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A METHOD FOR DETERMINING WHETHER PARAMETERS IN AGGREGATIVE MODELS ARE STRUCTURAL
A COMMENT

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In this novel paper Michael Parkin puts forth a new real business cycle model, proposes a new method to test the model, and carries out the proposed method using U.S. annual data from 1954 through 1986. The model differs in several ways from the well-known Kydland-Prescott type real business cycle model. The testing method also differs from well-known methods used to test real business cycle models, or other structural models. In my comments on the paper I will focus on these differences. I consider the model first and then the testing methods.

THE PARKIN MODEL VERSUS THE KYDLAND-PRESCOTT MODEL

The Parkin model, described in equations (5) and (6) of the paper, is simpler than the Kydland-Prescott model in three ways. First, the Parkin model does not have a "time to build" technology for investment. Kydland and Prescott found that this technology was necessary to capture empirically the dynamics of investment, at least in quarterly data, and used the approach as an alternative to the cost-of-adjustment approach. Instead, Parkin assumes that the capital stock adjusts instantaneously. Parkin does not motivate this modification of the Kydland-Prescott real business cycle model, but perhaps because he uses annual data, rather than quarterly data as Kydland and Prescott did, his abstraction that the capital stock adjusts instantaneously might be a satisfactory

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approximation.

Second, the Parkin model does not have a cumulative effect of leisure on utility. Parkin's utility function is separable over time so that consumption of leisure in the past has no bearing on the utility of leisure today. Kydland and Prescott found the assumption of nonseparable utility necessary for empirically capturing the persistence of employment and the cyclical behavior of productivity. They assumed that more leisure consumption in the past would reduce the utility of leisure consumption.

Third, Parkin's framework does not model the behavior of inventories. Inventories are included with total physical capital which deteriorates at the same rate as other capital. Again, the use of annual data rather than quarterly data might be one reason for the omission of inventories, but even in annual data inventories can explain part of the dynamic behavior of output.

In another way, the Parkin model is more complex than the Kydland-Prescott model. Parkin assumes that four of the parameters of the model are time varying and stochastic. The random parameters in the model are (1) the "leisure share" parameter in the representative agent's utility function, (2) the discount rate in the utility function, (3) the "labor share" parameter in the Cobb-Douglas production function, and (4) the depreciation rate on physical capital. The representative agent is assumed to know the distribution of these random parameters and uses this distribution in computing optimal paths for consumption and leisure.

EXPLAINING BUSINESS CYCLES: ECONOMIC THEORY OR SERIAL CORRELATION?

The exact stochastic structure for these random parameters is left unspecified, but it is clear that they must be serially correlated if the model is to fit the data. (Parkin's analysis of the parameters, discussed below, suggests that they are highly serially correlated.) In this sense the essential difference between the Parkin model and the Kydland-Prescott model is that Parkin replaces some of the economic structure that can explain business cycle persistence endogenously (e.g., time-to-build, nonseparable utility) with serially correlated shocks. The serial correlation of the shocks is not explained.

In my view, this replacement does not represent an improvement over the Kydland-Prescott model, even if the Parkin model explained the data

equally well. Using exogenous serially correlated shocks to explain certain features of business cycle persistence is a practical necessity in many applications, but replacing reasonable economic theory with exogenous time series processes seems like a step in the wrong direction to me. Progress in business cycle research should be measured by how much of the observed business cycle persistence we can explain by economic theory.

THE METHOD FOR TESTING THE MODEL

Parkin introduces an unusual method for testing the real business cycle model. He estimates, as residuals from the first-order conditions, the realizations of the four random parameters in each period of his sample of U.S. data. (This is analogous to estimating the residuals from a least squares regression.) He then examines the residuals over the sample period in order to assess the adequacy of the real business cycle model.

Based on an examination of the variance of the residuals (that is, the random parameters), he concludes, "A quick glance at the means and variances of the levels of the parameters suggests excellent news for the strongest form of the real business cycle model. The variances of the parameters...are very small...A more careful look, however, at the percentage changes suggests that the parameters...are highly variable." It is not clear what decision criterion for too large or very small is being used in this conclusion. Moreover, it is not clear how the size of these variances provides a test of any real business cycle model or permits a comparison of these models with monetary models. For example, one of the parameters is labor share in the U.S. which in Parkin's data hovers around .58 and is very stable. The relative constancy of labor share is a well-known property of U.S. time series data, and this constancy is a feature of monetary models as well as real models. For example, Phelps (1978) uses a monetary model with a production function in which, even in the absence of shocks to the labor share parameter, monetary shocks play an important role.

An additional part of Parkin's testing methodology involves estimating vector autoregressions of the estimated parameters. Using a single vector autoregression of the four time-varying parameters along with money, Parkin finds that money Granger-causes one of the parameters (the leisure share parameter) but not the others. Based on this finding, he concludes that "the results are not entirely consistent with real business cycle theory," but on the other hand "the role of money is not necessarily inconsistent

with a real view of the business cycle" because money is a productive asset that can enter the real business cycle model. This latter statement that money can enter real business cycle models seems at odds with the introduction to the paper which states that real business cycle theory "seems to set aside 250 years of what was thought to be progress in understanding the potentially causal role of fluctuations in monetary aggregates in the initiation and propagation of real fluctuations." More importantly, if money is a factor in real business cycle models, then what is the point of these Granger causality tests?

A deeper problem with these tests of real versus monetary models is that monetary business cycle models do not have production function or utility function parameters that are assumed to be functions of monetary shocks. Again, the model of Phelps (1978) is an example. The production function in that model does not depend on the monetary shocks. Yet Phelps' model, with wage rigidities as a source of non-neutralities, is a monetary model in a way that real business cycle models are not.

Given the problems with the methods that Parkin uses to test his model, I would prefer to use more conventional testing methods. Although computationally difficult, a more formal testing approach seems feasible. For example, using numerical solution methods one could solve the model for the distribution of the random parameters as estimated in the paper. The properties of the solution of the model could then be compared with the properties of the actual data to see if the model is a successful representation of the data. This is exactly the approach that Kydland and Prescott have taken in their research. It falls short of more difficult likelihood ratio tests, but it does provide a measure of how well a given model works in explaining the data.

In order to see whether this approach is possible for Parkin's model, I computed some stochastic simulations of the model for particular assumed distributions of the shocks. The solution method used was a linear quadratic approximation (using a program written by Ellen McGrattan). The simulations indicate that it is feasible to formally test a random coefficient model like Parkin's, and thereby see if it fits the data as well as Kydland-Prescott type models or even monetary models. But even if it does fit as well, I would prefer to rely on economic theory rather than exogenous serial correlation to explain the data.

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