



The Productivity Effects of Information Communication Technology

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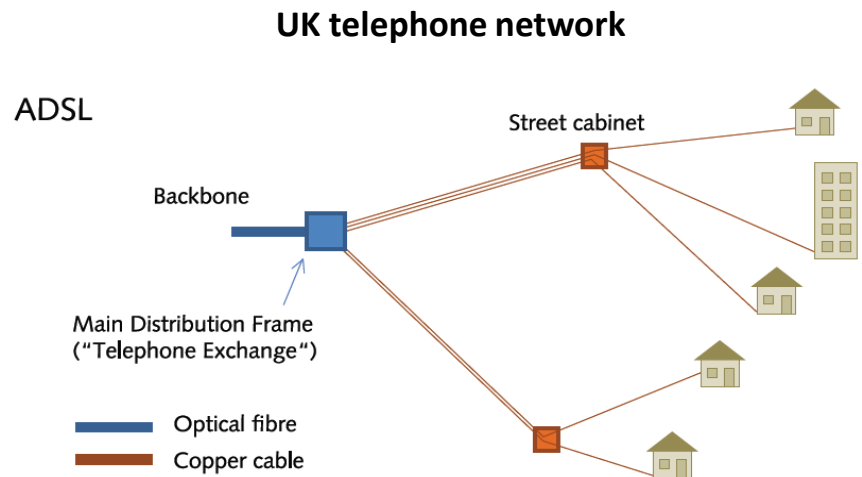
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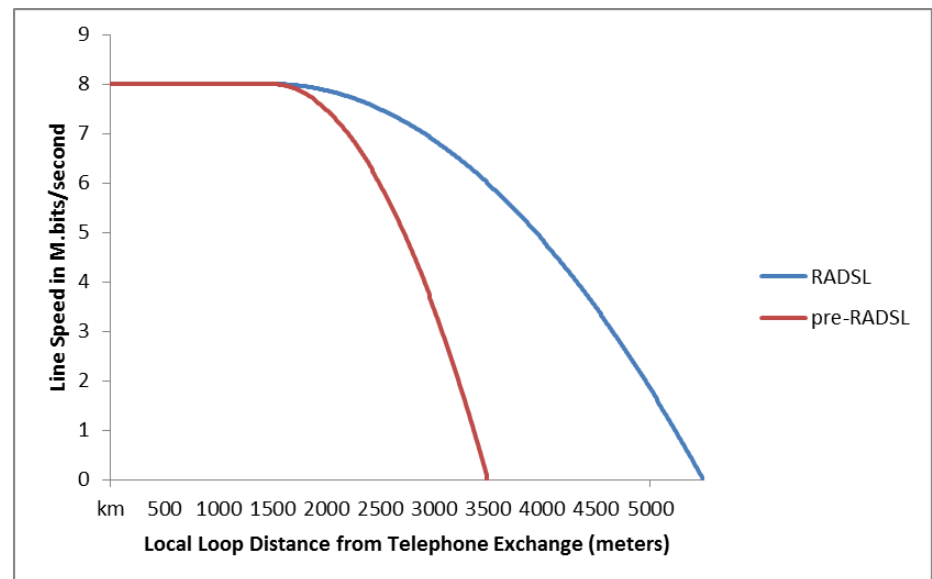


- Emerging consensus of ICT as a ‘general purpose technology’
- Bloom, Garicano, Van Reenan argue that ICT is not a homogenous capital
- The effects of ICT are distinct, depending on whether they affect information communication versus storage and processing
- We explore the sales, employment and productivity effects of communication-ICT

- Concerned by endogeneity bias
- Instruments based on telephone network infrastructure
- 5,630 Telephone exchange in UK
- *Instrument 1*: 0/1 indicator of TE if ADSL enabled *if enabled in wave 1*
- *Instrument 2*: Local Loop Distance
- Connection speeds deteriorate for cable-distances >2km. Max 3.5km
- Telephone quality okay up to 16km.
- Mid-2001, BT introduces RADSL technology – connection now up to 5.5km.
- Median (25%, 75%, 99%) distance 2.92km (2.01km, 4.10km, 6.02km)
- Wave 1 1999-2002; first 20% of exchanges



Cable Distance and Internet Speed

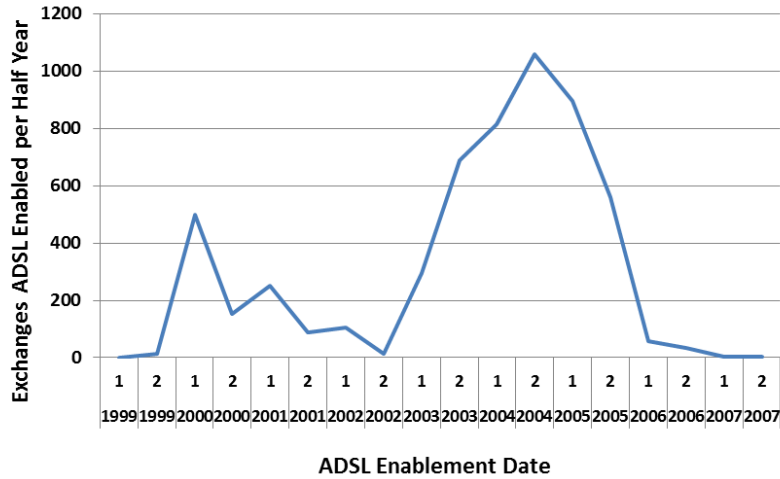




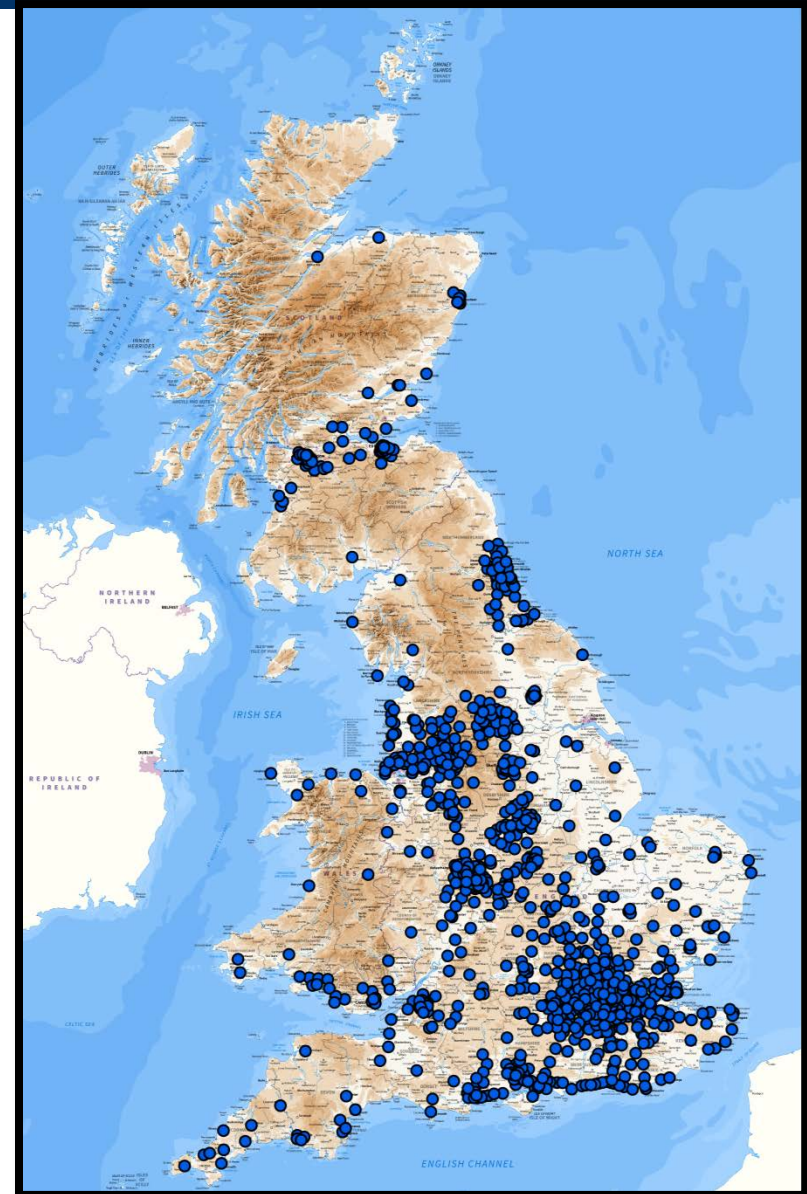
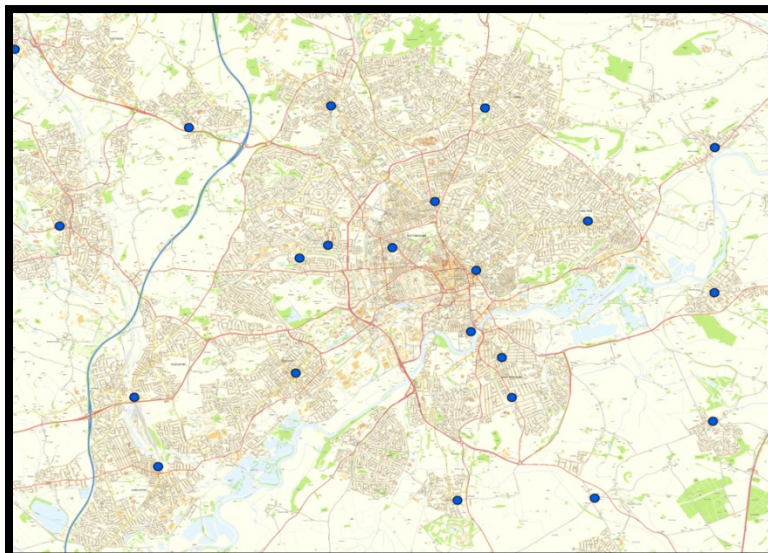
TEs Enabled by the end of 2002 (wave 1)



UK ADSL rollout across time



Location of TEs in Nottingham



Do Instruments Matter for ICT?



- ONS data on ICT capital stock. CiTDB data on ICT hardware and software
- First stage regressions for ICT use in year 2000 for firms who were connected to TEs enabled before end-2002
- Attached to ADSL enabled TE increases ICT, PCs but not software
- Greater cable distance reduces this

Dependent variable: ICT

Sample	Year: 2000; Exchanges Enabled in Wave 1 (1999-2002)					
ICT Variable	ICT Capital Stock	ERP software	ERP & Sales Software	PCs/ Emp.	Portable PCs/ Emp.	Pentium PCs/ Emp.
ADSL Enabled	0.908***	-0.004	-0.049	0.347***	0.494***	0.323***
Exchange	(0.171)	(0.030)	(0.040)	(0.080)	(0.120)	(0.090)
Loop distance*	-0.382***	-0.013	0.034	-0.201***	-0.298***	-0.199***
ADSL Enabled	(0.142)	(0.020)	(0.030)	(0.060)	(0.100)	(0.070)
Observations	3,331	4,830	4,831	4,830	3,281	4,686

Instrument Validity



- Objections to the instrument
 - Local loops are not randomly assigned
 - Other confounding factors are correlated with firm performance other than through broadband adoption
- Arguably unobserved geographic & firm factors may be important
- Provide evidence for
 - Introduction of RADSL
 - control for region dummies, no. households, no. businesses
 - Pre-ADSL firm characteristics (data from 1998)

Dependent variable: ICT

Exchanges	ADSL Enabled Exchanges				Non-Enabled Exchanges			
Enabled in..					Wave 1	Wave 1	Wave 1	Wave 2&3
Year	2000	2001	2002	2003	1998	1999	2000	2000
ICT Variable	ICT Capital Stock				ICT Capital Stock			
Loop Distance *	-0.336***	-0.250***	-0.169***	-0.151***	-0.129	0.184	0.065	0.159
ADSL enabled	(0.093)	(0.063)	(0.057)	(0.053)	(0.352)	(0.171)	(0.106)	(0.110)

Main Results: Aggregate ICT and Performance



Dependent Variable	Output		Employment		TFP		
	All Wave 1	Enabled By 2000	All Wave 1	Enabled By 2000	All Wave 1	Enabled By 2000	All
Exchanges							
Second Stage							
ICT Capital Stock	0.605***	0.471***	0.399***	0.399**	0.014	-0.158	0.058
	(0.072)	(0.115)	(0.065)	(0.120)	(0.092)	(0.107)	(0.042)
First Stage							
ADSL Enabled	0.908***		0.908***		0.908***		0.969***
Exchange	(0.171)		(0.171)		(0.171)		(0.143)
Loop distance	-0.382***	-0.336***	-0.382***	-0.336***	-0.382***	-0.336***	-0.414***
*ADSL Enabled	(0.142)	(0.093)	(0.142)	(0.093)	(0.142)	(0.093)	(0.122)
Cragg-Donald F Test	21.883	13.688	21.883	13.688	21.883	13.688	41.786
Kleibergen-Paap F Test	22.249	12.926	22.249	12.926	22.249	12.926	40.503
Hansen J Statistic	0.504		0.604		0.545		0.083
Observations	3331	2290	3331	2290	3331	2290	4807

Main Results: Types of ICT and Revenue



Dependent Variable	Revenue					
	All Wave 1	Enabled By 2000	All Wave 1	Enabled By 2000	All Wave 1	Enabled By 2000
Second Stage						
Exchanges						
PCs per employee	1.425***	1.904***				
	(0.424)	(0.402)				
Portable PCs			1.137***	1.186***		
per employee			(0.342)	(0.275)		
Pentium PCs					1.740***	2.181***
per employee					(0.569)	(0.527)
First Stage						
ADSL Enabled	0.347***		0.494***		0.323***	
Exchange	(0.078)		(0.123)		(0.089)	
Loop Distance	-0.201***	-0.225***	-0.298***	-0.305***	-0.199***	-0.203***
*ADSL Enabled	(0.061)	(0.033)	(0.097)	(0.053)	(0.070)	(0.038)
Cragg-Donald F Test	12.948	47.418	9.067	33.619	7.55	28.544
Kleibergen-Paap F Test	12.339	46.588	9.382	33.332	7.318	28.313
Hansen J Statistic	0.166		0.346		0.335	
Observations	4,830	3,276	3,281	2,246	4,686	3,169

- This paper considers whether communication-ICT affects the performance of UK firms
- We use an IV approach that uses communications-network infrastructure
- Find that instruments behave as expected and pass standard tests for instrument validity
- Find a strong effect on employment and revenue but not TFP.

Acknowledgements



The University of
Nottingham

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- **This work was based on data from the Annual Respondent Database, the E-Commerce and ITIS Database, produced by the Office for National Statistics (ONS) and supplied by the Secure Data Service at the UK Data Archive. The data are Crown Copyright and reproduced with the permission of the controller of HMSO and Queen's Printer for Scotland. The use of the data in this work does not imply the endorsement of ONS or the Secure Data Service at the UK Data Archive in relation to the interpretation or analysis of the data. This work uses research datasets which may not exactly reproduce National Statistics aggregates. In addition this research used data from them ICT Capital Stock Dataset provided by the VML.**