Strathmore
UNIVERSITY

# Strathmore Institute of Mathematical Sciences (SIMS)
# End of Semester Examination for the Degree of Bachelor of Business Science in Financial Economics

## BSE 4211: Panel Data Analysis

**DATE: 16th December , 2024** **Time: 2 Hours**

**Instructions**

- **This examination consists of FIVE questions.**
- **Answer Any Four Questions**

1. You have estimated the effect of R&D expenditures on firm performance using government subsidies as an instrument. Below are the results from the Two-Stage Least Squares (2SLS) estimation:

$$\text{Performance} = 2.1 + 0.9 \cdot \text{R\&D} + \epsilon$$

   - First stage: F-statistic for the instrument: 28
   - Second stage: $R^2 = 0.50$, coefficient for R&D: 0.9, standard error: 0.12.

   a) Explain the economic role of government subsidies as an instrument in this context and why it might address endogeneity concerns. **(5 marks)**

   b) Interpret the coefficient on R&D and its standard error. What does this imply about the impact of R&D on firm performance? **(5 marks)**

   c) Assess the strength of the instrument, given the first stage F-statistic. Discuss the consequences of weak instruments. **(3 marks)**

   d) Briefly explain how the Generalized Method of Moments (GMM) could be applied to estimate this model and the advantages of using GMM over Two-Stage Least Squares (2SLS). **(2 marks)**

2. You are analyzing the effect of firm size on profitability using a static panel model, and the following tests have been conducted:

   - Test for cross-sectional dependence: $p = 0.03$
   - Test for heteroskedasticity: $p = 0.02$
   - Poolability test: $p = 0.15$

- Serial correlation test: $p = 0.05$

a) Explain the economic implications of detecting cross-sectional dependence in panel data. How would this affect your model results? **(4 marks)**

b) Discuss the importance of testing for heteroskedasticity in panel data. What would the p-value of 0.02 imply for your analysis? **(3 marks)**

c) Given the poolability test result (p = 0.15), discuss whether pooling the data across entities is appropriate in this case. **(4 marks)**

d) Interpret the serial correlation test result (p = 0.05). How would serial correlation affect the validity of your panel model? **(4 marks)**

3. You are analyzing panel data on labor productivity using both fixed effects and random effects models. The following results are provided:

- Fixed Effects: Coefficient on capital: 0.7, standard error: 0.12
- Random Effects: Coefficient on capital: 0.8, standard error: 0.10
- Hausman test: $\chi^2(1) = 4.7$, p-value = 0.03.

a) Based on the Hausman test result, which model (fixed or random effects) is preferred? Explain your reasoning. **(5 marks)**

b) Interpret the coefficient on capital from the fixed effects model. What does it tell you about the relationship between capital and labor productivity? **(5 marks)**

c) Discuss the concept of unobserved heterogeneity and how the fixed effects model accounts for it. **(5 marks)**

4. You are estimating a dynamic panel model where past firm growth impacts current growth. Below are the results from the System GMM estimation:

$$\text{Growth}_{it} = 0.2 + 0.5 \cdot \text{Growth}_{i(t-1)} + 0.3 \cdot \text{Investment}_{it} + \epsilon_{it}$$

- Coefficient on lagged growth: 0.5, standard error: 0.1
- Coefficient on investment: 0.3, standard error: 0.08
- Sargan test of over-identifying restrictions: $p = 0.10$.

a) Explain the role of dynamic panels in capturing persistence in firm growth. Interpret the coefficient on lagged growth. **(5 marks)**

b) Discuss the importance of the Sargan test and interpret the test result. What does this imply about the validity of the instruments? **(5 marks)**

c) Explain why System GMM is preferred over Difference GMM in this dynamic panel context. **(5 marks)**

5. You are analyzing panel data on unemployment rates for multiple countries over 25 years and suspect the presence of unit roots.

a) Define *panel unit root* and explain why it is important to test for unit roots in panel data. **(5 marks)**

b) Describe the Levin-Lin-Chu (LLC) test procedure for panel unit root testing. What are the null and alternative hypotheses? **(5 marks)**

c) Assume the LLC test rejects the null hypothesis of a unit root. What does this imply about the dynamics of unemployment rates in these countries? **(5 marks)**

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