"Non-Convexities in Applied General Equilibrium Analyses of Business Cycles"

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Throughout most of the twentieth century, business cycle fluctuations have been the concern of leading economists including among others, Wesley Mitchell and his truly great student, Irving Fisher. These recurrent fluctuations of output and employment about trend were puzzling. Economists developed a plethora of stories attempting to explain why these fluctuations occurred. The failure to develop a successful theory of business cycles was that dynamic economic theory had not been developed at the time, much less applied dynamic economic theory. It is true that Irving Fisher on this side of the Atlantic, and Erik R. Lindahl on the other side, recognized that static general equilibrium theory could be made dynamic by adding a date index to commodities. But computer power to compute the dynamic equilibria along with recursive methods that facilitated the computation were not available until about 1970.

Absent theory, once good national income and product accounting systems became available, economists searched for the laws of motion governing the evolution of NIPA data. This research program dominated in the 1950s and 1960s, but this empirical effort failed and failed spectacularly. This failure, along with the development of dynamic economic theory, led Robert E. Lucas, Jr. (1971, 1976) to redirect the attention of the profession back to the study of business cycles. His dynamic equilibrium analyses explained by the empirical effort failed because the existence of policy invariant law of motion is inconsistent with dynamic economic theory.

Equilibrium elements of model economies are stochastic processes, typically Markov with a stationary transition probability measure. A question that troubled the economic profession throughout the 1970s and into the 1980s was whether the language of dynamic economic theory was useful in studying business cycle fluctuations.

In the 1970s the prevailing view of the profession was that changes in one set of factors, namely real factors such as taxes and total factor productivity, gave rise to the secular movement in the aggregate data; and another set of factors, namely nominal factors, gave rise to business cycle fluctuations.

The use of the discipline of applied dynamic general equilibrium surprised the profession and forced it to change its views. The result that surprised the profession, including Finn E. Kydland and myself who discovered it, is that random persistent changes in factors that altered the constant growth path of the growth model gave rise to business cycle fluctuations of the nature observed. This was a spectacular success for the discipline of applied dynamic general equilibrium.

Kydland and Prescott said how big the variance of the technology shock had to be to generate fluctuations of the magnitude observed. Prescott (1985)

estimated the magnitude of the shock and found that if technology shocks were the only shocks, the economy would have been 70 percent as volatile as it was in the 1954-1980 period. This is a *spectacular* success for the discipline of applied general equilibrium. It unified the theory of growth and business cycles.

This paper besides reviewing the development of business cycle theory, uses the discipline of applied general equilibrium. One notable success was the recognition that an aggregate result underlies the stand-in household theory. This result is analogous to the aggregation theory justifying the concave, constant-returns-to-scale aggregate production function. In spite of non-convexities at the firm or household levels, the aggregate economy is convex. This is a very important result. There is a fundamental non-convexity associated with the workweek length. Sherwin Rosen in the early 1970s pointed out that workweeks of different lengths were different commodities and this commodity was indivisible and Richard Rogerson (1988) formalized this concept in a static setting. Gary D. Hansen (1985) introduced this feature into real business cycle theory and found it resulted in much higher elasticities of labor supply for the stand-in household than for the people being aggregated. This theory predicts that in the aggregate the principle margin of adjustment is the number employed in a given week and not the length of the workweek, which is in conformity with observation.

On the technology side, Herbert Scarf's sS non-convexity in adjusting inventories or capacity has little consequence for aggregate behavior as established by Julia Thomas (1999). The margin of aggregate adjustment is the measure of the production units that adjust. In all analyses with one exception, the non-convexities at the micro level do not introduce important non-linearities at the aggregate level. The exception is Hansen and Prescott (2001), who studied a world with capacity constraints and find non-linearities of the type observed in the aggregate time series. The resulting aggregate production function is not a Cobb-Douglas, yet for secular growth its implications are the same as the Cobb-Douglas production function.