

ICT impact assessment by linking data

Investment in ICT statistics by NSIs in 13 countries,
building economic analysis across 200,000 firms

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Agenda

- What we set out to do
- Evidence used in data linking approach
- What the results tell us about impacts
- Next steps for data and analysis

What we set out to do

- **Exploit data on business behaviour and ICT use** available across all 27 EU countries from common surveys (which cost millions!)
- **Build shared analytical capability** to compare results across countries – essential to understand policy results
- **Integrate ICT analysis** alongside other complementary investments (skills, innovation, organisation)
- **Link macro economic effects to micro / firm level causes**, explains productivity and helps show which policy levers matter most
- **Deliver new evidence on ICT impacts**, without adding to the forms we ask firms to fill in.

What we set out to do



- Launched 2006
- Linking data sources “*To identify how ICT adoption affects business behaviour and performance*”
- Project focus shift:
started with Firm level analysis
at national level



finished with Cross-country
industry level analysis

2006/7	2007/8
U.K	added
Italy	
Denmark	Germany
Sweden	Czech Republic
Netherlands	Ireland
Finland	Norway
Austria	
France	
Slovenia	

200,000 firms in 13 countries

Evidence

ICT metrics from common surveys

Variables for most countries	'Lead NSI' variables
Firm uses computers	Use of electronic business processes
% workers using computers	Mobility of access to technology
Firm uses internet	Mobility of workers accessing technology
% of workers with access to internet	IT investment (or expenditure) at firm level (Hardware and / or software)
Firm has website	Outsourcing ICT services
Firm orders via internet (or EDI etc)	
E-commerce % of orders (or value)	
Firm sells via internet (or EDI etc)	
E-commerce % 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	

Evidence

Context and complementary assets

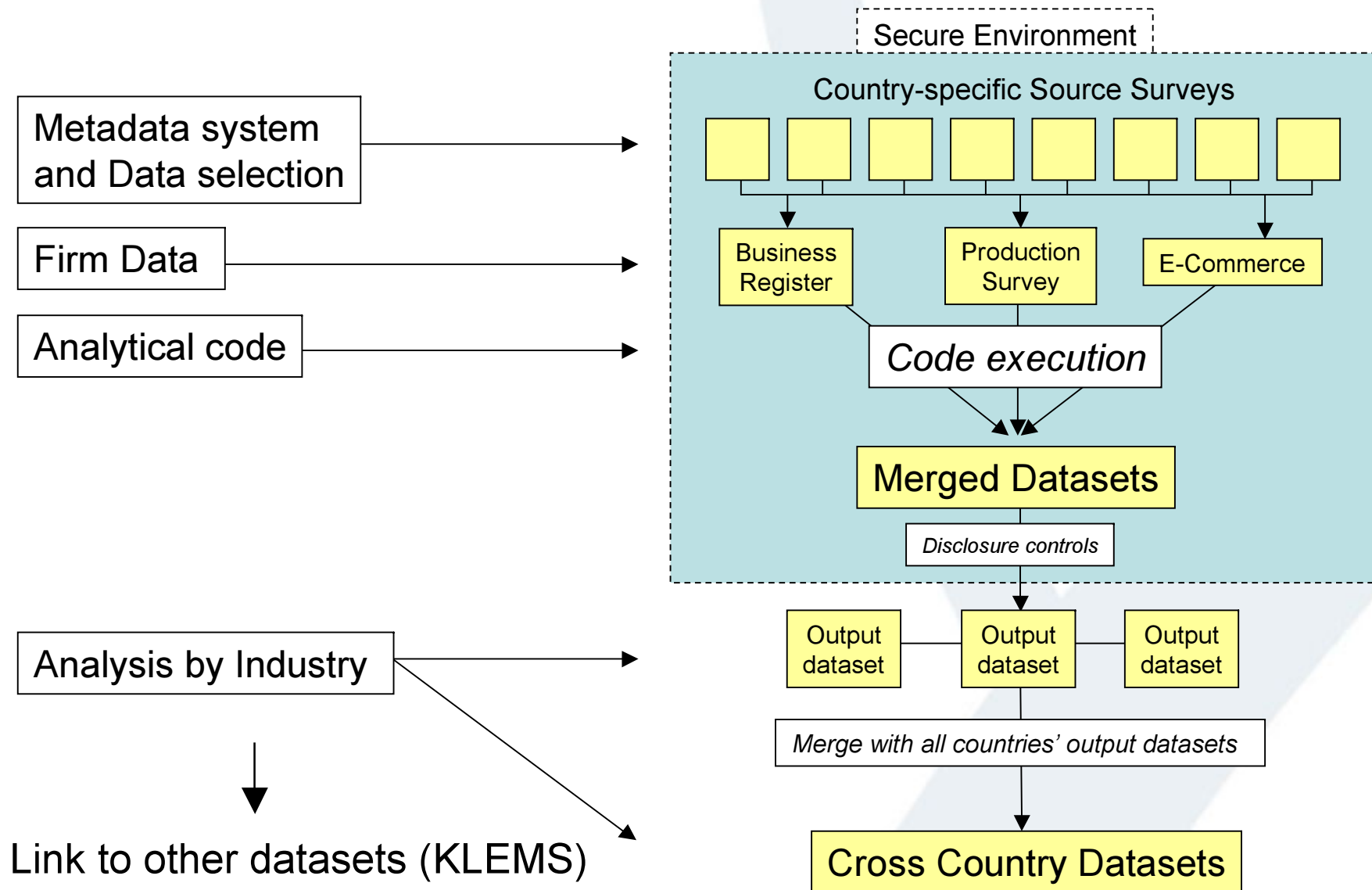
Variables for most countries	'Lead NSI' Variables
Firm size	Multinational organisation of firms (from FDI and ownership data)
Firm age	Employee skills (from linked employer – employee datasets)
Employment	Changes in organisation (from local surveys, or CIS)
Payroll	Measures of innovation (from CIS)
Capital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

Evidence

Impact Measures – from production surveys

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 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

Evidence – from micro to macro



Types of analysis

New results; of three main types;

- **Firm level regressions across all countries**, using standardised methods and data from ICT use surveys, production surveys and business registers from all 13 countries
- **Firm level regressions across 'lead' countries**, on skills, offshoring, innovation, investment
... both the above tend to identify 'within firm' productivity effects of ICT use
- **Cross industry / country analysis** using comparable indicators developed from microdata, combined with other sources
... analysis catches 'between firms' effects as successful business drive out unsuccessful ones .. and can capture policy differences between countries

Impacts - firm level

ICT use data 'explains' impacts well at firm level

- **ICT use in manufacturing** - positive labour productivity effects for all 13 countries in the study, and positive multifactor productivity in majority
- **ICT use in services** - more differentiated links with productivity, depending on country and industry; for the UK, France, Nordic countries and Netherlands positive correlations are clear; elsewhere not
- **Nordic states, Netherlands, UK and France** are also countries in our study where ICT use by firms, on comparable basis, is more intensive; appears to show 'increasing returns to ICT intensity' not (up to 2005) seen in other economies
- **ICT links to external market mechanisms important**
 - ICT enabled transactions within businesses have moderate effects
 - External supplier / customer links more powerful

Impacts - firm level

- For UK and NL we have firm level data on ICT investment and use, to test how ICT productivity impacts differ by business type
 - % e-procurement, and investment, matter most in manufacturing
 - % e-sales associated with higher productivity in distribution services
 - for business and financial services strongest relationship is with % employees using high speed internet
 - ICT capital is much more significant in UK (measured including software) than it is in Netherlands (where they only count hardware)
- Finland has data on flexibility / specialisation
 - flexibility associated with mobile access to IT has significant productivity benefits
 - outsourcing of IT services associated with large labour productivity advantages

Impacts – industry level

ICT use data ‘explains’ industry impact even better

- Relationship to productivity stronger than firm level
 - Industry differences across EU countries still evident
 - Impacts of usage even stronger, as data captures substitution effects
- Market mechanisms show up strongly
 - Clear relationship between intensity of IT use and market dynamism (but which way does causality run?)
- ‘Critical mass’ effects still there
 - Nordic countries, Netherlands UK, France show strongest relationships

Impacts - industry level

Broadband Adoption and Impact

$$a : v_{ijt} = a_0 + a_1 DSL\% + a_2 k^{IT} + a_3 k^N + a_4 hrs + dummies$$

$$b : DSL\%_{ijt} = b_0 + b_1 w_{-1} + b_2 Cap\%_{-1}^{IT} + b_3 HiSk_{-1} + b_4 Churn + dummies$$

v	(log) real value added
Kit	ICT capital service
Kn	Non-IT capital service
Hrs	hours
w	Average wage
Cap% _{it}	ICT-capital as share of cap.
HiSk _i	High skilled worker share
DSL%	Broadband penetration
Churn	Interquartile range of firm-level growth rate distribution

Impacts - industry level

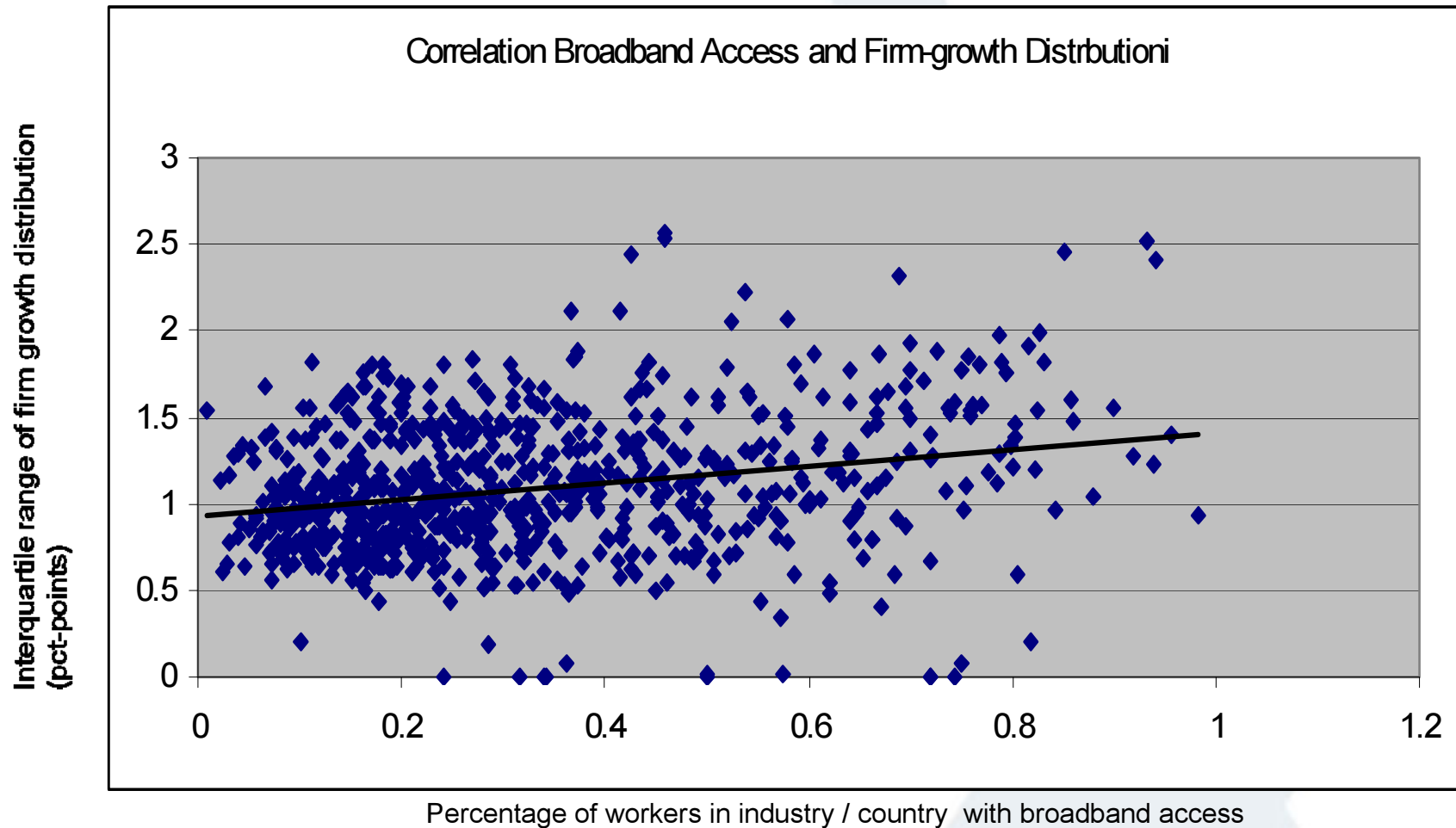
Broadband Adoption and Impact

Coef	Variable	DSL%		Internet%	
a1	ICT-indicator:	1.24	.90	1.20	1.05
a2	Kn	.35	.27	.34	.27
a3	Kit	-.07	.05	-.08	.05
a4	Hrs	.72	.68	.72	.68
b1	w(-1)	.24	.02	.30	.01
b2	Cap%it	.31	.20	.32	.17
b3	HiSkl	.18	.38	.19	.33
b4	Churn	.30	.15	.28	.14
	dummies	c,t	i,t	c,t	i,t
	D.F.	659	646	649	646

Kit generally insignificant; Other coefficients significant at 1%-level;

Impacts – industry level

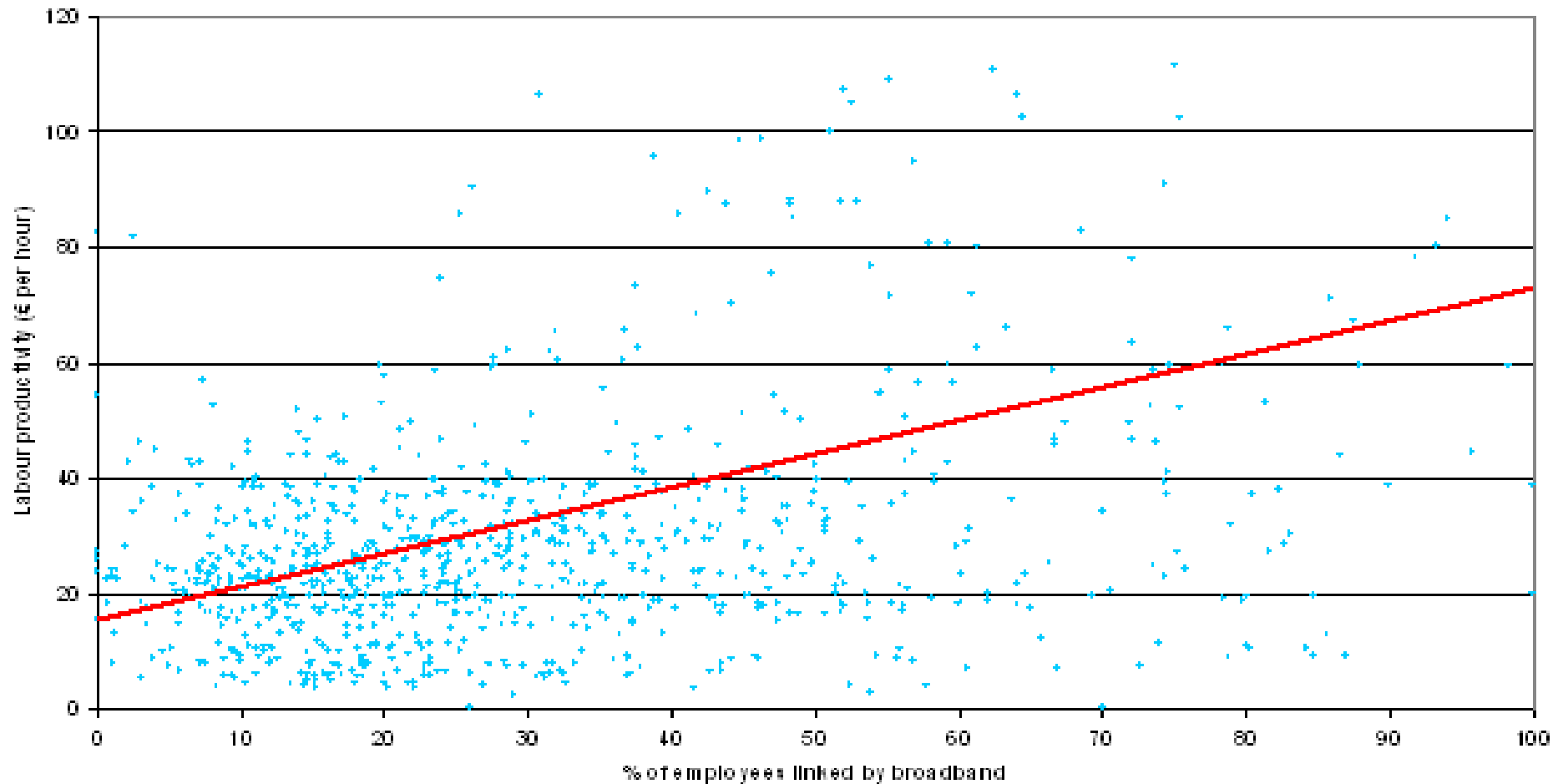
ICT use related to behaviour - 'competitive churn'



Impacts – industry level

ICT use related to performance - labour productivity

Labour productivity and broadband in selected EU countries (2001 - 2005)



Innovation impacts

ICT and the wider innovation story:

- ***Firm Level Results (UK, Netherlands, Sweden)***
- ICT networks support 'knowledge production'
 - More broadband enabled workers => more external ideas in innovation
 - More networked employees=> more new products / services
- ICT helps marketing new products
 - Netherlands analysis shows e-commerce linked to innovation success
- often ICT is the innovation
 - ICT use and process reorganisation drive productivity in new NL analysis
- ***Industry Level (across all countries)***
- ICT intensity changes degree of competitive innovation
 - Our evidence of relationship between ICT and competitive 'churn' matches US work showing successful firms in ICT intensive industries faster at rolling out innovation via ICT enterprise architecture

Impact indicators - industry level

Industry based 'network' indicators => new perspectives

	Elecom	MexElec	DISTR	FINBU	TOT
Sweden	Green	Dark Green	Medium Green	Dark Green	Dark Green
Norway	Dark Green	Medium Green	Green	Medium Green	Medium Green
Finland	Medium Green	Green	Dark Green	Green	Green
UK	Light Green	Light Green	Light Green	Yellow	Light Green
Netherlands	Yellow	Yellow	Orange	Light Green	Light Green
Slovenia	Light Green	Orange	Light Green	Light Green	Light Green
Denmark	Red	Light Green	Yellow	Red	Yellow
Germany	Yellow	Light Green	Orange	Orange	Yellow
Czech Rep	Orange	Orange	Light Green	Light Green	Orange
Austria	Light Green	Red	Red	Orange	Red
Italy	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red
Ireland	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red

Colour coded indicator for % broadband enabled employees; green highest, red lowest (2004)

Next Steps

Broadening the analysis

- Need longer panel data series
 - to solve some problems identifying chicken and egg
- Use 2007 Eurostat data module on business processes
 - to improve understanding of e-business links
- Extend framework to other NSIs
 - would like to add another 5+ countries in next round
 - needs significant investment (easier where survey questions harmonised)
- Link to more datasets on 'complementary assets'
 - R&D / innovation / skills / organisation etc
 - where we can't use micro-data for these inputs, link to industry analysis

Next Steps

Deepening the analysis

Complementary inputs ... micro check on macro analysis

- Software
- Technical R&D
- Non-technical innovation spending
- Workplace training / skills
- 'Organisational' investment / business process /
- Reputation

... analysis done at macro level in US / UK – can we 'drill down' to micro?

- **Differences between business types and models**
 - Impacts are model dependent, gains not evenly distributed
- **Understanding how ICT use changes competition**
 - US and EU data tell same story – market effects matter most
 - ICT networks strengthen competitive market effects
 - prices and market / knowledge access
 - Innovation data needs to be integral part of analytical framework

Next Steps

Recognise ICT interaction with other assets

