

# Modes of innovation: derivations and applications

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# Mixed modes of innovation

| <b>Innovation modes</b>  | <b>Measures feeding into modes</b>                   | <b>Methodology</b> | <b>Data</b>  | <b>Study</b>                           |
|--|--|--------------------|--|--|
| Mode 1: 'Science-based high-tech firms'<br>Mode 2: 'IT-oriented network-integrated developers'<br>Mode 3: 'Market-oriented incremental innovators'<br>Mode 4: 'Cost-oriented process innovators'<br>Mode 5: 'Low-profile innovators' | Inputs and outputs<br>Linkages                       | Exploratory        | Swiss Innovation Survey 1999<br>Private services sectors | Hollenstein 2003                       |
| Mode 1: 'Strategic innovators'<br>Mode 2: 'Intermittent innovators'<br>Mode 3: 'Technology modifiers'<br>Mode 4: 'Technology adopters'   | Technological inputs and outputs                     | Prescriptive       | Eurstat NewCronos (largely Eurostat CIS3 data)           | Arundel and Hollanders 2005            |
| Mode 1: 'Science, Technology and Innovation'<br>Mode 2: 'Doing, Using, Interacting'  | Inputs<br>Organisational indicators                  | Prescriptive       | 2001 Danish DISKO Survey                                 | Jensen, Johnson, Lorenz, Lundvall 2007 |
| Mode 1: 'Science-based'<br>Mode 2: 'Supplier-dominated'<br>Mode 3: 'Production intensive'<br>Mode 4: 'Market driven'   | Mainly inputs<br>Linkages                            | Exploratory        | CIS2 for Denmark and Finland                             | Leiponen and Drejer 2007               |
| Mode 1: 'Research'<br>Mode 2: 'User'<br>Mode 3: 'External'<br>Mode 4: 'Production'   | All available except. product and process innovation | Exploratory        | Eurostat CIS3  | Shrolec and Verspagen 2008             |
| Mode 1: 'New-to-market innovating'<br>Mode 2: 'Marketing-based imitating'<br>Mode 3: 'Process modernizing'<br>Mode 4: 'Wider innovating'   | Inputs and outputs                                   | Exploratory        | Innovation surveys of 9 OECD countries                   | Frenz and Lambert 2009                 |
| Mode 1: 'Organizational innovations'<br>Mode 2: 'Technological innovations'  | Mainly outputs                                       | Exploratory        | UK CIS4  | Battisti and Stoneman 2010             |

# Innovation modes

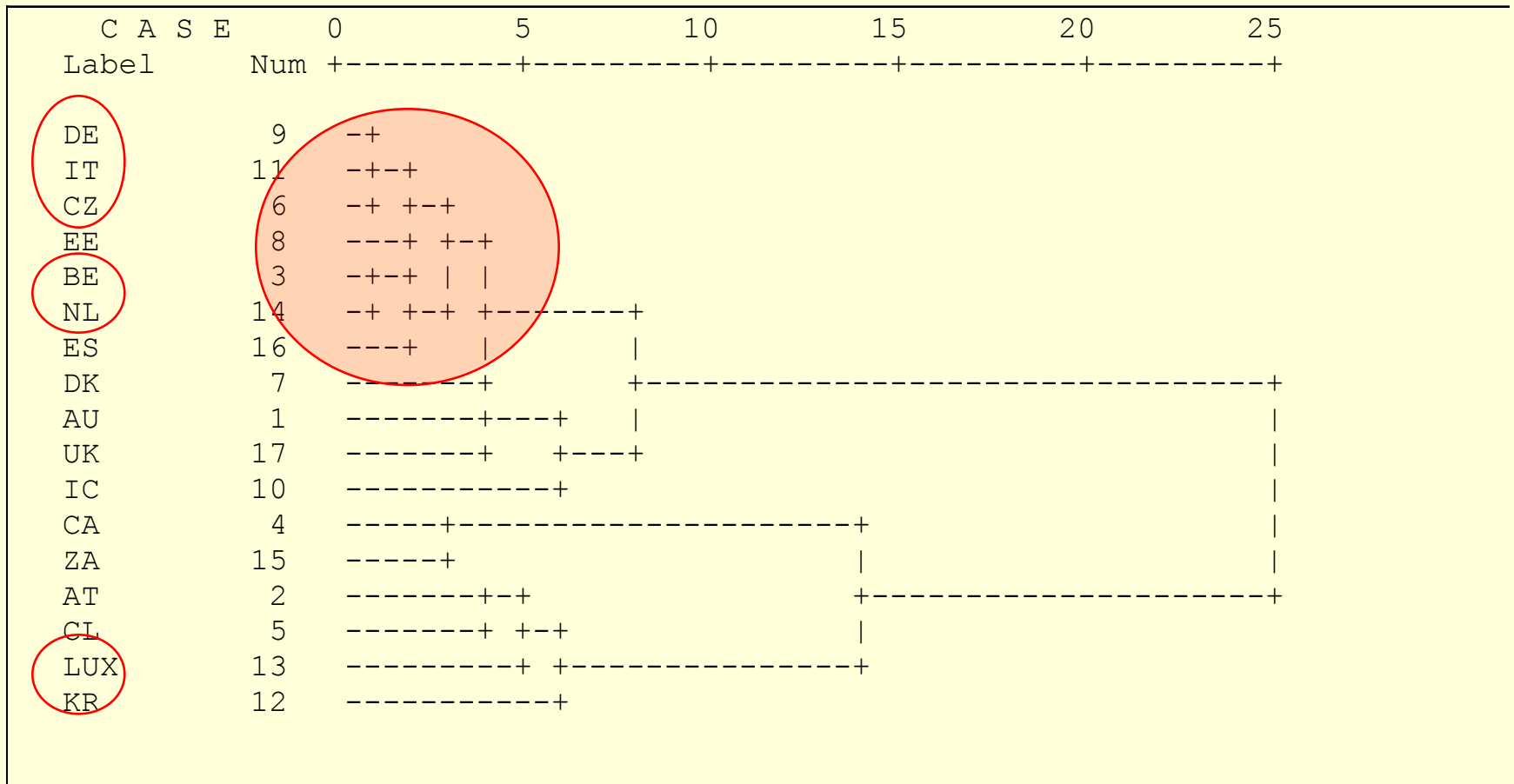
| <i>Measures feeding into the factor analysis</i> | IP / technology innovating | Marketing based innovating | Process modernizing | Wider innovating | Networked innovating |
|--|----------------------------|----------------------------|---------------------|------------------|----------------------|
| New-to-firm product                              |                            | xxx                        |                     |                  |                      |
| New-to-market product                            |                            | xxx                        |                     |                  |                      |
| Process  |                            |                            | xxx                 |                  |                      |
| Knowledge mngmt system                           |                            |                            |                     | xxx              |                      |
| Structure  |                            |                            |                     | xxx              |                      |
| Relations  |                            |                            |                     | xxx              |                      |
| Design or packaging                              |                            |                            |                     | xxx              |                      |
| Distribution method                              |                            | xxx                        |                     |                  |                      |
| In-house R&D                                     | xxx                        |                            |                     |                  | xxx                  |
| Patents  | xxx                        |                            |                     |                  |                      |
| Machinery  |                            |                            | xxx                 |                  |                      |
| Design right                                     | xxx                        |                            |                     |                  |                      |
| Copyright  | xxx                        |                            |                     |                  |                      |
| Training   |                            |                            |                     |                  |                      |
| Marketing  |                            | xxx                        |                     |                  |                      |
| Externally developed innov                       |                            |                            | xxx                 |                  |                      |
| Bought-in R&D                                    |                            |                            |                     |                  | xxx                  |
| Information market                               |                            |                            |                     |                  |                      |
| Information knowledge base                       |                            |                            |                     |                  | xxx                  |
| Cooperation                                      |                            |                            |                     |                  | xxx                  |

xxx  $r > 0.5$

# Innovation modes across countries

| <i>Country</i>      | IP / technology<br>innovating | Marketing<br>based imitating | Process<br>modernizing | Wider<br>innovating | Networked<br>innovating |
|---------------------|-------------------------------|------------------------------|------------------------|---------------------|-------------------------|
| Austria             | 1.0                           | 0.9                          | 0.8                    | 1.0                 | 0.9                     |
| Australia           | 0.9                           | 0.9                          | 0.8                    | 0.9                 | 0.6                     |
| Belgium             | 0.8                           | 0.8                          | 0.9                    | 1.0                 | 0.8                     |
| Canada              | 0.8                           | 0.9                          | 0.7                    | .                   | 0.5                     |
| Chile               | 0.7                           | 0.7                          | 0.7                    | 0.9                 | 0.5                     |
| Czech Republic      | 0.8                           | 0.9                          | 0.8                    | 0.9                 | 0.9                     |
| Denmark             | <b>0.2</b>                    | <b>0.3</b>                   | 0.7                    | 0.9                 | 0.8                     |
| Estonia             | 0.9                           | 1.0                          | 0.8                    | 0.9                 | 0.9                     |
| Germany             | 0.9                           | 0.8                          | 0.8                    | 0.8                 | 0.8                     |
| Iceland             | 0.6                           | 0.6                          | 0.6                    | 0.7                 | <b>0.3</b>              |
| Italy               | 0.9                           | 0.8                          | 0.8                    | 0.9                 | 0.7                     |
| Korea               | 0.8                           | 0.6                          | 0.5                    | 0.9                 | 0.6                     |
| Luxembourg          | 0.8                           | <b>0.2</b>                   | 0.7                    | 0.9                 | <b>0.3</b>              |
| Netherlands         | 0.9                           | 0.8                          | 0.9                    | 0.9                 | 0.9                     |
| South Africa        | 0.8                           | .                            | <b>0.3</b>             | 0.9                 | 0.5                     |
| Spain               | 0.9                           | 0.8                          | 0.7                    | 0.9                 | 0.8                     |
| UK                  | 0.9                           | 0.8                          | 0.5                    | 0.9                 | 0.7                     |
| Average correlation | 0.8                           | 0.7                          | 0.7                    | 0.9                 | 0.7                     |
| Standard deviation  | 0.2                           | 0.2                          | 0.2                    | 0.1                 | 0.2                     |

# Networked innovating



# Industry specialization

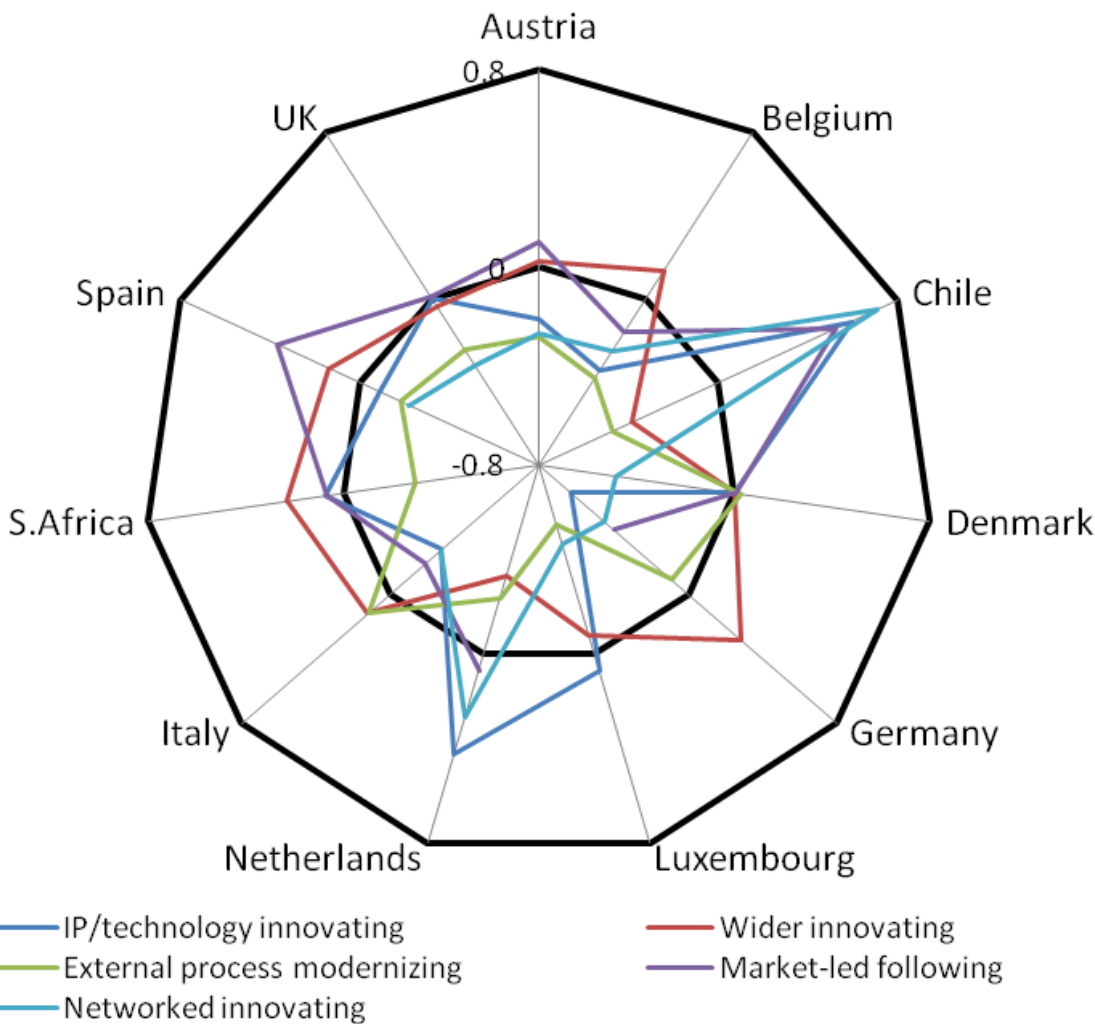
| Industry  | N   | IP/technology innovating | Marketing based imitating | Process modernizing | Wider innovating | Networked innovating |
|---|-----|--------------------------|---------------------------|---------------------|------------------|----------------------|
| Primary, extraction                                     | 8   | <b>0.1</b>               | <b>-0.5</b>               | 0.1                 | <b>-0.2</b>      | <b>0.3</b>           |
| Food, beverages   | 15  | 0.1                      | <b>0.2</b>                | 0.1                 | 0.0              | -0.1                 |
| Textiles, apparel, leather                              | 14  | 0.1                      | 0.1                       | -0.1                | <b>-0.2</b>      | 0.0                  |
| Wood, pulp, paper, publishing, printing                 | 15  | -0.1                     | -0.1                      | <b>0.2</b>          | 0.0              | <b>-0.2</b>          |
| Coke, petroleum, chemicals, rubber and plastics         | 15  | <b>0.3</b>               | 0.1                       | 0.1                 | -0.1             | <b>0.2</b>           |
| Mineral products, basic metals, metal production        | 15  | 0.1                      | -0.1                      | 0.1                 | <b>-0.2</b>      | 0.0                  |
| Machinery, electrical, communication, medical equipment | 15  | <b>0.3</b>               | <b>0.2</b>                | 0.0                 | -0.1             | 0.1                  |
| Motor vehicles, other transport equip.                  | 15  | <b>0.3</b>               | -0.1                      | <b>0.2</b>          | -0.1             | <b>0.2</b>           |
| Manufacturing n.e.c.                                    | 14  | 0.1                      | 0.0                       | 0.0                 | <b>-0.2</b>      | <b>-0.2</b>          |
| Electricity, gas, water supply, water purification      | 13  | <b>-0.2</b>              | <b>-0.4</b>               | 0.0                 | <b>0.2</b>       | <b>0.2</b>           |
| Construction  | 8   | <b>-0.3</b>              | <b>-0.3</b>               | 0.0                 | 0.1              | -0.1                 |
| Wholesale, trade  | 12  | <b>-0.2</b>              | -0.1                      | -0.1                | 0.1              | <b>-0.3</b>          |
| Hotels, restaurants                                     | 6   | <b>-0.3</b>              | 0.0                       | 0.1                 | 0.0              | <b>-0.4</b>          |
| Transport services                                      | 13  | <b>-0.4</b>              | <b>-0.2</b>               | 0.0                 | 0.1              | -0.1                 |
| Post and telecoms                                       | 9   | <b>-0.2</b>              | <b>0.2</b>                | -0.1                | <b>0.3</b>       | -0.1                 |
| Financial services and insurances                       | 13  | <b>-0.3</b>              | 0.0                       | 0.0                 | <b>0.4</b>       | 0.1                  |
| Real estate, renting of equipment                       | 5   | <b>-0.4</b>              | <b>-0.2</b>               | <b>0.2</b>          | 0.1              | <b>-0.2</b>          |
| KIBS, computer, R&D, legal, accounting                  | 13  | 0.0                      | 0.0                       | -0.1                | 0.0              | 0.1                  |
| Total   | 222 | 0.0                      | 0.0                       | 0.0                 | 0.0              | 0.0                  |

\* The observations are those countries that computed industry specialization scores (in total 15 countries)

# Industry specialization

| <b>Modes of innovation</b> |                | <b>Sum of Squares</b> | <b>df</b> | <b>Mean Square</b> | <b>F</b> | <b>p-value</b> | <b><math>\omega^2</math></b> |
|----------------------------|----------------|-----------------------|-----------|--------------------|----------|----------------|------------------------------|
| IP/technology innovating   | Between Groups | 10.26                 | 20        | 0.51               | 7.84     | 0.00           | 0.34                         |
|                            | Within Groups  | 13.15                 | 201       | 0.07               |          |                |                              |
|                            | Total          | 23.41                 | 221       |                    |          |                |                              |
| Marketing based imitating  | Between Groups | 7.77                  | 20        | 0.39               | 7.5      | 0.00           | 0.39                         |
|                            | Within Groups  | 10.41                 | 201       | 0.05               |          |                |                              |
|                            | Total          | 18.17                 | 221       |                    |          |                |                              |
| Process modernizing        | Between Groups | 2.2                   | 20        | 0.11               | 1.9      | 0.01           | 0.04                         |
|                            | Within Groups  | 11.63                 | 201       | 0.06               |          |                |                              |
|                            | Total          | 13.83                 | 221       |                    |          |                |                              |
| Wider innovating           | Between Groups | 6                     | 20        | 0.3                | 7.63     | 0.00           | 0.37                         |
|                            | Within Groups  | 7.59                  | 193       | 0.04               |          |                |                              |
|                            | Total          | 13.59                 | 213       |                    |          |                |                              |
| Networked innovating       | Between Groups | 6.1                   | 20        | 0.31               | 6.61     | 0.00           | 0.28                         |
|                            | Within Groups  | 9.28                  | 201       | 0.05               |          |                |                              |
|                            | Total          | 15.38                 | 221       |                    |          |                |                              |

# Relative specialisation of firms within wholesale industry



# Discussion

## Cross-country pattern

- High consistency with respect to IP/technology innovating mode and wider innovating
- Findings point towards greater heterogeneity across countries with respect to networked innovating, ie the way firms engage with the wider innovation environment
- Some unique modes emerge (e.g. Denmark, Korea, Luxembourg)

## Convergence at the level of the industry

- Some support for a convergence of specialisation within industries across countries in the case of IP/technology, marketing based innovating, and wider innovating.
- But, country specific conditions remain important (e.g. Chilean example).