Chapter 14

The Stylized Facts of the Monetary Variables

14.1. The Hodrick and Prescott Filter
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Kydland and Prescott in their 1990 article, "Business Cycles: Real Facts and a Monetary Myth," argue that business cycle research took a wrong turn when it abandoned the effort to account for the cyclical behavior of aggregate data, following Tjalling Koopmans’ (1965) criticism of the methodology developed by Arthur Burns and Wesley Mitchell (1946), as being 'measurement without theory.' Crediting Robert Lucas (1977) with reviving interest in business cycle research, they initiated a line of research that builds on the growth theory literature and part of it involves an effort to assemble business cycle facts.

Kydland and Prescott report some original evidence for the United States economy, and conclude that several accepted nominal facts, such as the procyclical movements of money and prices, appear to be business cycle myths. In this chapter, we follow Kydland and Prescott (1990) and examine the cyclical behavior of United States money, prices, nominal interest rates, and velocity, using the quarterly data that we discussed in the previous chapter. In doing so, we make comparisons among simple sum, Divisia, and currency equivalent monetary aggregates and discuss the robustness of the results to relevant (nonstochastic) stationarity-inducing transformations.
14.1 The Hodrick and Prescott Filter

For a description of the stylized facts, we follow the current practice of detrending the data with the Hodrick-Prescott (HP) filter — see Hodrick and Prescott (1980). For the logarithm of a time series $X_t$, for $t = 1, 2, \ldots, T$, this procedure defines the (smoothed) trend or growth component, denoted $\tau_t$, for $t = 1, 2, \ldots, T$, as the solution to the following minimization problem

$$\min_{\{\tau_t\}_{t=1}^{T}} \sum_{t=1}^{T} (X_t - \tau_t)^2$$

subject to

$$\sum_{t=2}^{T-1} [((\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1}))^2] \leq \Lambda.$$ 

That is, the smoothed trend component, $\{\tau_t\}_{t=1}^{T}$, is obtained by minimizing the sum of squared differences from the data subject to the constraint that the sum of the squared differences be less than an appropriate bound $\Lambda$.

The above minimization problem is equivalent to the following unconstrained (minimization) problem

$$\min_{\{\tau_t\}_{t=1}^{T}} \sum_{t=1}^{T} (X_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [((\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1}))^2]$$

for an appropriate value of $\lambda$ — the Lagrange multiplier. The smaller is $\lambda$, the smoother the trend path and when $\lambda = 0$, the linear trend results. In our computations we set $\lambda = 1,600$, as it has been suggested by Kydland and Prescott (1990) for quarterly data. Notice that $X_t - \tau_t$ is the filtered series.

As noted by Kydland and Prescott (1990), the HP filter has several attractive features. In particular, it occupies an intermediate position between the linear filter (which permits most low frequency components to pass through) and the first difference filter (which permits the least). Moreover, the HP trend is a linear transformation of the original series and is a smooth curve — like one that one would draw through a plot of the original series. An illustration of the HP filter, using quarterly real GNP data for the United States, is depicted in Figures 14.1 and 14.2. Figure 14.1 plots the logs of actual and trend real GNP during 1960:1-1999:4 and Figure 14.2 the corresponding percentage deviations from trend of real GNP.