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Chapter Author: Roque B. Fernandez

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Appendix 5-B Derivation of Transfer Functions for Prices

The hypothesis of rational expectations in our model implies that the expected p_t is computed as if the public attempted to obtain an optimal unbiased forecast of p_t using Equation (5–6). Combining (5–14) and (5–6) we can write:

$$p_t = (1/[1-b])\sum_{j=0}^{\infty}(1/[1-b^{-1}])^j(E\phi m_{t+j} - y_{n,t+j}) \tag{B5-1}$$

$$+ [J_3/(1-J_0)]\sum_{j=0}^{\infty}(\alpha/[1-b^{-1}])^j y_{c,t-1} + c_0 + u_{4t}$$

In (B5–1) we have a term in $E\phi m_{t+j}$. Developing this term for $j = 0,1,\ldots$ taking expectations and recalling that

$$\phi = \phi_0 + \phi_1 L + \phi_2 L^2 + \ldots,$$

we have

$$E\phi m_{t+j} = E\phi_0 m_t + \phi_1 m_{t-1} + \phi_2 m_{t-2} + \ldots \qquad j = 0$$

$$E\phi m_{t+j} = E\phi_0 m_{t+1} + E\phi_1 m_t + \phi_2 m_{t-1} + \ldots \qquad j = 1$$

$$E\phi m_{t+j} = E\phi_0 m_{t+2} + E\phi_1 m_{t+1} + E\phi_2 m_{t-1} + \dots \qquad j = 2$$

Recall that the E operator is conditional on the information in period $t - 1$, so $Em_{t-1} = m_{t-1}$, and so on, for periods before period $t - 1$. Now provided that we use the process (5–12) to obtain Em_{t+j}, $j = 1, 2, \dots$, we notice that the forecasts of m_t are obtained through linear combinations of $m_{t-1}, m_{t-2}, m_{t-3}, \dots$. These linear combinations should be combined with the other terms in $m_{t-1}, m_{t-2}, m_{t-3}, \dots$ that appear because of the lagged response of prices to changes in m_t, and with $y_{n,t+j}$, $j = 1,2, \dots$ and $y_{c,t-1}$ to forecast p_t. Then we can rearrange the terms in $m_{t-1}, m_{t-2}, m_{t-3}, \dots$, and rewrite (B5–1) as

$$p_t = v(L)Lm_t - (1/[1-b])\sum_{j=0}^{\infty} (1/[1-b^{-1}])^j y_{n,t+j}$$

$$+ (J_3/[1-J_0])\sum_{j=0}^{\infty} (\alpha/[1-b^{-1}])^j y_{c,t-1} + c_0 + u_{4t}$$

The first difference form of this equation is:

$$Dp_t = v(L)LDm_t + h_0 Dy_{c,t-1} + c + u_{5t} \qquad \text{(B5–3)}$$

where c accounts for the term in $y_{n,t+j}$ after differencing (recall that $y_{n,t}$ is a trend and differencing it yields the trend) and h_0 represents the coefficient of $y_{c,t-1}$.

Equation (B5–3) is reproduced in the text as equation (5–14–a), which in turn is parsimoniously (in terms of the number of parameters) represented by the transfer function (5–15).