

# Essay

- Data

( log - lin Visualization / Box-Cox test

- Specification

Ramsey test;

economic theory / logic;

endogeneity ( OVB (!) )

$$\frac{\beta_z \cdot \text{cov}(x_i, z_i)}{\text{var}(x_i)}$$

+ Multicollinearity

- Heterosc. / Autocorrelation

↳ 1) Test

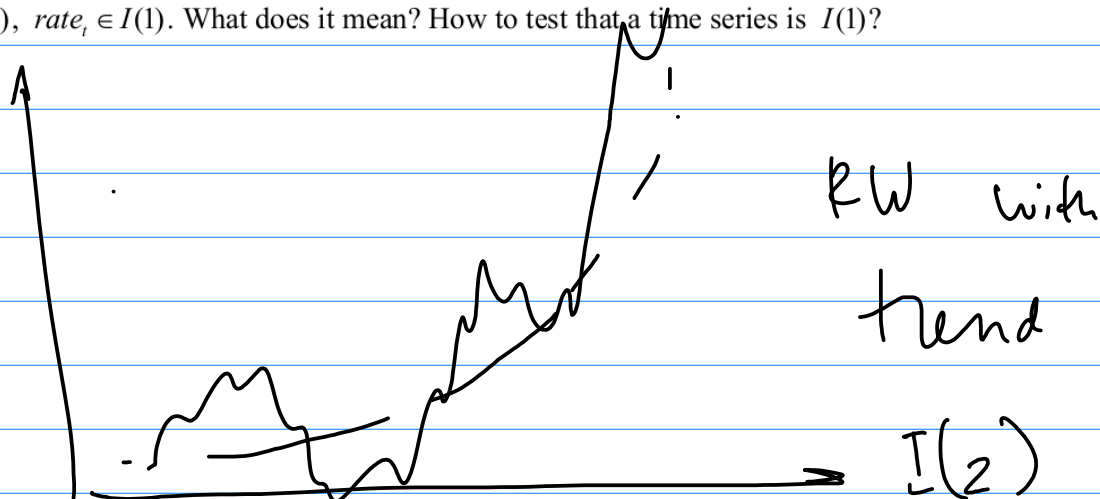
2) HAC (s.e.)

- Interpretation

#### Question 4.

Let us consider the relationship between the natural logarithm of GDP,  $GDP_t$ , and the lagged long-term interest rates  $rate_t$ , and  $rate_{t-1}$ .

- (a) (10 points) □ Assume that  $GDP_t$  and  $rate_t$  are difference stationary, or they are integrated of order 1:  $GDP_t \in I(1)$ ,  $rate_t \in I(1)$ . What does it mean? How to test that a time series is  $I(1)$ ?



- What is cointegration? How to test whether time series  $GDP_t$  and  $rate_t$  are cointegrated.

d → 1) Same order of integration

2) ∃ stat. lin. comb.  $z_t$

$$z_t = a_0 + a_1 \cdot GDP_t + a_2 \cdot rate_t$$



$$GDP_t = -\frac{a_0}{a_1} - \frac{a_2}{a_1} rate_t + \underbrace{\frac{z_t}{a_1}}_{\epsilon_t}$$

ADF test  $\hat{\epsilon}_t$

(b) (10 points) □ If  $GDP_t$  and  $rate_t$  are not co-integrated, what are the properties of an OLS estimator in the regression of  $GDP_t$  on  $rate_t$ ?

spurious regression :  $\alpha_2 = 0$

DS:



$$GDP_t = \alpha_1 + \alpha_2 \cdot rate_t + \epsilon_t$$

$$I(1) = \alpha_1 + 0 + \downarrow I(1)$$

GMT violated

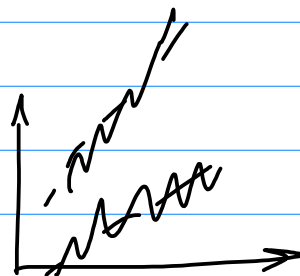
⇓

var / cov

heterosced. / ac.

$$E(\epsilon | x) = 0$$

$$\Rightarrow \text{cov}(\epsilon, x) = 0$$



(\*)

TS -  $GDP_t, rate_t$

$$GDP_t = \alpha_1 + \alpha_2 \cdot rate_t + \epsilon_t$$

Spurious?  $\alpha_2 = 0$

$\Rightarrow$  OVB (t - omitted)

$$\frac{\beta_2 \cdot \text{cov}(t, rate_t)}{\text{var}(rate_t)}$$