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THE IMPORTANCE OF MEASURING BUSINESS USE OF ICT

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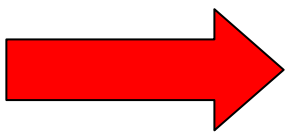
Why measuring business use of ICT?

- Assess take up and diffusion
  - … and compare with other countries
- How does the Internet change the way businesses run their operations
- Impacts on overall economic performance (productivity, growth, etc.)
  - … and compare with other countries



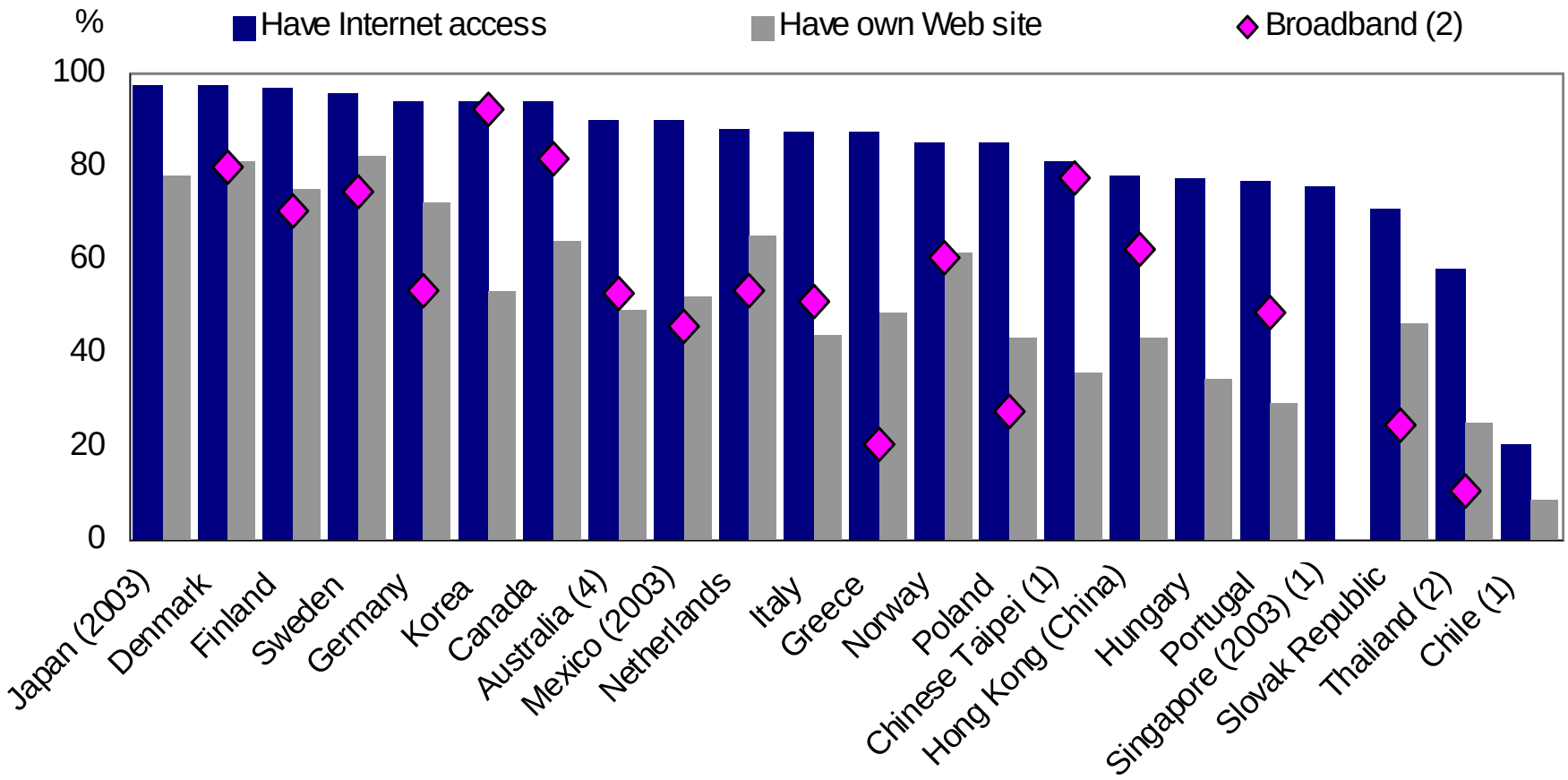
Policymakers need this information to make sound decisions

The state of ICT diffusion

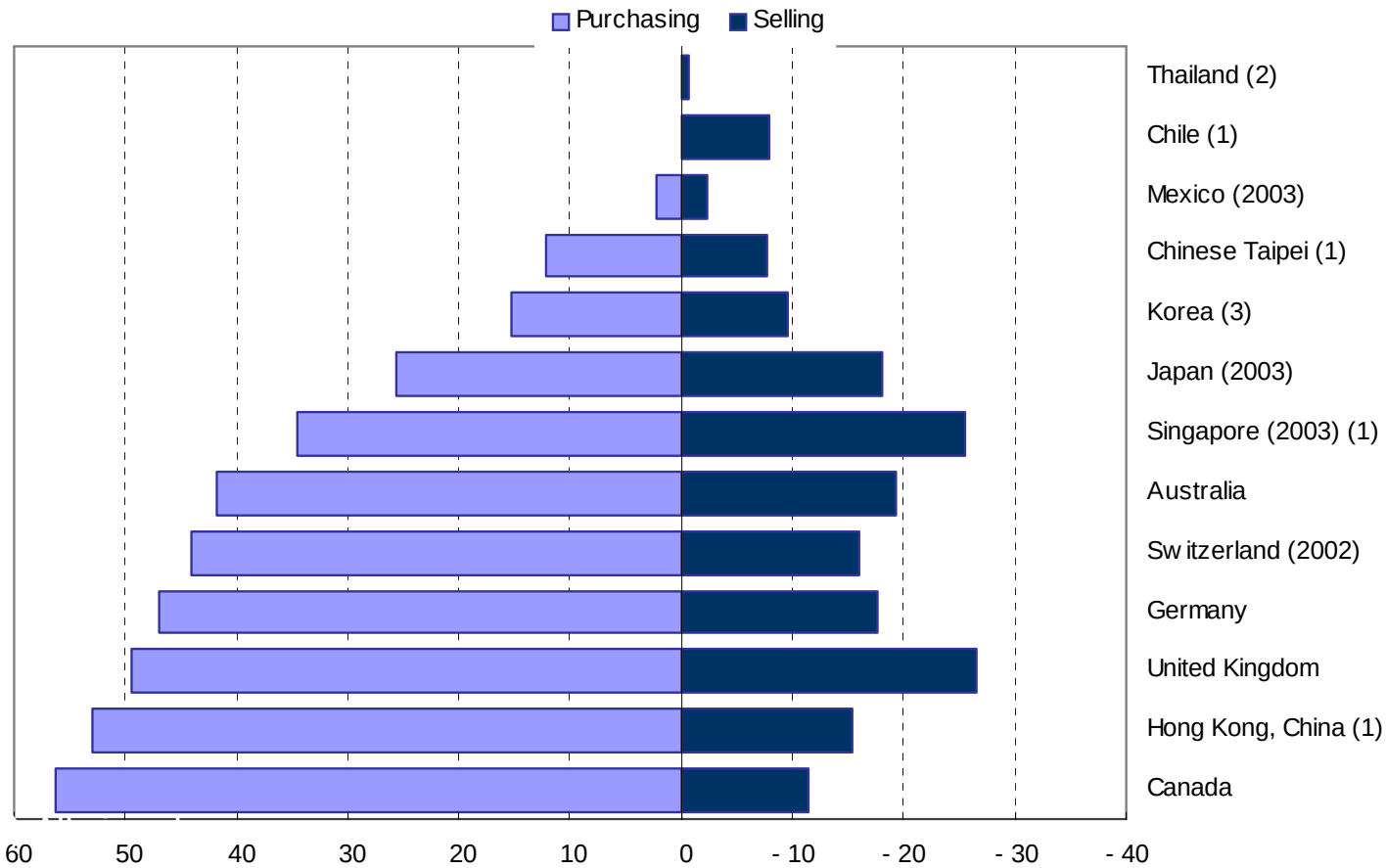
ICT diffusion among OECD- and non-OECD countries

- Diffusion can be measured by activity and financial statistics.
- OECD has been collecting activity statistics on ICT use and e-commerce from member countries for several years and first published data in 2001 (“OECD Science, Technology and Industry Scoreboard: Towards a Knowledge-based economy”).
- The most recent version of this publication has been the 2005 edition.

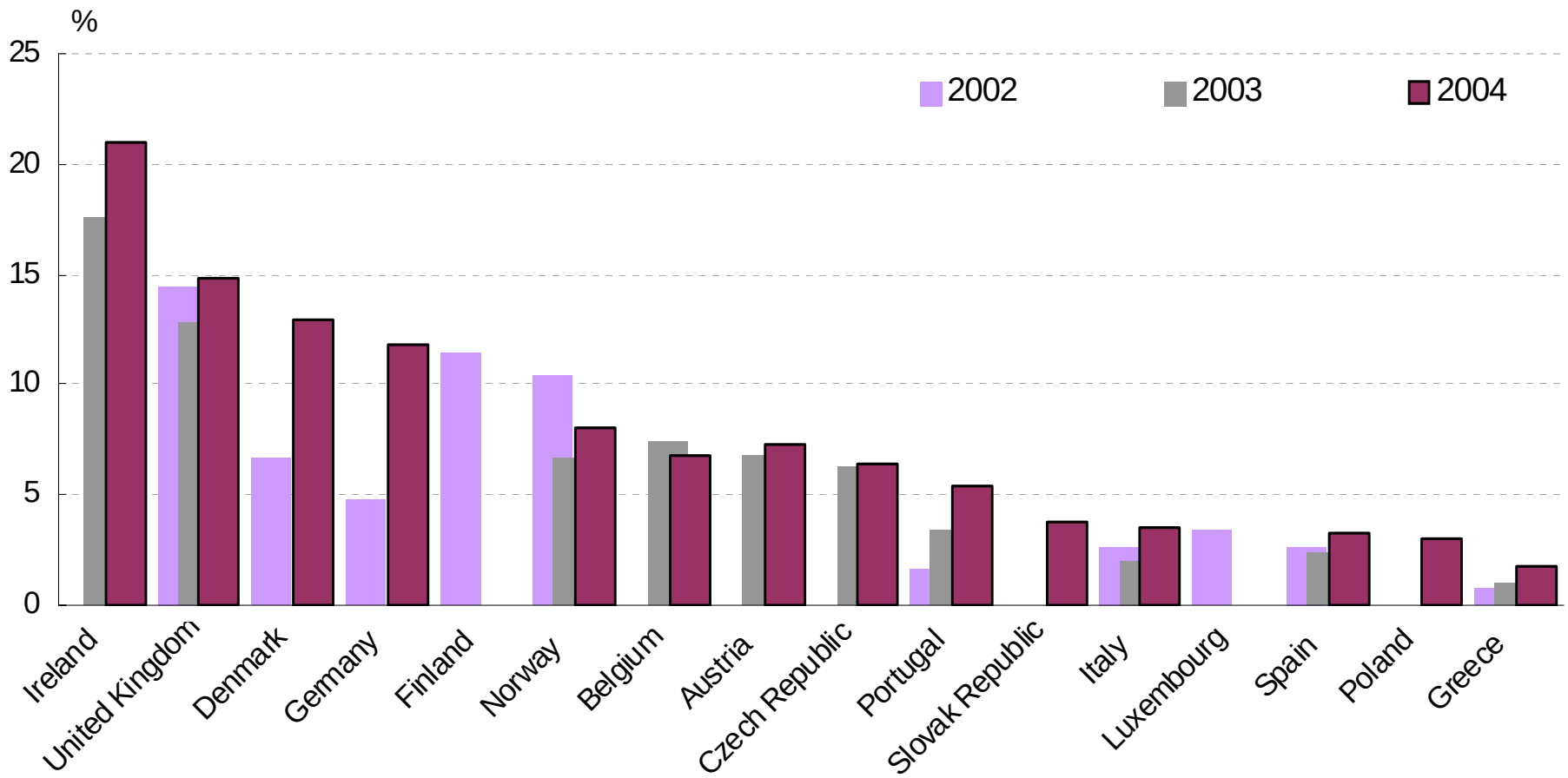
Business use of the Internet, 2004, Percentage of businesses with 10 or more employees



Internet selling and purchasing, 2004, Percentage of businesses with 10 or more employees



Total e-commerce transaction value (including via the Internet), 2002 to 2004. As a percentage of total enterprise turnover

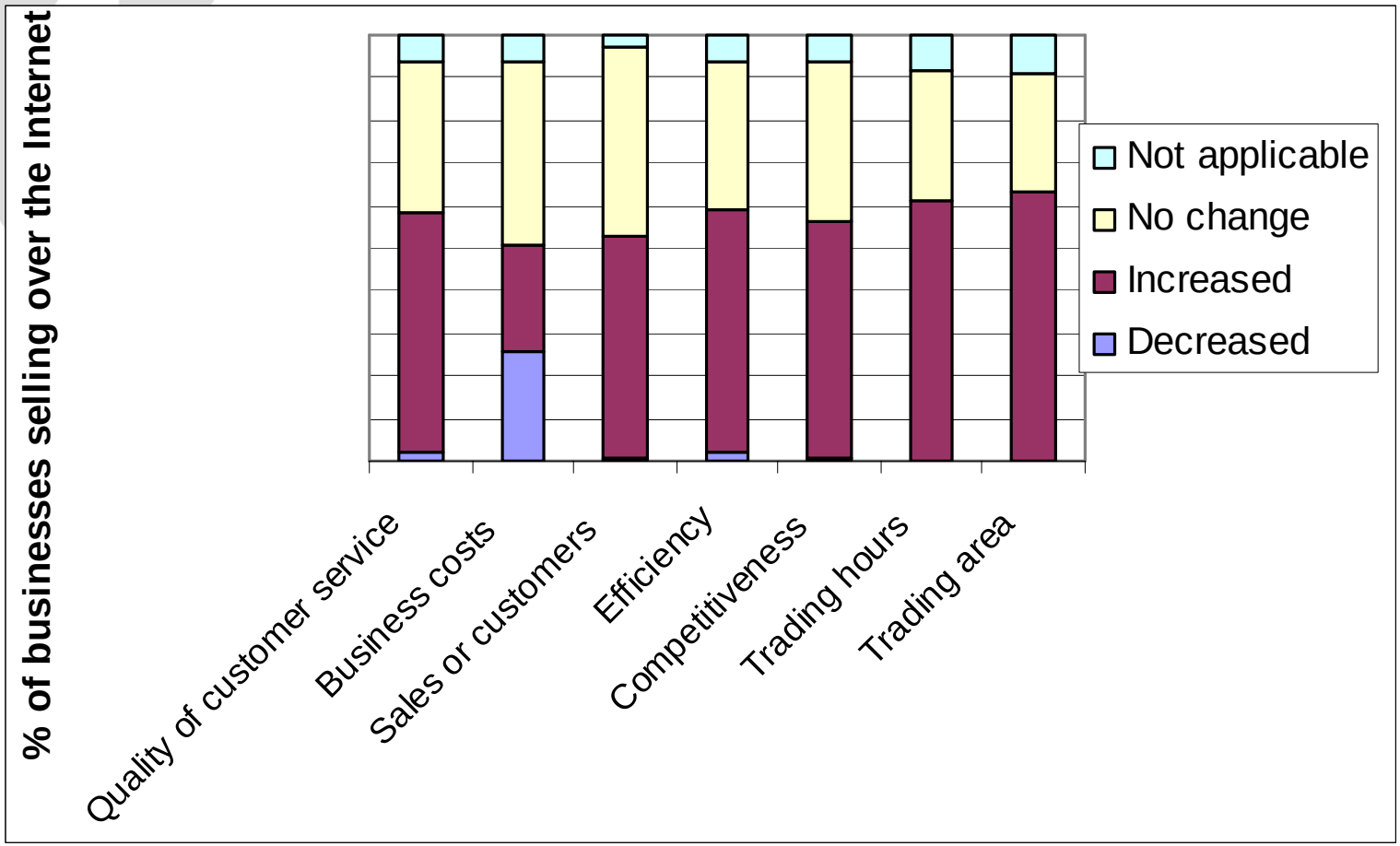


Business perceptions of the benefits of buying and selling over the Internet

Business perceptions of the benefits of buying and selling over the Internet

- Australian Bureau of Statistics data show that businesses which buy and sell over the Internet perceive benefits from doing so.
- The longer a business has been buying or selling over the Internet, the more likely it is to report benefits
  - first mover advantage?
  - survival of the fittest (those which are still selling are those which have succeeded and therefore are more likely to see benefits)?
  - or just getting better at it over time?

AUSTRALIA (ABS): BUSINESS PERCEPTIONS OF THE IMPACT OF RECEIVING ORDERS (SELLING) VIA THE INTERNET, 2000–01



OECD case study work on the impacts of e-business

OECD case study work: Electronic Commerce Business Impact Project (EBIP)

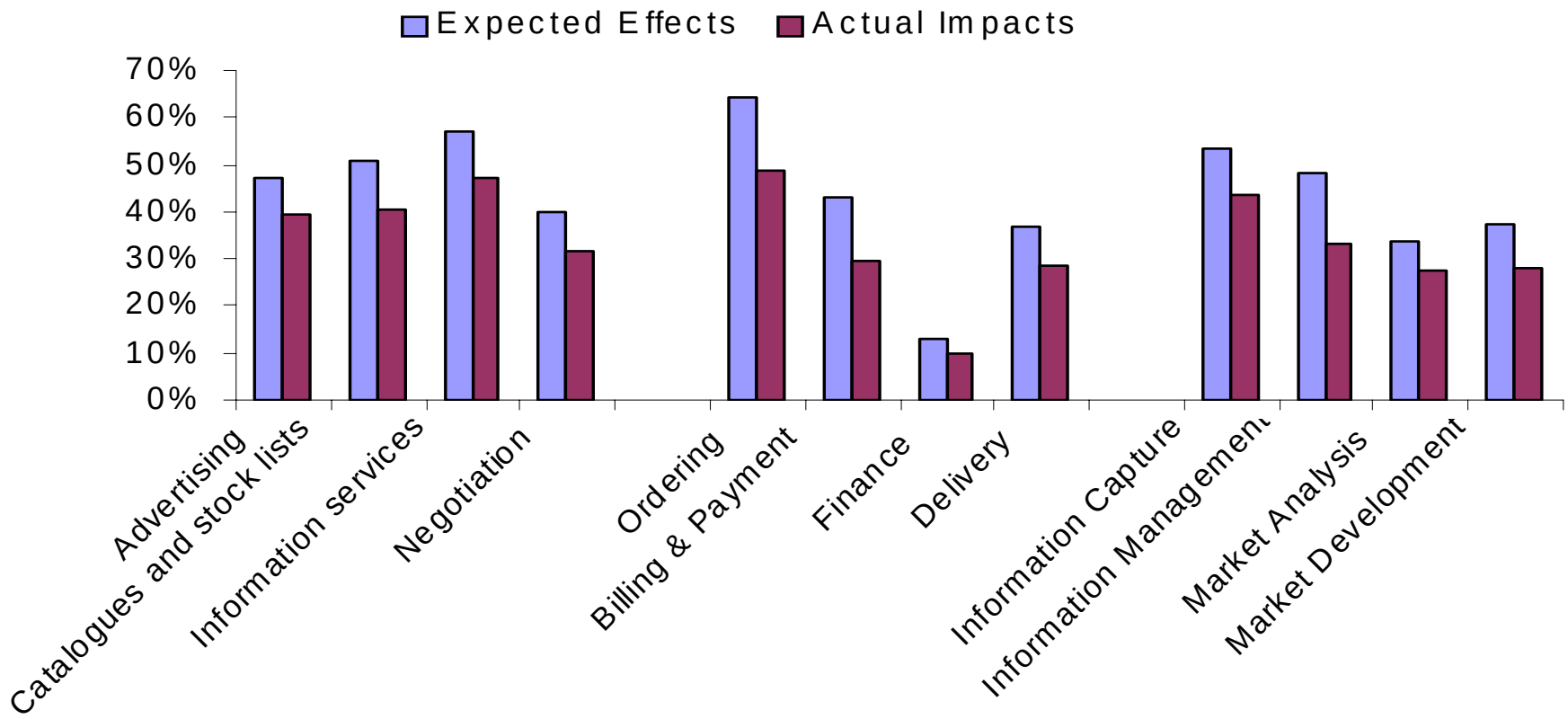
- During 2001-2002, the OECD co-ordinated a case study project on the impacts of electronic commerce on business. The study involved nearly 220 firms across 11 countries and a common methodology was used across 14 broad sectors.
- Participants: Canada, France, Italy, Korea, Mexico, the Netherlands, Norway, Portugal, Spain, Sweden, the United Kingdom.
- The aim of the project was to improve understanding of impacts of electronic commerce on business.
- EBIP used common methodology for firm-level case studies to improve cross-country and cross-sector comparability.
- Previous case study information is anecdotal, fragmented, not comparable across sectors or countries.

What is more important the ‘commerce’ factor or the ‘e’ factor?

- Successful e-commerce strategies led by commercial considerations.
- E-commerce part of larger business and economic transformations. Successful application and use are embedded in broader business strategies with major emphasis on both e-commerce and ICT skills.
- But e-commerce a major business innovation that most firms will have to adopt.

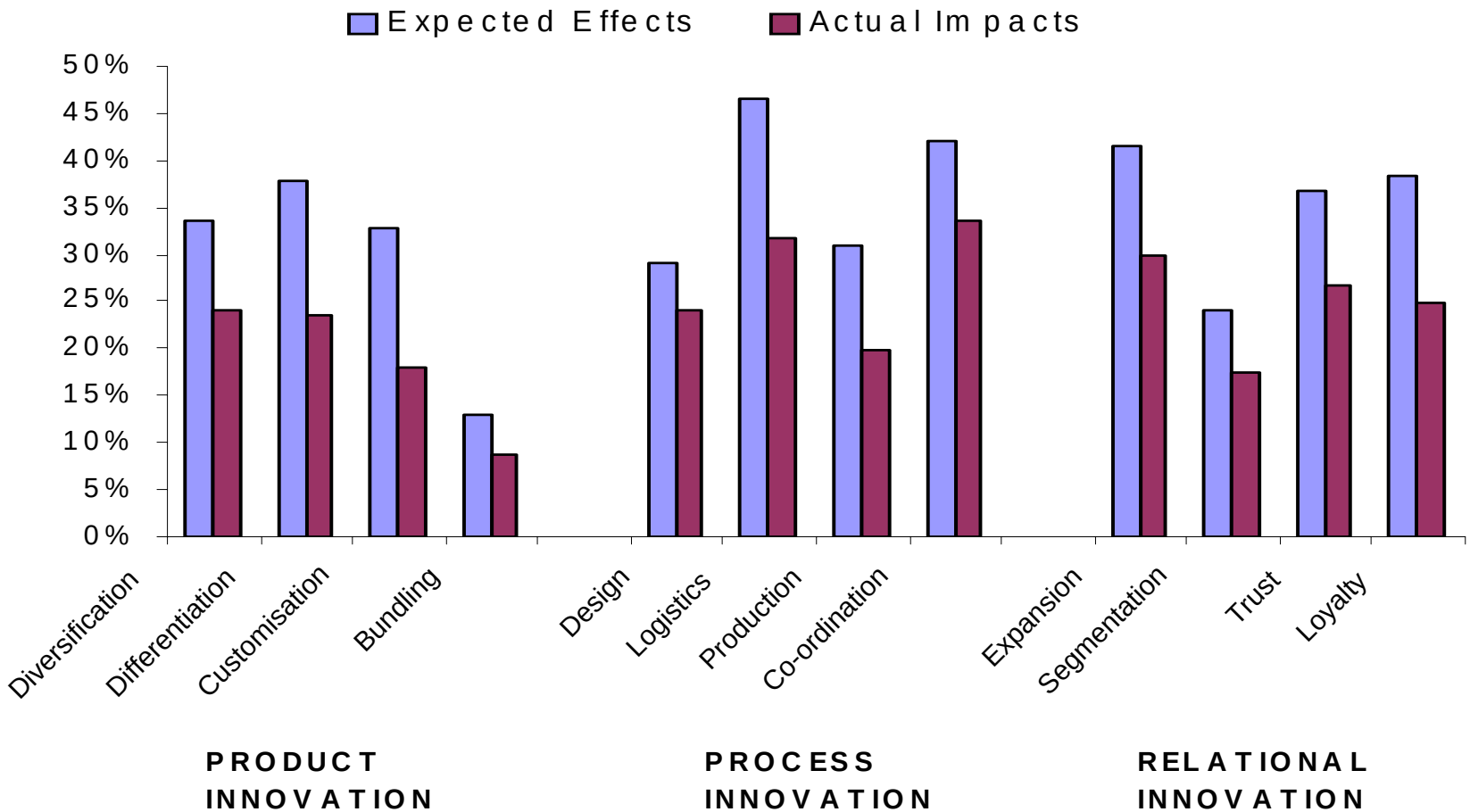
Overall the Internet is having large impacts on how firms conduct business

Expected/actual e-commerce impacts by business function

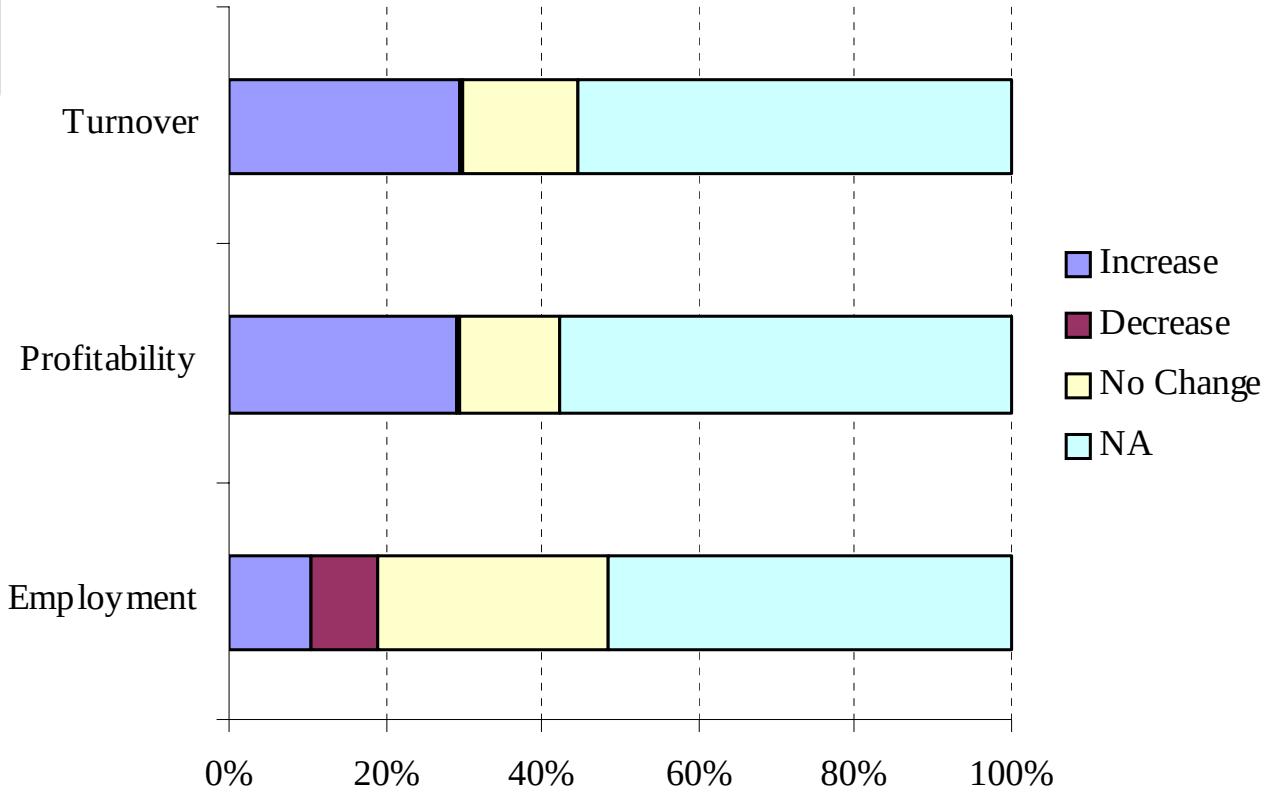


.. Reshaping many business processes

Expected/actual e-com process impacts by business process



.. With generally positive benefits: one-third of firms had positive impacts on turnover or profitability



Analysing the impacts of ICT

OECD Growth Project

- A two year study on the reasons for differences in underlying economic growth of OECD member nations during the 1990s.
- Final report released in 2001 - “The New Economy: Beyond the Hype”.
- General findings were that:
  - ICT is a key technology with the potential to transform economic and social activity.
  - But it is not the only factor, others are:
    - quality of human capital
    - providing more scope for entrepreneurs to explore business opportunities
    - support for innovation
    - getting the fundamentals right – sound macro-economic management, openness to trade and investment, efficient markets, well functioning economic and social institutions.

OECD Growth Project (continued)

- ICT plays three roles
  - Through capital deepening, as ICT is an important asset in overall business investment.
  - Through multi-factor productivity growth in the production of ICT goods and services (e.g. technological progress in semi-conductors).
  - Through MFP growth thanks to the use of ICT, either through efficiency gains in individual firms, or through network/spillover effects from its use.

OECD Growth Project (continued)

- Findings in respect of ICT considered both ICT production and consumption and were as follows:
  - Productivity in the ICT sector can improve economic productivity overall, but
  - … successful economies were more likely to have rapid diffusion of ICT, particularly in service industries.
  - Deregulation of ICT industries encourages competition and greater investment in ICT.
  - Policies which build confidence – an appropriate regulatory and legal environment and government leading by example – are important.

OECD Growth Project (continued)

- In respect of ICT particularly, the policy recommendation from the final report was that:
  - "ICT is an enabling technology, that is transforming economic activity.
  - Governments should:
    - focus policy efforts on increasing the use of new technology
    - increase competition and continue with regulatory reform in the telecommunications industry to enhance the uptake of ICT
    - ensure sufficient competition in hardware and software to lower costs
    - build confidence in the use of ICT for business and consumers; and, make e-government a priority."

More recent analytical work on ICT by the OECD and others

Much better evidence on the economic impacts of ICT at three levels of analysis

- through macro-economic evidence on the role of ICT investment in capital deepening
- through sectoral analysis showing the contribution of ICT-producing sectors and ICT-using services to productivity growth
- and through detailed firm-level analysis that has demonstrated the wide-ranging impacts of ICT in the economy, even in sectors where sectoral data suggested that little was happening – this result is thanks to work in 13 OECD countries.


The Economic Impact
of ICT

The data on ICT have improved

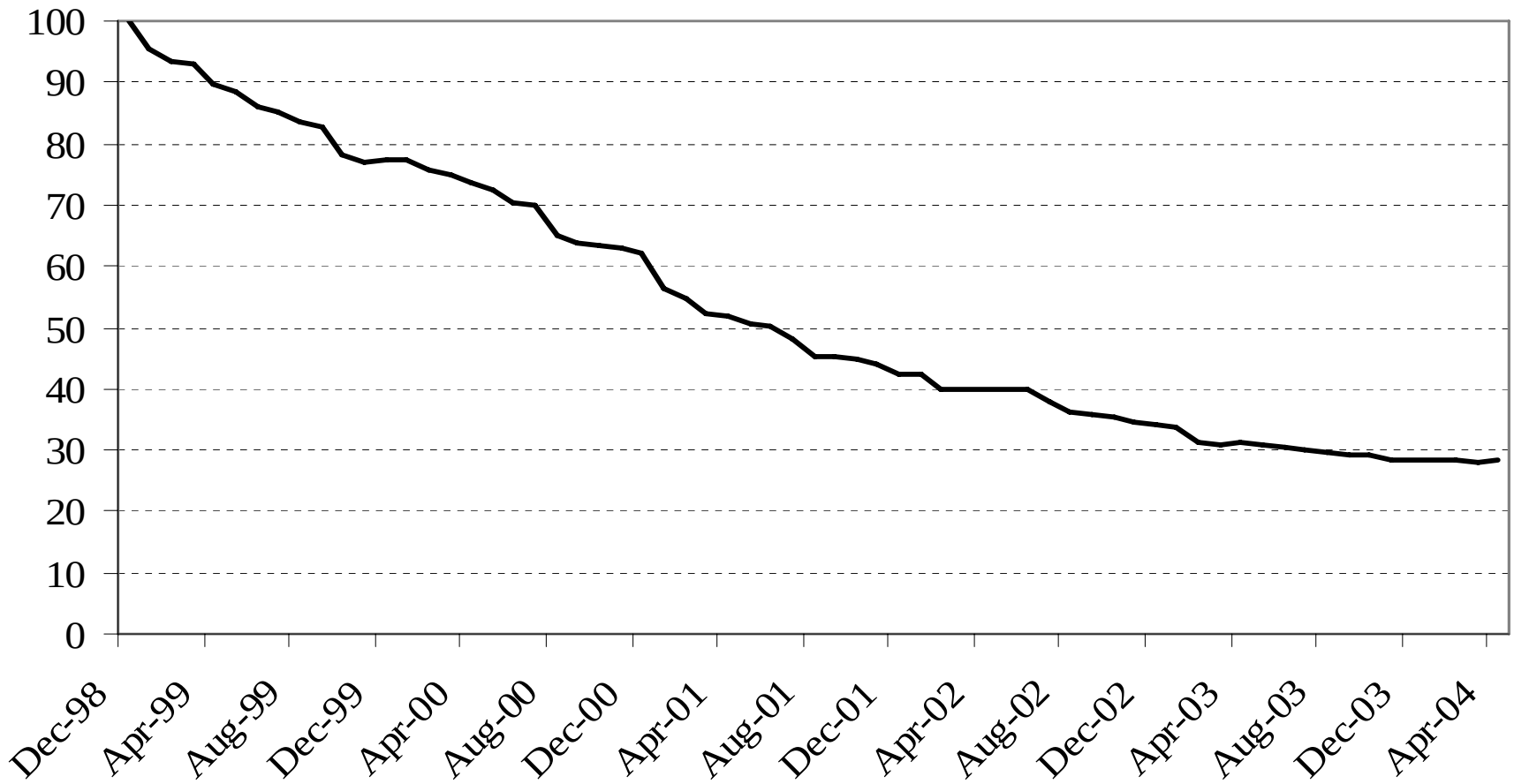
- Early 1990s: mainly private data, sometimes with poor coverage, sample bias, and unknown quality.

- Now:
  - Surveys on ICT use by households and businesses in most OECD countries, with considerable detail on uses and technologies.
  - Official estimates of ICT investment, including software.
  - Industry data for many countries.
  - Growing comparability of data.
  - Efforts to establish longitudinal (linked) databases in many countries.

- Greater prospects for empirical research on ICT.

Prices have fallen…

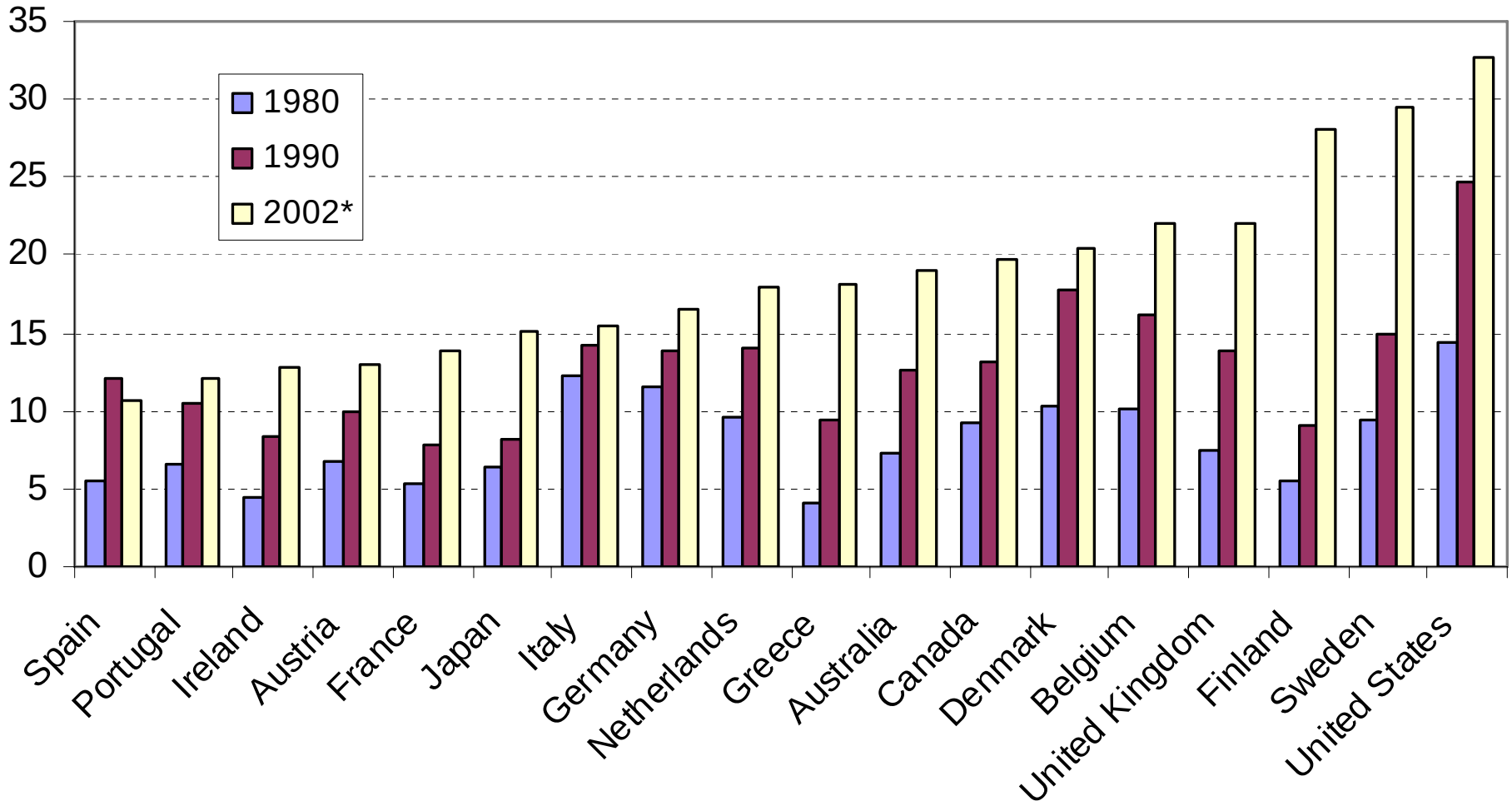
(producer price index for PCs and workstations, 1998=100)



Source: BLS.

But countries have not invested to the same extent…

(ICT investment as % of non-residential investment)



Source: OECD Database on Capital Services, March 2004.

Why the differences in growth from ICT?

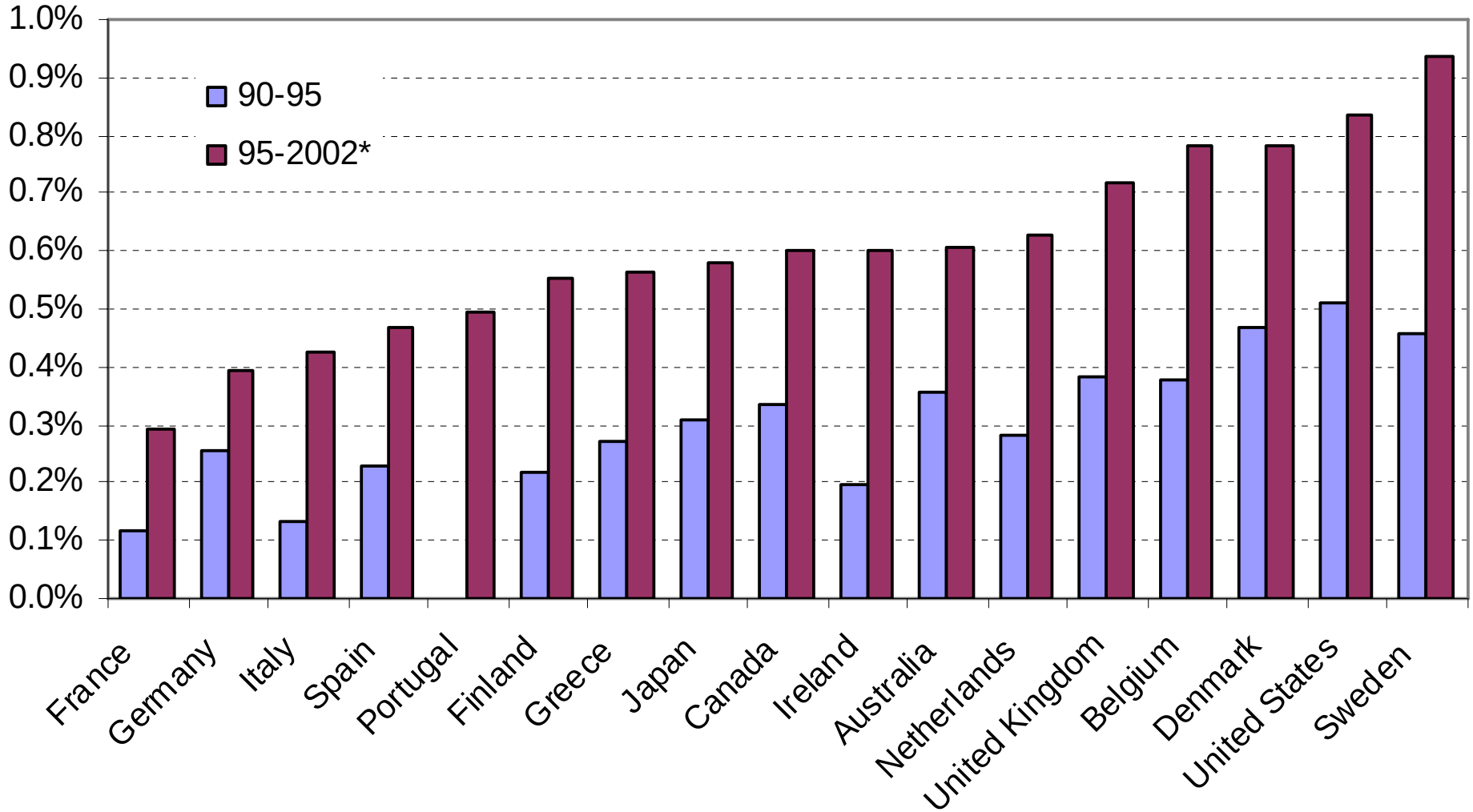
- Returns (& investment) in ICT depend on other factors:
  - Skills, innovation, organisational changes.
  - Not all firms succeed – experimentation and selection play a role – can successful firms gain market share?
  - The scope for change depends on the business environment; impacts in the US seem larger, perhaps because of greater scope for innovation and organisational change.
- Competition matters:
  - Competition forces firms to enhance efficiency.
  - Firms that invest first/most in ICT are often new or foreign.
  - Competition reduces the costs of ICT & fosters diffusion.
- Structural factors – share of services and of large firms.

Aggregate impacts of ICT investment

- Mainly analysed through standard growth accounting approach, based on capital services:
  - Requires long time series of ICT investment.
  - For international comparisons – use of hedonic deflators for all countries to enhance comparability of results.
- Official data on ICT investment are now available for 15-20 OECD countries.
- Still some measurement problems, e.g. as regards software investment.

The US and small EU countries have had a large contribution of ICT investment, France, Germany and Italy a small one

(contribution to GDP growth, in percentage points)



Source: OECD Productivity Database, May 2004.

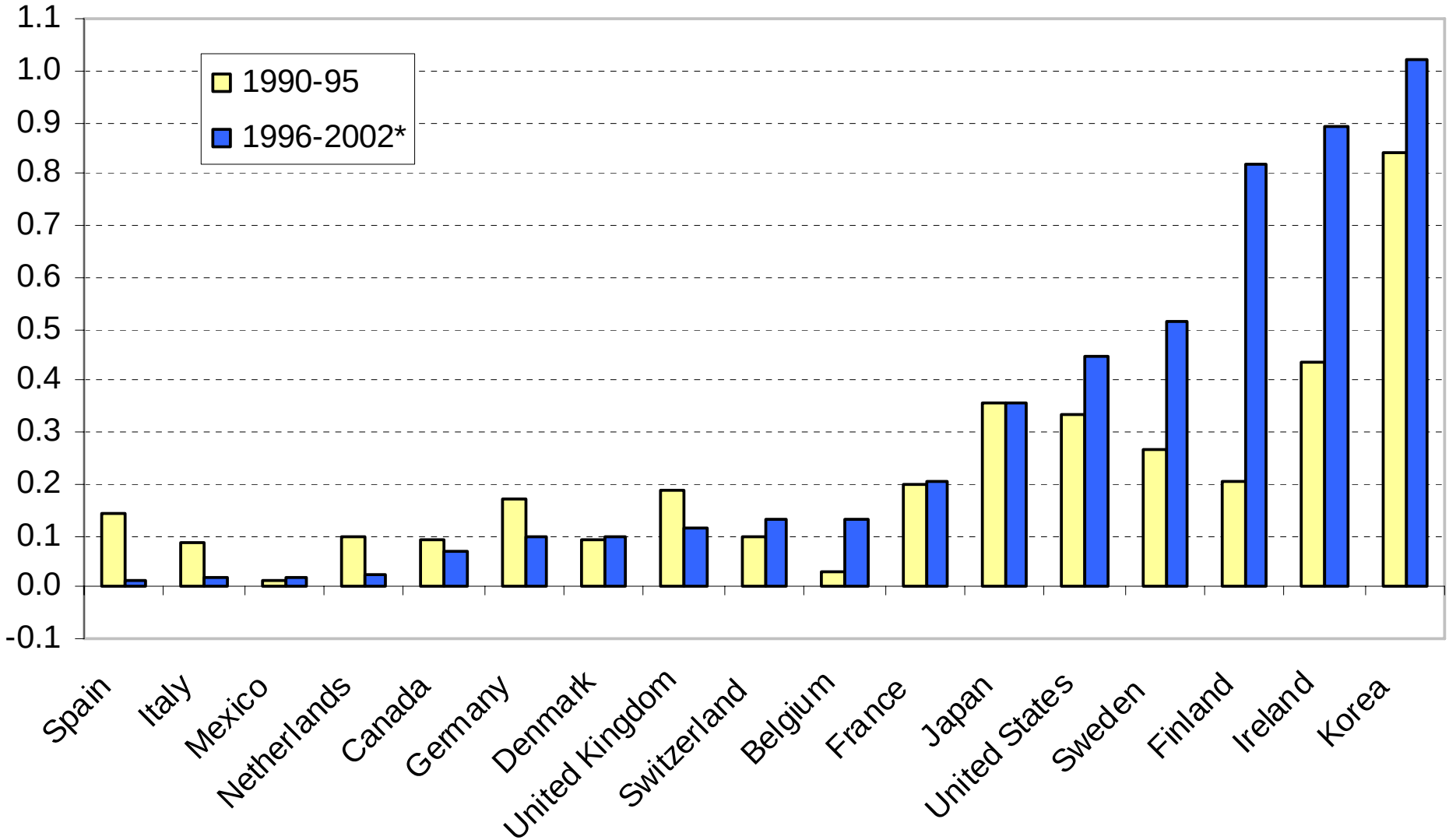
Finding: ICT investment and diffusion mainly differ because of lack of demand

- Demand has been held back by a business environment that was not sufficiently geared towards effective use of ICT – e.g. regulatory barriers, lack of skills, difficulty to change organisational set-ups, lack of innovation, etc.
- Competition has not been equally strong in all countries – costs of ICT and communications differ, as do pressures to improve performance.
- Demand has been held back by lack of security and trust.
- Structural factors also matter – ICT is not suited to all markets, sectors, or business models.

Sectoral approach to impacts of ICT

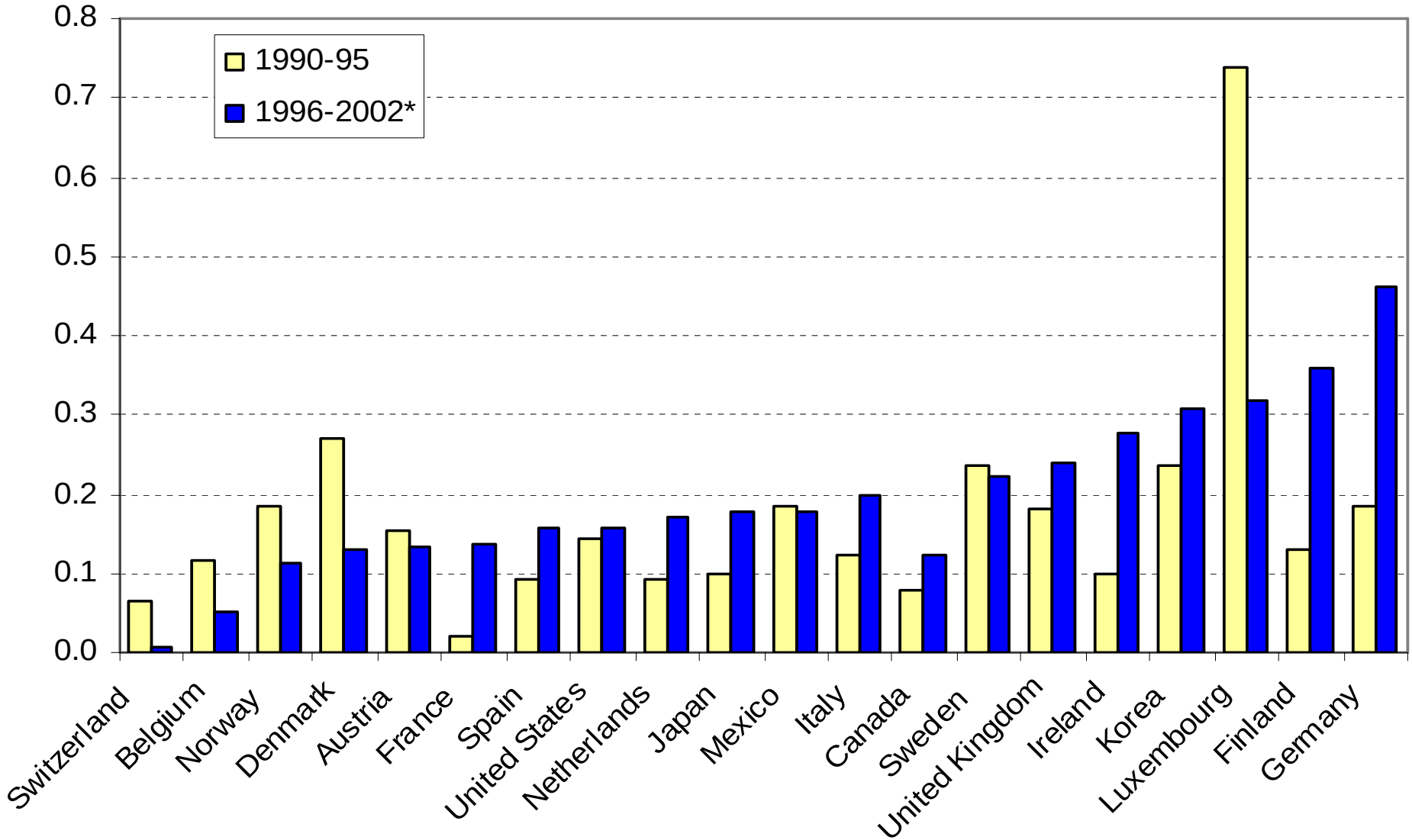
- Focus on ICT production – what role does it play, does it explain US-EU differences:
  - Requires definition of ICT production:
    - Developed by OECD (both ICT manufacturing and ICT services)
    - But not easily applicable for constant price series.
  - Typically focus on some key components.
- Focus on ICT-using industries:
  - Sectors that use ICT most (or have the greatest potential for ICT use) might first observe productivity impacts – these are mainly services industries.
  - Definitions differ and are not used the same across studies.

ICT manufacturing is only important for some countries
(average annual contribution to labour productivity growth, in %)

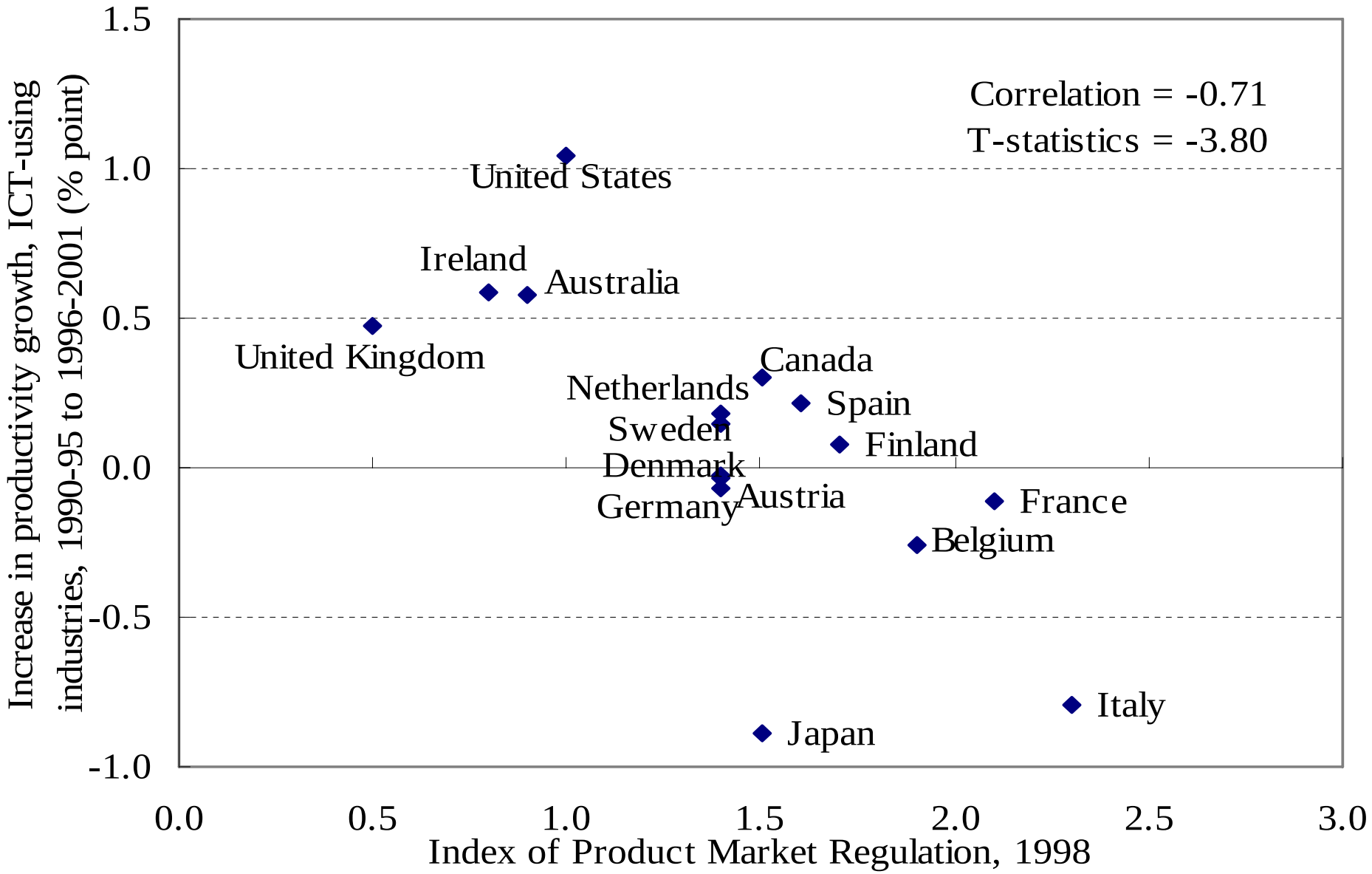


Productivity growth in ICT services (telecom and software) also plays a role

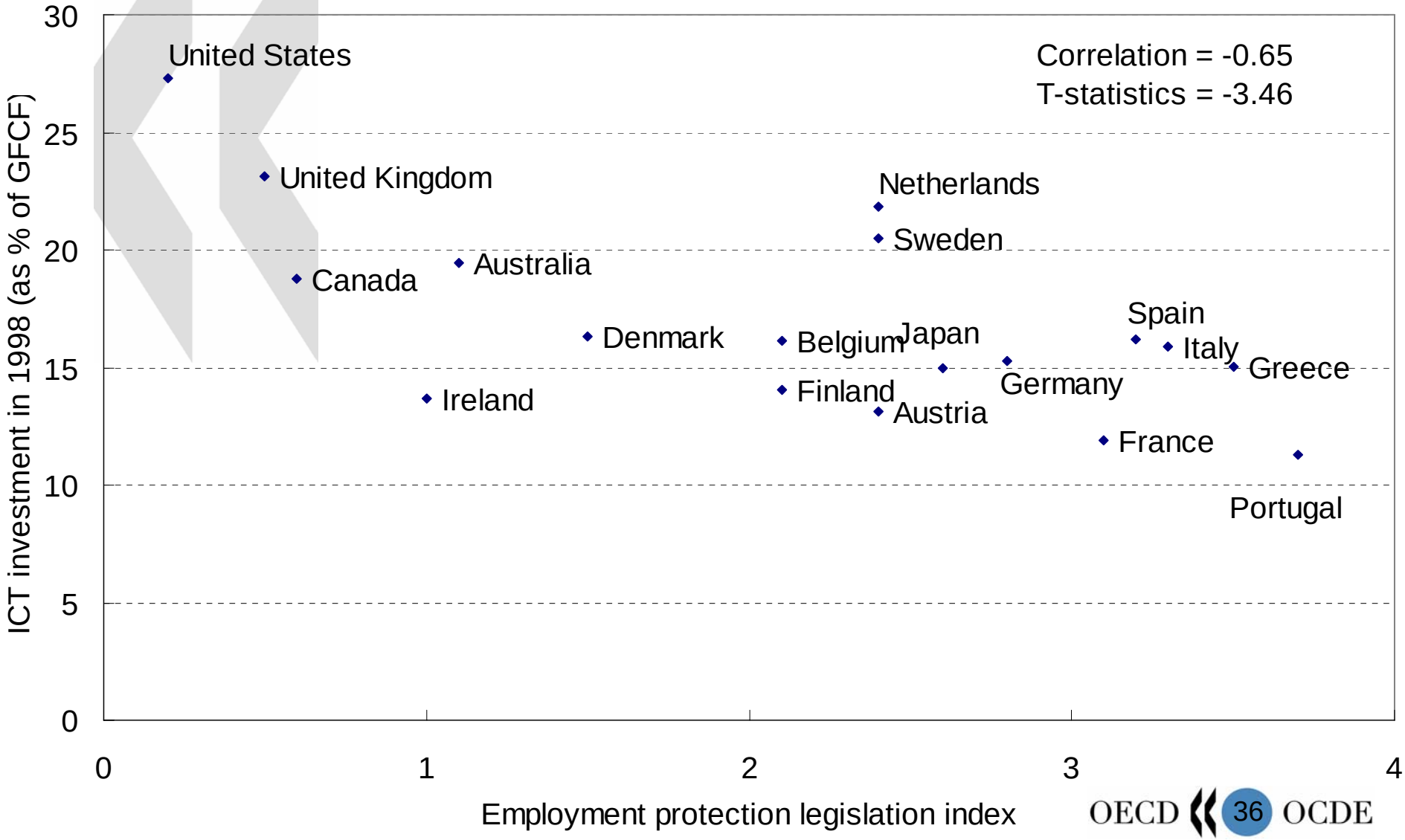
Annual average contribution to labour productivity growth, in %



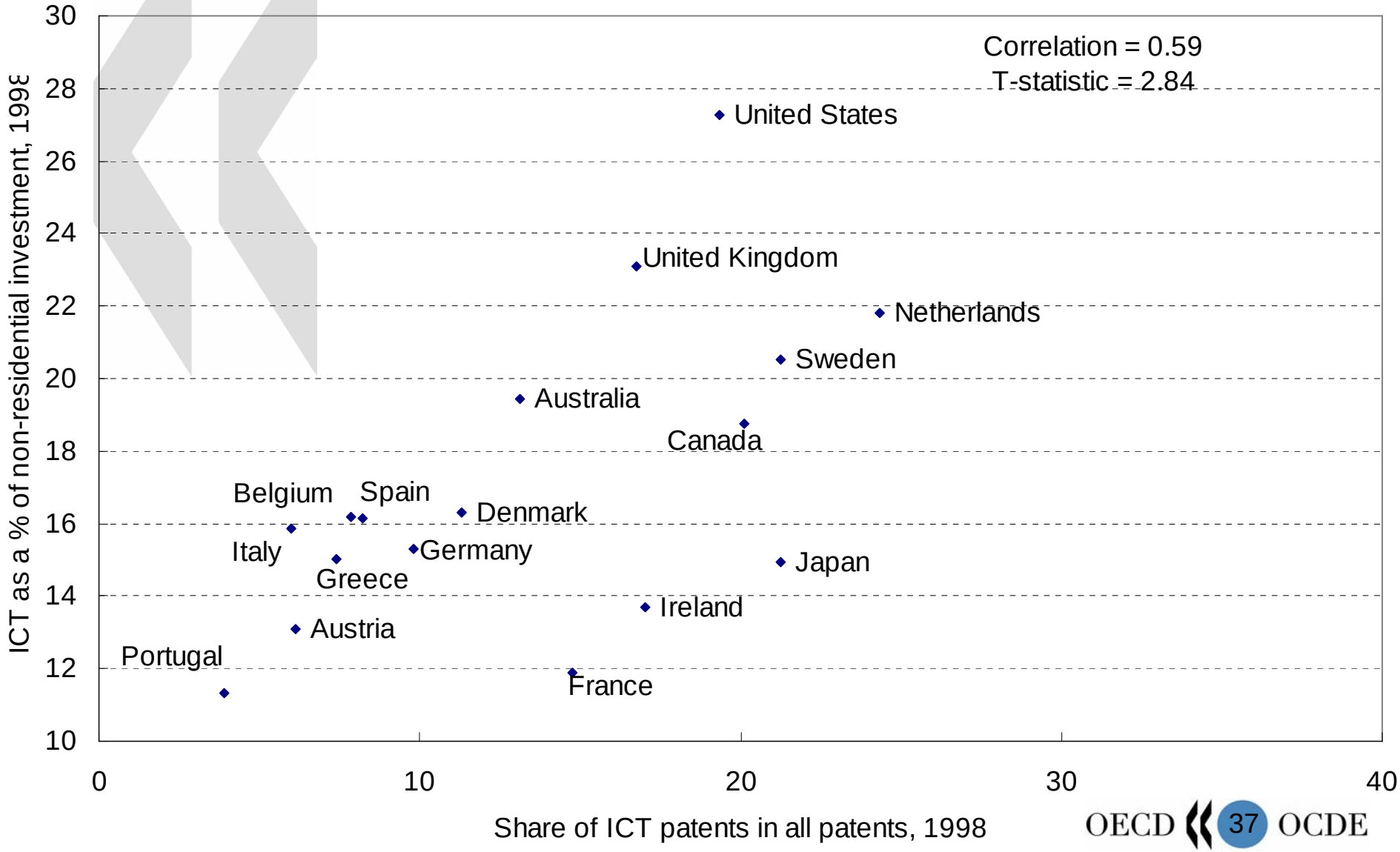
Countries with less product market regulation have seen a stronger pick-up in productivity in ICT-using services



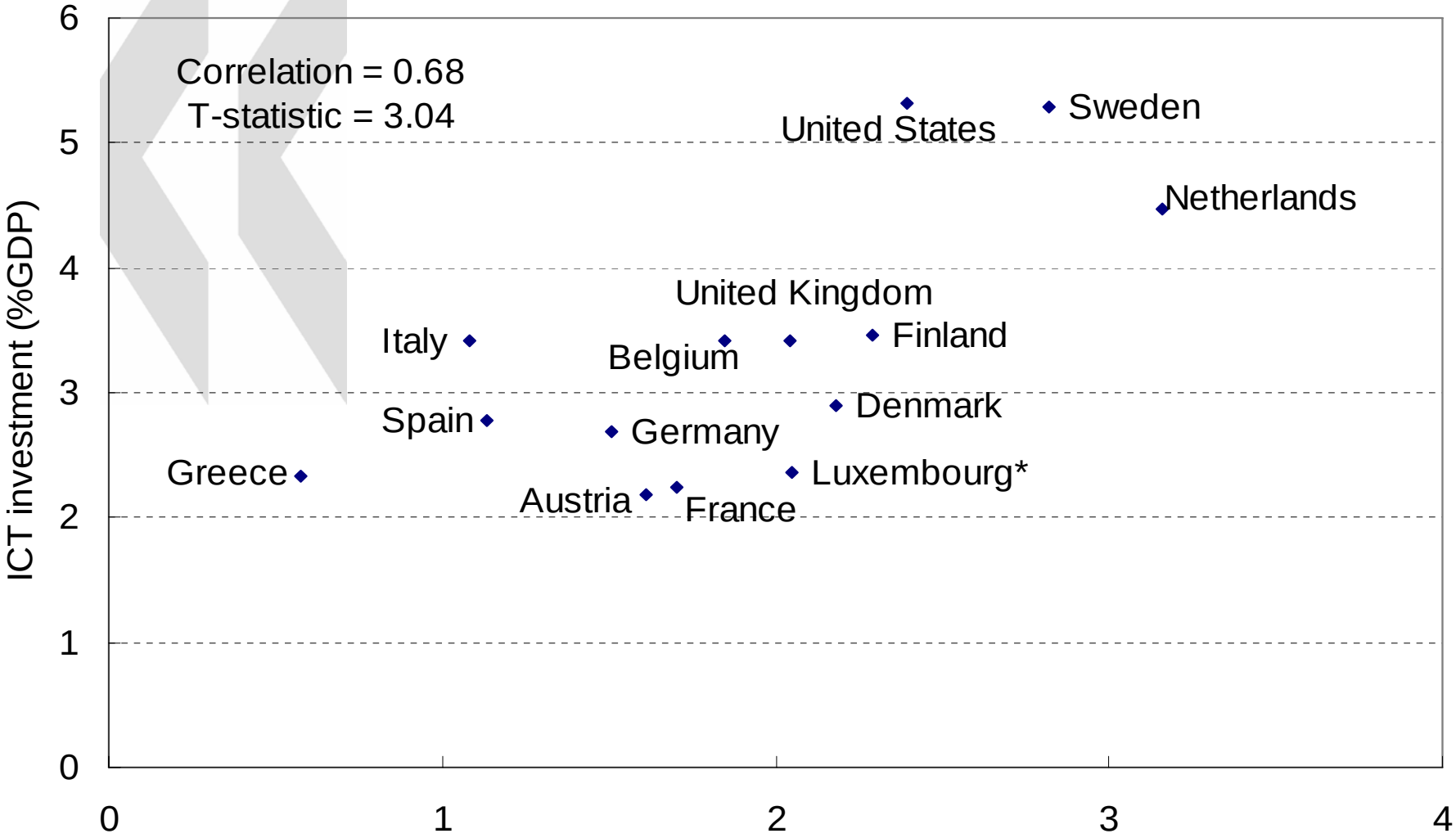
Countries with strict employment protection legislation and product market regulation have invested less in ICT



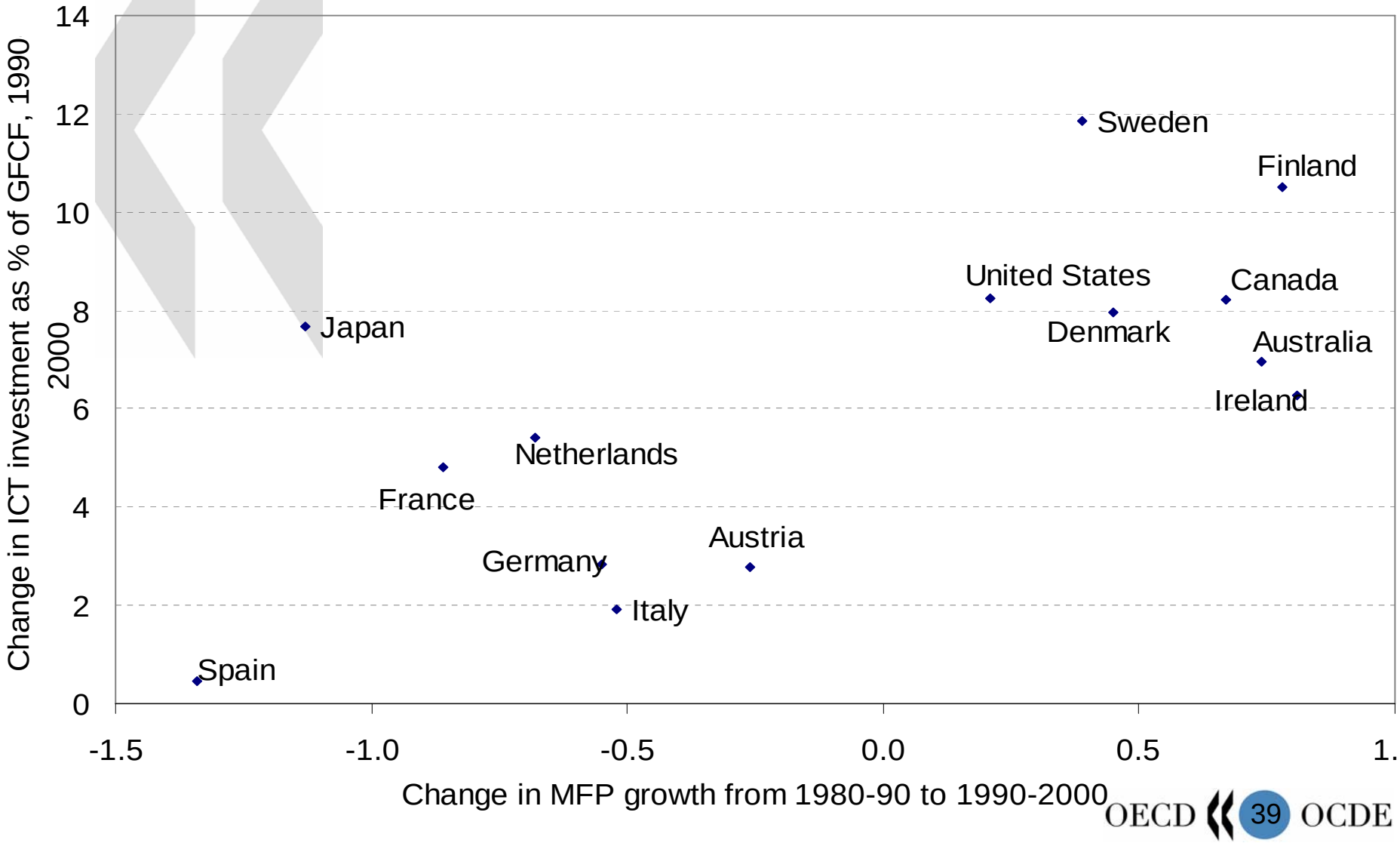
Countries with strong innovation in applications and software have invested more in ICT



Countries with an abundance of high-skilled workers have invested more in ICT



And countries with a rapid increase in investment in ICT have had more rapid MFP growth



Problems with the industry approach

- Breakdown in ICT-producing and ICT-using industries is not always very satisfactory.
- Industry data are not always comparable, e.g. for ICT production and certain services.
- The impact of ICT on productivity is not formally analysed, ideally:
  - Regression analysis of impacts ICT use/ICT capital at the industry level.
  - Growth accounts at the industry level.
- Unfortunately, industry data on ICT investment are still lacking for many countries (no time series).

A firm-level perspective on ICT

OECD project involving researchers and statisticians in 13 countries

Large variety of methods and data

- Data based on combination (linking) of sources:
  - Economic performance often from production surveys;
  - ICT from investment surveys, specialised ICT and e-commerce surveys, innovation surveys (US from computer network use survey).
  - Additional data, e.g. on organisation, skills & innovation.
- Methods include:
  - Labour productivity regressions.
  - Estimates of production functions.
- Variety of methods and data can help strengthen evidence.
- The studies point to many important interactions.

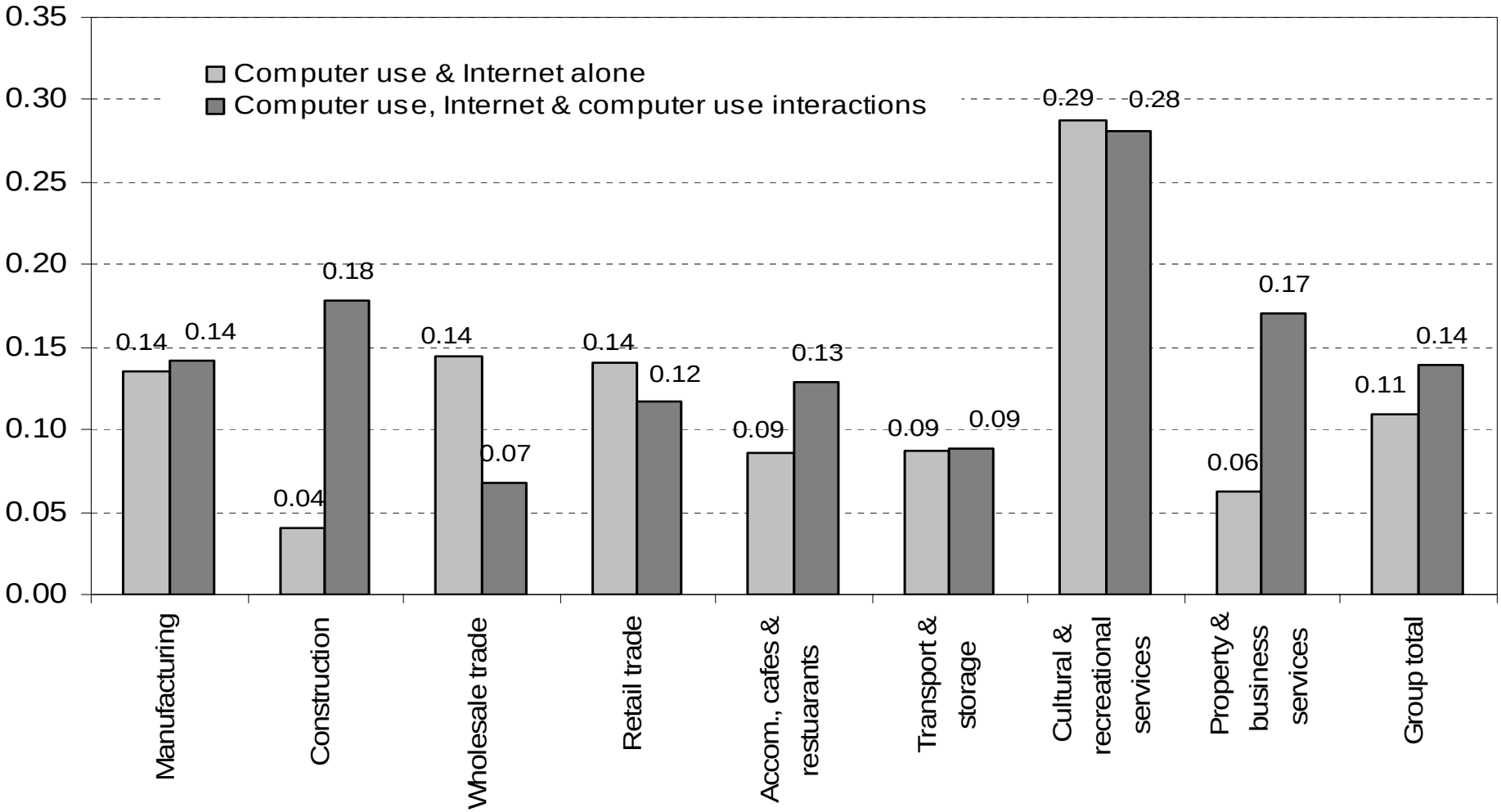
Example 1
Hollenstein: What determines ICT uptake by firms?

- Study for Switzerland, shows that ICT is linked to other firm-level factors.
- Firms that adopt ICT:
  - Anticipate benefits from improved customer-orientation and lower costs.
  - Have overcome problems in financing and skills.
  - Have a high capacity to absorb new knowledge (linked to human capital and innovation).
  - Are faced with strong competition and in markets with a high level of uptake of ICT.
  - Also introduce new forms of work organisation.

Example 2
Gretton, et. al: The impacts of ICT in Australia

- The use of ICT raised aggregate multi-factor productivity by about 0.2% points – over and above impacts of ICT capital.
- Impacts are largest in finance and insurance.
- Impacts taper off over time – they are largest a few years after adoption.
- Complementary factors play a large role in explaining firm's success with ICT – human capital, experience with innovation, use of advanced business practices and intensity of organisational restructuring.
- Early users of ICT are large firms with skilled managers.
- Firms with high openness to trade use more ICT.

Estimated contribution of ICT to MFP growth in Australia (% points)



Source: Gretton, et al. 2004.

Example 3
Hempell, et al. : The link between ICT and innovation

- Comparative study with comparable data for Germany and the Netherlands from innovation surveys.
- Key question: do firms that engage in complementary innovation benefit more from investment in ICT?
- In both countries, returns to ICT investment are much higher when accompanied by innovation.
- Continuous innovation leads to higher returns than occasional innovation efforts.
- This is also the case in the services sector.

Example 4
Maliranta and Rouvinen: The impacts of ICT in Finland

- The additional productivity of ICT-equipped workers ranges from 8 to 18% (after controlling for many other factors).
- This effect is higher in young (new) firms and in the ICT-producing sector.
- Manufacturing firms benefit mostly from internal networks (e.g. local area networks), whereas service firms benefit most from external networks (e.g. the Internet).
- Organisational factors are important, as suggested by the greater productivity effects in new firms.
- Selection also plays a role – not all firms succeed – having a dynamic business sector is important.

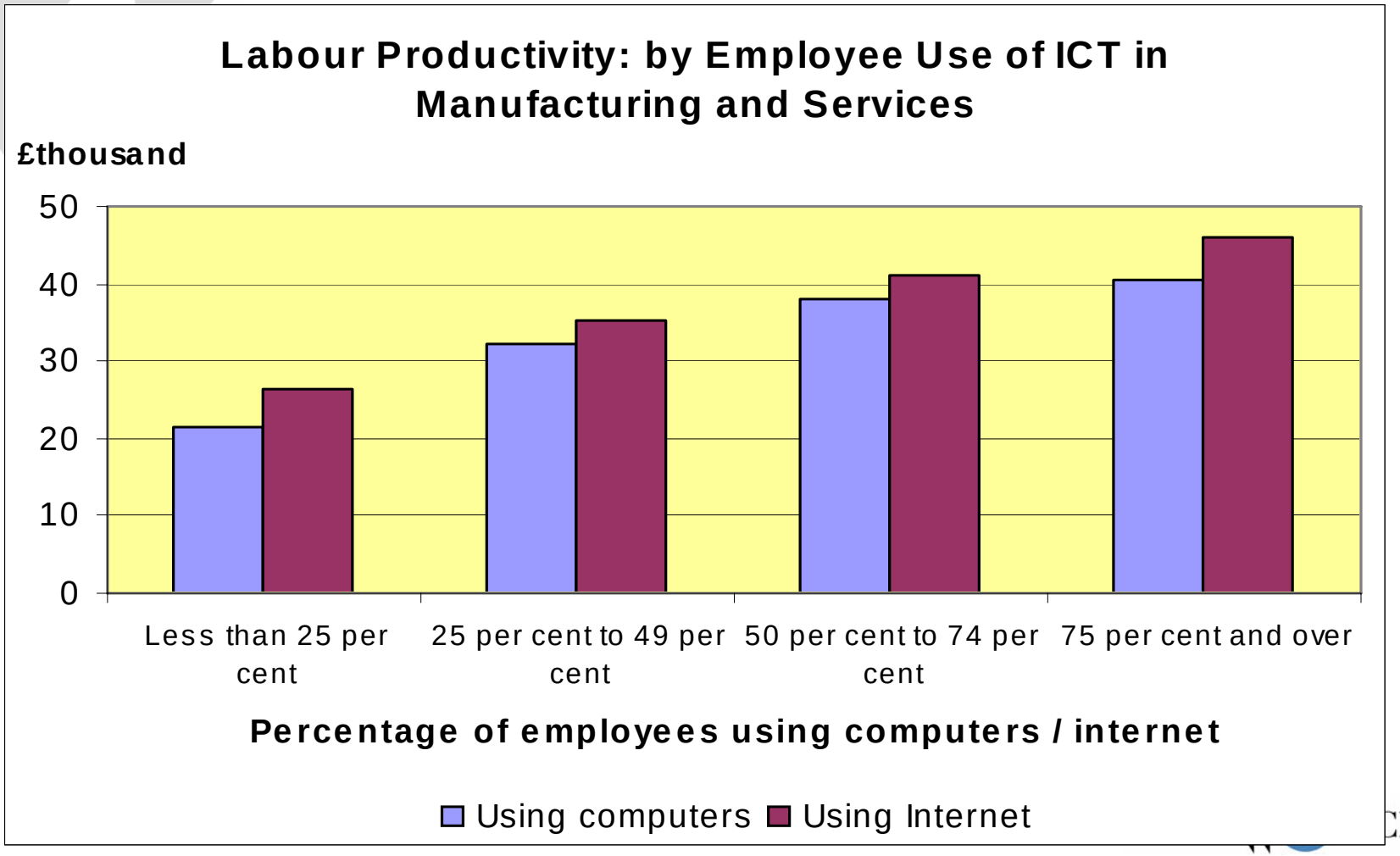
Example 5
Clayton, et al.: Impacts of e-commerce in the UK

- Computer networks for trading have positive impacts on productivity.
- E-buying has positive impacts on output growth, whereas E-selling has negative impacts.
- This is likely due to pricing effects – e-buyers can source more competitively, e-sellers may loose out.
- In some industries, e-commerce seems to have contributed to lower prices, perhaps due to greater price transparency and more rapid reactions of suppliers.

UK: Productivity analysis and IT

Investment + Employees + Transactions + Communications

Purpose of analysis is to understand different effects



UK: Productivity analysis and IT

Significant results – IT investment

- Hardware *and* software capital show significant productivity gains, both levels and yearly changes
- Gains attributable to IT capital across service sectors higher than those in manufacturing
- Returns to IT capital across high and low user sectors, and for large and small firms
- IT capital reinforces productivity effects of other capital investment, and of skills
- Returns to IT investment 'explains' productivity advantage of US multinationals in UK, concentrated in high IT using sectors

UK: Productivity analysis and IT

Significant results – IT use

- Employee use adds significantly to productivity, *over and above* effects of hardware and software capital,
  - after controlling for sector, size, ownership etc
- Manufacturing firms achieve an extra 2.2% output for each additional 10% employees using computers
- For employees using internet the extra is 2.9%
- Productivity effect greater for more recently created firms
- Productivity effects associated with communications use

UK firm level productivity results can be found in full at
http://www.statistics.gov.uk/cci/article.asp?ID=1235 (Web link to ONS summary article)
and are broadly consistent with firm level results for Chinese manufacturing at
http//www.mo.rcast.u-tokyo.ac.jp/index-eng.html (analysis by Kazu Motohashi)

UK: Productivity and broadband

Significant results – broadband use

No clear link from broadband *availability* to productivity, but:

- Investment in IT higher in regions / sectors with broadband available, especially for UK firms in non-IT intensive industries.
- Early adopters of broadband experienced high initial telecommunication costs but these have declined over time
- Broadband users more likely to have multiple e-business links.
- Multiple links plus broadband improve labour productivity.
- Firms with a high broadband equipped labour share have significantly higher productivity

Full results in OECD paper DSTI ICCP IIS(2006)9 Shikeb Farooqui and Raffaella Sadun

Example 6
Atrostic et al. : Impacts of computer networks in the United States, Japan and Denmark

- Computer networks have positive impacts on productivity in all three countries.
- In the US manufacturing sector, plants using computer networks have 5-11% higher productivity than plants not using networks.
- In Japan, both interfirm and intrafirm networks are linked to strong firm performance.

The firm-level studies all show that ICT use can contribute to improved firm performance

- Positive impacts of ICT on labour productivity (and MFP, where measured) or market shares in all countries:
  - But these are conditional on other factors and firm characteristics (skills, innovation, organisational change).
  - Not all firms succeed – selection plays a role.
  - ICT is only part of a broader strategy to improve firm performance.
- Networking technologies are particularly important.
- The impacts of ICT are also found in the service sector (despite lack of evidence at the industry level).

Why the difference between firm-level and aggregate evidence on ICT's impacts?

- Aggregate impacts ICT in some countries may still be disguised by other factors.
- Lags – the US invested earlier and more – aggregate impacts in other countries might still come.
- US firm-level impacts may be larger – because of scope for reorganisation and complementary innovation.
- Successful US firms may be able to gain more market share (e.g. Walmart) – more re-allocation.
- Spill-over effects? - Perhaps already some of this in the US (and Australia), not much in other OECD countries.

Conclusions

- Better data have enabled a wide range of empirical research on ICT and its economic impacts.
- This research has had important policy implications:
  - It has shown that ICT plays an important role in economic growth.
  - ICT is no panacea, and linked to many other factors – only focusing on ICT diffusion is not sufficient.
  - Countries have not equally benefited from ICT – there is scope for learning and improvements in the policy environment.
- There is scope for much more analysis, in particular with firm-level data, and in the context of international comparisons.

Policy implications from work on ICT and growth

- Fostering a business environment for effective use of ICT
  - Competition matters for ICT uptake and effective use.
  - Regulatory burdens may limit investment and experimentation.
  - Enable firms to make the necessary organisational changes.
  - New skills are needed, requiring changes to education and training systems.
  - Need for coherent innovation policies.
  - Management matters – ICT is no panacea.

Policy implications (continued)

- Competition in ICT goods and services
  - Evidence of the benefits of competition is convincing and liberalisation should be pursued.
  - Crucial for broadband development.
  - Regulators must be vigilant for anti-competitive behaviour.
  - Technology continues to develop – policy frameworks and regulations should be technology neutral.

Policy implications (continued)

- Boost Security and Trust
  - Uncertainty remains regarding the security of electronic commerce.
  - Attention is required to security of information systems and networks, authentication, protection of privacy and consumer protection.
  - Cross-border issues and enforcement.
  - E-government can help build confidence – and is important to improve government efficiency and the delivery of public services.

Policy implications (continued)

- Unleash growth in the services sector
  - particularly important because of the potential benefits
  - policies to reduce regulation and reduce barriers to entry
- Harness the potential of innovation and technology diffusion
  - ICT linked to, and assists, innovation
  - ICT fosters networking and knowledge transfer.

Measurement issues

- Better measurement has clarified the picture
  - Quality-adjusted price indices have helped demonstrate the impact of ICT on growth.
  - Software was included in 1993 SNA as an asset.
  - Measures of R&D are being improved:
    - New (2002) edition of OECD Frascati Manual.
    - R&D may be included in new SNA.
  - Measures of innovation are being improved.
  - There is more attention at statistical offices for analysis at the firm level -linking existing data sources can help.
  - Data on ICT demand are improving with adoption of OECD standards.

However, some measurement problems remain

- Skills data (apart from formal education statistics) are poor.
- Organisational factors are difficult to capture.
- Software investment is not yet fully picked up in national accounts.
- Deflators for ICT production differ considerably.
- Measurement of services output is poorly in some areas e.g. finance, health, education.
- Cross-country firm-level studies are still scarce, although much work is underway. OECD is trying to act as forum for exchange of best practices.

THANK YOU!

www.oecd.org/sti/measuring-infoeconomy

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