92.3.5. *Efficiency of Maximum Likelihood*, proposed by Peter C.B. Phillips. In the linear model

$$y_t = bx_t + u_t, \qquad (t = 1, \ldots, n) \tag{1}$$

the parameter has true value $b_0 \neq 0$ and $u_t \equiv$ i.i.d. $N(0, b_0^2)$. The x_t are nonrandom and $n^{-1}\Sigma_1^n x_t^2 \to m_x > 0$ as $n \to \infty$.

(i) Derive the asymptotic properties of the maximum likelihood estimator $\tilde{b}$ of b_0 in (1).

(ii) Compare the limit distribution of $\tilde{b}$ to that of the OLS estimator $\hat{b}$ of b_0 in (1). Is OLS asymptotically efficient?