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The Efficieny of Saxony's Municipalities - A Distance Function Approach

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Motivation I

- Municipal revenues will decline
  1. Currently nearly 50% of revenues come from transfers
     - ↪ Shrinking funds from the European Union
     - ↪ Reduction of federal fiscal transfers
  2. Most funds are allocated on a per capita basis
     - ↪ Declining and ageing of the population
- Efficiency in the expenditures becomes more important in the face of declining revenues

Motivation II

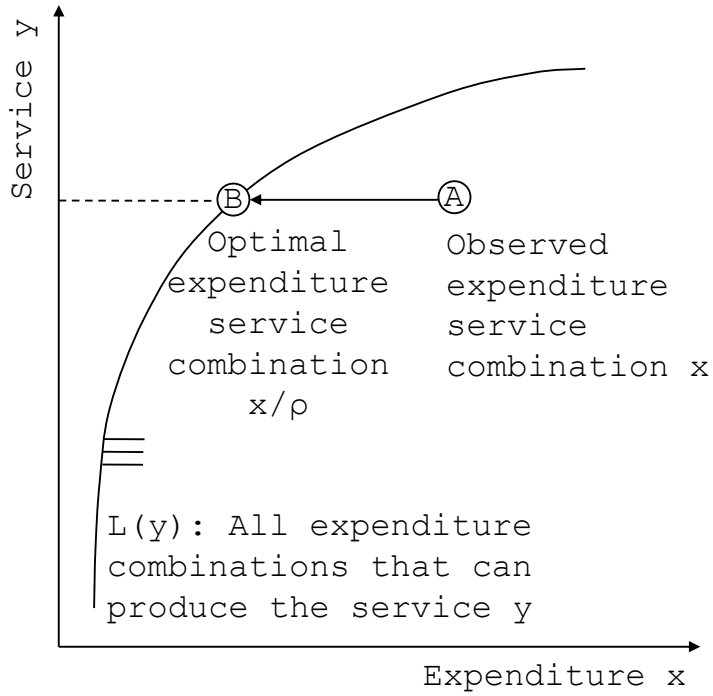
1. How efficient are the municipalities in Saxony?
2. Is there a relationship between population decline and efficiency?
3. Is there a relationship between population ageing and efficiency?

Literature review

- De Borger, Kerstens, Moesen and Vanneste (1994) or De Borger and Kerstens (1996)
  - ↪ Estimate the efficiency for the municipalities in Belgium, comparison of different methods
- Geys (2006) or Geys, Heinemann and Kalb (2007)
  - ↪ Cross section studies with data from the year 2000 for 304 Flemish municipalities and from the year 2001 for 1111 municipalities in the German state Baden-Württemberg
- Problems:
  - Outputs identification
  - Missing price system
  - Unobserved heterogeneity

Efficiency and Input Distance Function

- A municipality is defined as efficient if it is not possible to reduce their expenditures to provide their individual services.



- Input distance function: $D_I(x, y) = \max \rho : \frac{x}{\rho} \in L(y)$
  $L(y) = x$ can produce y

The Functional Form I

Translog function:

$$\ln D_I(x_{it}, y_{it}) =$$

$$\alpha_0 + \sum_{m=1}^{M} \alpha_m \ln y_{mit} + \frac{1}{2} \sum_{m=1}^{M} \sum_{n=1}^{M} \alpha_{mn} \ln y_{mit} \ln y_{nit}$$

$$+ \sum_{k=1}^{K} \beta_k \ln x_{kit} + \frac{1}{2} \sum_{k=1}^{K} \sum_{l=1}^{K} \beta_{kl} \ln x_{kit} \ln x_{lit} + v_{it}$$

- y are the services provided by the municipalities with the indices $m = 1, ..., M$ and $n = 1, ..., M$
- x are the expenditures of the municipalities with the indices $k = 1, ..., K$ and $l = 1, ..., K$
- α and β are the parameter to be estimated
- i and t are indices for the municipalities and the time
- v_{it} is an iid $N(0, \sigma_v^2)$ error term

The Functional Form II

By imposing homogeneity of degree 1 in inputs

$$\frac{D_I(x_k,y)}{x_K} = D_I(\frac{x_k}{x_K}, y)$$

the function changes to

$$\ln \frac{D_I(x_{it},y_{it})}{x_{Kit}} =$$

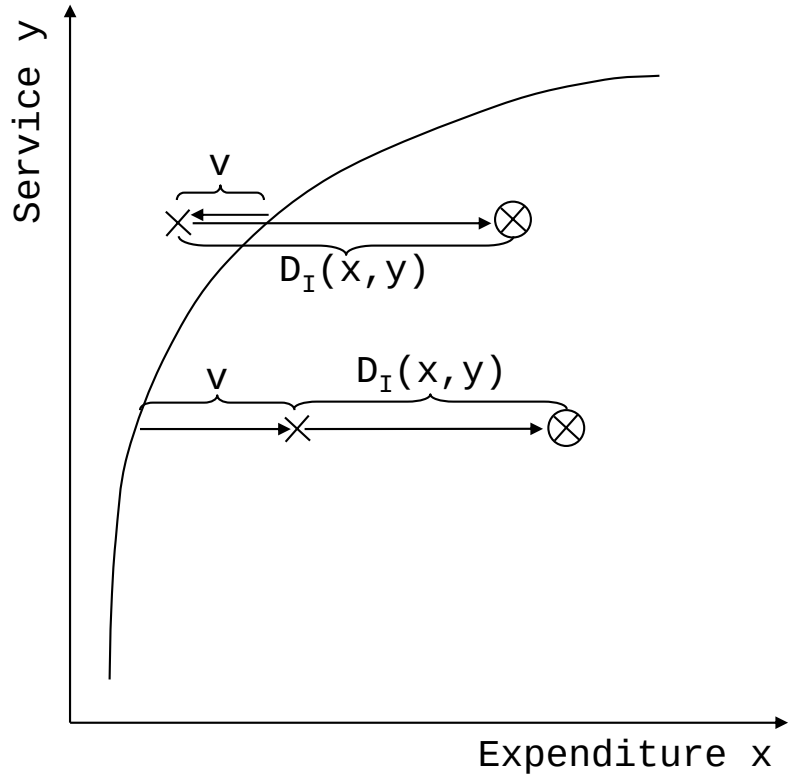
$$\alpha_0 + \sum_{m=1}^{M} \alpha_m \ln y_{mit} + \frac{1}{2} \sum_{m=1}^{M} \sum_{n=1}^{M} \alpha_{mn} \ln y_{mit} \ln y_{nit}$$

$$+ \sum_{k=1}^{K-1} \beta_k \ln x^*_{kit} + \frac{1}{2} \sum_{k=1}^{K-1} \sum_{l=1}^{K-1} \beta_{kl} \ln x^*_{kit} \ln x^*_{lit} + v_{it}$$

where $x^*_k = \frac{x_k}{x_K}$. Rearranging gives

$$-\ln x_{Kit} = \alpha_0 + TL(x_{it}, y_{it}) + v_{it} - \ln D_I(x_{it}, y_{it})$$

Stochastic Frontier Analysis



$$-\ln x_{Kit} = \alpha_0 + TL(x_{it}, y_{it}) + \epsilon_{it} \qquad \epsilon_{it} = v_{it} - \ln D_I(x_{it}, y_{it})$$

$$v_{it} \sim N(0, \sigma_v^2) \text{ and } D_I(x_{it}, y_{it}) \sim N^+(0, \sigma_u^2)$$

Data

Variable	Mean	Min	Max
Expenditures of the current budget			
Spendings on personnel	3,276,976	4,468	343,569,091
Cost of materials	1,944,124	56,048	193,344,019
Other expenditures	2,579,544	93,098	297,631,332
Services provided by the municipalities			
Population younger than 20	1,525	72	86,938
Populaton between 20-65	5,321	246	320,646
Population older than 65	1,749	86	106,473
Child care possibilities	0.74	0.00	2.71
Number of schools	4	0	188
Employees	2,812	53	217,390
Price for drinking water	1.84	0.00	2.74

505 municipalities, 6 years (2000-2005)

Unobserved Heterogeneity

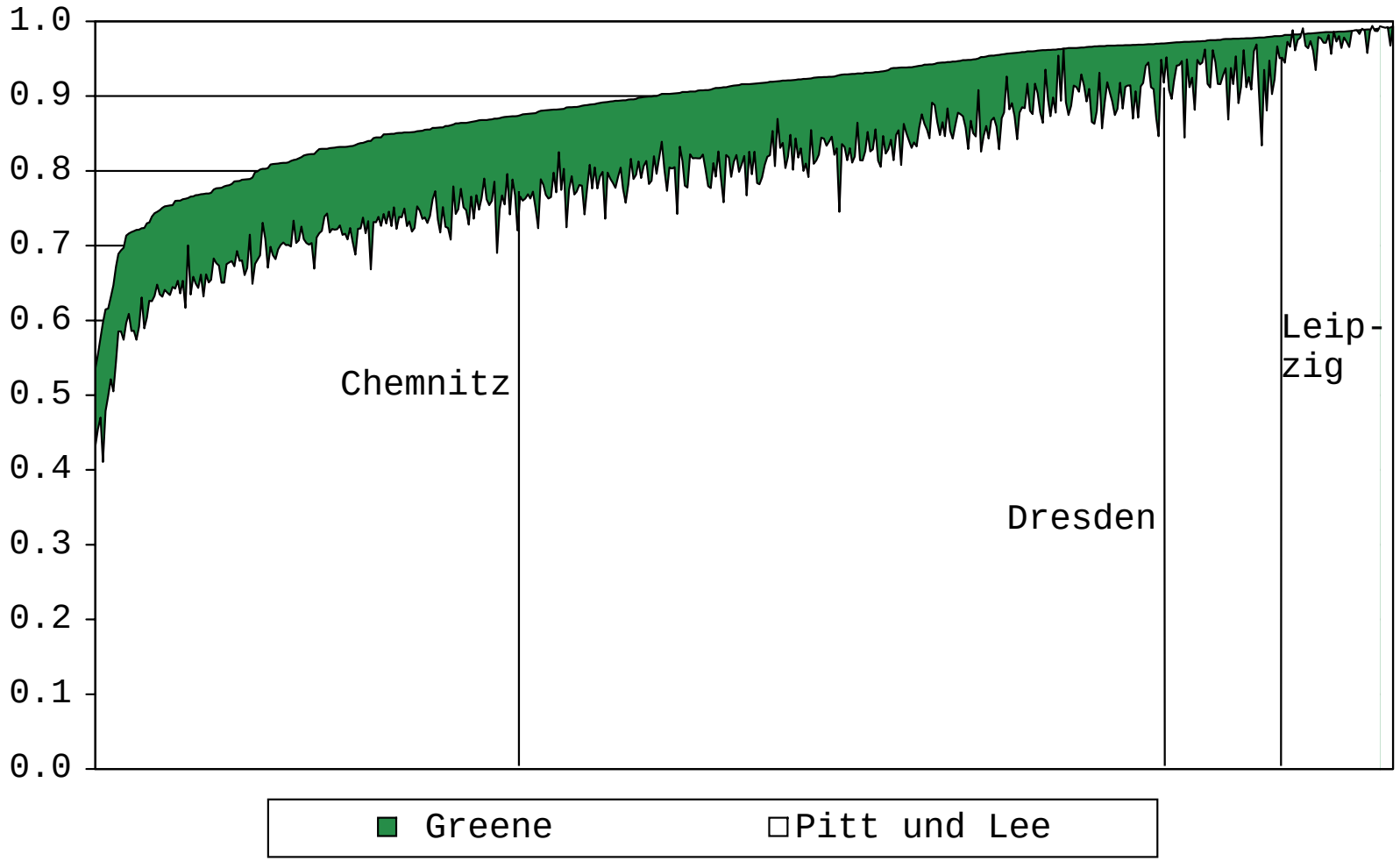
Challenge

- Since municipalities are different, they can have different expenditures for the same service without being inefficient
- How to deal with that?

Solution

- Estimation of two models
  1. Ignore the different characteristics (Model tends to have low efficiency values)
     Pitt and Lee (1981) $\hookrightarrow$ Lower bound for efficiency values
  2. Take all effects that not change over time as characteristic differences (Model tends to have high efficiency values)
     Greene (2005a, b) $\hookrightarrow$ Upper bound for efficiency values

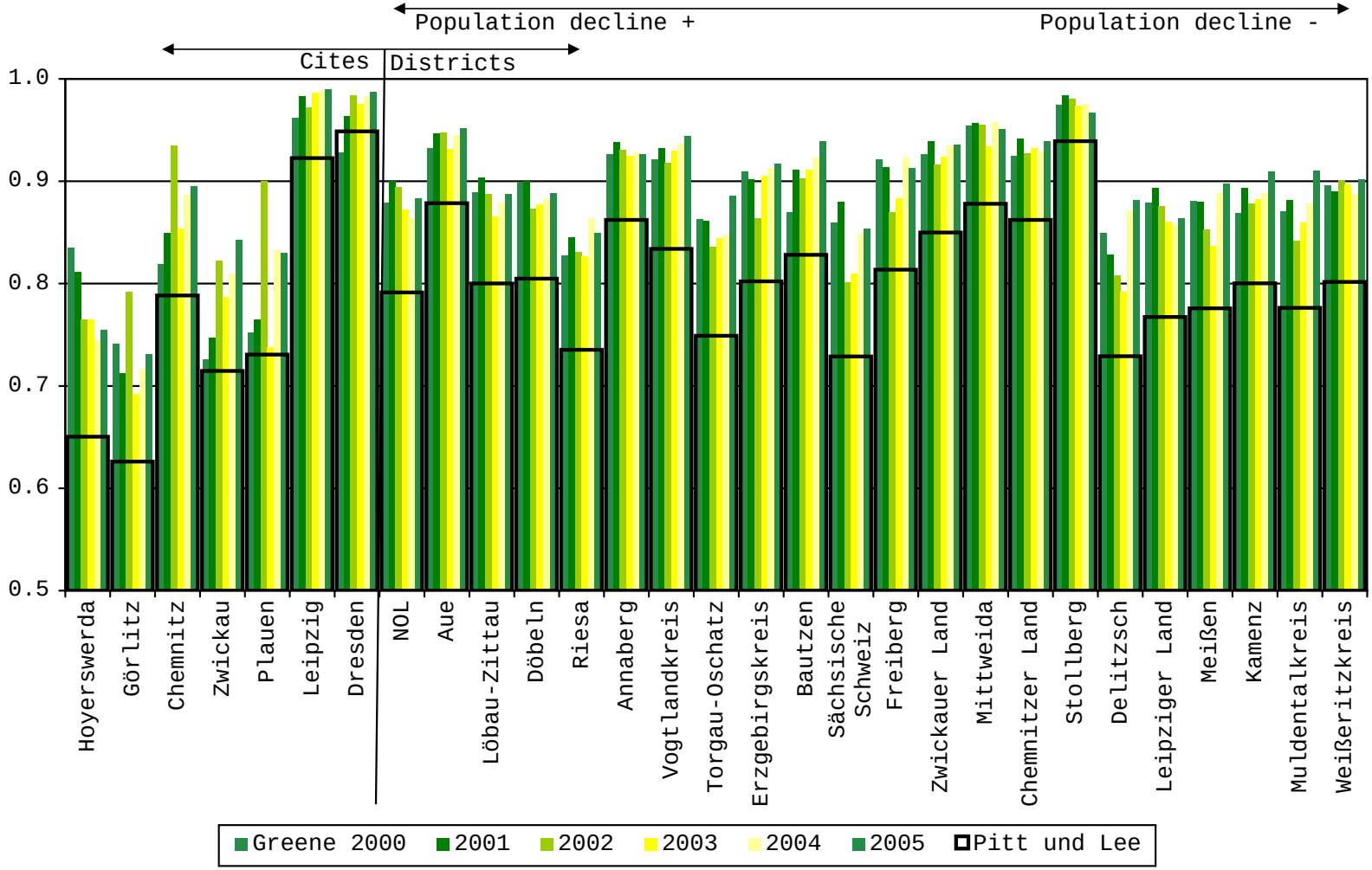
Efficiency Scores I



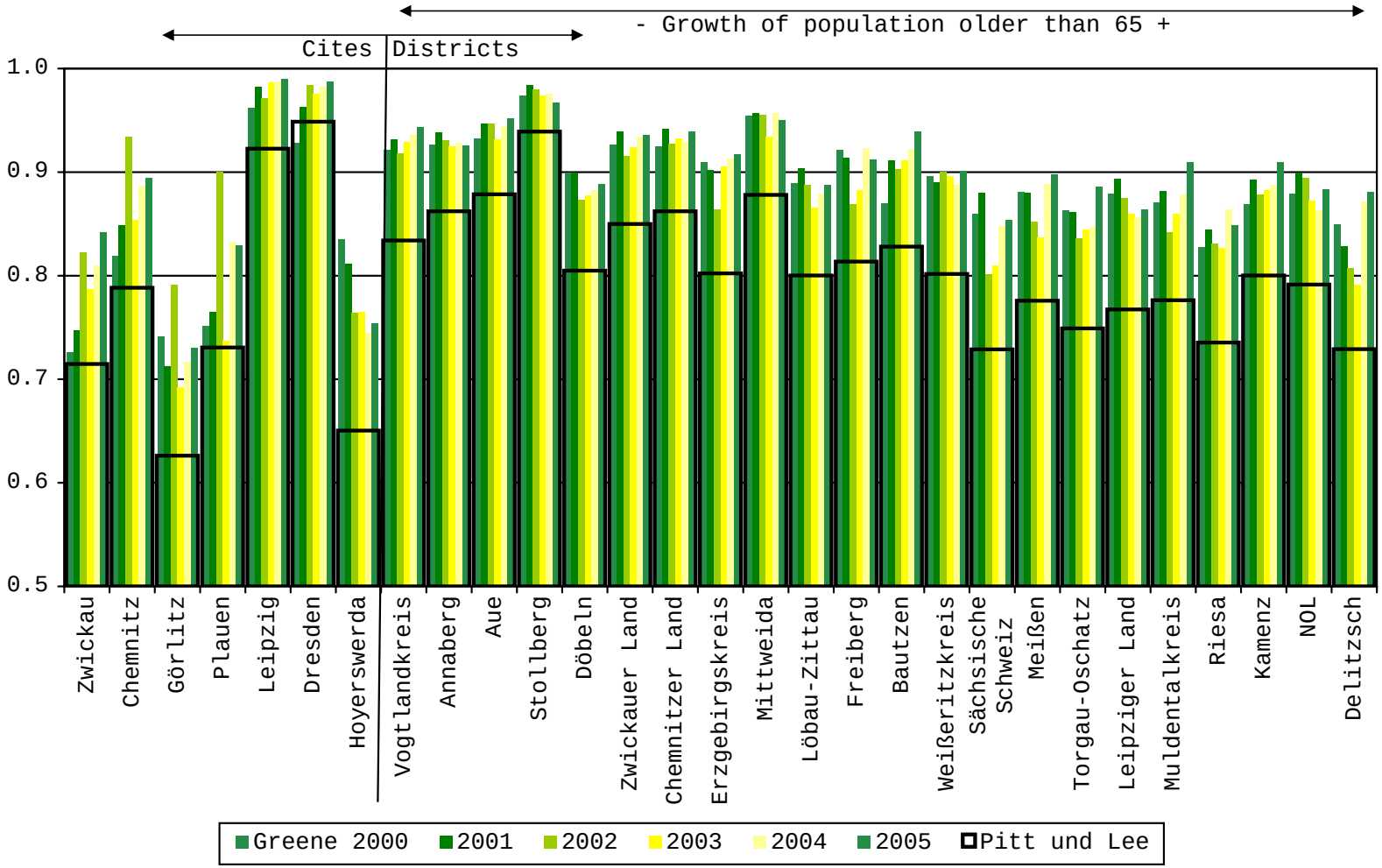
Efficiency Scores II

Model	Pitt and Lee	Greene
Mean	0.8073	0.8963
Standard Deviation	0.1084	0.0810
Minimum	0.4106	0.5356
Maximum	0.9939	0.9934

Efficiency and Population Decline



Efficiency and Growth of the Elderly



Conclusions

- Expenditures of the municipalities in Saxony between 11% to 20% above the efficient level
- There is no clear relationship between efficiency and population decline
- There seems to be a relationship between efficiency and population ageing

Thank you for the attention!

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