# THE EVOLUTION OF THE INTERNATIONAL SPATIAL ARCHITECTURE OF CLUSTERING AND VALUE NETWORKS

**OECD Directorate for Science, Technology and Industry**

*Indicators and Analysis for Science, Technology and Innovation Seminar*

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# A quick bio

- 5 years working on science and technology indicators.
- 5 years working on agricultural and food innovation policy - principally biotechnology issues.
- 5 years for the AEGIS research centre in Australia - principally indicator analysis for studies.
- The following presentation emerges from my doctoral research completed at AEGIS (University of Western Sydney).
- Recently emigrated to Canada

# This presentation

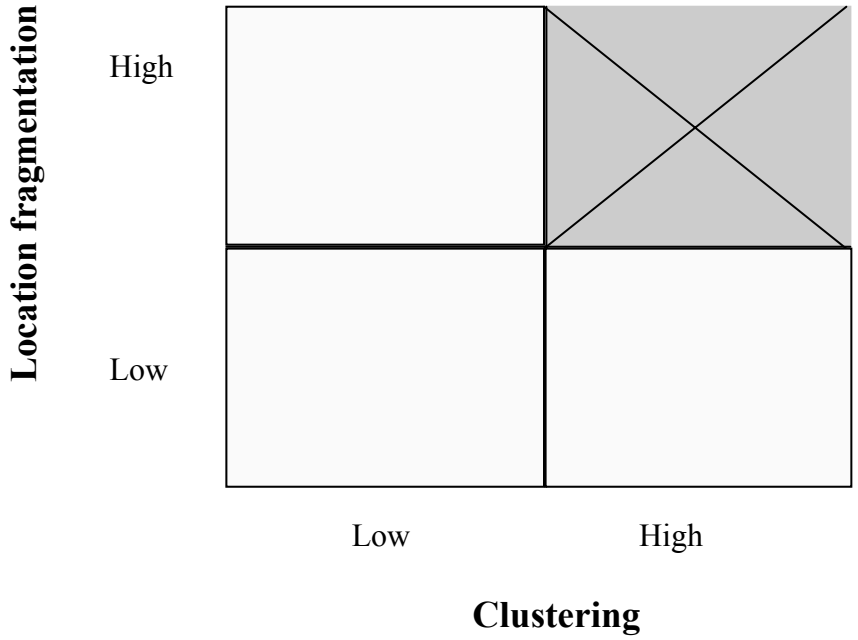
- The purpose of the research
- The methodology
- The evolution of the internationalisation of production
- The spatial structure of networks
- The evolution of ICT networks
- Implications

# Global Political Economy

| | |
|---|---|
| Institutions such as:<br>. WTO<br>. World Bank & IMF<br>. NAFTA & etc | Investment, ownership, brands, FDI, mergers acquisitions etc |
| Production activity<br>. Clustering<br>. Fragmentation<br>. Offshoring<br>. Outsourcing | Socio-polity economic<br>. Culture<br>. Wages<br>. Self-determination<br>. Rights & freedoms etc etc |

Globalisation has a number of dimensions, this presentation pursues the angle of the structure of global production.

# Current debates - clustering *or* fragmentation



# Literature

- Clusters
  - agglomerated economic entities that are often argued to be based in tacit knowledge flows.
  - The external relationships are often ignored
  - What are the functional clusters (highly linked but geographically distant or separated by borders)?
- GPNs - coordination of product development & production
- Global Cities – cities are linked & organised hierarchically
- Systems of innovation - innovation is a systemic property not the activity of a sole enterprise.

# Research questions

- Are clusters linked as sub-systems and organised hierarchically?
- Is fragmentation random on cost basis or is it structured?

# Multi-regional data

- Rather than just using trade data I have constructed the analysis around multi-country input-output data.
  - Input-output data has been correlated to user-producer relationships which are in turn related to innovation.
  - On the other hand, trade analysis is often limited:
    - It does not analyse which industries are using the imports – the best it can do is IIT;
    - Without some I-O data it is extremely difficult to calculate the proportions of final and industrial goods.
- I-O data is however scarce, typically national, based in large industry categories.

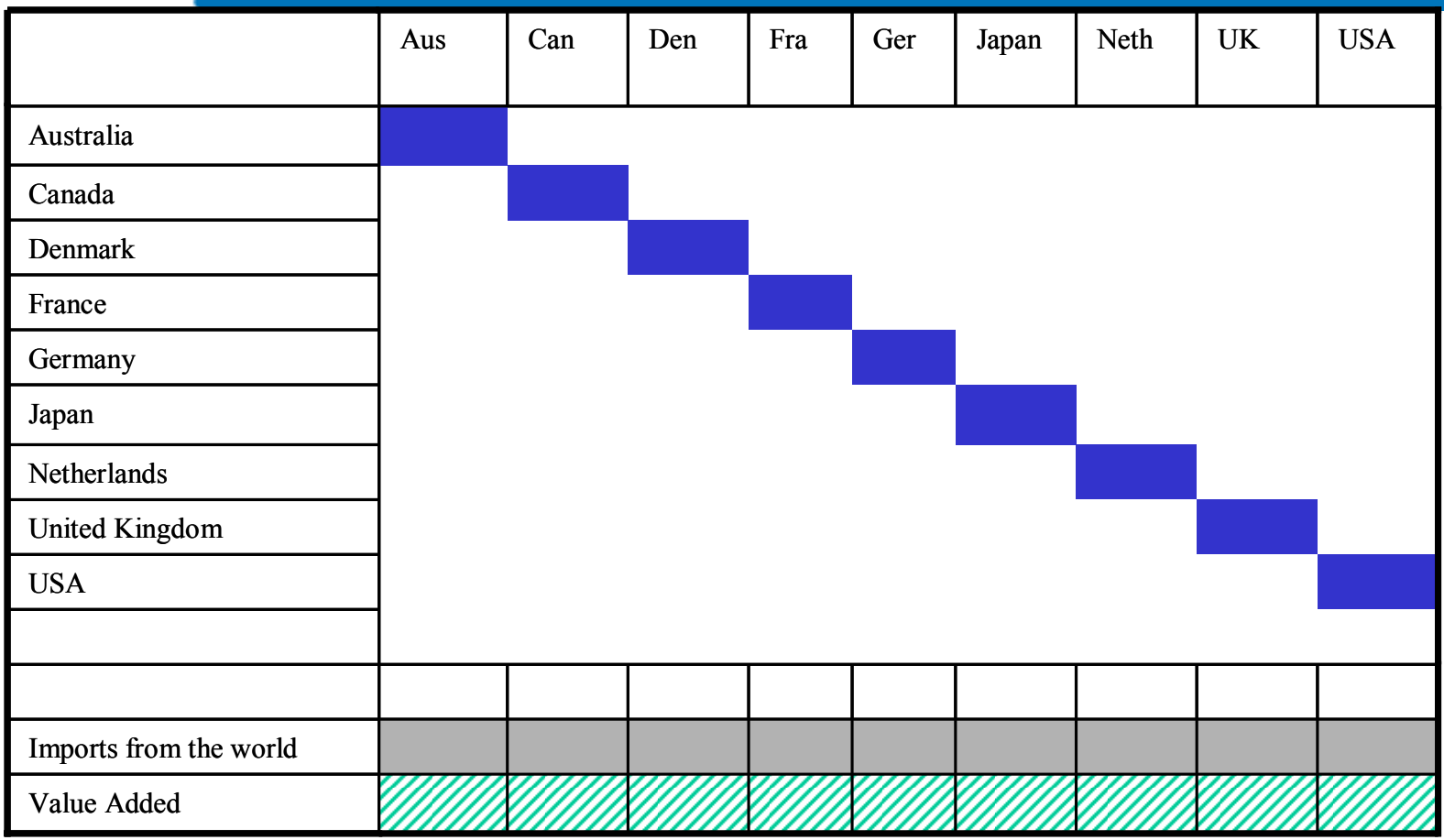
# Multi-regional modelling

- I-O tables provide both domestic and imported supply and use.
- To make them multilateral it is necessary to apply trade ratios to the imports tables to separate them into multiple tables – 1 for each country in the model plus in this case a Rest of the World category.
- My colleague Russel Cooper has developed software to process these tables in terms of 'net value added' rather than the usual I-O production effects approach.

# Standardised multi-regional tables

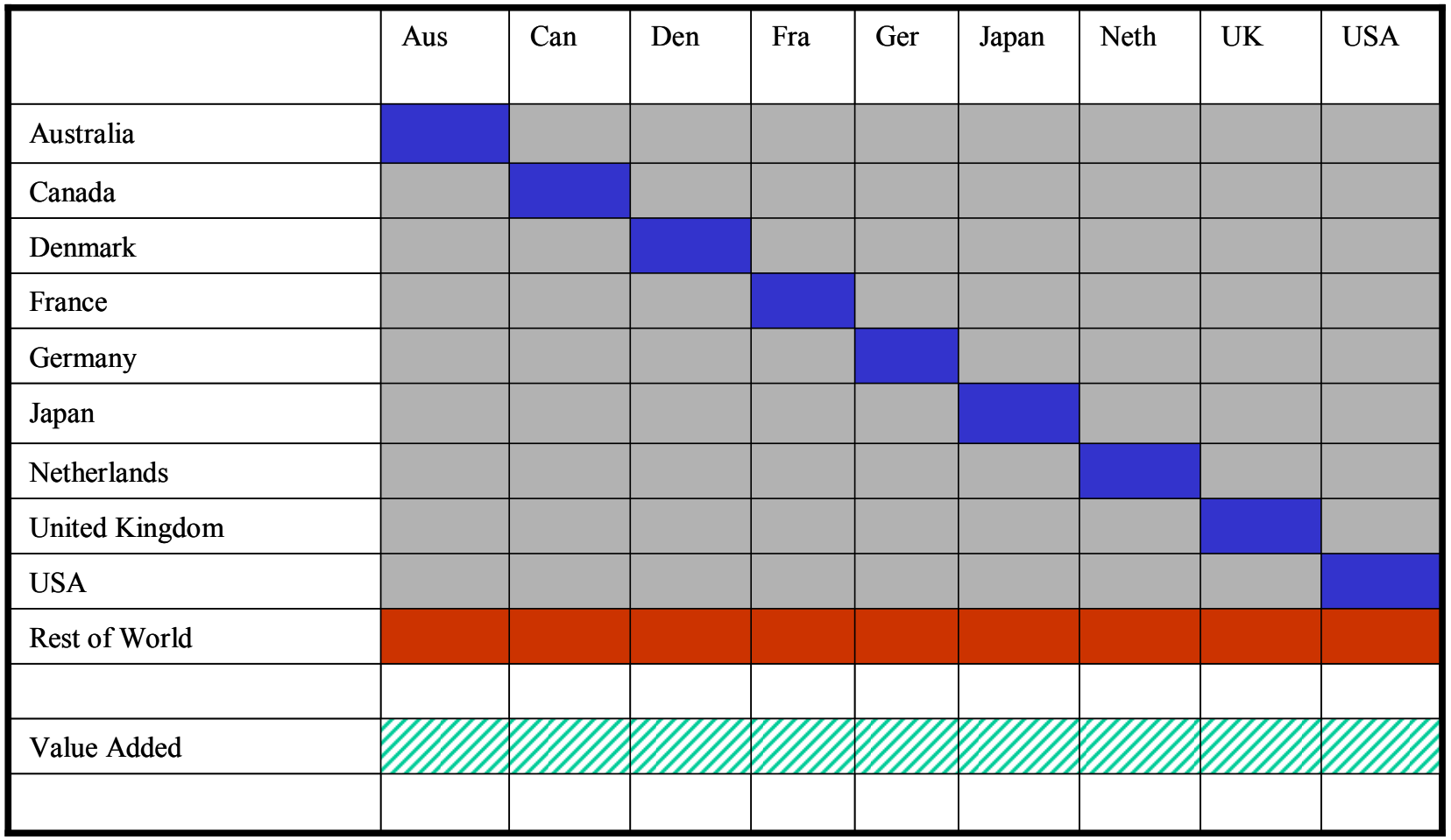
- OECD 1970-1990 (9 countries) [33 industries] ✓
- OECD mid to late 1990s 20 countries [41 industries] (released 2005) ✓
- EU 1995 (14 countries + residual) [25 industries] ✓
- EU 2000 + [15+ *European* countries ]
- EU 1965 & 1985 [6 countries - 25 industries] ✓
- Asia 1970, 1990, … (IDE – Japan)
- Canadian Inter-provincial tables
- Queensland intra-State multi-regional model

# Example of purchased data



| | Aus | Can | Den | Fra | Ger | Japan | Neth | UK | USA |
|---|---|---|---|---|---|---|---|---|---|
| Australia | | | | | | | | | |
| Canada | | | | | | | | | |
| Denmark | | | | | | | | | |
| France | | | | | | | | | |
| Germany | | | | | | | | | |
| Japan | | | | | | | | | |
| Netherlands | | | | | | | | | |
| United Kingdom | | | | | | | | | |
| USA | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| Imports from the world | | | | | | | | | |
| Value Added | | | | | | | | | |

# Finished tables



# The evolution of internationalisation

| Top Importing Clusters | 1970 (9) | 1990 (9) | 2000 (9) ‡ | 2000 (20)* |
|---|---|---|---|---|
| Petroleum & coal products | 9 | 8 | 8 | 14 |
| Office equip & Radio TV & comms | 2 (of 14 series) | 7 (of 14 series) | 11 (of 17 series) | 27 (of 38 series) |
| Motor vehicles | 3 (of 8 series) | 5 (of 8 series) | 5 | 12 |
| Aircraft | 4 | 4 | 5 | 9 |
| Non-ferrous metals | 6 | 6 | 4 | 9 |
| Iron and steel | 4 | | 3 | 8 |
| Shipbuilding & repairing ships | | 1 | 3 | 3 |
| TCF | 5 | 5 | 2 | 2 |
| Industrial chemicals | 2 | 4 | | 2 |
| Other transport | 3 | 2 | 2 | 2 |
| Paper, paper prods & printing | | 1 | | |
| Wood products & furniture | 2 | 1 | 1 | 2 |
| Rubber & plastic products | | 1 | | 4 |
| Other manufacturing | 2 | | | |
| Mining & quarrying | | | 1 | 1 |
| Professional goods | 1 | | | |
| Food, beverages & tobacco | 1 | | | |
| Transport & storage | 1 | | | |
| Pharmaceuticals | | | | 2 |
| Electrical Machinery | | | | 2 |
| Computer services | | | | 1 |
| **Total** | 45 (9 * 5) | 45 (9 * 5) | 45 (9 * 5) | 100 (20 * 5) |

# Internationalisation and technological complexity

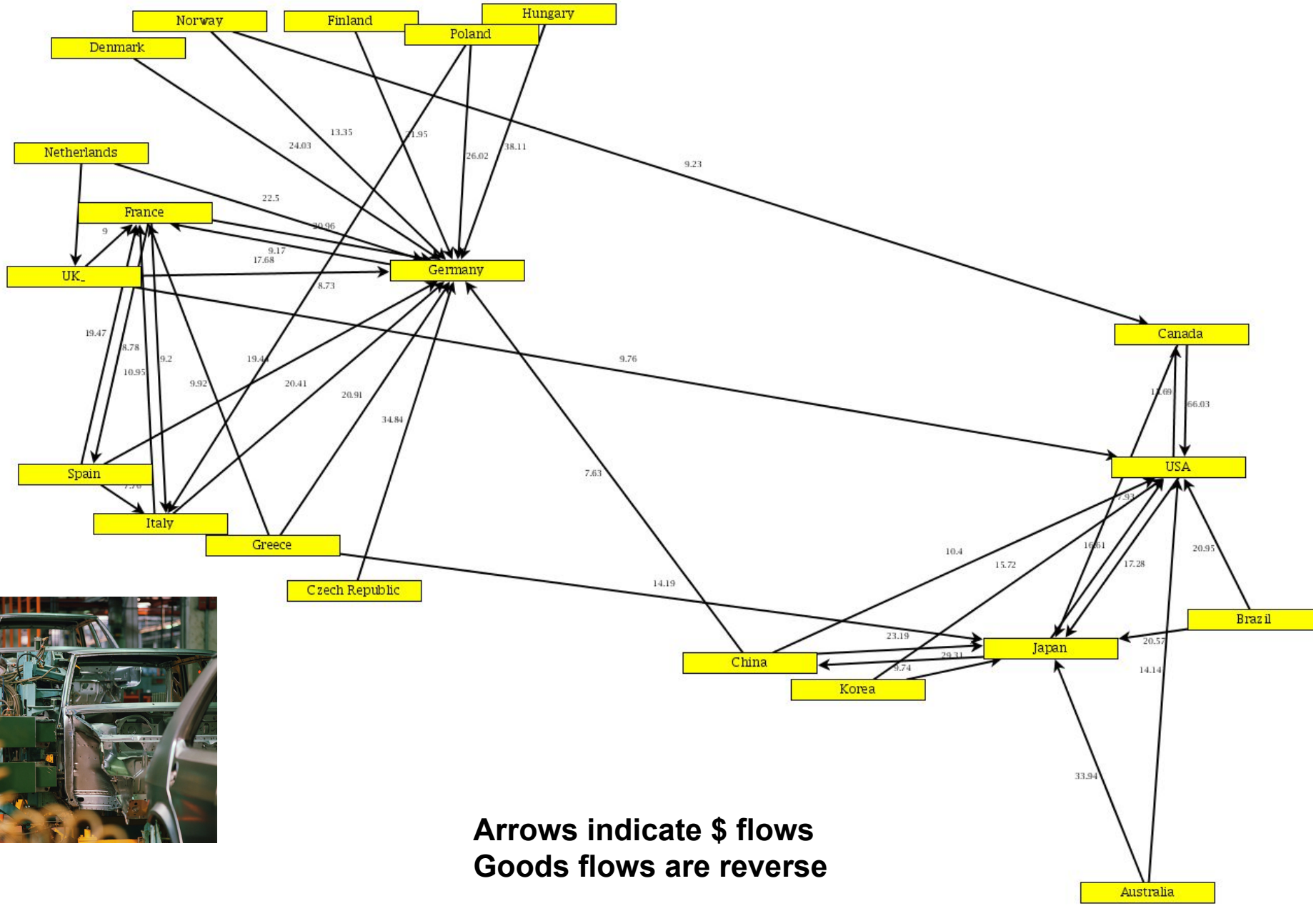
| | 1970 (9) | 1990 (9) | 2000 (9) | 2000 (20) |
|---|---|---|---|---|
| High Technology | 7 | 11 | 16 | 38 |
| Medium-High Technology | 8 | 11 | 7 | 18 |
| Medium-Low Technology | 19 | 16 | 18 | 38 |
| Low Technology | 10 | 7 | 3 | 4 |

Categories are based on the latest OECD technology classification and not the relevant OECD categories for different periods nor an individualised country assessment of technological content.

# Observations on internationalisation patterns

- High technology is increasingly internationalised.
- Medium-High technology is stable to declining.
- Medium-Low technology is relatively stable.
- Low technology is increasingly non-internationalised but it maybe off-shored completely.
- Thus there a gradual move towards greater levels of technological content but almost entirely due to the effect of ICT related mfg imports.

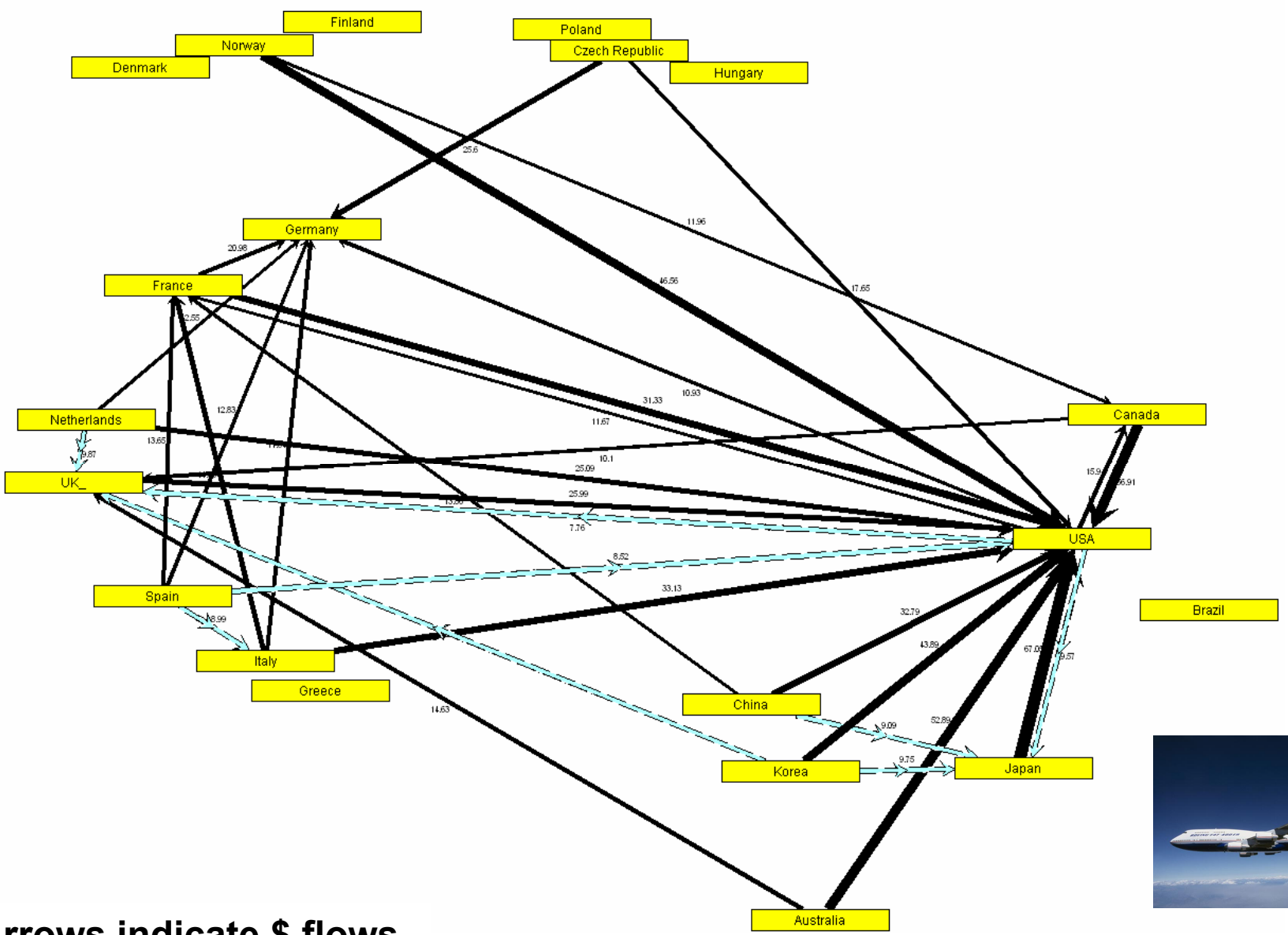
# Dependency spatial structure – motor vehicles






**Arrows indicate $ flows**
**Goods flows are reverse**

# Dependency spatial structure - aerospace






**Arrows indicate $ flows**
**Goods flows are reverse**

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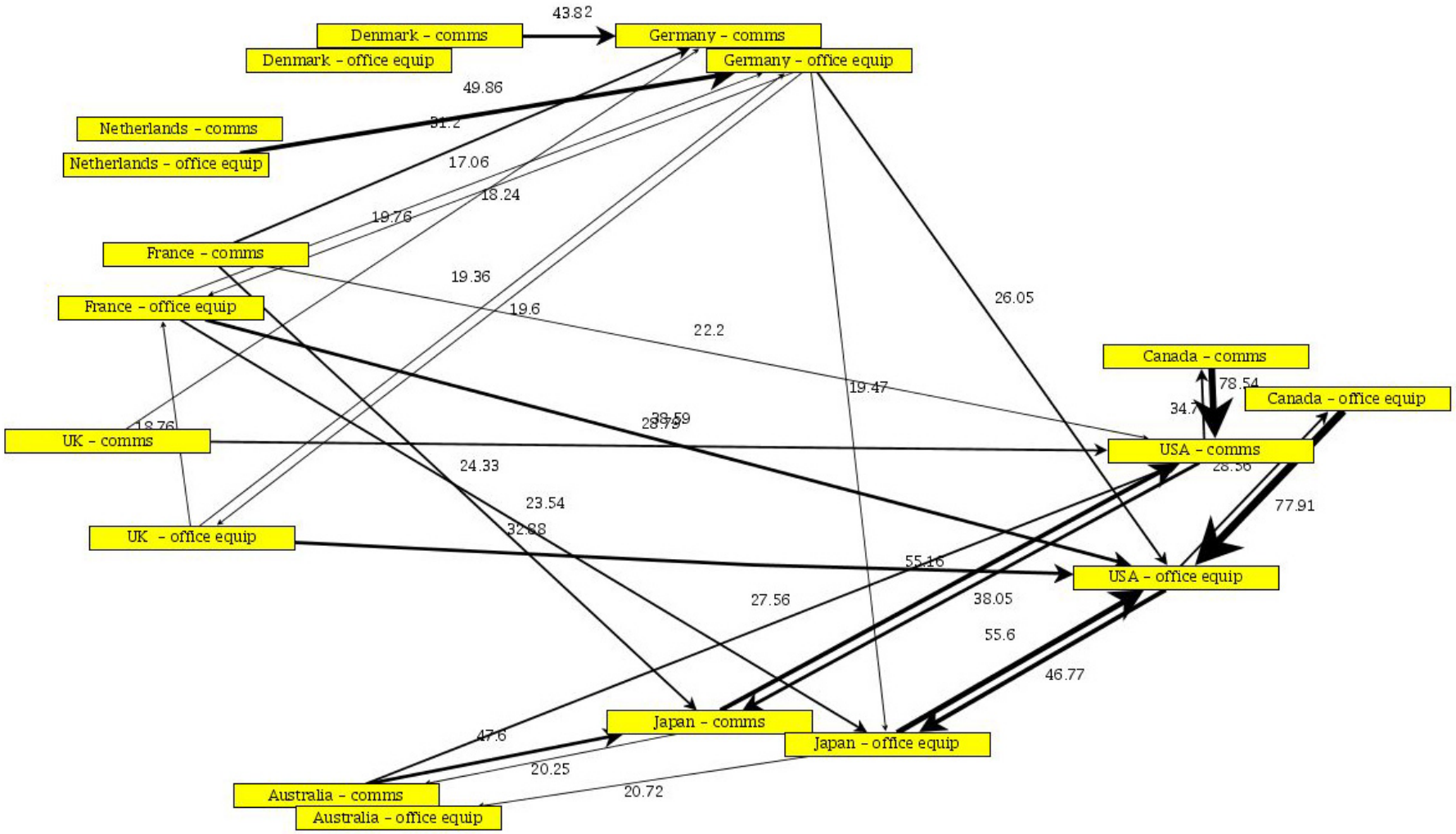
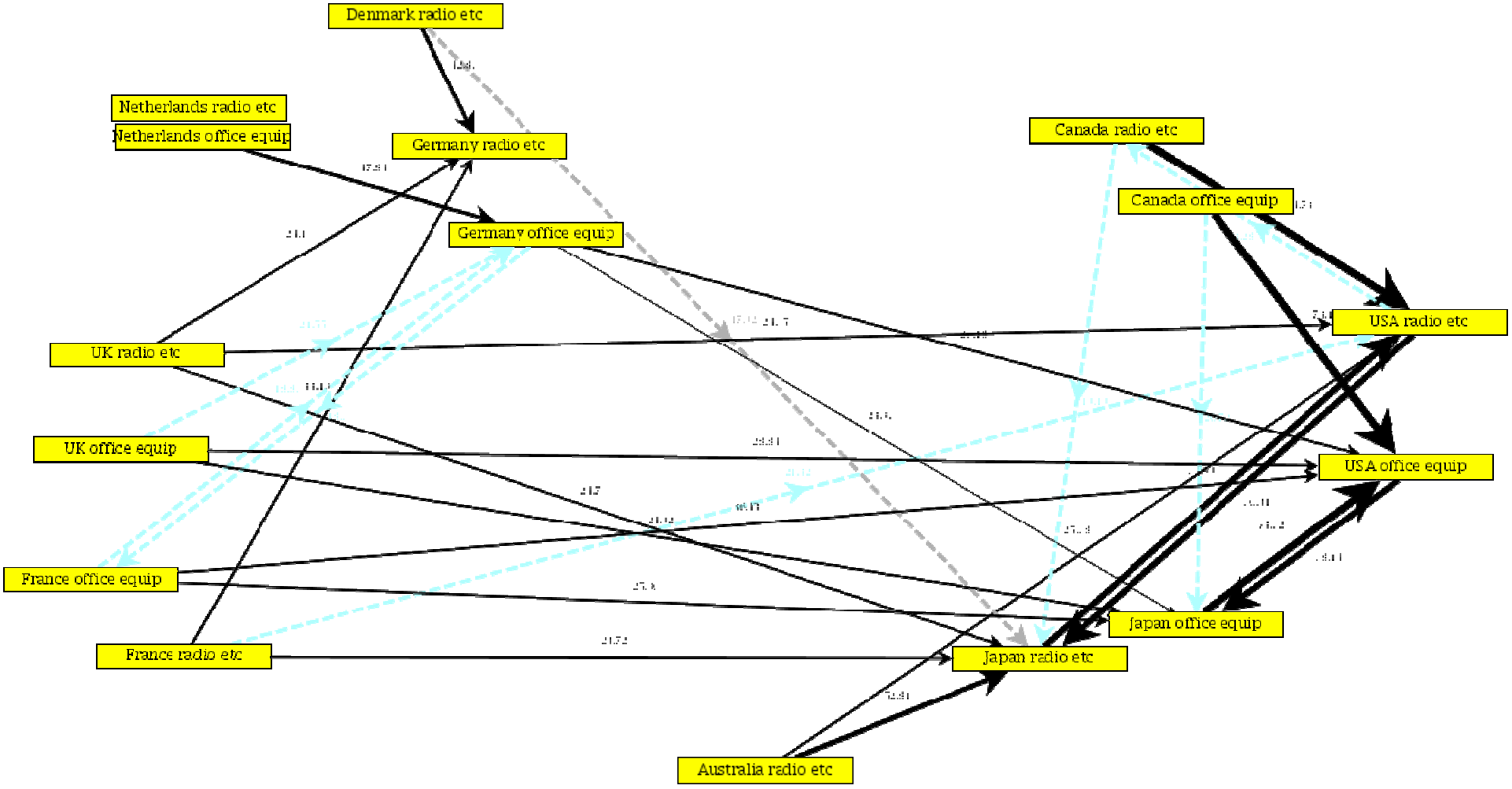
# Dependency spatial structure – ICT 1970

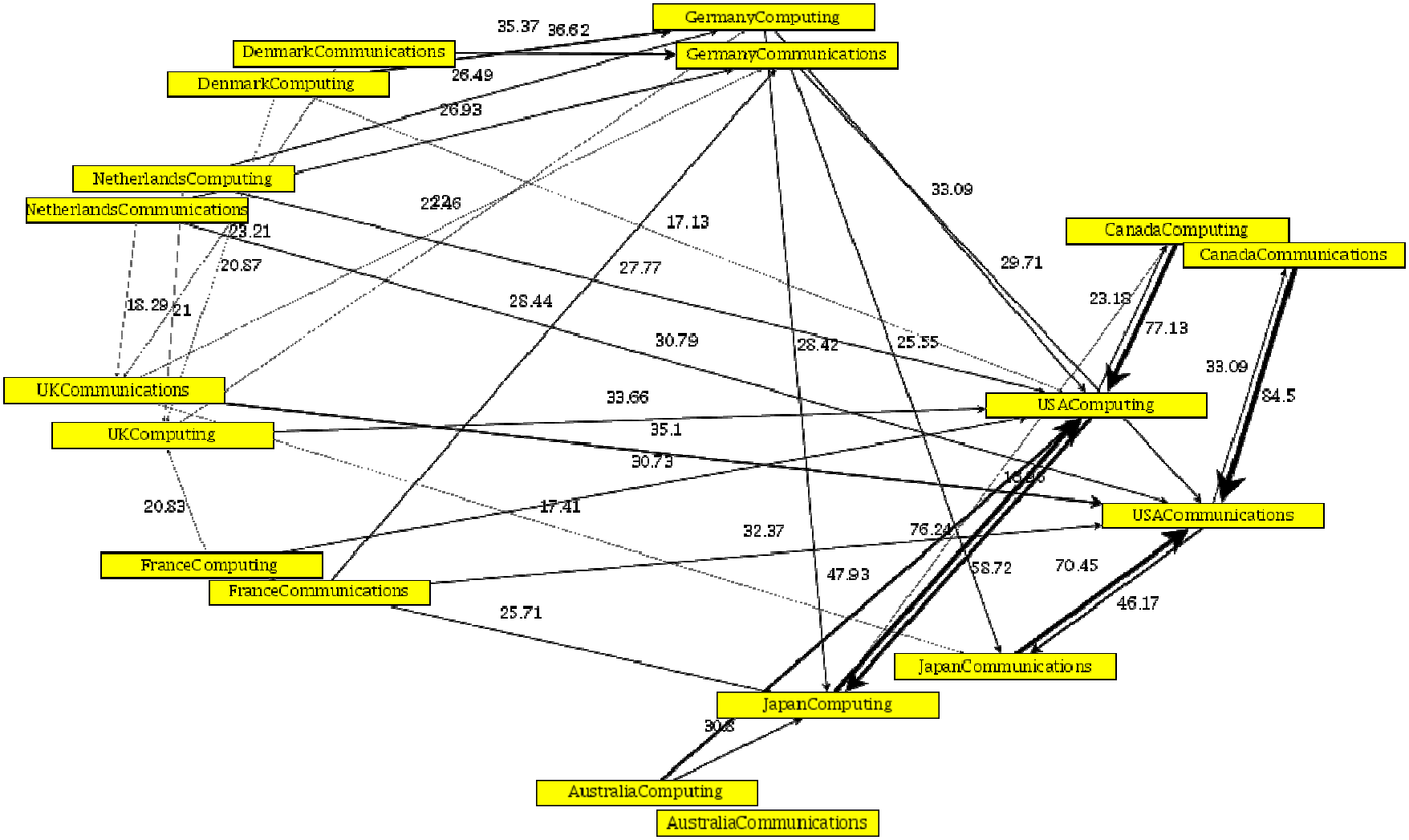



**Arrows indicate $ flows**
**Goods flows are reverse**

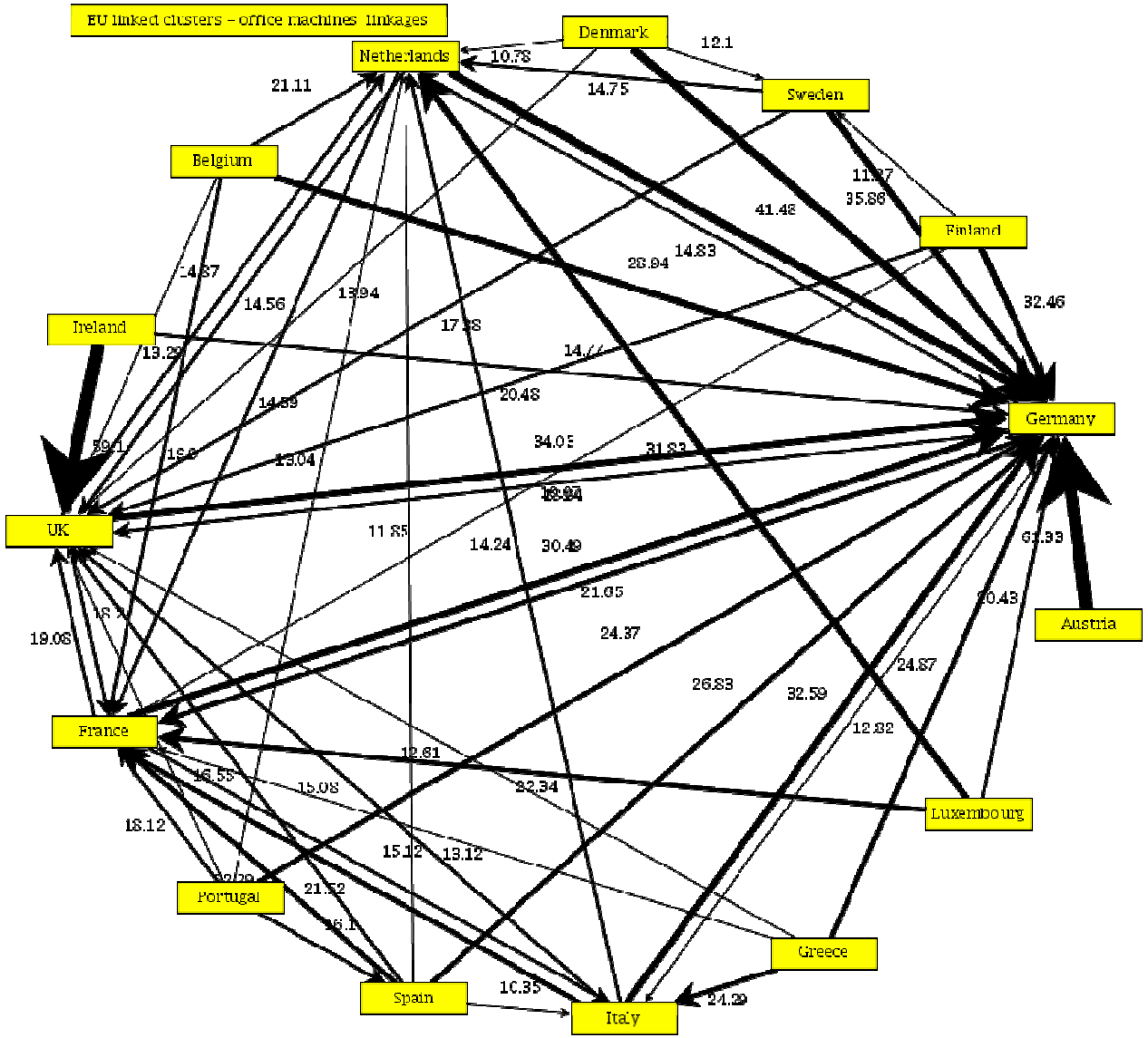
# Dependency spatial structure – ICT 1990



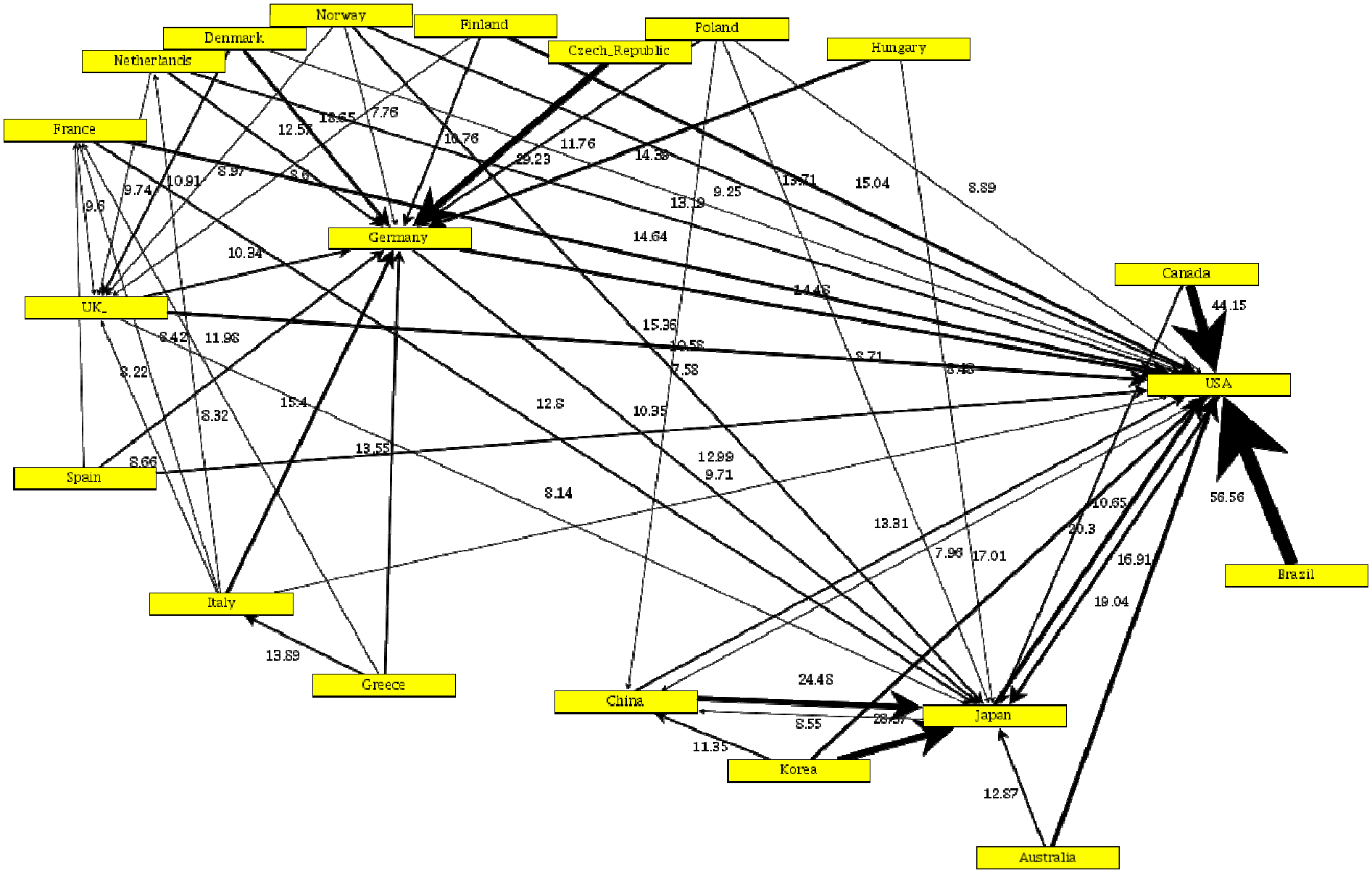
# Dependency spatial structure – ICT 2000 (a)



# Dependency spatial structure – Office equip EU 1995



# Dependency spatial structure – ICT 2000 (b)

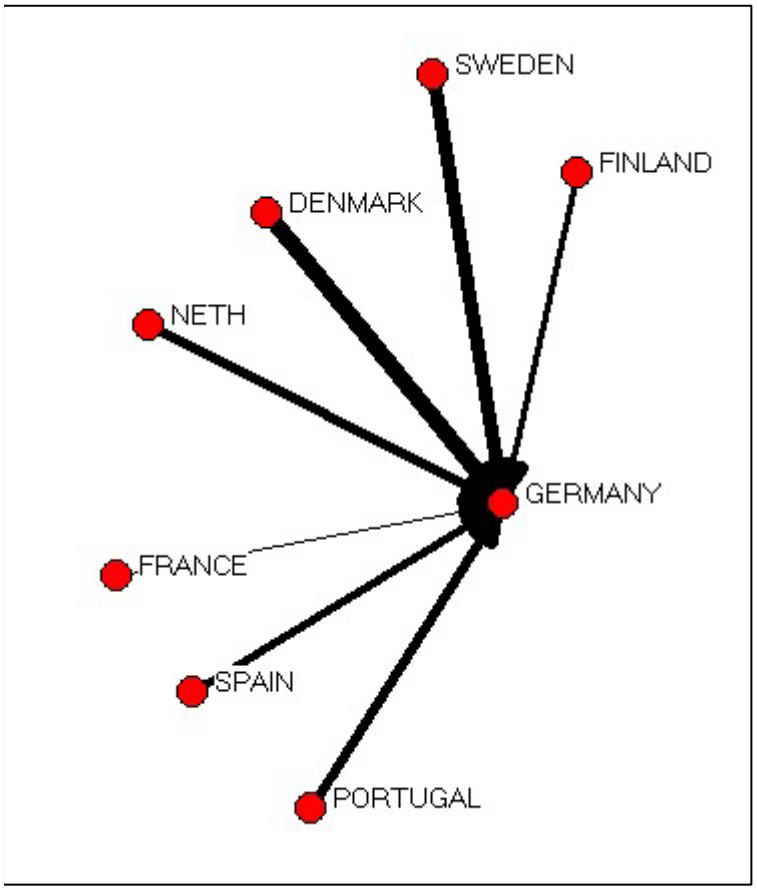


# Multi-configuration technologies (ICT)

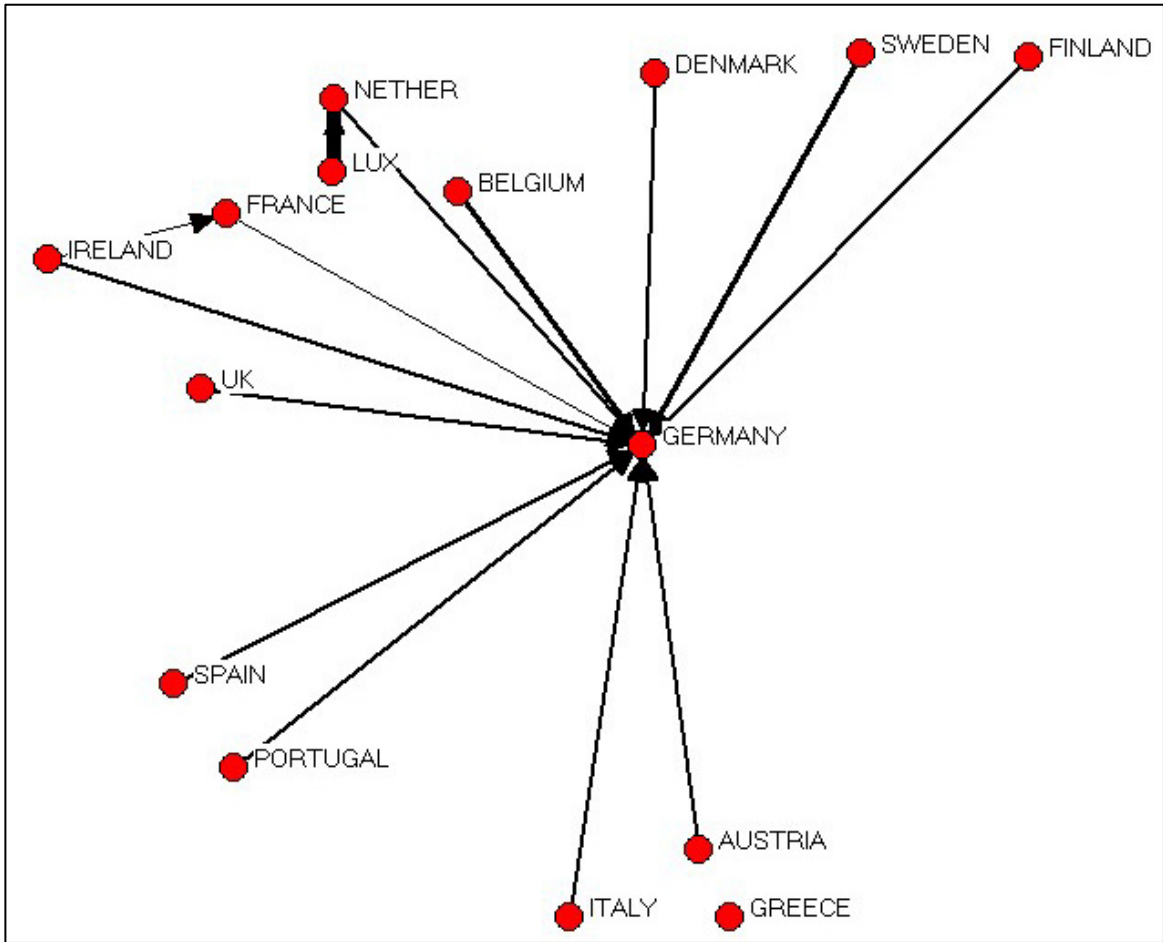
- In analysing the 1970, 1990 and 2000 inter-country input-output models it is apparent that:
- Intermediate imports as a share of value added have increased significantly;
- The level of reliance on key bilateral trade relationships has weakened but remain;
- Typically new relationships have been added to the existing networks.

# Gains from trade (EU 1995)

**Transport sector**




**Office equip**



# Assembly vs multi-configuration technologies

- Assemblers – (aerospace and motor vehicle) strong central nodes in distinct systems.
  - For auto: Germany in Europe and Japan and the USA in the Asia-Pacific - North America system.
  - Auto production is increasingly modular, but hub hierarchies not weakening.
  - Aerospace: the USA is a key hub economy for components. France, Germany, the UK and Japan - emerging as second tier producers.
- ICT
  - hub economies present but structure more varied.

# Implications & Conclusions

- In terms of intermediate goods, it is the technologically intensive products that are requiring greater levels of inputs.
- Much of this trade is between advanced economies, but with ICT the East Asian economies are significant players.
- Manufacturing clusters exist within value chains that have particular spatial structures.
    - This is at least true for *national* clusters and I would hypothesise is also true regionally.
- Assembler industries and multi-configuration technology industries have different spatial dynamics.
- Public policy for clustering should not ignore global strengths, weaknesses and niches.

# Future research

- Value chains Research
  - Production geography (clustering & fragmentation)
  - Knowledge geography
  - Business networks
- What is the role of large businesses in structuring their markets (opportunities, threats, suppliers, technological capabilities etc) and the role of clusters in fostering new capabilities and technologies?
- In the strategies of the mega-corporations when do clusters compete and when are they complementary?
- What are the policy implications of strong networks for advanced & developing countries?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