



Public Investment and Decentralization - Dynamic Panel Data Analysis

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Public Investment and Decentralization - Dynamic Panel Data

1. Public Investment and Decentralization
2. Data Issues
3. Dynamic Panel Data Estimation
4. Exercise



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1. Decentralisation and public investment

- ❖ Based on Kappeler and Välilä (2008)
- ❖ Composition of public investment in Europe
- ❖ Public investment \neq infrastructure
 - ❖ Highways vs. swimming pools
 - ❖ Private infrastructure investment
- ❖ Determinants of the composition of public investment
 - ❖ special focus on decentralisation (autonomy of regions)
- ❖ Discriminate among conflicting theories
- ❖ Eurostat data available only at country level



1. Theoretical predictions

- ❖ Keen and Marchand (1997): Fiscal competition and the relative composition of public investment.
 - ❖ Regions compete in public inputs for private investment projects
 - ❖ But they also compete in taxes
 - ❖ Tax income needed to provide public inputs (and public consumption goods)
- ❖ Decentralisation leads to *relative* increase in public inputs compared to public consumption goods
- ❖ Unclear whether public inputs also increase in absolute terms with decentralisation



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2. Data issues

- ❖ Eurostat (ESA95, COFOG)
- ❖ Sample EU10 (unbalanced, 1990-2005)
- ❖ Gross capital formation (includes changes in inventories)
- ❖ Types of public investment (based on ESA 95 COFOG):

<i>Type of Public Investment</i>	<i>ESA 95 COFOG</i>
1. Infrastructure (INF)	Economic Affairs;
2. Hospitals and Schools (HS)	Health; Education;
3. Public Goods (PG)	Defence; General Public Services; Environment; Order and Safety;
4. Redistribution (RED)	Housing; Recreation; Social Protection



1. Measuring decentralization

- Share of tax revenue of sub-national levels of government (regional and local governments)
- Stegarescu (2005) also accounts for the autonomy of subnational governments to determine their tax base and/or tax rate.

Classification of Taxes (in Decreasing Order of Control over Revenue, (OECD, 1999):

(a)	sub-central government (SCG) determines tax rate and tax base
(b)	SCG determines tax rate only
(c)	SCG determines tax base only
(d)	tax sharing:
(d.1)	SCG determines revenue-split
(d.2)	revenue-split only changed with consent of SCG
(d.3)	revenue-split unilaterally changed by centr. gov. (CG) (legislation)
(d.4)	revenue-split unilaterally changed by CG (annual budget)
(e)	CG determines tax rate and tax base

2. Summary statistics



Variable	Obs	Mean	Std.Dev.	Min	Max
inv1	134	0.00766	0.00351	0.0027	0.01849
inv2	134	0.00511	0.00235	0.00127	0.01345
inv3	132	0.00596	0.00196	0.00231	0.00944
inv4	133	0.00456	0.00246	0.00142	0.01215
tax	158	0.18972	0.11003	0.02061	0.35691
captr	151	0.00735	0.00476	0.0013	0.02004
gdp	160	0.02173	0.00403	0.01373	0.03075
lend	157	-0.03798	0.14311	-0.90478	0.45339
debt	159	0.72395	0.28398	0.14797	1.44307
pop	160	30953	28077.3	4964	82520



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3. Econometric approach

- Reduced form model to be estimated

$$I_{c,it} = \alpha + \beta_1 I_{c,it-1} + \beta_2 tax_{it-1} + \beta_3 cap_{it} + \beta_4 gdp_{it-1} + \beta_5 debt_{it-1} + \beta_6 lend_{it-1} + \beta_7 pop_{it-1} + \beta_8 year_t + \gamma_i + u_{it}$$

- relative to GDP (apart from GDP/capita and population density)
- Q-test for autocorrelation of dependent variables:
 - Dependent variables auto-correlated and persistent
- Im, Pesaran and Chin test (IPS) for unit root:
 - variables are either stationary or trend stationary
 - include time trend



3. Econometrics - Arellano Bond Estimator

- By construction, y_{it-1} is correlated with the unobserved individual-level effect γ_i
 - Removing γ_i by within transformation inconsistent with T fixed
- First difference both sides

$$y_{it} = \delta \Delta y_{it-1} + \Delta \beta x_{it} + \Delta u_{it}$$

- γ_i gone, but y_{it-1} in Δy_{it-1} is a function of u_{it-1}
 - also in Δu_{it}
- So Δy_{it-1} is correlated with Δu_{it} by construction
- GMM estimator with further lags of y_{it} (and Δy_{it}) as instruments for Δy_{it-1}



3. Econometrics - Arellano Bond Estimator

- If error term not serially correlated and explanatory variables weakly exogenous, higher-order lags of the dependent variable constitute valid instruments:

$$Z_i = \begin{pmatrix} I_{c,t-2} & 0 & 0 & \dots & 0 & \dots & 0 \\ 0 & I_{c,it-2} & I_{c,it-3} & \dots & 0 & \dots & 0 \\ \cdot & \cdot & \cdot & \dots & \cdot & \dots & \cdot \\ 0 & \cdot & 0 & \dots & I_{c,it-2} & \dots & I_{c,i1} \end{pmatrix}$$



3. Econometrics - Arellano Bond Estimator

- Overidentification (more instruments than explanatory variables) allows the testing of the moment conditions and improves efficiency
- Orthogonality (moment) conditions of GMM estimator:

$$E(Z'_{c,i} \Delta u_i) = 0 \text{ for } i = 1, 2, \dots, N$$

$$\text{with } \Delta u_i = (\Delta u_{i3}, \Delta u_{i4}, \dots, \Delta u_{iT})'$$

- lagged levels of the dependent variable have to be orthogonal to the differenced disturbances



3. Econometrics - Arellano Bond Estimator

- One step estimator minimizes

$$W_N = \left[\frac{1}{N} \sum_{i=1}^N Z'_{c,i} H Z_{c,i} \right]^{-1}$$

- where H is a (T-2) square matrix with 2's on the main diagonal, -1's on the first off-diagonals and zero elsewhere.
- Two-step procedure: first estimate $\widehat{\Delta u_i}'$. Then minimize a function depending on $\widehat{\Delta u_i}'$ and the instrument matrix Z_i



3. Econometric Approach – Diagnostic tests

- Test residual autocorrelation of order 1 and 2
 - first order serial correlation should be present (first differences)
 - second order serial correlation should be absent

- Sargan test for joint orthogonality of instruments
 - Sargan test for overidentifying restrictions

$$E(Z'_{c,i} \Delta u_i) = 0 \text{ for } i = 1, 2, \dots, N$$

- H_0 : overidentifying conditions are valid
- residuals should be uncorrelated with the set of exogenous variables if the instruments are truly exogenous



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Detailed instructions will be distributed on a separate sheet.



- ❖ Bond S. (2002). Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice. cemmap working paper CWP09/02.
- ❖ Kappeler A., Vällilä T. (2008). Fiscal federalism and the composition of public investment in Europe. *European Journal of Political Economy* 24, 562–570.
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- ❖ OECD, 1999. Taxing powers of state and local government. *OECD Tax Policy Studies* 1, OECD, Paris.
- ❖ Stegarescu D. (2005). Public Sector decentralization: Measurement Concepts and Recent International Trends. *Fiscal Studies* 26/3, 301–333.