Using Panel Data Econometrics in Tourism Demand Research

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Presented by:
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Overview

• Introductory to panel data
  – Models for pooled time series
  – Models for longitudinal data
  – Dynamic panel models

• Applications of panel data in tourism research

• Future tourism research topics
Introductory of Panel Data

Panel data is known as **pooled time series or longitudinal data**, where the behaviour of entities are observed across time. The entities can be individuals, firms, states, countries etc... (For more info: http://dss.princeton.edu/training/Panel101.pdf)
A. Model for Pooled Time Series

- A pooled time series data regression can be written as follows:

\[ y_{it} = \beta_0 + \beta_1 x_{1,it} + \beta_2 x_{2,it} + \beta_3 x_{3,it} + \ldots + \beta_k x_{k,it} + e_{it} \]

where \( y \) = dependent variable, \( \beta \) = coefficient, \( x \) = independent (or explanatory) variables; \( i \) = individuals, \( t \) = time periods, \( k \) = number of independent variables, \( e \) = error term.
A. Model for Pooled Time Series

- Small number of individual units (N), but large time series (T). ($N < T$)
- For example: Number of nights visited by domestic visitors
  
  $N = 8$ Australian States and Territories
  
  $T = 48$ (from Quarter 1, 1999 to Quarter 4, 2010)
A. Model for Pooled Time Series

• T is large enough to run separate regression for each individual; however, combining individual could yield more efficient estimates (Peter Schmidt, UQ, July 2011)

... Why combining all time series could yield better results than single time-series??
A. Model for Pooled Time Series

Four estimation methods:

1. **Homoskedasticity** – variance of error term is constant across individuals (use Ordinary Least Squares or OLS).

2. **Cross-sectional heteroskedasticity** – variance of error term is allowed to vary across individuals (use Generalised Least Squares or GLS).

3. **Cross-sectional heteroskedasticity and contemporary correlation** – error terms are correlated across individuals at the same time (use Seemingly Unrelated Regression Estimations or SURE).
A. Model for Pooled Time Series

4. Autocorrelation – error terms are correlated over time but are not correlated across individuals (use Autoregressive Regression Estimations or AR).
B. Model for Longitudinal Data

• Large number of individuals (N) but small time-series (T). \((N > T)\)

• For example: Household, Income and Labour Dynamics in Australia (HILDA)

  \[N = 19,914 \text{ individuals}\]

  \[T = 12 \text{ years}\]
B. Model for Longitudinal Data

- A simple regression for longitudinal data can be written as follows:

\[ y_{it} = \beta_0 + \beta_1 x_{1,it} + \beta_2 x_{2,it} + \beta_3 x_{3,it} + \cdots + \beta_k x_{k,it} + \alpha_i + e_{it} \]

where \( y \) = dependent variable, \( \beta \) = coefficient, \( x \) = independent (or explanatory) variables; \( i \) = individuals, \( t \) = time periods, \( k \) = number of independent variables, \( e \) = error term, and \( \alpha_i \) = time-invariant individual’s \( i \) effect
B. Model for Longitudinal Data

• However, there is an issue in the regression. How to measure $a_i$?

Need to make assumptions...
B. Model for Longitudinal Data

• Fixed effects
  – Treat $\alpha_i$ as fixed and develop dummy variables to capture the individuals’ effects.
  – **Problem:** Too many dummies $\rightarrow$ multicollinearity
    Imagine if you have 20,000 individuals. You may need to develop 20,000 dummy variables!!
  – **Solution:** Take deviations from individual means to remove $\alpha_i$.
B. Model for Longitudinal Data

• Random effects
  – Treat $\alpha_i$ as part of the error term components.
  – Using OLS is unbiased but the variance can be large and inefficient. Better use GLS.
B. Model for Longitudinal Data

• Fixed versus Random? Which to choose?
  – Fixed effects model is more appropriate.
  – Random effects model is appropriate if N is very large.
  – Use Hausman test (not to be discussed in this seminar).
C. Dynamic Panel Model

• Dynamic panel model includes lagged dependent variable.

\[ y_{it} = X_{it} \beta + \delta y_{it-1} + \alpha_i + e_{it} \]

• This is to capture the dynamic effects of the investigating variable (i.e. y).

• **Problem**: We cannot use OLS, GLS, fixed and random effects models because \( y_{it-1} \) is correlated with \( \alpha_i \).
C. Dynamic Panel Model

• Some popular alternative measurements:

1. **Anderson-Hsiao**: First-difference Instrument variables (IV).
   \[ \Delta y_{it} = \Delta X_{it} \beta + \delta \Delta y_{it-1} + \Delta e_{it} \text{ (no } a_i \text{) }, \]
   and use IV (i.e. \( \Delta y_{it-2} \) )

2. **Ahn & Schmidt**: Use generalised methods of moments (GMM)
   \[ E \{ Z_{it} (y_{it} - X_{it}' \beta - \delta y_{it-1} - a_i) \} = 0 \]
   , where instrument variable \( Z \) contains variables \( X \) and other exogenous variables.
C. Dynamic Panel Model

3. Blundell & Bond: Includes T-1 moment conditions in GMM.

\[ E \{ \Delta y_{it-1} (y_{it} - X_{it}' \beta - \delta y_{it-1} - \alpha_i) \} = 0 \]
Applications of panel data in tourism research

• Panel data econometrics have been used in tourism demand research for two purposes:
  1. To estimate elasticities of demand for travel
  2. To develop a statistical tourism demand model for forecasting purposes.
Applications of panel data in tourism research

• Panel data has an advantage over pure time series or cross-sectional data because:
  – Large number of observations, more informative and more degrees of freedom
  – Control for individual differences (or heterogeneity)
  – Able to study the dynamics of adjustment.

(Refer to Baltagi’s *Econometric Analysis of Panel Data*, 2008)
Applications of panel data in tourism research

- Romilly et al. (1998) – used panel data to develop a model of international tourism spending using both economic and social variables for a total of 138 countries over 7 years.
- Naude & Saayman (2005) – identified factors affecting tourist arrivals to Africa.
Applications of panel data in tourism research

- Taylor & Ortiz (2009) – examined whether climate change has impacted regional tourism in the UK.
- Brida & Risso (2009) – studied the German demand for tourism in South Tyrol using dynamic panel data.
- Kuo et al. (2009) – estimated the impact of Avian Flu on international tourist arrivals to Asian, European and African countries.
- Habibi et al. (2009) - developed a panel data model of international tourism demand for Malaysia.
Applications of panel data in tourism research

- Allen et al. (2009) and Yap & Allen (2010) – investigated the factors that influence the Australians’ demand for domestic travel in Australia.
- Seetaram (2010) – modelled the international tourist arrivals to Australia.
Future Tourism Research Topics??

Some examples:

• Effects of political instability and corruptions on tourism development
  – Political tensions in Middle East and North Africa
  – Riots and demonstrations in Greece and London

• Tourism impacts on economic growth

• How changes in climate affect demand for ecotourism destinations?
References

- Schmidt, P. (2011). *Panel Data Econometrics*, Unpublished book. (A workshop was held at the University of Queensland, Australia, 20th-22nd July 2011.)
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**Brief Profile:**

Dr Ghialy is an economics lecturer with the School of Accounting, Finance and Economics. She obtained her master degree in economics from the University of Western Australia and a PhD from Edith Cowan University, where she was trained to conduct economic policy analyses and quantitative research using advance econometrics models. She has extensive knowledge in econometric modelling and forecasting. Her main research strengths include tourism demand modelling and forecasting, as well as economics empirical research using time-series and panel data econometrics. She is an active researcher and currently, she is co-supervising PhD students in economics and finance disciplines.