Discussion: Financial Markets and the Real Economy[1]

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John Cochrane has done an admirable job of summarizing a rather extensive empirical literature. The work is so exhaustive that I will not even attempt to comment on it in a systematic way. There are many very nice aspects to his discussion, and what follows merely provides some minor amendments.

To his credit, Cochrane considers again some of the early literature on consumption-based asset pricing and compares quotes across papers in an attempt at intellectual history. This is interesting reading, but I would urge others to read the whole papers, not just quotes. Some important breakthroughs occurred prior to Mehra and Prescott (1985) and Hansen and Singleton (1983). While the Shiller (1982) paper that Cochrane features is a nice paper, I am personally a big fan of Grossman and Shiller (1980, 1981). These two joint papers really got researchers like Singleton and myself and others thinking of empirical implications of the consumption-based capital asset pricing model along with the earlier theoretical work of Rubinstein (1976), Lucas (1978), and Breeden (1979). It is unfortunate that only an abbreviated version, Grossman and Shiller (1981), was published because Grossman and Shiller (1980) was familiar to many people at the time. In this sense, the analogy to Columbus versus Erikson in the discovery of America is a bit misleading, although the important influence of Mehra and Prescott (1985) in subsequent research is undeniable. Given my Nordic origins, I have always been a bit partial to Erikson.

It is interesting that the Shiller inequality that Cochrane refers to differs from the ones Cochrane uses to frame most of his discussion. Shiller deduced his inequality using information about the marginal distribution for consumption or more generally a stochastic discount factor along with the marginal distributions for separate returns. Hansen and Singleton (1982) used information from the joint distribution of stochastic discount factors and returns following in part Grossman and Shiller (1980). Hansen

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and Jagannathan (1991) and the Hansen comment on Shiller used marginal information on stochastic discount factors in conjunction with information on the joint distribution of returns. This latter approach was motivated by an aim to produce a common set of diagnostics for a rich family of stochastic discount factor models. All three approaches are interesting and arguably serve different purposes. It is certainly true that the Shiller paper was a natural precursor to my work with Jagannathan.

In Cochrane's discussion of the Hansen and Singleton (1983) paper in his section of the equity-premium puzzle, it is not clear why Ken and I are even mentioned as part of the same discovery game. We focused on monthly postwar data and used a sample with a shorter span (but observed more frequently) for estimation and inference in contrast to both Grossman and Shiller (1980, 1981) and Mehra and Prescott (1985). For the postwar data sample we used, the mean returns could not be estimated with enough accuracy for reliable inference. A narrowly framed equity premium puzzle based on postwar data would have been much less dramatic and much easier to debunk. Perhaps we erred in focusing on such a short time period, but this choice is non-trival and has important consequences. It revolves in part around the following question: Did postwar investors presume the prewar volatility was germane when making investments?

The whole point of Hansen and Singleton (1983) is to show that by exploiting conditioning information one can make non-trivial inferences with postwar data. Unfortunately, this led us to a related problem. While conditioning information could be helpful in identifying the intertemporal elasticity of substitution from asset market data and consumption, actual use of this information put us in a bind. You cannot simultaneously explain the conditional distribution of consumption as well as multiple returns. This bind was reflected in the conclusion of our paper, but certainly our prose did not match the elegance of Mehra and Prescott (1985).

While our paper in the *Journal of Political Economy* exploited log-normality, our companion paper Hansen and Singleton (1982) (and awkwardly the errata in Hansen and Singleton (1984)) published in *Econometrica* found comparable results with multiple returns and conditioning information constructed as scaling factors using an estimation method that avoided log-normality. It is evident from our work that the heterogeneity in the risk exposure of returns including those we constructed through scaling posed a serious challenge to the power utility, representative consumer model. On the other hand, we were not as clever as Mehra and Prescott in describing and framing this as a puzzle. In contrast to Mehra and Prescott, statistical inference was front and center in our analysis and formally shaped how we looked at evidence, but this is only part of the difference in approaches.

Although vast in its coverage, there is a missing link in Cochrane's essay that is worth further consideration. Cochrane has separate discussions of the Fama and French (1995) empirical evidence based on portfolio constructed using ratios of book equity to market equity and Hall (2001)'s analysis of intangible capital. While I share Cochrane's interest in Hall's work, in Hansen et al. (2005), we view the Fama–French work as suggesting possibly important differences in the risk exposure of technologies that feature different mixes of tangible and intangible capital. If intangible capital is a primary source of

divergence in measures of book equity and market equity, then the Fama and French (1995) analysis suggests that the macroeconomic risk exposure of intangible capital may be fundamentally different from that of measured capital. This has potentially important modeling implications that are worth exploring further.

Restoy and Weil (1998), Hansen et al. (1998), Tallarini (2000), and others feature the use of continuation values computed from consumption dynamics in conjunction with recursive utility. While Restoy and Weil (1998) focus on the role of consumption, they exploit its link to wealth and the return on the wealth portfolio. The link between continuation values and wealth becomes degenerate when the intertemporal elasticity of substitution is unity. This leads Restoy and Weil (1998) to exclude this case. Even with a unitary elasticity of substitution, however, continuation values still can be inferred from consumption dynamics by solving the utility recursion exactly or at least approximately. In fact, a unitary elasticity of substitution simplifies the calculation, as is evident from Cochrane's discussion.

By working with continuation values, Hansen et al. (2006) show that an approximation around $\rho = 1$, where ρ is the reciprocal of the intertemporal elasticity of substitution, is straightforward to compute for some alternative models of consumption dynamics. From Eq. (14) in Cochrane's essay, the logarithm of the marginal utility of consumption is

$$\log m_{t+1} = -\rho(\log c_{t+1} - \log c_t) + (\rho - \gamma)\log U_{t+1} + \pi_t,$$

where π_t is in the date t information set and U_{t+1} is the continuation value for consumption at date $t+1$. The term π_t is inconsequential when characterizing the innovation to the logarithm of the marginal rate of substitution. Differentiating $\log m_{t+1} - \pi_t$ with respect to ρ gives

$$-\log c_{t+1} + \log c_t + \log U_{t+1} + (\rho - \gamma)\frac{d\log U_{t+1}}{d\rho}.$$

To localize around unity, we evaluate both $\log m_{t+1} - \pi_t$ and its derivative at $\rho = 1$, scale the latter by $\rho - 1$, and add the terms:

$$\log m_{t+1} - \pi_t \approx -(\log c_{t+1} - \log c_t) + (1-\gamma)\log U_{t+1}|_{\rho=1} + (\rho - 1)\left[-\log c_{t+1} + \log c_t + \log U_{t+1}|_{\rho=1} + (\rho - \gamma)\frac{d\log U_{t+1}}{d\rho}|_{\rho=1}\right].$$

Hansen et al. (2006) compute continuation values and derivatives for log-normal consumption dynamics and for consumption dynamics that include some forms of stochastic volatility. These are analogous approximation formulas that characterize how asset values and local risk prices change as a function of the intertemporal substitution elasticity of investors.

My final thought is a reflection about how explorations into alternative preferences have been or will be useful in macroeconomic analyses. Recently, Backus et al. (2004) wrote a useful summary on so-called exotic preferences and why they might or should

be of interest to macroeconomists. In asset pricing, are exotic preferences merely a device to account for asset pricing facts, or do we aim for this evidence to be formally integrated into, say, macroeconomics models to be used in policy analysis? Similarly, what role will the asset pricing-based models with market imperfections have to play in constructing heterogenous agent models for use in addressing macroeconomic policy questions? It will be interesting to see how this empirically ambitious literature summarized by Cochrane will influence the construction of dynamic general equilibrium models. Will there be an analogous ambition that will pervade dynamic economic modelling more generally, or will asset pricing evidence be viewed in isolation? The jury is still out on such questions.

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