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# Accounting for regional success

## A statistical analysis of international regional data

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Gerald Holtham; Hodge Professor of Regional Economics; Cardiff Metropolitan University

Rob Huggins; Professor of Economic Geography; Cardiff University

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# WCIR data examined

- Data set of 20 variables measuring or affecting competitiveness for over 400 hundred sub-state regions around the world
- We separate the measurement (success or output) variables from those affecting competitiveness (input variables).
- Output is a combination  of GVA per head, labour productivity, monthly average wages and the economic activity rate. Correlation with  GVA is 91%
- Then we test the data set for clusters in the output variables

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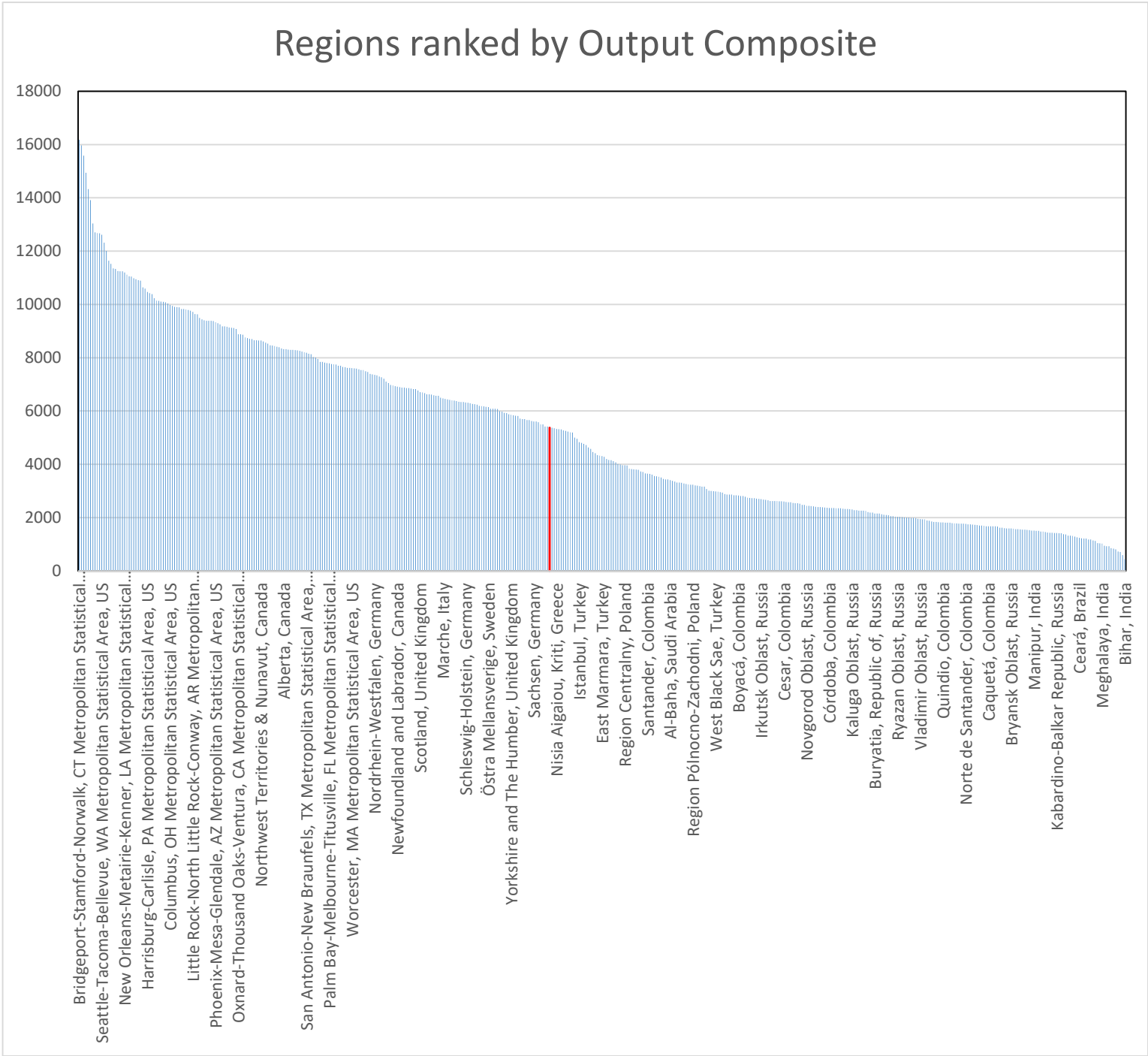
The plot of ouput variables appears to have kinks

Cluster analysis finds two groups whose means are significantly different relative to dispersion of group members

The break between clusters is near the main visual break in the graph

So we look at input variables and run discriminant analysis



# Discriminant Analysis

Identifies the linear combination of input variables that is most different between the two clusters

Significant variables in the discriminant function in order of importance were:

- broadband access per 1000 inhabitants
- per capita expenditures on primary and secondary education
- per capita expenditures on higher education
- number of managers per 1000 employees
- secure servers per million inhabitants

There was a negative coefficient on employment in electrical machinery. The results essentially pointed to education and connectivity as most important in the transition from the less wealthy to the more wealthy cluster

# Cross-section regressions

Are the same factors important at all stages of the development process?

To test this regressions were run on the two clusters separately so results could be compared with each other and with the discriminant analysis

- A few factors were consistently important, notably education expenditures and business spending on R&D
- Others changed with income level
- Not all the factors that were important for low income countries or were associated with the transition to the richer cluster remained important in promoting success within the richer cluster
- Notably connectivity variables and private equity investment showed diminishing returns; they are important up to a certain level but after that have no further association with success rankings.

# Regression results for poorer cluster

**Coefficients**[a,b,c]

| | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. |
| (Constant) | 609.277 | 125.191 | | 4.867 | 0.000 |
| Employment in IT | 10.254 | 11.963 | 0.057 | 0.857 | 0.392 |
| Employment in Biotech | 48.606 | 15.204 | 0.176 | 3.197 | 0.002 |
| Employment in Auto | -4.952 | 3.107 | -0.117 | -1.594 | 0.112 |
| Employment in Instrumentation | -3.914 | 4.380 | -0.066 | -0.894 | 0.372 |
| Employment in High-Tech Services | 0.583 | 3.878 | 0.008 | 0.150 | 0.881 |
| Managers per 1,000 employees | 6.705 | 1.548 | 0.180 | 4.332 | 0.000 |
| Govt Expenditures on RD | -0.749 | 1.207 | -0.036 | -0.620 | 0.536 |
| Business Expenditures on RD | 3.651 | 0.725 | 0.285 | 5.035 | 0.000 |
| Patentsper one million inhabitants | -0.833 | 0.201 | -0.313 | -4.137 | 0.000 |
| Private Equity Investment | 6.729 | 2.017 | 0.196 | 3.336 | 0.001 |
| Public Expenditures Primary and Secondary Education | 1.367 | 0.145 | 0.433 | 9.452 | 0.000 |
| Public Expenditures Higher Education | 0.711 | 0.451 | 0.086 | 1.579 | 0.116 |
| Secure Servers per one million inhabitants | 0.593 | 0.566 | 0.072 | 1.048 | 0.296 |
| Internet Hosts per 1,000 inhabitants | -2.094 | 0.794 | -0.180 | -2.637 | 0.009 |
| Broadband Access per 1,000 inhabitants | 2.878 | 0.420 | 0.527 | 6.857 | 0.000 |

a. TwoStep Cluster Number = 2

b. Dependent Variable: Weighted geo avg GVA, earnings, lab.prod and activity

c. Selecting only cases for which TwoStep Cluster Number = 2

Variables associated with success:

- Employment in biotech
- Managers per 1000 employees
- Business spending on R&D
- Private equity investment
- Public spending on primary and secondary education
- Broadband access per 1000 inhabitants.

# Regression results for wealthier cluster

**Coefficients[a,b,c]**

| | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. |
| (Constant) | 4040.390 | 623.267 | | 6.483 | 0.000 |
| Employment in IT | 22.250 | 14.543 | 0.085 | 1.530 | 0.128 |
| Employment in Biotech | 15.777 | 20.444 | 0.038 | 0.772 | 0.441 |
| Employment in Auto | -3.014 | 4.921 | -0.038 | -0.612 | 0.541 |
| Employment in Instrumentation | -2.252 | 13.671 | -0.015 | -0.165 | 0.869 |
| Employment in High-Tech Service | 13.074 | 3.593 | 0.188 | 3.639 | 0.000 |
| Managers per 1,000 employees | 4.014 | 4.127 | 0.061 | 0.973 | 0.332 |
| Govt Expenditures on R&D | 1.245 | 0.702 | 0.085 | 1.773 | 0.078 |
| Business Expenditures on R&D | 0.795 | 0.310 | 0.195 | 2.568 | 0.011 |
| Patents per one million inhabitants | 1.132 | 0.611 | 0.140 | 1.854 | 0.065 |
| Private Equity Investment | -3.088 | 1.221 | -0.158 | -2.528 | 0.012 |
| Public Expenditures Primary and Secondary Education | 1.025 | 0.305 | 0.226 | 3.358 | 0.001 |
| Public Expenditures Higher Education | 2.497 | 0.528 | 0.317 | 4.731 | 0.000 |
| Secure Servers per one million inhabitants | -0.109 | 0.291 | -0.025 | -0.374 | 0.709 |
| Internet Hosts per 1,000 inhabitants | -2.656 | 0.748 | -0.234 | -3.550 | 0.000 |
| Broadband Access per 1,000 inhabitants | 0.341 | 0.869 | 0.035 | 0.392 | 0.695 |

a. TwoStep Cluster Number = 1

b. Dependent Variable: Weighted geo avg GVA, earnings, lab.prod and activity

c. Selecting only cases for which TwoStep Cluster Number = 1

Significantly positive variables:

- Employment in hi-tech services
- Business spending on R&D
- Public spending on primary and secondary education
- Public spending on higher education

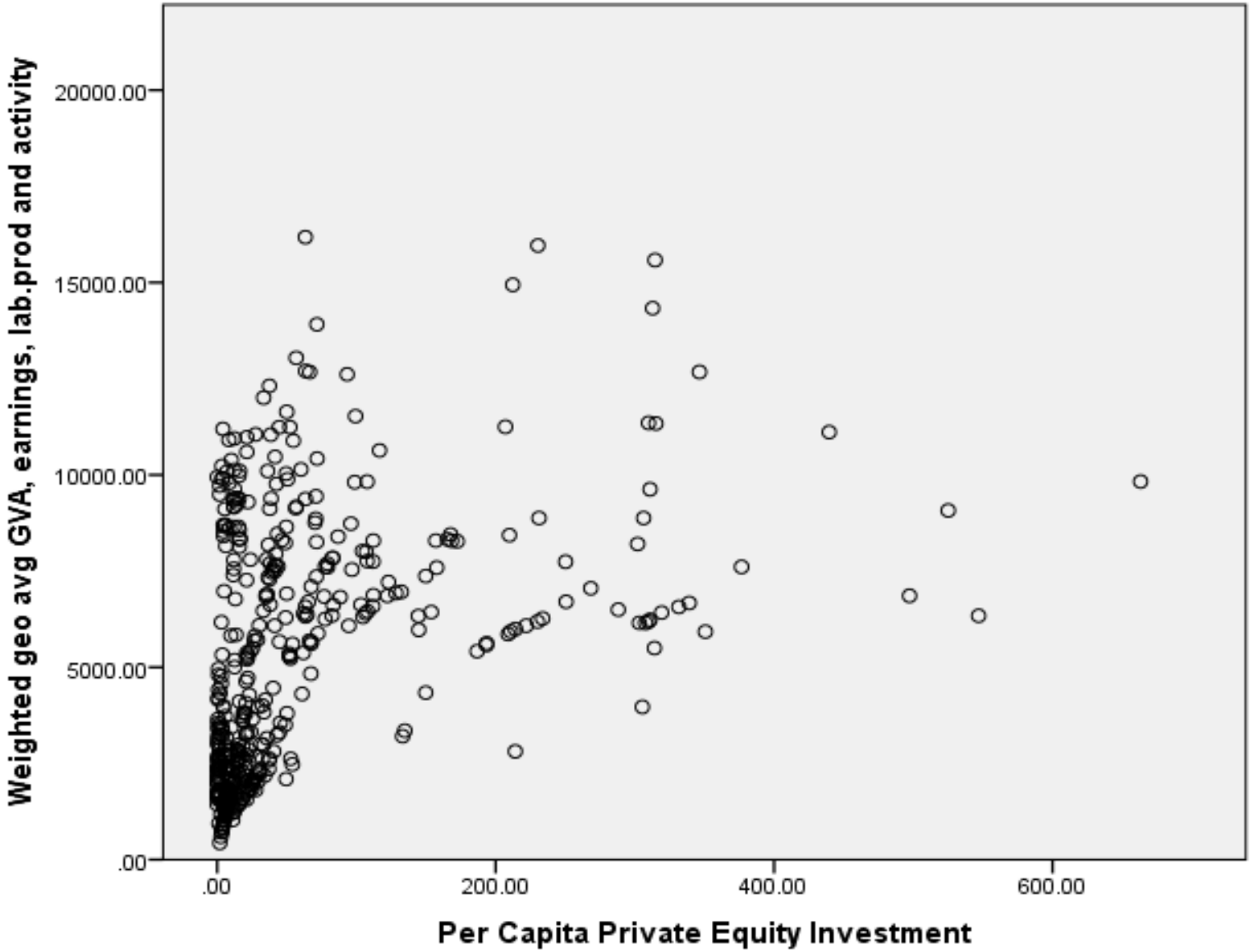
Variables with almost significant influence:

- Patents per million inhabitants
- Govt spending on R&D

Significantly negative variables:

- Private equity investment
- Internet hosts per 1000 inhabitants

# Diminishing Returns to Private Equity Investment




At low levels of the output measure the association is positive but weakens at higher levels. Outliers give a negative association in higher cluster.

Scatter plots for connectivity variables show a similar pattern

<= *cluster break near 6000*

# Conclusions

- Public spending on primary and secondary education is always important.  Public spending on higher education becomes more important for the wealthier cluster of countries
- Business spending on R&D is always important. Government spending on R&D shows some effect among wealthier countries only (92 per cent significant)
- Broadband connectivity is very important among poorer countries in achieving progress but it appears once a certain level of connectivity is reached, more does not add to economic success
- The same applies to private equity investment.  Experience among wealthier countries is highly diverse and outliers result in a negative association, possibly spurious
- There is evidence of a product cycle: poorer countries that do relatively well are specialised in biotechnology whereas among wealthier countries those doing best are specialised in high tech services
- Regression results are much better for the poorer cluster where the explained variance is higher. Wealthier countries are more diverse and less subject to simple classification.