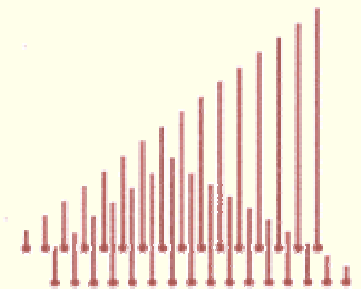


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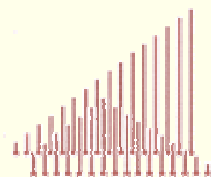
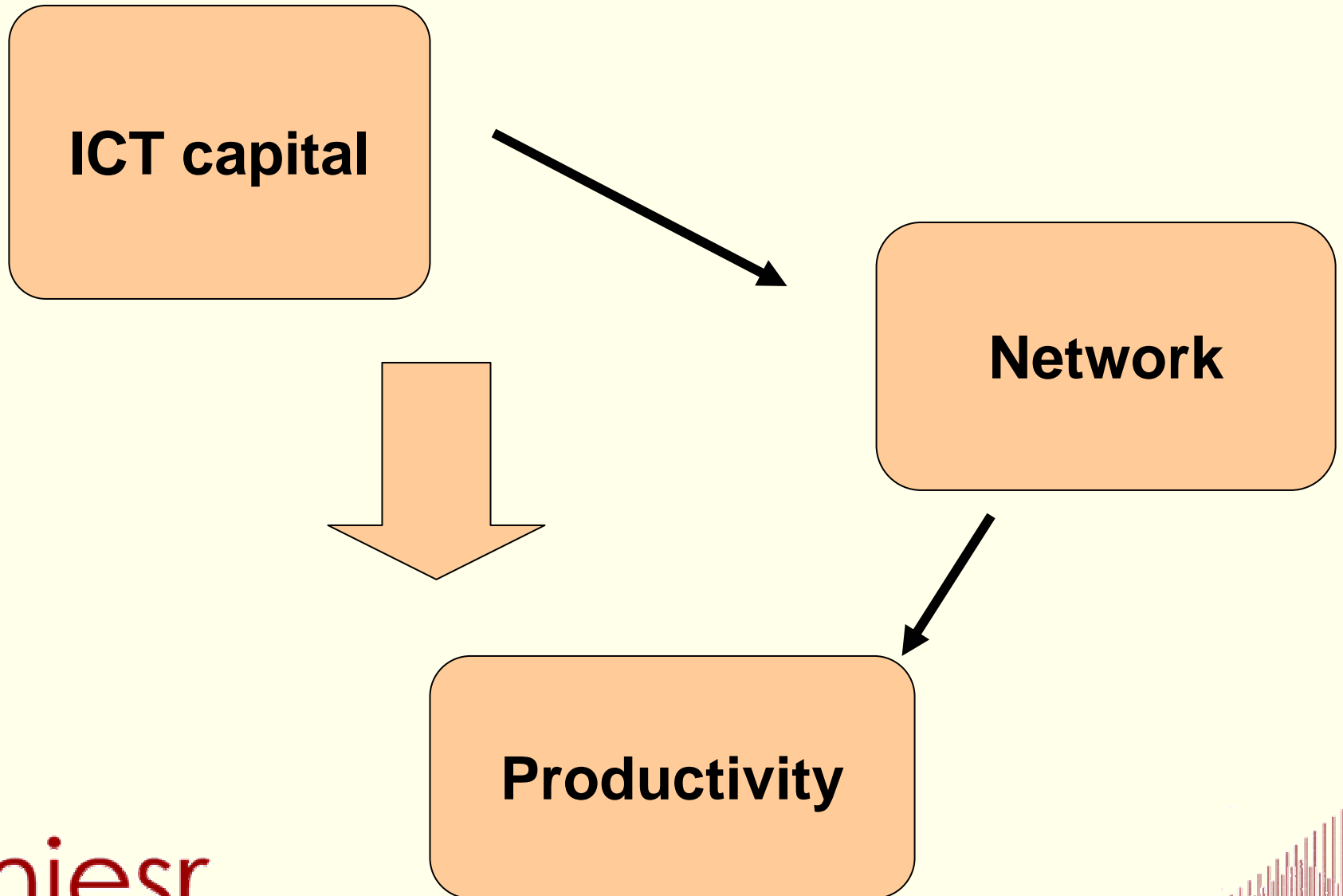
## The productivity impact of e-commerce in the UK, 2001: Evidence from Microdata

*Ana Rincon, Catherine Robinson  
and  
Michela Vecchi.*



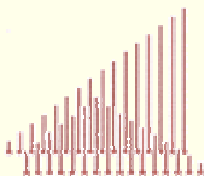
National Institute  
of Economic and  
Social Research

# Introduction



# Aims of this paper

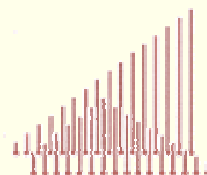
- To examine the direct impact that e-commerce has had on establishment level productivity for all sectors of the economy, using data from the UK E-commerce survey, linked with financial data from the ABI survey.
- Evaluate the productivity gains of firms that more likely to engage in E-commerce activities and firms that are less likely to do so.



# Definition of E-commerce

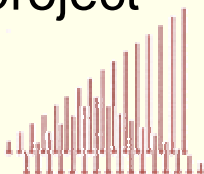
E-commerce is defined here as *“Transactions over the Internet or over other computer mediated networks. The goods and services are ordered over those networks but the payment and delivery of the goods may be conducted on or off line”*

(E-commerce Survey, ONS 2002)



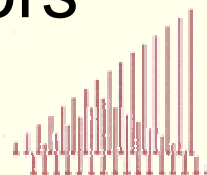
# ONS micro data

- The Business Data Linking (BDL) unit
  - Started back in 1997 with the data that underlies the ACOP – Oulton was the first to draw attention to it. Now extended to include service sectors (from 1997) and called the ABI (Annual Business Inquiry – sometimes, ARD)
  - Data sets have been expanded to include a number of government surveys at the reporting unit level, including innovation surveys, skills surveys and ecommerce surveys (latter used here). These have been linked to the financial data in the ABI using a common sampling frame and reference no.
  - Access to data is very restrictive – use only on-site, all output rigorously checked, access is permitted on a project by project basis.



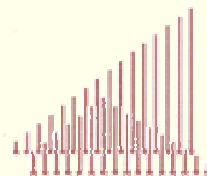
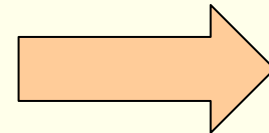
# ABI and E-Commerce

- The data used here:
  - The Ecommerce survey is a relatively small sample (only 12,000 enterprises included). It has been carried out in three years so far, 2000-2002.
  - ABI data has only recently become available for 2002 and so has not been matched in.
  - E-commerce questions for 2000 very different to the other two, the sample size is much smaller and the results have been said to be hugely affected by substantial investment around the millennium bug issue.
- So, we use a matched dataset for 2001, covering both production and service sectors



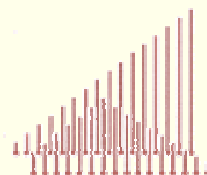
# ABI and E-Commerce - *continued*

- In addition to the data for 2001, we have matched the E-commerce survey data for 2001 into previous years' financial data – back to 1997, when the services began to be included. Thus we have traced firms back over time. These data are used to evaluate the relationship between past performance and E-commerce activities.
- Capital data estimated by Martin (2002) for production and ONS for services.
- E-commerce 2001 main questions



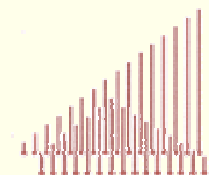
# Use of Internet for placing/receiving orders

Q no.	Question	format	% Production (n=1536)	% services (n=1903)
q090 (E-buy)	Do you use the internet for placing orders?	yes/no	35.48	39.73
q101	mean % of orders from the internet as a % of all orders	%	1.16	2.2
q110 (E-sell)	Do you use the internet for receiving orders?	yes/no	14	21.44
q121	mean % of orders received from internet as a % of all orders	%	1.3	1.11



# Connectivity measures

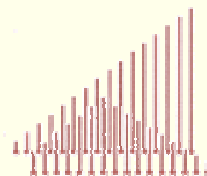
Q no.	Question	format	Production services	
			(n=1536)	(n=1903)
q010	Did your enterprise use PCs	yes/no	99.48	98.63
q021	mean % employees without Internet	%	28.5	28.24
	100% employees without Internet	%	NA	NA
q022	mean % of employees using Internet	%	27.15	36.14
	100% of employees using Internet	%	4.69	12.72
q051	mean no of years using Internet	no.	3.43	3.32
q052	mean no of months using Internet	no.	1.69	1.72
q061	how do you connect?	% with broadband	26.17	32.05
q080	do you have a Website?	yes/no	83.27	84.87



# Network of systems

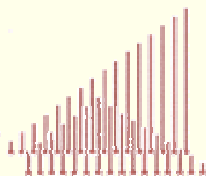
Q no.	Question	format	%	%
			Production (n=1536)	services (n=1903)
q160	use internet etc for receiving payment	yes/no	62.63	58.01
q170	use internet etc for making payment	yes/no	70.7	68
q181	link to suppliers' systems	yes/no	16.67	23.33
q182	reordering of replacement supplies	yes/no	14.26	17.71
q183	link customers' systems	yes/no	26.5	15.5
q184	invoicing and payment system	yes/no	35.74	34.42
q185	production/service operation	yes/no	22.01	19.39
q186	logistics system	yes/no	23.57	19.81
q187	marketing	yes/no	7.75	11.61

Intense indicator



# Modelling productivity - 1

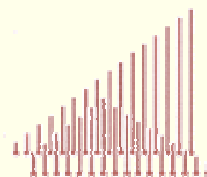
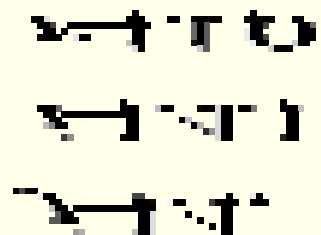
- Gross output specification including intermediate materials (Baily 86, Basu and Fernald 97, Atrostic and Nguyen 04)
- We focus on e-buy and e-sell plus two combined variable, e-trade and e-trade2
- We include a set of control variables: Multiplant, Foreign ownership, Age of the reporting unit, Industry and Region.



# Modelling productivity - 2

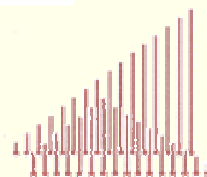
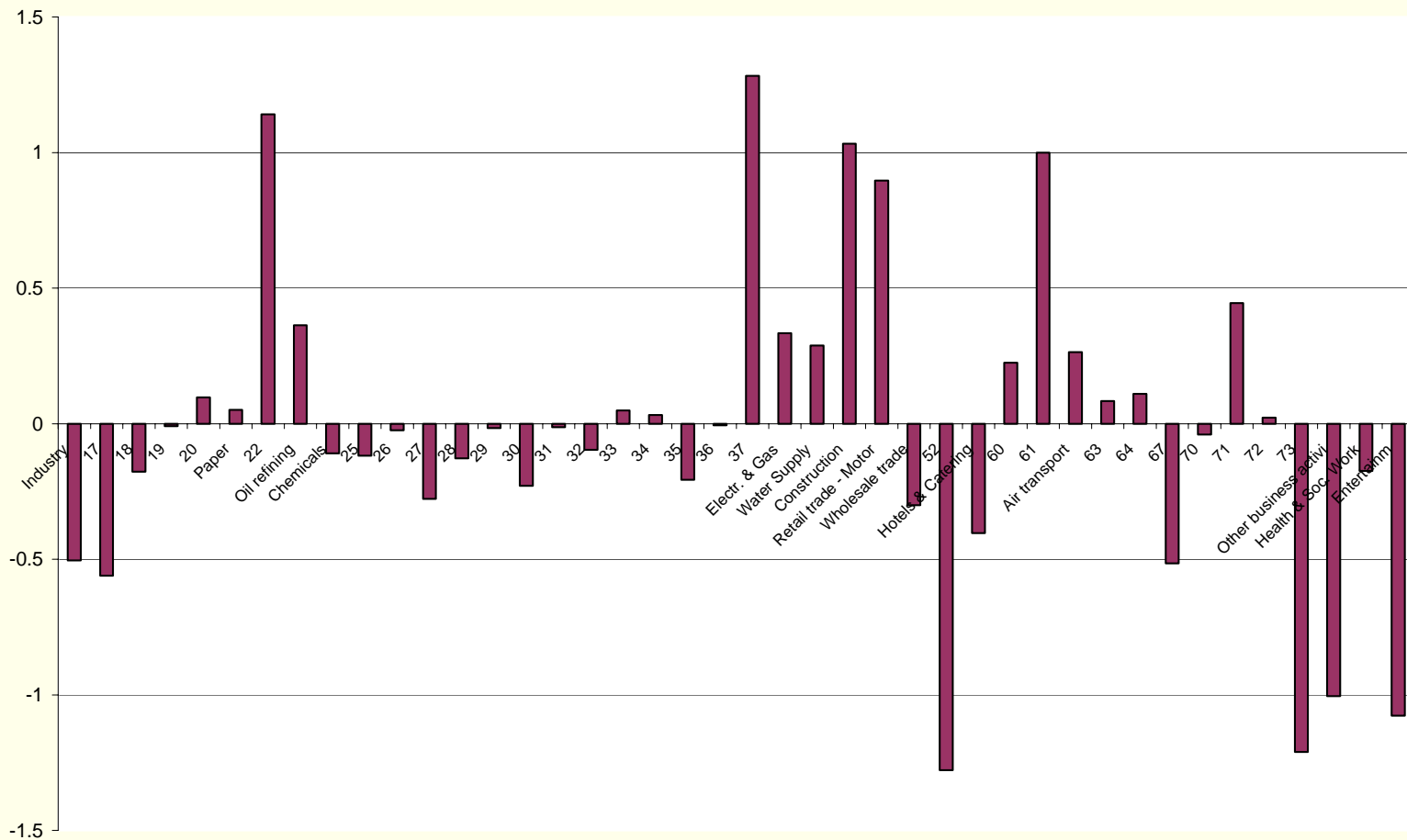
1) 
$$\ln(Q_i) = \alpha_0 + \alpha_1 \ln(L_i) + \alpha_2 \ln(K_i) + \alpha_3 \ln(M_i) + \varepsilon_i,$$

2) 
$$\begin{aligned} \ln(Q_i) = & \alpha_0 + \alpha_1 \ln(L_i) + \alpha_2 \ln(K_i) + \alpha_3 \ln(M_i) + \alpha_4 Z_{ij} + \\ & + \alpha_5 Multi + \alpha_6 FO + \alpha_7 age + \sum \gamma_i Ind + \sum \gamma_r reg + \varepsilon_i \end{aligned}$$



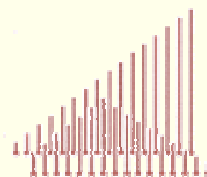
# Figure 1

## Average Labour Productivity Growth by Industry



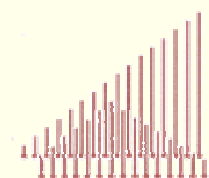
# Table 3: Rate of Growth of Labour Productivity in E-Trade and non E-Trade firms

	Total	E-buy	E-sell	E-trade2	NO E-trade
1998	-0.001	0.132	0.151	0.155	-0.097
1999	-0.002	0.141	0.171	0.217	-0.111
2000	-0.006	0.099	0.117	0.127	-0.095
2001	0.001	0.146	0.228	0.239	-0.128



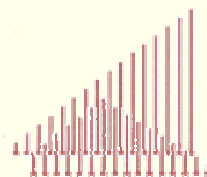
# Table 4: cross section results, OLS

	Total	Production	Services
Constant	1.441*	1.444*	1.459*
	(.099)	(.131)	(.241)
Emp	0.252*	0.210*	0.266*
	(.016)	(.024)	(.020)
K (2001)	0.124*	0.092*	0.156*
	(.022)	(.031)	(.031)
Inter	0.636*	0.688*	0.598*
	(.024)	(.039)	(.032)
e-buy	-0.014	-0.010	-0.018
	(.017)	(.019)	(.028)



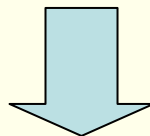
# Table 4 cont.: Impact of trading on the Internet - OLS results

	All Sectors	Production	Services
e-buy	-0.014 (.017)	-0.010 (.019)	-0.018 (.028)
e-sell	0.012 (.019)	0.007 (.019)	0.006 (.030)
e-trade	-0.008 (.018)	-0.006 (.019)	-0.015 (.029)
e-trade2	0.004 (.027)	-0.001 (.024)	0.001 (.041)
Observations	2435	1188	1247

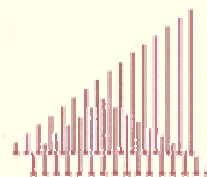


# Selection bias and treatment

- OLS results are likely to be inconsistent because of the correlation between explanatory variables and disturbances
- Correlation between the decision of trading on the web and productivity
- Selectivity bias

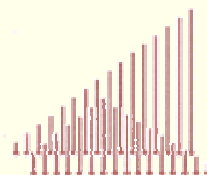


**We instrument the endogenous binary variable  
(treatment effect estimator)**



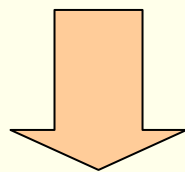
# Treatment effect estimator - 1

- Two alternative estimation techniques:
- 2sls (probit in the first stage, OLS in the second).
- Maximum likelihood estimator - just one step therefore more efficient.
- Instrument set includes: Broadband, Webusers, Experience, Website, Intense.

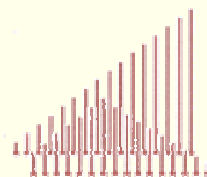


# Treatment effect estimator - 2

$$3) \quad Z_j = \beta_{0j} + \beta_{1j} \textit{Broadband} + \beta_{2j} \textit{Webusers} + \beta_{3j} \textit{Experience} \\ + \beta_{4j} \textit{Website} + \beta_{5j} \textit{Intense} + \beta_{6j} \textit{Output}_{t-1} + u_j$$

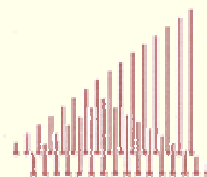


$$2) \quad \ln(Q_i) = \alpha_0 + \alpha_1 \ln(L_i) + \alpha_2 \ln(K_i) + \alpha_3 \ln(M_i) + \alpha_4 \hat{Z}_{ij} + \\ + \alpha_5 \textit{Multi} + \alpha_6 \textit{FO} + \alpha_7 \textit{age} + \sum \gamma_i \textit{Ind} + \sum \gamma_r \textit{reg} + \varepsilon_i$$



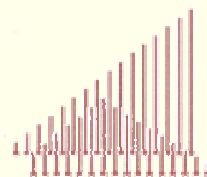
# Results: The impact of buying on the Internet on productivity

	All Sectors	Production	Services
Constant	1.580* (.087)	1.541* (.099)	2.090* (.454)
Emp	0.260* (.012)	0.214* (.016)	0.277* (.017)
K (2001)	0.111* (.013)	0.077* (.014)	0.141* (.021)
Inter	0.622* (.013)	0.684* (.015)	0.588* (.020)
e-buy	0.302* (.070)	0.342* (.032)	0.206 (.132)
L. ratio test	5.920* (.015)	34.43* (.000)	2.640 (.104)



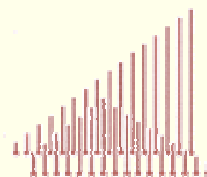
# The impact of trading on the Internet on productivity

	All Sectors	Production	Services
e-buy	0.302* (.070)	0.342* (.032)	0.206 (.132)
e-sell	0.224* (.057)	0.242* (.048)	0.331* (.084)
e-trade	0.364* (.045)	0.346* (.032)	0.399* (.081)
e-trade2	0.064 (.063)	0.178* (.060)	0.046 (.105)



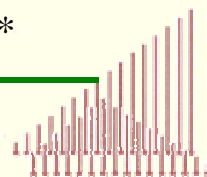
# Looking at the probability of trading on the Internet

Percentiles (%) of Pr (Trading on the Internet)	Percent increase in Labour productivity.
Total	
1% (0.0798) vs. 99% (0.8914)	29.54%
10%(0.2200) vs 90% (0.7416)	18.98%
25%(0.3317) vs 75% (0.6147)	10.30%
Production	
1% (0.1048) vs. 99% (0.8215)	24.79%
10%(0.2166) vs 90% (0.6599)	15.33%
25%(0.3053) vs 75% (0.5410)	8.15%
Services	
1% (0.0780) vs. 99% (0.9781)	35.91%
10%(0.3069) vs 90% (0.9009)	23.7%
25%(0.4762) vs 75% (0.8135)	13.45%



# Determinants of the probability of trading on the Internet

		<i>e-buy</i>	<i>e-sell</i>	<i>e-trade</i>	<i>e-trade2</i>
<i>Production</i>	Constant	-2.205*	-3.341*	-2.101*	-4.092*
	Output-1	0.106*	0.138*	0.118*	0.106*
	Website	0.272*	0.629*	0.333*	0.704*
	Experience	0.049*	0.016	0.039*	0.073*
	Intense	0.064*	0.131*	0.078*	0.169*
	Webusers	0.015	0.374‡	0.075	0.396
	Broadband	0.134*	-.464*	0.013	-0.319
<i>Services</i>	Constant	-1.095	-3.610*	-2.415*	-1.725*
	Output-1	0.034	0.181*	0.198*	-0.028
	Website	0.366*	0.487*	0.433*	0.368
	Experience	0.087*	-0.007	0.051*	0.035
	Intense	0.055*	0.108*	0.075*	0.123*
	Webusers	0.417*	0.257‡	0.374*	0.349*
	Broadband	0.081	0.517*	0.134	0.528*



# Conclusions

- When using OLS we do not find any significant impact of E-commerce on productivity.
- When we correct for selectivity bias the effect is positive and strong.
- Further developments: construct a TFP measure and analyse the impact of e-commerce on productivity growth.

