

Productivity impact of broadband and ICT use

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Outline of presentation

- Some results of core analysis EUROSTAT ICT– project for the Netherlands, w.r.t.
 - readiness
 - intensity of ICT use
- Econometric analysis of ICT impact on productivity using data on broadband a composite indicator for ICT maturity (stage of ICT development)
- First results and suggestions for further research



ICT readiness

	2000		2002		2004	
	Panel	Macro	Panel	Macro	Panel	Macro
Website	67.3	61.1	79.6	68.8	89.6	83.1
Internet	91.6	87.7	95.4	88.8	97.8	95.1
Epurch	49.3	48.1	47.6	40.6	52.0	46.3
Esales	42.7	40.8	36.8	32.7	34.6	29.0
DSL	??		51.2	46.0	89.6	81.6

- macro: core analysis EUROSTAT ICT project
- panel : linked data EC, SBS, and Investment survey's



Intensity of ICT use

Average intensity (2004)

	macro	panel
% Employees using PC	0.56	0.55
% Employees using internet	0.41	0.35
Epurchpct	0.03	0.04
Esalespct	0.05	0.07
DSLpct	0.37	0.34

- How to assess productivity impacts ?
- Focus on broadband use



Empirical approach (I)

- Disentangle ICT productivity impacts in shifts of PF frontier and changes in efficiency (distances to PF frontier) due to achieving a higher level of ICT use: Generalized Stochastic Frontier (GSF) model of Battese and Coelli (1993)
- How: combine data on ICT intensity ('traditional' PF inputs) with firm characteristics on how ICT is used, both in PF and DTFP equation



Empirical approach (II)

$$\log\left(\frac{Y}{L}\right) = \beta_0 + \beta_1 \log\left(\frac{C_1}{L}\right) + \beta_2 \log\left(\frac{C_2}{L}\right) + (\beta_1 + \beta_2 - 1)\log(L) + \gamma'X + (V - U)$$

Y : Value added

C_1 : Non-ICT capital stock

C_2 : ICT capital stock

L : Labour inputs

X : PF 'shifters': Intensity of Broadband use,
stage of ICT development + interaction with
ICT intensity (C_2/L)

$V - U$: composite disturbance



Empirical approach (III)

$$\log\left(\frac{Y}{L}\right) = \beta_0 + \beta_1 \log\left(\frac{C_1}{L}\right) + \beta_2 \log\left(\frac{C_2}{L}\right) + (\beta_1 + \beta_2 - 1)\log(L) + \gamma'X + (V - U)$$

V : i.i.d. noise

U : $U = \delta'Z + W$

W : drawing from normal distribution with mean 0 and variance σ^2 and truncated at $-\delta'Z$.

Z : variables explaining efficiencies (distances to frontier)

U is non-negative drawing from $N(\delta'Z, \sigma^2)$ because W is truncated at $-\delta'Z$ ($W \geq -\delta'Z$).

DTF (efficiency) = $\exp(-U) = \exp(-\delta'Z - W) \leq 1.0$



Empirical approach (IV)

Specification of X and Z :

- 1) Use EUROSTAT broadband variable DSLpct

DSLpct = use of DSL*% of employees using internet

- 2) Construct composite indicator for the stage of ICT development (Stage)
- 3) Include interactions with ICT-intensity ($\log(C_2/L)$)
- 4) Start from same specification for X and Z .
- 5) Exclude variables from X or Z on the basis of Likelihood-Ratio (LR) tests



Approximating ICT maturity

- Based on chapter 4 of DDE (The Digital Economy, 2006)
- ICT use evolves according to stages:
 - 1) The use of external data communication (C of ICT)
 - 2) The set up of a website
 - 3) The realization of electronic sales (e.g. via websites)
 - 4) The provision of electronic after-sales services
 - 5) The linkage of own ICT systems with ICT systems of clients

Stage 5 maximum level of ICT maturity (2004 5% of firms)

More than website: 2002 21 %, 2004 25 % of firms

Esales distribution is very skewed!!



Empirical implementation

1. Classify firms according to emergence of different forms of ICT use
2. Do 1) but take difference from maximum level (5)
3. Do 1) and use boolean transformation
 - 1 : more than Website available
 - 0 : no more than Website



First results (I)

1) Production frontier

	OLS	T	GSF	T	GSF	T
log(C1/L)	0.15	15.9	0.15	18.0	0.16	18.4
log(C2/L)	0.04	4.0	0.05	4.9	0.05	5.6
Log(L)	0.04	4.8	0.01	1.0	0.02	2.7
Stage	0.00	0.5	0.00	-0.1		
Stage*log(C2/L)	0.02	1.3	0.02	1.4		
Boolean_stage					0.01	0.3
Boolean_stage*log(C2/L)					0.00	-0.3
DSL_pct	0.26	3.7	0.30	5.3	0.27	7.2

– Time -, size and sector dummies included

– Unbalanced panel for 2002 – 2004 (N = 2541)



First results (II)

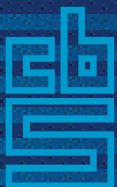
2) Model for Distances to Frontier (DTF)

	GSF	T	GSF	T	GSF	T
Stage	-0.06	-2.2				
Stage*log(C2/L)	-0.12	-3.0				
Boolean_stage			-0.92	-8.3		
Boolean_stage*log(C2/L)			-0.12	-1.8		
Dif_stage					-0.41	-7.8
Dif_stage*log(C2/L)					-0.06	-2.4
DSL_pct	0.06	0.5	0.04	0.2	-0.01	-0.1
DSL_pct*log(C2/L)	0.05	0.9	0.02	0.3		

– Time and size dummies included;

– Higher levels of ICT maturity imply smaller DTF;

– No contribution of Broadband intensity



Wrapping up and TO DO list

- Broadband shifts frontier
- Conditional on using broadband, distance to frontier determined by level of ICT maturity

TO DO:

- evaluate efficiency scores
- extend model to include data on internal ICT linkages and organisational practices (De Graaf et al. (forthcoming))
- Robustness analysis with DEA??



Thank you for your attention

