Chapter 11

Balanced Growth, the Demand for Money, and Monetary Aggregation

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In this chapter, building on a previous empirical study by King, Plosser, Stock, and Watson (1991), we apply the Johansen (1988) maximum likelihood approach for estimating long-run steady-state relations in multivariate vector autoregressive models, to test the implications of neoclassical stochastic growth theory and traditional money demand theory. As we argued in Chapter 10, the Johansen approach is superior to the Engle and Granger (1987) methodology, because it fully captures the underlying time series properties of the data, provides estimates of all the cointegrating relations among a given set of variables, offers a set of test statistics for the number of cointegrating vectors, and allows direct hypothesis tests on the elements of the cointegrating vectors.

Our objective is to apply the Johansen methodology to U.S. quarterly observations over the 1960:1 to 1999:4 period, and also determine whether the evidence supports certain theoretical claims in the real business cycle literature as well as in the traditional money demand literature. In doing so, we make comparisons among simple-sum, Divisia, and currency equivalent monetary aggregates (of M1, M2, M3, and MZM), to deal with the possible anomalies that arise because of different definitions of money. The monetary aggregates were obtained from the

A. Serletis, *The Demand for Money*
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St. Louis MSI database, maintained by the Federal Reserve Bank of St. Louis as a part of the Bank's Federal Reserve Economic Database (FRED). The monetary data and the different monetary aggregation procedures will be discussed in great detail in Chapters 12-14.

11.1 Theoretical Background

Following King et al. (1991), let's consider the following simple real business cycle model. The single final good, $Y_t$, is produced via a constant-returns-to-scale Cobb-Douglas production function,

$$Y_t = \lambda_t K_t^{1-\theta} L_t^{\theta},$$

(11.1)

where $K_t$ is the predetermined capital stock, chosen in period $t-1$, and $L_t$ is labor input in period $t$. Total factor productivity, $\lambda_t$, follows a logarithmic random walk

$$\log(\lambda_t) = \mu_\lambda + \log(\lambda_{t-1}) + \xi_t,$$

(11.2)

where $\mu_\lambda$ represents the average productivity growth rate and $\xi_t$ is an independent and identically distributed process with mean zero and variance $\sigma^2$. In equation (11.2), $\mu_\lambda + \log(\lambda_{t-1})$ represents the deterministic part of the productivity evolution and $\xi_t$ represents the stochastic innovations (or shocks).

Under the assumption that the intertemporal elasticity of substitution in consumption is constant and independent of the level of consumption, the basic neoclassical growth model with deterministic trends implies that the two great ratios — the log output-consumption ratio and the log output-investment ratio — are constant along the steady-state growth path, since the deterministic model’s steady-state common growth rate is $\mu_\lambda/\theta$. With stochastic trends, however, there is a common stochastic trend $\log(\lambda_t)/\theta$ with a growth rate of $(\mu_\lambda + \xi_t)/\theta$, implying that the great ratios, $c_t - y_t$ and $i_t - y_t$ become stationary stochastic processes — see King, Plosser, and Sergio Rebelo (1988) for more details.

As we argued in Chapter 10, these theoretical results can be formulated as testable hypotheses in a cointegration framework. Let $X_t$ be the multivariate stochastic process consisting of the logarithms of real per capita consumption, investment, and output, $X_t = [c_t, i_t, y_t]$. Each component of $X_t$ is integrated of order one [or I(1) in the terminology of Engle and Granger (1987)] — because of the random walk nature of productivity. The balanced growth implication of the neoclassical growth model with stochastic trends is that the differences $c_t - y_t$ and $i_t - y_t$ will be I(0) variables. That is, there should be two cointegrating vectors, $[1, 0, -1]$ and $[0, 1, -1]$. 