



Assessing ICT Impact Using Official Surveys

Emerging findings from EU project
with 13 Statistics Offices

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Who we are

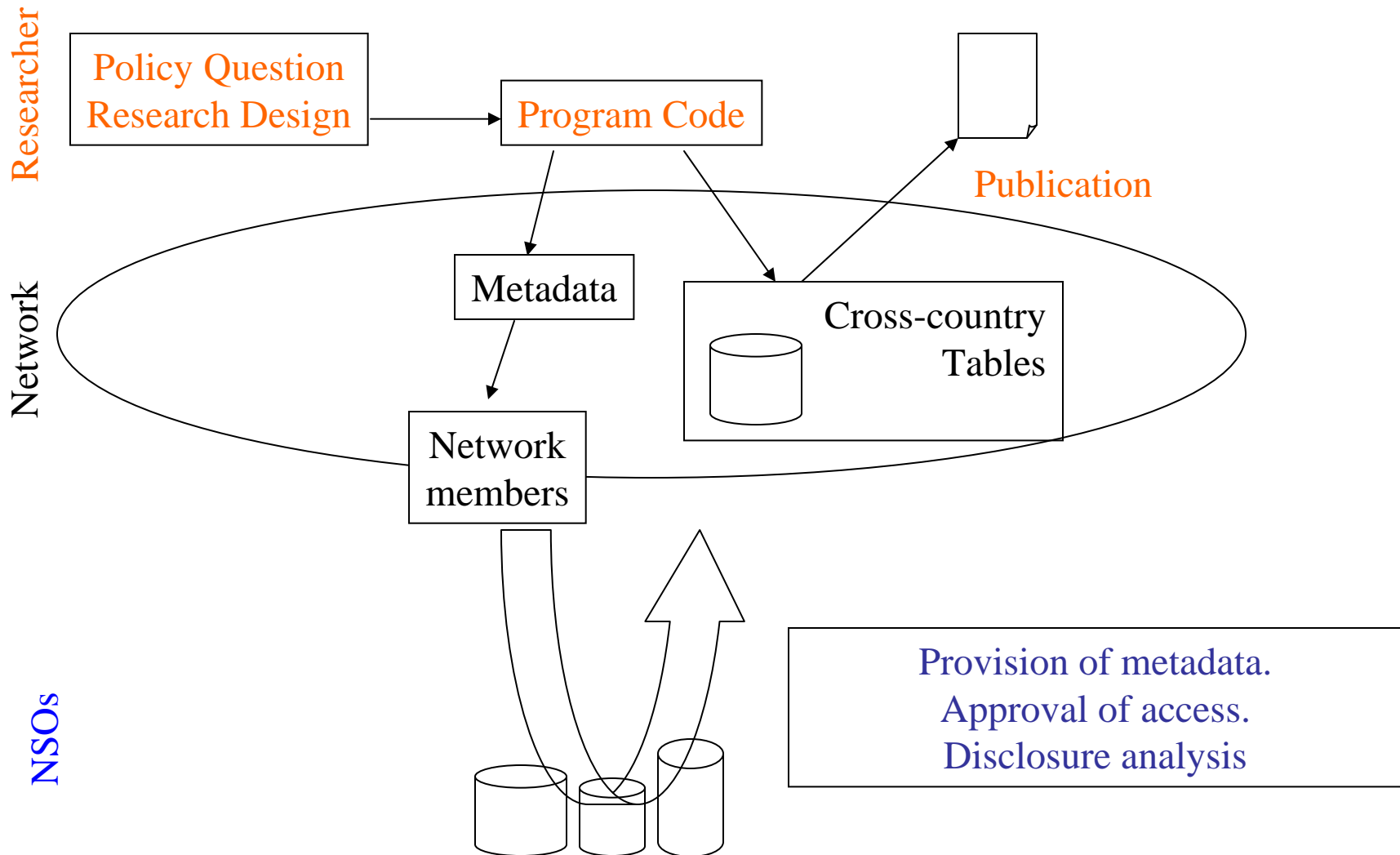
- 8 NSIs directly involved in developing research, metadata and method
 - UK, Sweden, Finland, Denmark, Italy, France, Austria, Netherlands
 - Slovenia involved through Ljubljana University
- 4 more joined to use method and contribute to analysis
 - Germany, Norway, Czech Republic and Ireland
- Academic support from Free University of Amsterdam

What we've done

- Firm level analysis within countries, linking surveys on ICT use, output, productivity, IT investment, skills, innovation ...
 - Core variables from common EU ICT use survey
 - 'Add-on' analysis in countries with extra survey data
- Built metadata system to aggregate data for industries / countries consistently
 - Country / industry (meso) indicators built using survey data
 - Able to bring in other data from National Accounts
 - Analysis across different environments
 - New method for indicators

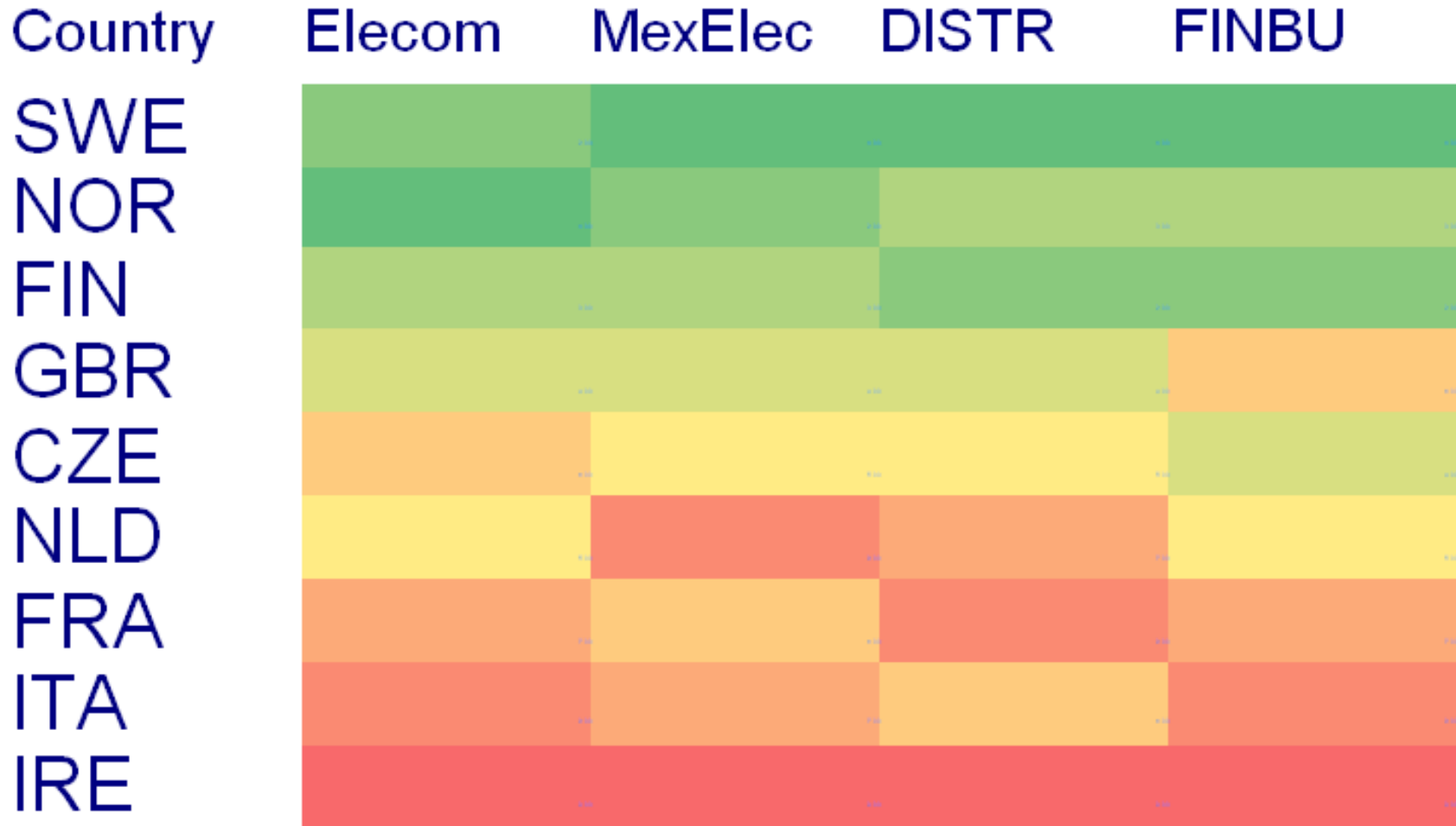
- From micro analysis we get
 - Clear evidence on how inputs to innovation affect behaviour, competition and performance at level where firms' decisions are made
 - 'Levers to pull' in terms of firm level incentives
- From 'meso' analysis we get
 - Ability to do analysis across different national policy environments.
 - Ability to bring in data not available at firm level
 - Quantification of effects at macro level – £billion more impressive than a regression coefficient!

Distributed micro data research



...and what it can deliver

(example; index of BB enabled workers)



Analytical Variables

ICT metrics

Variables for most countries	'Add-on' variables
<p>Firm uses computers % workers using computers Firm uses internet % of workers with access to internet Firm has website Firm orders via internet (or EDI etc) % of orders (or value) Firm sells via internet (or EDI etc) % of sales (or value) Firm has intranet % of workers with access to intranet Firm has fast internet access % of workers with access to fast internet access</p>	<p>Use of electronic business processes Mobility of access to technology Mobility of workers accessing technology IT investment (or expenditure) at firm level</p>

Analytical Variables

Contextual variables / complements to IT

Variables for most countries	'Add-on' Variables
<p>Firm size</p> <p>Firm age</p> <p>Employment</p> <p>Payroll</p> <p>Capital Stock</p> <p>Ownership (local or international)</p> <p>Outsource ratios (measured as purchases / sales or similar)</p> <p>Measures of labour 'quality' (measured in terms of pay per person)</p> <p>Industry characteristics (growth, entry / exit, firm share turbulence)</p>	<p>Multinational organisation of firms (from FDI and ownership data)</p> <p>Employee skills (from linked employer – employee datasets)</p> <p>Changes in organisation (from some local surveys, or CIS)</p> <p>Measures of innovation (from CIS)</p>

Analytical Variables

Measures of Impact

Levels	Growth rates
<p>Productivity measured as</p> <ul style="list-style-type: none"> - Gross sales / employee (vs industry) - V.A. / employee (vs industry) <p>Productivity measured in terms of Multi-Factor Productivity (for countries which have firm level data on investment, IT investment, labour and other inputs)</p>	<p>Productivity change measured as</p> <ul style="list-style-type: none"> - Gross sales / employee (vs industry) - V.A. / employee (vs industry) <p>Growth rates measured for:</p> <ul style="list-style-type: none"> - Gross sales (deflated by industry PPI) - Market share of IT using firms in industry - Value added (double deflated where possible) - Employment, or share of employment in industry

What countries have to do to join

- Assemble data
 - Put production survey, ICT use survey and business register datasets in single research environment
- Construct metadata
 - Describe each survey in standard terms; variable names, format, range,
 - Test linkages between units in surveys using register identifiers
- Run analytical code on datasets, using metadata to access and interpret
 - Produce results / aggregates which can be shared

Headline findings

- Consistent labour productivity effects across manufacturing firms
 - Employees broadband enabled
 - Firms using e-commerce to buy / sell
 - More variation across countries for services
- Analyses completed for groups of countries using firm level data
 - Skills and ICT, using both 'hard' data and pay as proxy
 - ICT business integration – linked processes
 - IT investment – hardware / software – and communications use
 - ICT in combination with other forms of innovation

Interest from Finland

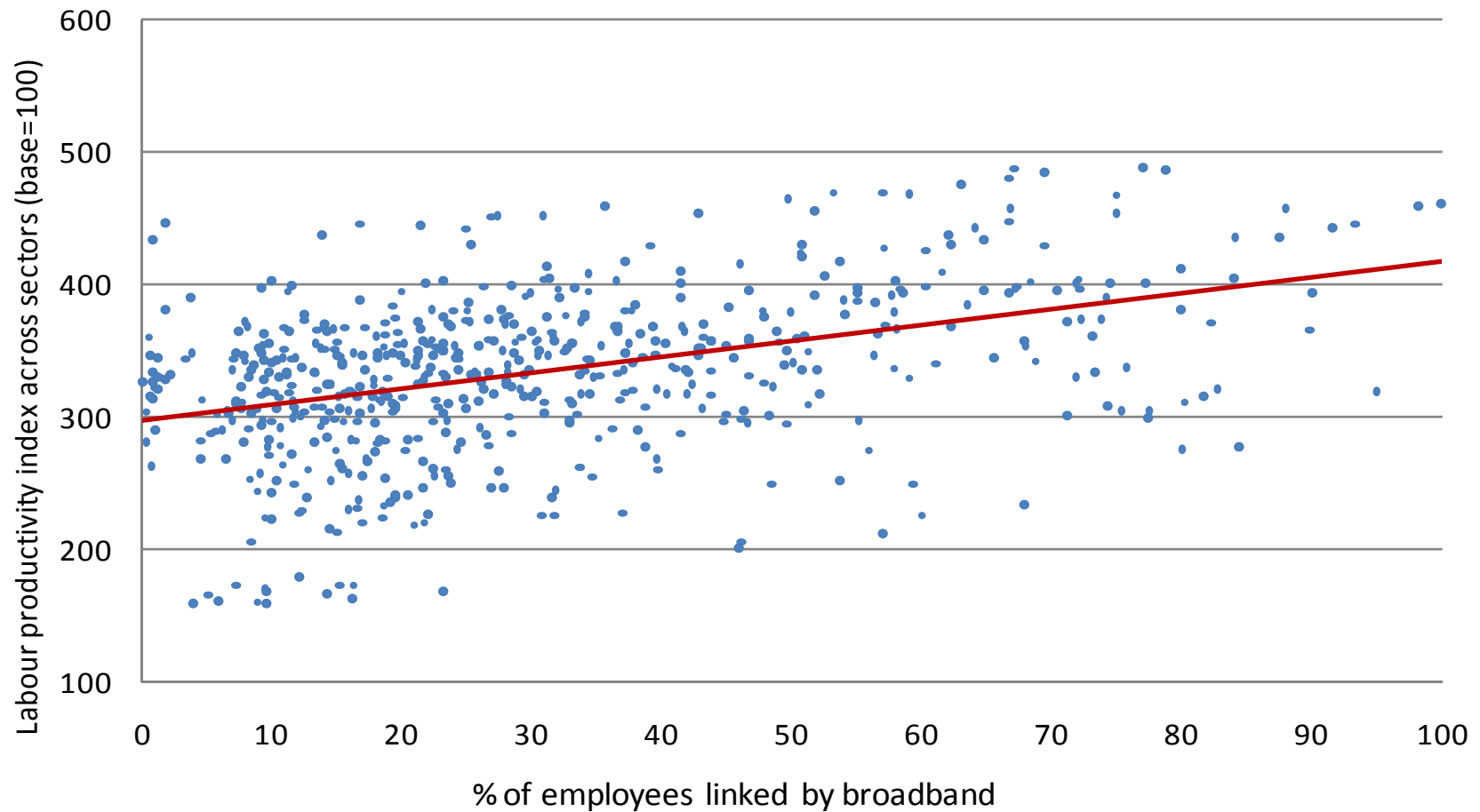
- Mobile access to networks through laptops boosts productivity
 - Finnish data permits 'hedonic' approach to access characteristics
 - Significant effects associated with mobility
- Outsourcers do better
 - Finnish surveys ask about source of ICT services in firms
 - Over last few years, outsourcers get better productivity returns from ICT use by employees
 - measurement implications for measuring IT capital

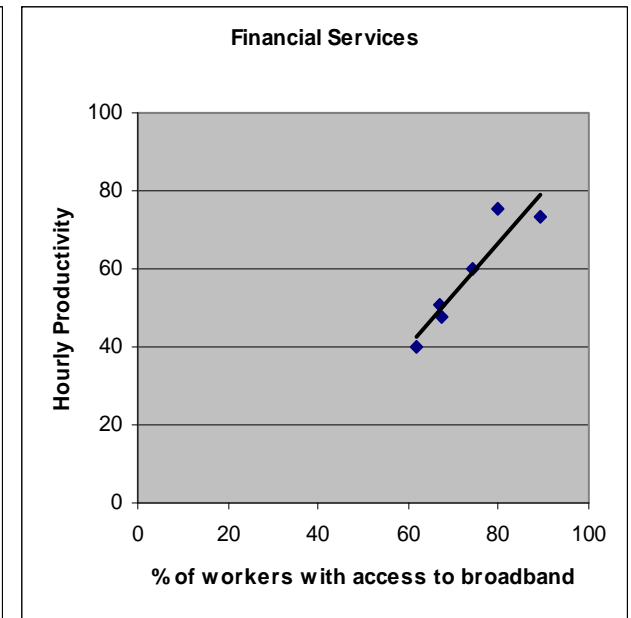
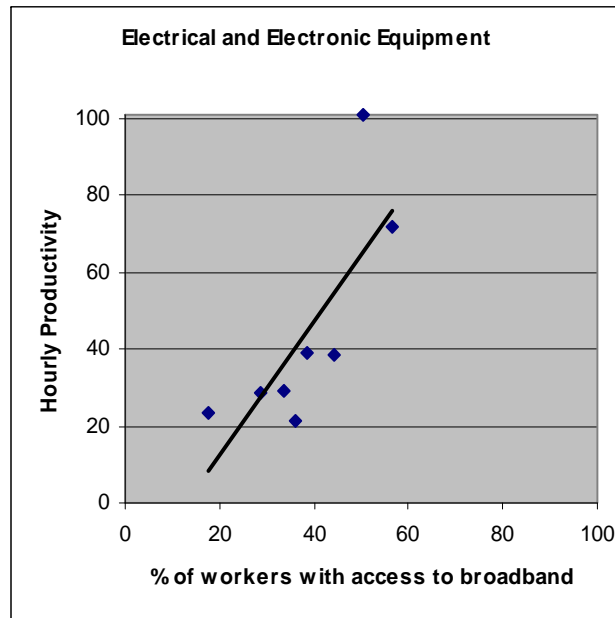
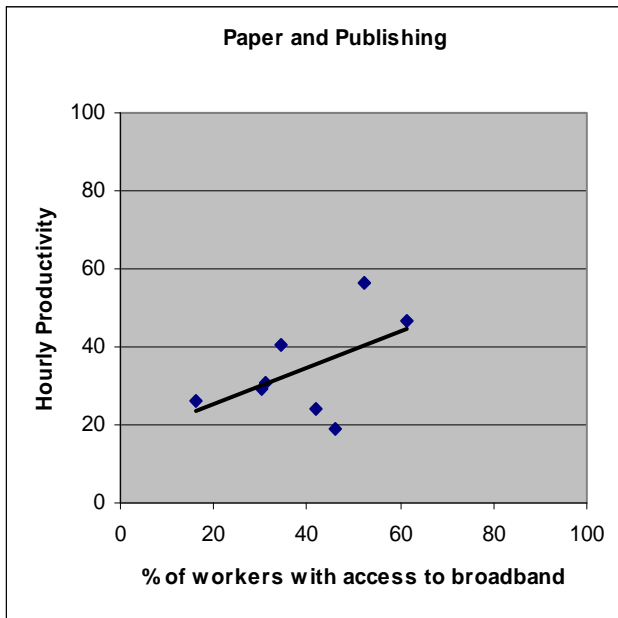
- ICT user firms more likely to innovate
 - Swedish and UK analyses show propensities linked
 - Difficult to tell whether this is because ICT aids innovation origination (the knowledge production function) or diffusion
- Innovators make better returns on ICT investment, or from use
 - NL study based on firm level IT investment data and Innovation Survey
 - Swedish study based on ICT use survey and CIS

- In this and earlier work on growth / productivity effects (with firm level data) we see that
 - IT reinforces productivity of other capital and skills
 - IT investment has bigger returns in newer / more innovative firms
 - IT productivity advantage largest for US firms in UK, in IT high using sectors ... reflects business systems?
 - Employee use adds significantly to productivity, *over and above* effects of hardware and software capital
 - Broadband use by employees increases the impact further



Labour productivity and broadband in selected EU countries (2001-04)





.....industry splits tend to support UK microdata results showing

- IT capital matters most in manufacturing
- Broadband enabled employees matter more in differentiated services

For more findings ...

- Come to the project conference
 - Thursday May 22nd,
 - Intercontinental Hotel in Budapest
- What have we learned from the project so far?
 - About the overall approach to analysis of ICT and innovation
 - About the links between firm, industry and macro analysis

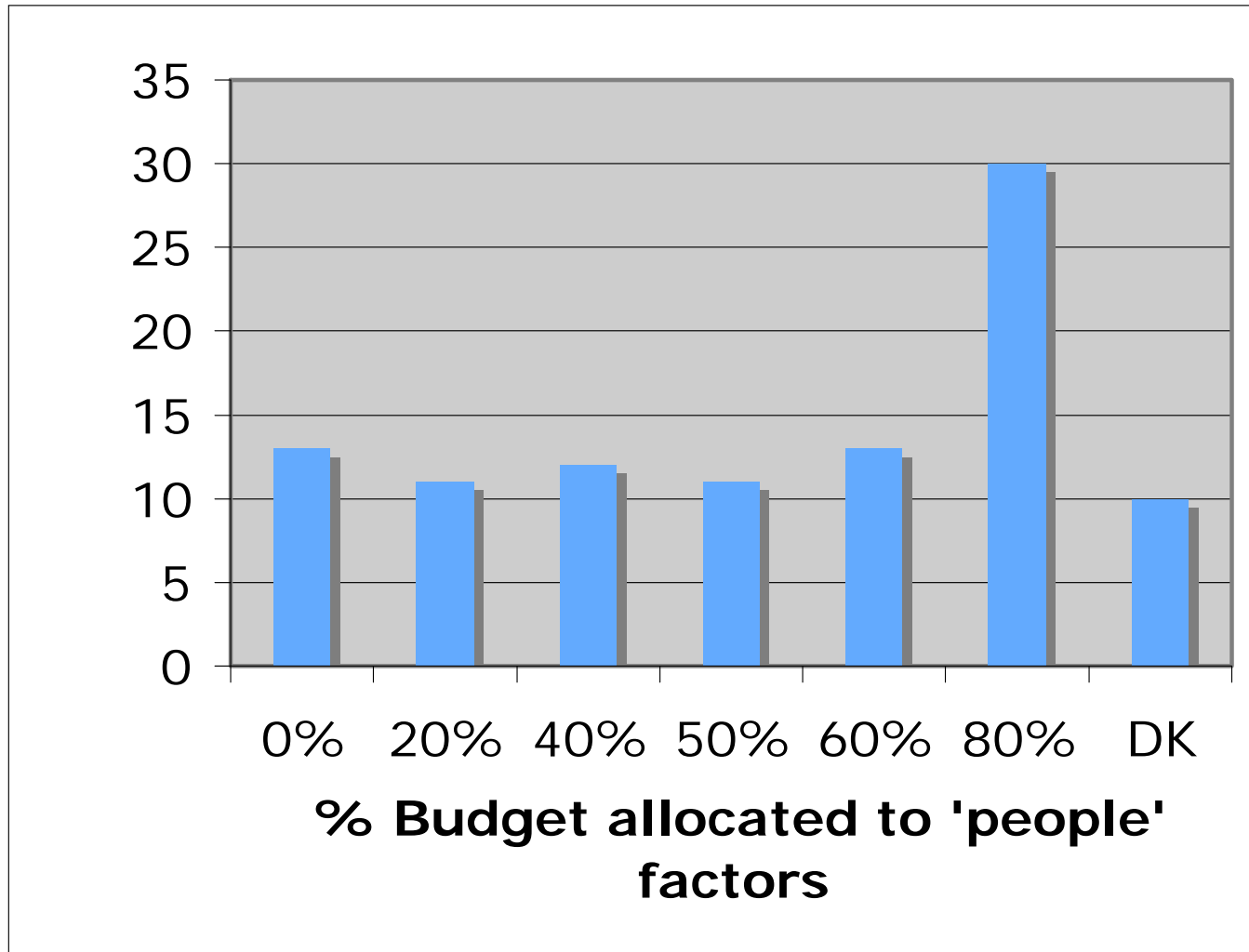
'Complementary assets' to ICT

Type of intangible investment	Includes the following intangibles	Treatment in SNA
Computerised information	<ul style="list-style-type: none"> (1) Computer software (2) Computer databases 	Both now treated as investment
Innovative property	<ul style="list-style-type: none"> (1) Scientific R&D (2) Mineral exploration (3) Copyright and license costs (4) New product development costs in the financial industry (5) New architectural and engineering designs (6) R&D in social science and humanities 	Only (2) and (3) treated as investment
Economic competencies	<ul style="list-style-type: none"> (1) Brand Equity (2) Firm-specific human capital (3) Organisational structure 	None of these treated as investment

- **Technical Innovation**
 - R&D survey
 - Innovation survey
- **Non-technical innovation**
 - Extended Innovation survey? Design, other inputs?
- **Skills / training**
 - Qualifications / Occupations
 - Training activity?
- **Organisation**
 - Multinational scope / ownership / practices? / processes?
 - Mobility / networks
- **Reputation**
 - Marketing spend? ? = not yet analysed

- UK evidence on US firms (firm level data)
 - Bloom / Sadun / Vanreenen attribute US productivity to management practices / processes centred on people
 - Discussion with firms points to business process reengineering (eg 6Sigma)
- US evidence on ICT speeding up innovation / organisation change (industry data)
 - Brynyolfson & co evidence on ICT intensity and ability to replicate successful business models
 - EU country / industry data from our study shows this effect of 'enterprise architecture'

Cost split; technology vs 'people'



'People' spend includes: business process re-engineering, internal communications, training, changes to performance measurement, reward,...

UK 'mid size' firms

- Add innovation to the analysis framework
 - evidence that innovation is associated with higher returns on ICT inputs
 - little data so far to look at different business types, or to analyse how different forms of innovation relate to ICT
- Look for ways of measuring, and adding:
 - other measures of intangible / innovation inputs
 - types of innovation behaviour

What we don't (yet) know....

- EU study shows impact of ICT metrics
 - investment
 - people engaged
 - communications
- Do we understand differences between...
 - Influence of ICT when it is the innovation, or the business system representation of it
 - ICT as infrastructure for rolling out organisation or service product change
 - ICT network supporting knowledge creation for innovation