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Reply to Solow*

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ABSTRACT _____

Here we reply to Robert Solow's comment (forthcoming) on our work (Chari and Kehoe (2007)).

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We welcome this opportunity to respond to Robert Solow, whose seminal contributions set the stage for how we now construct models and how we conduct quantitative analyses. In writing down a one-sector production function in his growth model, he sacrificed realism for an abstraction that has proved invaluable. In this growth accounting, he showed us how we should use this abstraction to provide a quantitative answer to an important economic question.

In his comment, Solow eloquently voices the commonly heard complaint that too much of modern macroeconomics starts with a model with a single type of agent. In our response we clarify that modern macroeconomics does not end there—and may in fact not end too far from where Solow prefers.

Solow also argues that improvements can be made in how macroeconomists use data to discipline their models and, in that context, approvingly cites the work of Hansen and Heckman (1996). We agree with much of the constructive research program that Hansen and Heckman offer and elaborate on this agreement below.

Finally, Solow wonders why bright young economists are attracted to modern macroeconomics. We present one answer below.

The Trade-Off between Transparency and Detail in Model Building

Professor Solow's comments beautifully illustrate a struggle that academic macroeconomists engage in every day. On the one hand Solow says, "My general preference is for small, transparent, tailored models, often partial equilibrium, usually aimed at understanding some little piece of the (macro-) economic mechanism." On the other hand he also says that

a modern economy is populated by consumers, workers, pensioners, owners, managers, investors, entrepreneurs, bankers and others, with different and sometimes conflicting desires, information, expectations, capacities, beliefs and rules of behavior. Their interactions in markets and elsewhere are studied in other branches of economics; mechanisms based on those interactions have been plausibly implicated in macroeconomic fluctuations. To ignore all this in principle does not seem to qualify as mere abstraction—that is setting aside inessential details. It seems more like the arbitrary suppression of clues merely because they are inconvenient for cherished preconceptions.

Clearly, it is impossible to have a small model that incorporates all the richness that Solow sees in a modern economy.

From our perspective, models are designed to answer specific questions. Understanding the answers from the model requires understanding the economic mechanism—which is easier to do when the model is a simple one. In this sense, we entirely share Solow's preference for small, transparent, tailored models, although the kind of macroeconomic questions we ask typically require general equilibrium models.

Solow seems to think that, in principle, modern macroeconomics ignores all the rich detail that he sees in the modern economy. In this belief, we think he is wrong. Most of modern macroeconomics is about examining mechanisms based on the kinds of interactions that Solow seems to have in mind. For example, Ríos-Rull (1996) develops a life-cycle model with consumers, workers, and pensioners and uses it to ask questions about the quantitative sources of business cycle fluctuations. Krusell and Smith (1998) develop an incomplete markets model with heterogeneous consumers possessing conflicting desires and use it to ask questions about business cycle fluctuations. Rogerson and Wallenius (2007) use a life cycle in which agents have different capacities for supplying labor and use it to ask questions about tax rates and average employment rates across countries. Bernanke, Gertler, and Gilchrist (1999) and Cooley, Marimon, and Quadrini (2004) develop models with investors, entrepreneurs, and bankers who have conflicting desires and use these models to study the role of financial constraints over the business cycle.

Solow's principal complaint seems to be that the style in modern macroeconomics is to start with a model with a single type of agent and then enrich it with enough necessary detail to answer the question at hand. Instead, he seems to prefer starting with a model with eight types of agents and then trimming the unnecessary details to end up with the small model he prefers. Does it really matter whether we start with a single type of agent and then boost it to three types to answer the question at hand, or that he starts with eight types of agents and then reduces the number to three to answer the same question? Analogies about school colors and carrots aside, there does not seem to be much of substance here to argue about.

Implications of the Sonnenschein-Mantel-Debreu Result

The Sonnenschein-Mantel-Debreu result implies that if we have only aggregate data, theory imposes little discipline on the modeling of aggregates. Some may despair at this lack of discipline. Fortunately (the Sonnenschein-Mantel-Debreu result notwithstanding), if we have micro data on how individual households and firms behave, then theory imposes many restrictions on the behavior of aggregates. The whole point of modern macroeconomics is to build models at the level of individual households and firms, disciplined by microeconomic evidence, and use these models to answer aggregate questions.

This disciplining method is still a work in progress. Professor Solow approvingly cites Hansen and Heckman (1996), who suggest ways to improve the process of using microeconomic evidence in building macroeconomic models. Interestingly, Hansen and Heckman argue that for this process to succeed, microeconomists need to change the way they do business. Indeed, Hansen and Heckman (1996, p. 100) write,

A more productive research program would provide clearly formulated theories that will stimulate more focused microeconomic empirical research. Much recent micro research

is atheoretical in character and does not link up well with macro general equilibrium theory. . . . A redirection of micro empirical work toward providing input into well-defined general equilibrium models would move discussions of micro evidence beyond discussions of whether wage or price effects exist, to the intellectually more important questions of what the micro estimates mean and how they can be used to illuminate well-posed economic questions.

We wholeheartedly agree, and we look forward to seeing this new strain of microeconomic empirical research.

Winning Young Minds with Economic Theory

Solow wonders why bright young economists are attracted to modern macroeconomics. We think it is for the same reason that, along with many other contributions, Robert Solow developed the growth model, James Tobin developed portfolio theory, and Paul Samuelson developed the overlapping generations model. These economists were, like the generations that followed, attracted to using what was then the frontier of economic theory to shed light on macroeconomic questions.

References

Bernanke, Ben S., Mark Gertler, and Simon Gilchrist (1999), “The Financial Accelerator in a Quantitative Business Cycle Framework,” in *Handbook of Macroeconomics*, Vol. 1C, ed. John B. Taylor and Michael Woodford (Amsterdam: North-Holland).

Chari, V. V., and Patrick J. Kehoe (2006), “Modern Macroeconomics in Practice: How Theory is Shaping Policy,” *Journal of Economic Perspectives* 20 (4) (Fall): 3–28.

Cooley, Thomas, Ramon Marimon, and Vincenzo Quadrini (2004), “Aggregate Consequences of Limited Contract Enforceability,” *Journal of Political Economy* 112 (August): 817–47.

Hansen, Lars Peter, and James J. Heckman (1996), “The Empirical Foundations of Calibration,” *Journal of Economic Perspectives* 10 (Winter): 87–104.

Krusell, Per, and Anthony A. Smith, Jr. (1998), “Income and Wealth Heterogeneity in the Macroeconomy,” *Journal of Political Economy* 106 (October): 867–96.

Ríos-Rull, José-Víctor (1996), “Life-Cycle Economies and Aggregate Fluctuations,” *Review of Economic Studies* 63 (July): 465–89.

Rogerson, Richard, and Johanna Wallenius (2007), “Micro and Macro Elasticities in a Life Cycle Model With Taxes.”

Solow, Robert (forthcoming), “The State of Macroeconomics,” *Journal of Economic Perspectives*.