Requiem for the Representative Consumer? Aggregate Implications of Microeconomic Consumption Behavior

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Macroeconomists pursuing microfoundations for aggregate consumption have generally adopted one of two approaches: either to model microeconomic consumption behavior carefully and then to aggregate, or to understand thoroughly the behavior of a "representative consumer" in general equilibrium and then to introduce microeconomic risk and heterogeneity. The broad conclusion from the "bottom–up" approach has been that precautionary saving and microeconomic heterogeneity can profoundly change behavior (Stephen P. Zeldes, 1989; Angus S. Deaton, 1991; Carroll, 1992). The broad conclusion from the "top–down" approach has been that precautionary saving is of little importance in determining the aggregate capital stock (S. Rao Aiyagari, 1994; Per Krusell and Anthony A. Smith, 1998), leading some economists to conclude that heterogeneity is unimportant for macroeconomic purposes. This paper shows that, while general-equilibrium effects do imply that the aggregate magnitude of precautionary saving is modest, nevertheless, when a model with uninsurable idiosyncratic risk is modified so that it can match key microeconomic facts, it produces behavior very different in important respects from that in the representative-agent economy. This leads to the conclusion that, for many purposes, the representative-consumer model should be abandoned in favor of a model that matches key microeconomic facts.[1]

I. On the Concavity of the Consumption Function

Unfortunately, the theoretical conditions under which an economy composed of many individuals will behave exactly as though it contains a single representative agent ("exact aggregation holds") are very stringent. The most problematic requirement is that consumers can completely insure their income against idiosyncratic shocks. In reality, household-level income data that include information on the existing sources of insurance (such as unemployment insurance, government transfers, and support from family and friends) show large fluctuations in post-tax, post-transfer idiosyncratic income, and there is now a large literature showing that consumption responds strongly to uninsured income shocks (a few examples are work by John H. Cochrane [1991], Jonathan McCarthy [1995], Orazio P. Attanasio and Stephen J. Davis [1996], and Tullio Jappelli and Luigi Pistaferri [1999]).

Uninsurable risk prevents aggregation because risk causes the consumption-policy function to become nonlinear (it becomes strictly concave, even in the absence of liquidity constraints [Carroll and Miles S. Kimball, 1996]). Figure 1 presents an example, drawn from the model specified below. The ratio of consump-

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[1] See Alan P. Kirman (1992) for a broader critique of the representative-agent model.

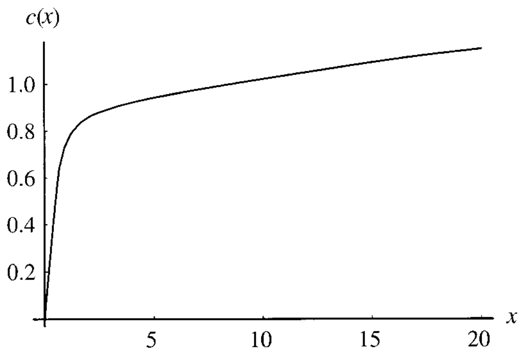

FIGURE 1. THE CONCAVE CONSUMPTION FUNCTION.

Notes: The figure shows $c(x)$ for the third model described in the text, for an unemployed consumer during the "good" aggregate state, where both c and x are normalized by permanent quarterly wage and salary income. For comparison, the numbers in Table 1 are normalized by annual rather than quarterly income.

TABLE 1—SURVEY OF CONSUMER FINANCES (SCF) DATA AND MODEL RESULTS

	K/wL			
		By percentile		
Source	Aggregate	0–66	67–100	MPC
A. *Empirical Data*				
K = net worth	6.2	1.2	10.8	—
K = liquid assets	1.5	0.1	2.9	—
B. *Models*				
RA	3.906	—	—	0.040
RA + AShocks	3.929	—	—	0.043
AShocks + IShocks	3.963	3.48	4.95	0.045
AShocks + IShocks + Hetero	3.910	0.39	11.06	0.187
ρ = 1.00	3.912	0.11	11.63	0.471

Notes: The first column is the ratio of total aggregate wealth to total aggregate annual labor income. The second column reports, for the consumers in the bottom two-thirds of the wealth distribution, the ratio of their total aggregate wealth to their total aggregate annual labor income; the third column reports the corresponding statistics for the consumers in the top third of the wealth distribution. Empirical data are from the 1995 Survey of Consumer Finances; similar results hold for earlier surveys. The four models are described in the text. RA = representative agent; AShocks = aggregate shocks; IShocks = idiosyncratic shocks; "Hetero" indicates the model with preference heterogeneity. Further details of the data and theory can be found in the technical appendix to the paper, available at ⟨http://www.econ.jhu.edu/people/ccarroll/requiem.html⟩.

tion C to permanent labor income wL, $c = C/wL$, is a concave function of the ratio of total current resources (nonhuman wealth plus current income, X) to permanent labor income, $x = X/wL$, for a microeconomic consumer for whom interest rates, wages, and labor supply are fixed at their steady-state levels. This nonlinearity implies that the distribution of wealth will affect the level of aggregate consumption, the average marginal propensity to consume, and other aggregate statistics.

Despite the global nonlinearity of $c(x)$, it is relatively smooth and is almost linear at large values of x. If aggregate wealth were distributed relatively tightly around some large value of x, aggregate behavior would closely resemble the behavior of a representative consumer with wealth equal to the mean of the distribution. Conversely, if wealth is very unequally distributed, the grounds for hoping for any "approximate aggregation" result are much weaker. This figure therefore indicates that the structure of the wealth distribution is of key importance for understanding macroeconomic behavior.

Consider what the figure implies about a statistic which is critical to the analysis of fiscal and monetary policies: the aggregate marginal propensity to consume (MPC). Concavity implies that the MPC is much higher at low wealth than at high wealth. If there are many consumers with little wealth one would expect an aggregate MPC much higher than implied by the representative-agent model; if most consumers had large amounts of wealth, one would expect the representative-consumer model to perform well. Alternatively, one can reason in reverse: the average MPC can be measured, and if it turns out to be much larger than implied by the representative-agent model, one can conclude that many consumers are holding levels of wealth that are in the steeply sloping region of the consumption function.[2]

II. The Microeconomic Facts

Table 1A presents information on the distribution of wealth across U.S. households. The

[2] Of course, a high average MPC might be explained by models other than the rational, time-consistent optimization model employed here; see David Laibson (1997) for an alternative.

data show that the ratio of wealth to labor income for households in the top third of the wealth distribution is enormously higher than the ratio in the bottom two-thirds of the distribution, whether the measure of wealth is total net worth or liquid assets. (The same qualitative pattern holds true of the ratio of wealth to total income, and at all ages.)

Representative-agent models are typically calibrated to match an aggregate wealth-to-income ratio like the one in the first column of the table. The table shows that the typical household's wealth is much smaller than the wealth of such a representative agent. Judging from Figure 1, this would lead one to expect that the behavior of the median household may not resemble the behavior of a representative agent with a wealth-to-income ratio similar to the aggregate ratio.

Empirical evidence bears out this prediction. Below, I show that the annual MPC predicted by a standard representative-agent model is about 0.04. Many empirical analyses performed with household data sets in the 1950's and 1960's found an annual MPC in the range of 0.2–0.4.[3] A more recent literature, starting with Robert E. Hall and Fredrick S. Mishkin (1982) and with contributions by McCarthy (1995), Annamaria Lusardi (1996), Jonathan Parker (1999), Nicholas S. Souleles (1999), and others has found annual MPC's typically in the range of 0.2–0.5.

III. Four Models

Consider a standard model in which a representative agent maximizes the discounted sum of expected future utility $E_t\,[\sum_{s=t}^{\infty} \beta^{s-t}\, C_s^{1-\rho}/(1-\rho)]$ subject to an aggregate capital-accumulation constraint:

$$K_{t+1} = (1-\delta)(X_t - C_t) \tag{1}$$

$$X_{t+1} = K_{t+1} + \theta_{t+1} K_{t+1}^{\alpha} L_{t+1}^{1-\alpha} \tag{2}$$

where K_{t+1} is capital at the start of period $t+1$, equal to undepreciated savings from period t, and X_t represents the total resources available for consumption in period t, the sum of capital and current income $\theta_t K_t^{\alpha} L_t^{1-\alpha}$; θ is an aggregate productivity shock. I consider first a version of the model with no uncertainty in which aggregate shocks and the aggregate labor supply are each normalized to 1 ($\{\theta_t, L_t\} = \{1, 1\}\ \forall t$).

The first row of Table 1B presents the statistics of interest in this model under conventional parametric choices and considering the model period as one quarter.[4] The ratio of the steady-state capital stock to steady-state labor income is 3.906, and the MPC is 0.04 at an annual rate.[5]

Today, the standard version of this model is one with aggregate shocks but no uninsurable idiosyncratic shocks. Following Krusell and Smith (1998), consider a version of the model in which there are two aggregate states: a "good" state where the aggregate productivity parameter is $\theta = 1.01$ and a "bad" state where the aggregate productivity parameter is $\theta = 0.99$. The model is parameterized so that the economy spends half its time on average in each state, and the average durations of expansions and contractions are identical and equal to eight quarters. Furthermore, to capture the cyclical variability in the unemployment rate, assume that the aggregate labor supply is $L = 0.96$ in the good state and $L = 0.90$ in the bad state. The second row of Table 1B presents the key results. The effect of the aggregate uncertainty on the aggregate capital-to-income ratio (the precautionary-saving effect) is modest: the average value of the K/wL ratio rises by only about 0.6 percent. The reason the precautionary effect is so modest is obvious from Figure 1: the representative agent has a very large amount of wealth and therefore spends essentially all of its time in a region where the consumption function is very flat.

The greatest contribution of Krusell and Smith (1998) is to show how to solve for the dynamic behavior of a model when households

[3] See Milton A. Friedman (1963) or Thomas Mayer (1972) for summaries of the early evidence.

[4] Specifically, mostly following Krusell and Smith (1998), I assume $\rho = 3$, $\alpha = 0.36$, $\delta = 0.025$, and $\beta = 0.99$. Under these parameter values, the model substantially underpredicts the empirical K/wL ratio, but this problem could be rectified by assuming a higher β.

[5] Details of the calculation can be found at ⟨http://www.econ.jhu.edu/people/ccarroll/requiem.html⟩. Here and henceforth, "annual rate" MPC's are defined to be four times the quarterly MPC.

are subject to uninsurable idiosyncratic risk as well as aggregate risk. Using their methodology, I now solve a version of the model in which fluctuations in aggregate labor supply reflect fluctuations in employment of individual households. Krusell and Smith (1998) assume that unemployment spells represent periods when a household's labor income is zero. Here, for greater realism, I assume the existence of an unemployment-insurance system that replaces half of permanent wage income. The third row of Table 1B presents the results. The first important conclusion is that, as Krusell and Smith (1998) found, adding idiosyncratic risk makes little difference to the magnitude of the aggregate capital-to-labor income ratio, which rises by only a little less than 1 percent when the idiosyncratic risk is added. The remaining columns show why idiosyncratic risk has so little effect: the distribution of wealth is fairly tightly centered around the steady-state average level of wealth. Returning to Figure 1, again the essential reason why aggregate precautionary saving is modest is that, even after the introduction of idiosyncratic shocks, the vast majority of consumers have high levels of wealth fairly close to the level that was held by the representative agent in the model without idiosyncratic shocks. This high-mean, low-variance wealth distribution generates an attractive "approximate aggregation" result: behavior of the economy is very similar in essentially all respects to behavior in the representative-agent model. Thus, the approximate aggregation result depends critically on the model's failure to capture either of the key microeconomic facts cited above: the extreme skewness of the wealth distribution and the (consequent) high average value of the marginal propensity to consume.

Fortunately, a final simple modification makes the model capable of generating both skewness in the wealth distribution and a high MPC: relax the assumption that all consumers have identical tastes. Specifically, suppose that there are two classes of consumers, a "patient" group with a quarterly time-preference factor of 0.99 and an "impatient" group with a time-preference factor of $\beta' = 0.975$, for an annual rate of 10 percent.[6] Suppose further that the impatient consumers compose two-thirds of the population.

A brief theoretical digression is necessary at this point. Long ago, Hirofumi Uzawa (1968) showed that, in a nonstochastic economy populated by infinitely-lived agents with different time-preference rates, eventually the entire capital stock will be owned by the agent with the lowest time-preference rate, because at any aggregate interest rate higher than this time-preference rate the most patient agent will accumulate wealth indefinitely. The reverse logic shows that any agent who is less patient will run down his wealth indefinitely, so the patient agent eventually owns all the capital.

As shown in the next-to-last row of Table 1, the wealth distribution is now highly skewed, in a manner roughly similar to the data,[7] and the average annual MPC is almost 0.2. Note that aggregate precautionary saving is *lower* in this model than in the model where all consumers have identical tastes, because the patient agents whose behavior determines the size of the aggregate capital stock now hold much more wealth than the typical agent held before and are much farther out to the right in Figure 1, where the consumption function is nearly linear. The last row of Table 1 shows that, under the alternative assumption of log utility ($\rho = 1$), the wealth distribution becomes even more skewed, and the MPC is nearly 0.5.[8]

Many economists are uncomfortable explaining the inequality of the wealth distribution by assuming that consumers have differing tastes. But similar results can be obtained by assuming identical tastes but differing expectations about income growth.[9] Perhaps the most attractive interpretation is one in which consumers

[6] Marco Cagetti (1999) estimates time preference rates even lower than 0.975 for many consumers.

[7] Because the net worth of the median household is mostly housing equity, which may be illiquid and difficult to use for high-frequency consumption-smoothing, it is not clear whether the right goal is to match net worth or liquid assets.

[8] Krusell and Smith (1998) also show that adding heterogeneous preferences results in a much more realistic distribution of wealth, and a higher correlation between aggregate consumption and income.

[9] Mark Huggett (1996) argues that much of the inequality of the wealth distribution is attributable to differences in expectations about income growth between working life and retirement. Vincenzo Quadrini and José-Víctor Ríos-Rull (1997) examine various other mechanisms for matching the wealth distribution.

labeled as "impatient" here are thought of as young consumers in the "buffer-stock" saving phase of the life cycle because they anticipate an age profile of rapid income growth through roughly age 50, while the model's "patient" consumers represent consumers in the latter phase of the life cycle or in retirement who expect slow or no income growth.[10] The crucial requirement for many purposes is likely to be simply that the model have multiple classes of households: some with little wealth and a high MPC, and some with substantial wealth and a low MPC—qualitatively, a structure similar to that of Hall and Mishkin (1982) and of John Y. Campbell and N. Gregory Mankiw (1989), though with important differences caused by the stochastic environment.

IV. Conclusions

Constructing secure microeconomic foundations for macroeconomic models has long been a central goal of macroeconomists. An apparent message from several recent papers (especially Aiyagari [1994]) that have introduced idiosyncratic risk into representative-agent economies has been that microeconomic heterogeneity may not matter much for macroeconomic outcomes. This paper argues that the models that produce this "approximate aggregation" result do not really have solid microeconomic foundations, in the sense that they do not match the key microeconomic facts of a skewed wealth distribution and a high MPC.[11] When the model is modified in ways that help it to capture these microeconomic facts, the behavior of the resulting aggregate economy differs from the behavior of the representative-agent economy in ways that may be very important for understanding aggregate fluctuations and analyzing the effects of economic policies, though perhaps not for analyzing the long-run questions typically addressed in growth models.

[10] See Carroll (1997), Cagetti (1999), or Pierre-Olivier Gourinchas and Jonathan Parker (1999) for just such an interpretation of life-cycle patterns of saving; see Gourinchas (1999) for an ambitious attempt to solve a general-equilibrium model of this type with a full specification of life-cycle behavior.

[11] By "approximate aggregation" I mean that a representative-agent model is a good approximation in all important macroeconomic dimensions. Nothing in this paper undermines Krusell and Smith's (1998) finding that the evolution of the economy is well captured by an AR(1) process which they call a "quasi-aggregation" result, but which does *not* imply that aggregate data can be rationalized by a representative agent.

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