

POL 606 Time Series Analysis
Week 14
Dynamic Panel Models and Other Issues in PCTS
April 30th and May 7th 2008

As data accumulate there is a growing focus on larger T as opposed to larger N in PCTS studies.

As we think about asymptotics in T, there are two new strands of ideas.

The first is the idea of heterogeneous regressions, i.e. one for each country or unit. (see Pesaran and Smith (1995) and others).

This literature relies on T large enough so that coefficients (slopes now, not intercepts) can be estimated for each country's regression separately.

Fixed effects is a poor method if the coefficients are very different for the cases.

From this literature comes models like the random coefficient model.

A second strand of literature brings together many of the topics we have dealt with for single case studies such as non-stationarity, spurious regressions, and cointegration.

For example, studies of a set of countries and their economic indicators will have within unit stationarity problems. These become more obvious, more problematic, and easier to deal with as T increases.

Most of the literature in panel and PCTS avoid the question of stationarity altogether. (In the book I am cribbing this all from it isn't mentioned until the last chapter).

Books may say that this is forgivable with a very small N but really, even in the cases where we can't rely much on unit-root tests, if we have theoretical reasons for suspecting non-stationarity we should deal with the data to avoid spurious regressions.

Estimates will eventually be consistent even with non-stationary data as N and T approach infinity – but they won't approach it very soon.

Several unit-root tests have been extended to PCTS.

Some assume cross-sectional independence and some do not.

The simplest tests perform Dickey-Fuller tests for each cross-sectional unit.

But then there is the problem of what to do if some DF tests indicate stationarity and some don't.

Tests that allow cross-sectional dependence keep the data set in one piece.

These tests are out there in the Stata and RATS literature.

Panel Cointegration Tests

Looking at each cross-sectional unit separately will be problematic.

You have low T and that lowers the already low power of unit root tests.

Fractional integration may be present but will be very difficult to test for with small N in each unit.

Keeping the panel in one piece and adding cross-sectional variation to the data will increase the power of unit root tests or panel cointegration tests.

Residual-Based DF and ADF Tests.

Begin with the panel regression model:

$$y_{it} = x_{it}'\beta + z_{it}'\gamma + e_{it}$$

where y_{it} and x_{it} are $I(1)$ and not cointegrated.

For $z_{it} = \{\mu_i\}$, Kao (1999) proposes DF and ADF-type unit root tests for e_{it} as a test for the null of no cointegration.

The DF-type tests can be calculated from the fixed effects residuals:

$$\hat{e}_{it} = \rho \hat{e}_{it-1} + v_{it}$$

where $\hat{e}_{it} = \tilde{y}_{it} - \tilde{x}_{it}'\hat{\beta}$ and $\tilde{y}_{it} = y_{it} - \bar{y}_i$.

To test the null hypothesis of no cointegration, the null can be written as $H_0 : \rho = 1$.

The OLS estimate of ρ and the t -statistic are given as:

$$\hat{\rho} = \frac{\sum_{i=1}^N \sum_{t=2}^T \hat{e}_{it} \hat{e}_{it-1}}{\sum_{i=1}^N \sum_{t=2}^T \hat{e}_{it}^2}$$

and:

$$t_{\rho} = \frac{(\hat{\rho} - 1) \sqrt{\sum_{i=1}^N \sum_{t=2}^T \hat{e}_{it-1}^2}}{S_e}$$

$$\text{Where } S_e^2 = \frac{1}{NT} \sum_{i=1}^N \sum_{t=2}^T (\hat{e}_{it} - \hat{\rho} \hat{e}_{it-1})^2.$$

See Baltagi (2005) “Econometric Analysis of Panel Data.”

Dynamic Panels

Remember that our data structure lets us overcome immeasurable effects that do not vary over time but might vary over cases.

If we difference our data we can hold these things constant.

The best example I have is from Carson, Koger and Lebo where (in one table) we overcome the problem of measuring legislator ideology in a PCTS design by differencing our data.

In the first tables, we use Nominat scores for legislator ideology. These vary across cases but not within cases.

Table 1:

```
xtivreg inc2sh3_100 presvote chql frosh presapp_rescale_in midterm_in rdi_q3_in
(partynuity_1= dwnomlrecode inparty), first
```

This tells us that the effects of Nominat are strong on Party Unity which in turn is a big predictor of vote share for legislators running for reelection.

If we change the dependent variable to be the *difference* in vote shares between one election and the next one, we can assume that ideology doesn't change from Congress to the next.

Voting behavior by legislators can change, however. So we see the same type of pattern – as legislators' level of unity goes up, their vote share is lower.

Stata command for Table 6 in CKL:

```
xtivreg inc2sh3_100_diff presvote_diff chql_diff spendgap_diff
presapp_rescale_in_diff midterm_in_diff inparty_diff rdi_q3_in_diff
(partynuity_diff = dwnomlrecode_diff frosh_diff), first
```