

## A reply to Caplin and Shapiro

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We thank Andrew Caplin and Jesse Shapiro for providing interesting comments and for offering new angles to the arguments we proposed in the Presidential Address. Their comments bring to the fore some important issues that are present in the paper but need to be stressed further.

The first part of Caplin's comment focuses on the analysis of subjective expectations and the importance to validate them. The suggestion of linking them to administrative data, as done in the remarkable Danish example, or more generally to 'choice data', even in surveys, is a key one. The issue is not so much to 'test' some of the assumptions used in the absence of subjective expectation data, such as Rational Expectation, but rather to identify the drivers of individual choices. Caplin et al (2023) show both that the subjective expectation data are credible and survive several validation checks, and that perceptions of risk and uncertainty inferred from such data are much smaller than that derived from administrative data. The latter finding signals that individuals have much information that is hidden in the administrative data, where part of unobserved heterogeneity is effectively interpreted as uncertainty. What matters for individual decisions is their perceptions of the relevant process, regardless of whether these perceptions are fully rational or contain additional information relative to what can be inferred from realized data. The elicitation of such perceptions, therefore, becomes key.

The point that Caplin makes about the importance of elicitation technology is also an important one. As researchers attempt to measure new latent variables, new measurement tools are developed, which need to be validated and tested. Much progress has been made in the elicitation of subjective expectations about income and other variables, reflected in sophisticated instruments used in a variety of contexts. However, even in the context of subjective expectations much work is still needed, as many issues, such as the anchoring of the variable of interest, the elicitation of expectations with different conditioning sets and the elicitation of the joint distribution of several variables, are still open.

This type of problems is even more salient for measures of different domains and variables, including tools to measure beliefs or different types of skills, discussed by Caplin in the second part of his comments. Here he stresses the link between the development of new measurement tools, aimed at capturing specific variables, and the development of new theoretical models, such as those on rational inattention Caplin mentions, or models where the production function considered separates *skills* and *tasks* such as in the paper by Acemoglu and Autor (2011) and Deming (2017). This point has a general relevance and inspires most of the content of our paper: the development of new measurement tools is stimulated and driven by the need of theoretical models that involve rich sets of variables and relationships. Another example that is briefly mentioned in our paper is that of models of asymmetric information, where the development of measures of the quality of information in certain contexts (villages, extended families and the like) could be extremely useful to bring these models to data..

In his comment, Shapiro, to flesh out the approach outlined in our paper, considers a simple example: the modelling of the share of savings invested in risky commodities, with a theoretical framework, represented by a function  $F()$ , of some latent variables  $\theta$  and a measurement system  $g()$  that relates available measures to the latent variables of interest. The table he presents clarifies the different set of assumptions needed on  $g()$  and  $F()$ , as well as the *definition of the latent variable of interest*  $\theta$ , when one varies the *measures available for analysis* and *the nature* of the model considered.

The first two rows of the table consider ‘choice data’, possibly of different quality (administrative data and self-reported value in the survey), which have been traditionally used in the literature. The measures considered in the third row in the table are the closest to those discussed in our paper: answers to questions about choices in hypothetical situations. Such questions have been around in economics for a while but have often been dismissed as not useful, as we discuss in the paper. However, they are now much more common, which, in our opinion, is a very welcomed trend. That does not diminish the fact that such questions are not easy to design and need to be, as stressed above, validated. The comment emphasizes, as our paper, this need. Validation can take different forms, although the predictive power of measures derived from hypothetical scenarios and choice data is one of the most important tools, pointing again at the simultaneous use of new and traditional measures.

Such an approach to the nature of measurement suggests that the design of questionnaires and surveys should be partly informed by the usefulness of controlling the nature of  $g()$  and the measurement error  $\epsilon$ , possibly incentivizing field experiments aimed at identifying participants tastes or attitudes, or simply, when fielding a survey, investing resources to make the measurement errors associated with different measures satisfy the assumptions needed for identification.

In the last row of the table, Shapiro considers an alternative approach, which attempts to elicit directly the *structural parameters* that inform, *in the model*, individual behavior. In the example considered, the coefficient of risk aversion becomes the latent variable of interest  $\theta$  about which one could try to elicit information. While interesting, we are skeptical of such an approach, as Americks et al (2021) and, it seems, Shapiro himself.

A theoretical model is a conceptual framework that can be used to interpret a set of facts (and measures) and establish *causal links* between certain constructs. To use the terminology used by Heckman and Pinto (2023), models are *thought experiments* that define such causal links. The construction of new measures, possibly in the form of questions about hypothetical situations, can be useful to identify and estimate rich versions of such models. Collecting new measures to capture specific drivers of behavior, however, does not necessarily mean imposing a theoretical structure on survey respondents. Individuals’ behaviors and preferences might be well represented by that model, but they might not conceptualize it as researchers do and might not be fully aware of or understand it. The citation of Friedman and Savage’s billiard players is quite appropriate here. In the example considered, individuals may have a constant relative risk aversion that can be revealed through observed choices -- but asking directly about it might not be revealing much. A revealed preference approach still has much to it, and the use of incentivized experiments or even hypothetical choice ones may therefore be very useful.

In his comment, Shapiro also mentions the desirability of collecting information “not (only) on how agents behave in different environments, but also on how agents perceive these environments, and how agents perceptions shape their behavior’. Such a statement can be interpreted as the consideration of richer models of individual behavior, which include models of how individuals see their environment and the causality that they infer from that. This is similar to the parental investment model considered in Section 4 of the paper, where parental behavior depends, among other things, on their *perception of the production function of child development*. In the empirical exercise in Section 6, indeed, we document how measurements of such beliefs are predictive of parental investment.

**Additional references (already in the paper)**

Acemoglu, D. and D. H. Autor (2011). “Skills, tasks and technologies: Implications for employment and earnings.” In *Handbook of Labor Economics* Vol. 4, (edited by Ashenfelter, O. and D. E. Card). Amsterdam: Elsevier

Deming, D. J. (2017). “The Growing Importance of Social Skills in the Labor Market.” *The Quarterly Journal of Economics*, 132(4), 1593–1640.

Heckman, J.J, and R. Pinto (2023): “Econometric Causality: The Central Role of Thought Experiments”, NBER WP No 31945