ECONOMETRIC TECHNIQUES FOR REVENUE FORECASTING USING EVIEWS

Session 4: More Statistical Problems

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Violating Assumption 4: Measurement Errors and Autoregression

- Assumption 4 requires that observations of independent variables be fixed in repeated samples.
- If this assumption is relaxed and the explanatory variables are distributed independently of the disturbance terms, the OLS estimator maintains desirable properties.
- However, if the regressors are correlated to the disturbance term, the parameter estimates are biased.

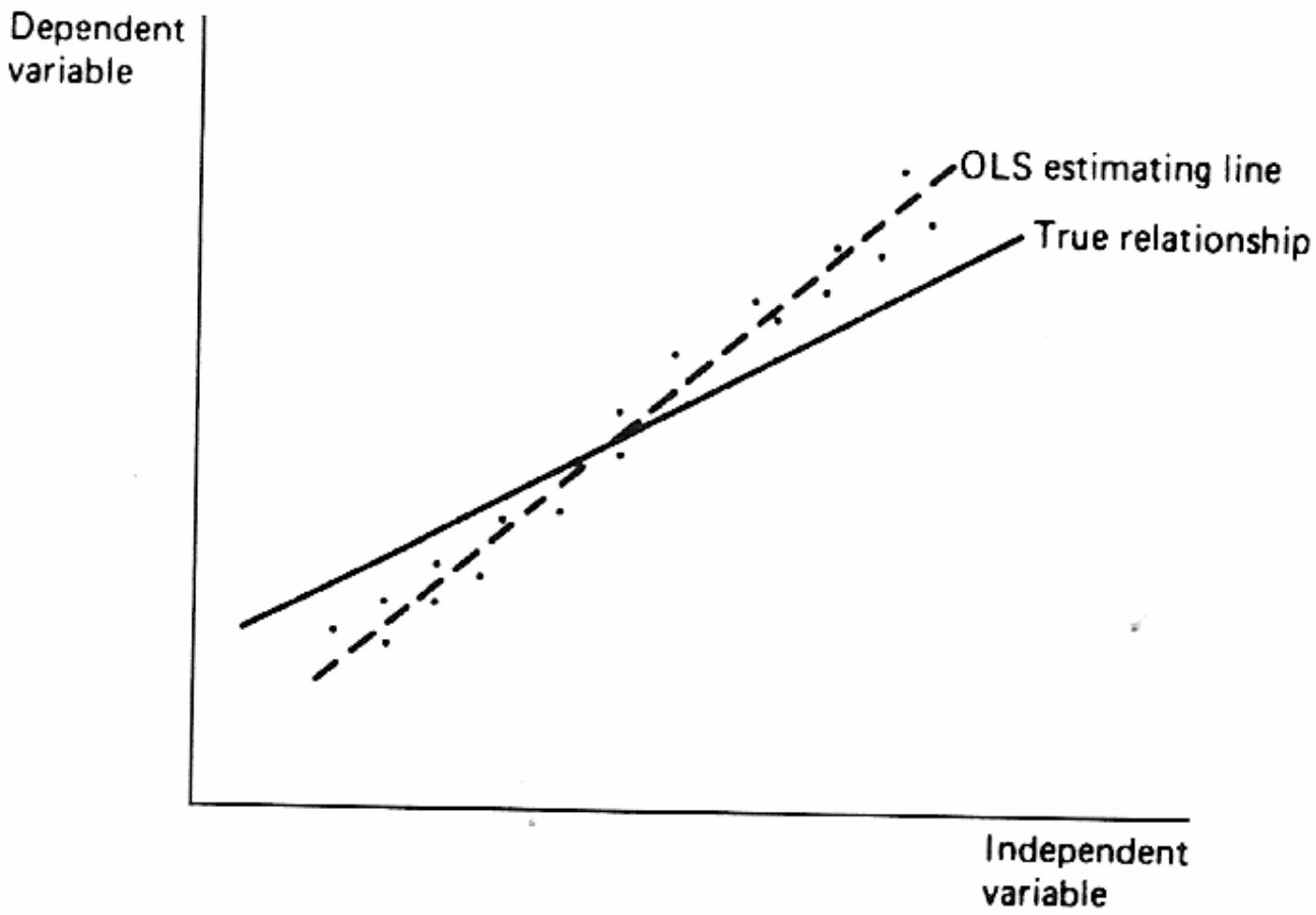


Figure 9.1 Positive contemporaneous correlation

Source: Peter Kennedy, *A Guide to Econometrics* (2003).

Violating Assumption 4: Measurement Errors and Autoregression

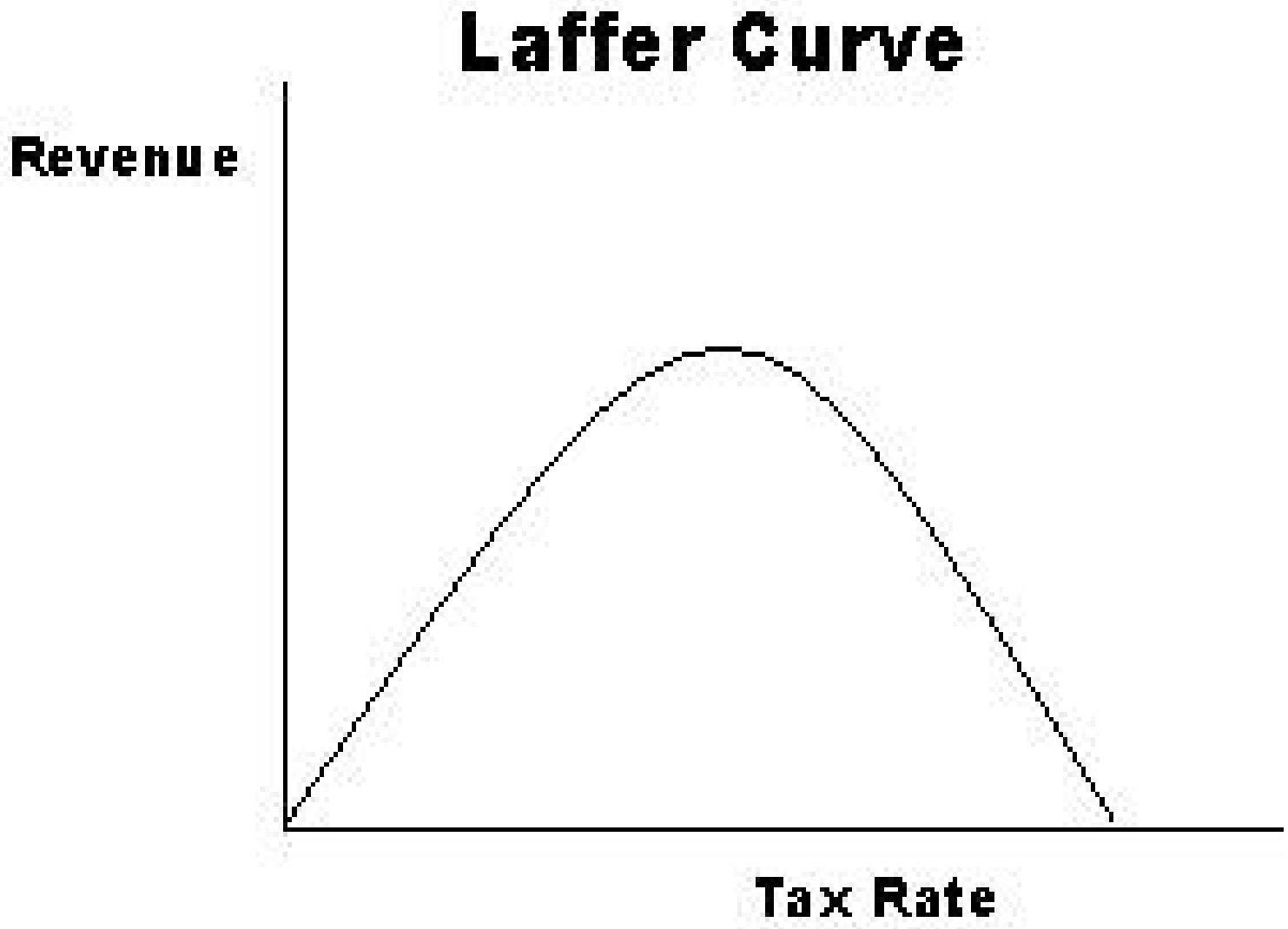
- How do you know that the independent variables and the regressors are correlated?
  - Hausman test
- How do you deal with the problem?
  - Instrumental variables estimation

Violating Assumption 4: Measurement Errors

- Measurement errors for the dependent variable are incorporated in the disturbance term.
- Measurement errors for a independent variable make that variable stochastic.
- Replacing a correctly measured independent variable with one that is not measured correctly creates a new disturbance term.
- Since this error is also reflected in the mismeasured independent variable, there is a correlation between the independent variable and the disturbance in the equation to be estimated.

Violating Assumption 4: Simultaneous Equations

- Simultaneous equation models like macroeconomic models also usually violate assumption 4 unless they're recursive.
- But non-recursive simultaneous equation models are not usually needed for revenue forecasting.
- That is unless changes in particular taxes are large enough to have a significant effect on GDP and/or specific tax bases.
- Or if tax rates are so high as to have a large effect on behavior.


Laffer Curve
Revenue
Tax Rate

Violating Assumption 4: Autoregression

- For a variety of reasons, lagged dependent variables are included in equations to be estimated.
- This is called autoregression.
- It violates assumption 4 because it is a stochastic variable.
- Key question is whether it is correlated with the contemporaneous disturbance.
- This depends on the particular specification used.
- For instance, in the cases of Koyck lags and adaptive expectation specifications, both assumption 3 and 4 are violated creating biased coefficients.

Autoregression

- first order autocorrelated error suggested by low Durbin-Watson
- $\varepsilon_t = \rho\, \varepsilon_{t-1} + u_t$
- transformed equation with spherical error
- $y_t = \rho\, y_{t-1} + \alpha + \beta(xt - \rho\, x_{t-1}) + u_t$

Autoregression
Koyck distributed Lag

- $y_t = \beta x + \beta\lambda x_{t-1} + \beta\lambda^2 x_{t-2} + \beta\lambda^3 x_{t-3} + \ldots\ldots + \varepsilon_t$
- transformed by subtracting λ times the equation lagged one period
- $y_t = \lambda y_{t-1} + \beta x_t + (\varepsilon_t - \rho\, \varepsilon_{t-1})$
- which has a MA(1) error

Autoregression
Partial Adjustment Model

- $y_t^* = \beta_0 + \beta_1 x_t + \varepsilon_t$
- $y_t - y_{t-1} = \alpha (y_t^* - y_{t-1}) + u_t$
- Substituting for y_t^* gives
- $y_t = \alpha\beta_0 + (1-\alpha)y_{t-1} + \alpha\beta_1 xt + (\alpha \varepsilon_t + u_t)$
- error is spherical

Autoregression
Adaptive Expectations

- $y_t = \beta_0 + \beta_1 x_t^* + \varepsilon_t$
- the expectations of x_t^* is determined by

- $x_t^* = x_{t-1}^* + \alpha(x_t - x_{t-1}^*) + u_t$

- $y_t = \alpha\beta_0 + (1-\alpha)y_{t-1} + \alpha\beta_1 x_t + (\varepsilon_t - (1-\alpha)\varepsilon_{t-1} + \beta_1 u_t)$

- which is an autoregressive estimating equation with a MA(1) error.