, J., R. Pinto, and P. Savelyev (2013). Understanding the mechanisms through which an influential early childhood program boosted adult outcomes. *American Economic Review 103*(6), 2052–86.

Heckman, J. J., B. Liu, M. Lu, J. Zhou, et al. (2020). Treatment effects and the measurement of skills in a prototypical home visiting program. Technical report, Institute of Labor Economics (IZA).

Hossain, T. and R. Okui (2013). The binarized scoring rule. *Review of Economic Studies 80*(3), 984–1001.

References XIV

Jöreskog, K. G. and A. Goldberger (1975). Estimation of a model with multiple indicators and multiple causes of a single latent variable. *Journal of the American Statistical Association*, 631–639.

Juster, F. T. (1966). Consumer buying intentions and purchase probability: An experiment in survey design. *Journal of the American Statistical Association 61*(315), 658–696.

Juster, F. T., R. P. Shay, et al. (1964). Consumer sensitivity to finance rates: An empirical and analytical investigation. *NBER Books*.

Karadja, M., J. Mollerstrom, and D. Seim (2017). Richer (and holier) than thou? the effect of relative income improvements on demand for redistribution. *Review of Economics and Statistics 99*(2), 201–212.

Katona, G. (1959). On the predictive value of consumer intentions and attitudes: A comment. *The Review of Economics and Statistics*, 317–317.

References XV

Katona, G. (1974). Understanding consumer attitudes. *Surveys of Consumers 1976*, 203–219.

Kesternich, I., F. Heiss, D. McFadden, and J. Winter (2013). Suit the action to the word, the word to the action: Hypothetical choices and real decisions in medicare part d. *Journal of Health Economics 32*(6), 1313–1324.

Keynes, J. M. (1936). The general theory of interest, employment and money.

Kindermann, F., J. Le Blanc, M. Piazzesi, and M. Schneider (2019). Learning about housing cost-survey evidence from german house price booms. Technical report, mimeo, Stanford University.

Kuziemko, I., M. I. Norton, E. Saez, and S. Stantcheva (2015). How elastic are preferences for redistribution? evidence from randomized survey experiments. *American Economic Review 105*(4), 1478–1508.

References XVI

Kuznets, S. (1941). Statistics and economic history. *The Journal of Economic History 1*(1), 26–41.

Kuznets, S. et al. (1937). National income and capital formation, 1919-1935. *NBER Books*.

Lechene, V., K. Pendakur, and A. Wolf (2020). Ols estimation of the intra-household distribution of expenditure.

Levinsohn, J. and A. Petrin (2003). Estimating production functions using inputs to control for unobservables. *The review of economic studies 70*(2), 317–341.

List, J., J. Pernaudet, and D. . Suskind (2020). It all starts with beliefs: Addressing the roots of educational inequities by changing parental beliefs. Technical report.

Luce, R. and P. Suppes (1965). Preference, utility, and subjective utility. *Handbook of Mathematical Psychology, III, New York: Wiley*, 249–409.

References XVII

Luce, R. D. (1956). Semiorders and a theory of utility discrimination. *Econometrica, Journal of the Econometric Society*, 178–191.

Luce, R. D. (1959). Choice behavior. a theoretical analysis.

Luce, R. D. and J. W. Tukey (1964). Simultaneous conjoint measurement: A new type of fundamental measurement. *Journal of mathematical psychology 1*(1), 1–27.

Manski, C. F. (2004). Measuring expectations. *Econometrica 72*(5), 1329–1376.

Manski, C. F. and F. Molinari (2010). Rounding probabilistic expectations in surveys. *Journal of Business & Economic Statistics 28*(2), 219–231.

Miller, G., Á. De Paula, and C. Valente (2020). Subjective expectations and demand for contraception. Technical report, National Bureau of Economic Research.

Nyarko, Y. and A. Schotter (2002). An experimental study of belief learning using elicited beliefs. *Econometrica 70*(3), 971–1005.

References XVIII

Olley, G. S. and A. Pakes (1992). The dynamics of productivity in the telecommunications equipment industry. Technical report, National Bureau of Economic Research.

Potter, S. (2016). The advantages of probabilistic survey questions: remarks at the it forum and rcea bayesian workshop, keynote address, rimini, italy, may 2016. Technical report, Federal Reserve Bank of New York.

Potter, S., M. Del Negro, G. Topa, and W. Van der Klaauw (2017). The advantages of probabilistic survey questions. *Review of Economic Analysis 9*(1), 1–32.

Ringdal, C. and I. Hoem Sjursen (2017). Household bargaining and spending on children: Experimental evidence from tanzania. *NHH Dept. of Economics Discussion Paper* (19).

Stigler, G. J. and G. S. Becker (1977). De gustibus non est disputandum. *The american economic review 67*(2), 76–90.

References XIX

Stone, R. (1954). Linear expenditure systems and demand analysis: an application to the pattern of british demand. *The Economic Journal 64*(255), 511–527.

Stone, R. (1984). Richard stone-prize lecture: The accounts of society. *Nobelprize. org. Nobel Media AB*.

Tobin, J. (1959). On the predictive value of consumer intentions and attitudes. *The review of economics and statistics*, 1–11.

Todd, P. and K. Wolpin (2003). On the specification and estimation of the production function for cognitive achievement. *The Economic Journal 113*, F3–F33.

Van der Klaauw, W. and K. I. Wolpin (2008). Social security and the retirement and savings behavior of low-income households. *Journal of econometrics 145*(1-2), 21–42.

References XX

Wiswall, M. and B. Zafar (2015). Determinants of college major choice: Identification using an information experiment. *The Review of Economic Studies 82*(2), 791–824.

Wright, S. (1934). The method of path coefficients. *The annals of mathematical statistics 5*(3), 161–215.

Zheng, Y., J. Pantano, et al. (2012). Using subjective expectations data to allow for unobserved heterogeneity in hotz-miller estimation strategies. In *2012 Meeting Papers*, Number 940. Society for Economic Dynamics.

Experimental literature

- Lab work on various mechanisms to elicit primitives.
  - Nyarko and Schotter (2002);
  - Hossain and Okui (2013);
  - Danz, Vesterlund, and Wilson (2020);
  - Charness, Gneezy, and Imas (2013).
- Lab in the field:
  - Alesina, Stantcheva, and Teso (2018) Almås, Cappelen, and Tungodden (2020) ;
  - Ghisolfi (2020) and Cappelen, List, Samek, and Tungodden (2020);
  - Cavatorta and Groom (2020) ;
  - Alan and Ertac (2019) and Almås, Berge, Bjorvatn, Somville, and Tungodden (2020) .

Back

References: stated preferences, deviation from rational expectations and beliefs and policy preferences

- Stated preferences:
  - Ben-Akiva, McFadden, Train, et al. (2019);
  - Kesternich, Heiss, McFadden, and Winter (2013);
  - Blass, Lach, and Manski (2010);
  - Ameriks, Briggs, Caplin, Lee, Shapiro, and Tonetti (2020).
- Deviations from rational expectations:
  - Hansen and Sargent (1981);
  - Chen et al. (2020);
  - Kindermann, Le Blanc, Piazzesi, and Schneider (2019);
  - Bianchi, Ludvigson, and Ma (2020).
- Beliefs and policy preferences:
  - Kuziemko, Norton, Saez, and Stantcheva (2015);
  - Karadja, Mollerstrom, and Seim (2017);
  - Alesina and Angeletos (2005).

Back

References: subjective expectations

- Collecting subjective expectations data:
  - Manski (2004);
  - Manski and Molinari (2010);
  - Giustinelli, Manski, and Molinari (2019);
  - NY Fed work on collecting subjective expectations data systematically (Potter, Del Negro, Topa, and Van der Klaauw, 2017; Potter, 2016).
- ...and using it.:
  - Van der Klaauw and Wolpin (2008);
  - de Bresser (2019);
  - Arcidiacono, Hotz, Maurel, and Romano (2017);
  - Wiswall and Zafar (2015);
  - Zheng, Pantano, et al. (2012);
  - Attanasio and Kaufmann (2014);
  - Delavande and Zafar (Delavande and Zafar).

References: beliefs, attitudes, preferences

- Cunha et al. (2013), Attanasio et al. (2019), Baranov, Bhalotra, Biroli, and Maselko (2020), List, Pernaudet, and Suskind (2020) on beliefs about child development;
- Dizon-Ross (2019); Bobba and Frisancho (2020) on perceptions of ability;
- Boneva and Rauh (2018); Attanasio, Boneva, and Rauh (2019) on returns to education.
- Miller, De Paula, and Valente (2020) on beliefs about contraception effectiveness.
- Bobba and Frisancho (2020) collect and use data about self-perceptions about academic achievement among high school students in Mexico;
- Andrew Caplin and collaborators have been working with Vanguard samples, engineering new measures and questions:
- Ameriks et al. (2020).
- Attitudes
  - Falk, Becker, Dohmen, Enke, Huffman, and Sunde (2018); Becker, Enke, and Falk (2020); Falk and Hermle (2018); Dohmen, Falk, Huffman, and Sunde (2018);

References: The allocation game

- Forsythe, Horowitz, Savin, and Sefton (1994);
- Juster et al. (1964);
- Almås, Attanasio, Jervis, and Ringdal (2020);
- Ringdal and Hoem Sjursen (2017).

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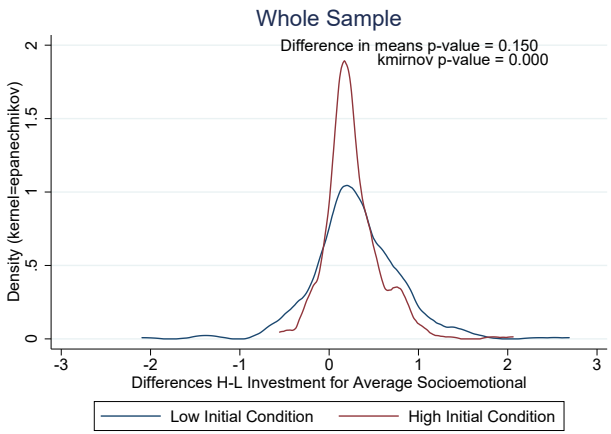
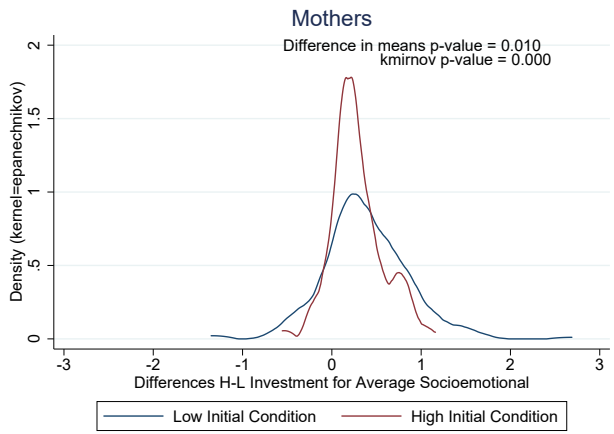
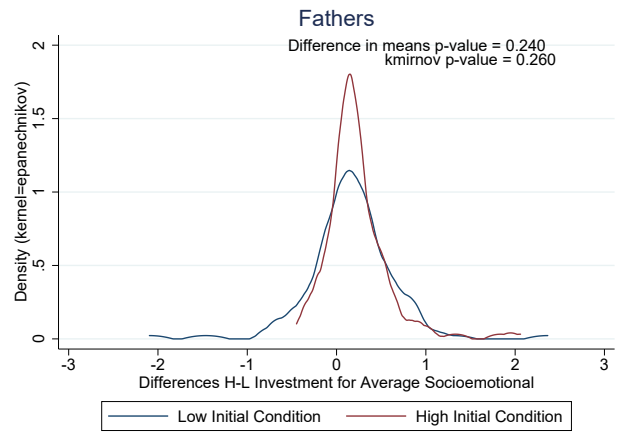
Beliefs on returns to investment: socio-emotional development







- Returns to investment are perceived to be higher

  for low initial conditions than for high initial conditions;
  difference in means:
  - for whole sample = 0.044 (p-value=0.150);
  - for mothers = 0.097 (p-value=0.010);
  - for fathers = -0.063 (p-value=0.240).
- The entire distribution seems to be different, with the low initial condition returns presenting more dispersion and shifted to the right.

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Beliefs on returns to investment: socio-emotional development

	Mothers	Fathers	difference (p-value)
Low Initial Condition	0.379	0.163	0.216
(behave very badly)	(0.030)	(0.043)	(0.000)
High Initial Condition	0.282	0.227	0.055
(behave very well)	(0.019)	(0.032)	(0.112)
Number of observations	246	126	

Notes: The table shows the means for the returns of investment. Standard errors in parentheses.

- Mothers have a higher expected return to investment for low initial condition children than fathers: difference = 0.216 (p-value=0.000).
- The difference in expected return when initial condition is high is smaller and not significant.

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