

Long term implications of the ICT revolution: applying the lessons of growth theory and growth accounting

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The issue

What will be the future impact of the ICT revolution on long run labour productivity growth?

N. Oulton, “Long term implications of the ICT revolution: applying the lessons of growth accounting and growth theory”

[*Economic Modelling*, vol. 29, pages 1722-1736, 2012;

CEP Discussion paper no. 1027, November 2010

<http://cep.lse.ac.uk/pubs/download/dp1027.pdf>]

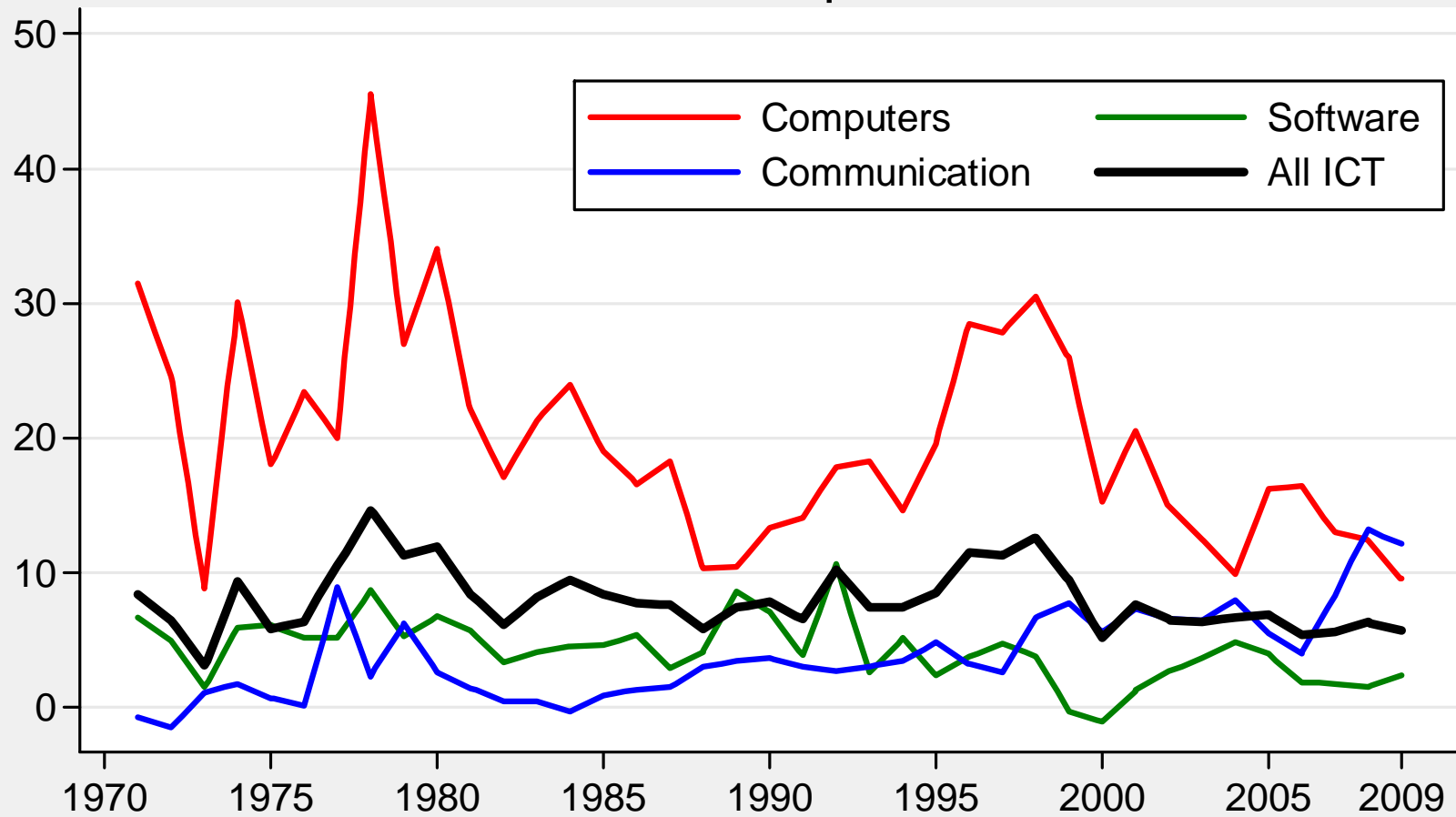
It's the Great Recession, stupid!

- “This paper is irrelevant because it is going to ignore the effect of the Great Recession”
- No, because the most likely effect of the Great Recession will be to reduce the *level* of GDP but leave the long run *growth rate* unaffected.
- According to Perron (Econometrica, 1989), this was the effect of the Great Depression of the 1930s on the US.

Background

- One-sector model
Solow (RES, 1956)
- Two-sector model
Barro and Sala-i-Martin (1995)
Whelan (JMCB, 2001)
Oulton (JME, 2007)
- Growth accounting and database
www.euklems.net; O'Mahony and Timmer (EJ, 2009)

Rate of decline of relative price of ICT products U.S., % p.a.



Source: U.S. NIPAs, Table 5.5.4.

Note: All prices relative to price of non-farm business sector output.

ICT: computers, software and communication.

A growth theory perspective

Two ratios matter:

- ICT share of *output* ---
value added in ICT production as a % of
GDP
- ICT share of *income* (β)---
Profit attributable to ICT assets as a % of
GDP

Long run growth in the *one*-sector model

Long run growth rate of GDP per hour

$$= \frac{\text{Growth of TFP}}{\text{Labour share}}$$

PARADOX

If a country does not produce ICT goods and services, then it gains nothing from the ICT revolution!

Or does it?

Two-sector model

- Two sectors
 1. Non-ICT: produces consumption goods and non-ICT capital goods
 2. ICT: produces ICT capital goods
- Productions functions are identical in the two sectors, except for TFP which grows faster in ICT
- This implies:

Rate of decline of relative price of ICT goods =
TFP growth in ICT *minus* TFP growth in non-ICT

Long run growth in a *two*-sector model

Assume that ICT is a second form of capital, that all ICT goods are *imported*, and there is no ICT production. Then:

Growth of GDP per hour =

$$\frac{\text{Growth of TFP in non-ICT sector}}{\text{Labour share}}$$

plus $\frac{\text{ICT income share} \times \text{Rate of decline of ICT relative price}}{\text{Labour share}}$



ICT use effect

Long run growth, with some ICT output

Growth of GDP per hour =

$$\frac{\text{Growth of (non-ICT) TFP}}{\text{Labour share}}$$

plus $\frac{\text{ICT income share} \times \text{Rate of decline of ICT relative price}}{\text{Labour share}}$

plus ICT output share \times Rate of decline of ICT relative price



ICT output effect

ICT effect on long run growth

Total ICT effect on GDP growth =

ICT *use* effect plus ICT *output* effect

Note: growth of consumption is affected only by the ICT *use* effect (reason: international trade)

Data

- EU KLEMS Database, November 2009 release for ICT income shares; March 2011 update for output shares for 15 EU countries.
- Methodologically consistent .
- ICT income and output shares available for 19 countries, of which 15 in EU.
- ICT relative prices: U.S. NIPAs.

ICT income shares

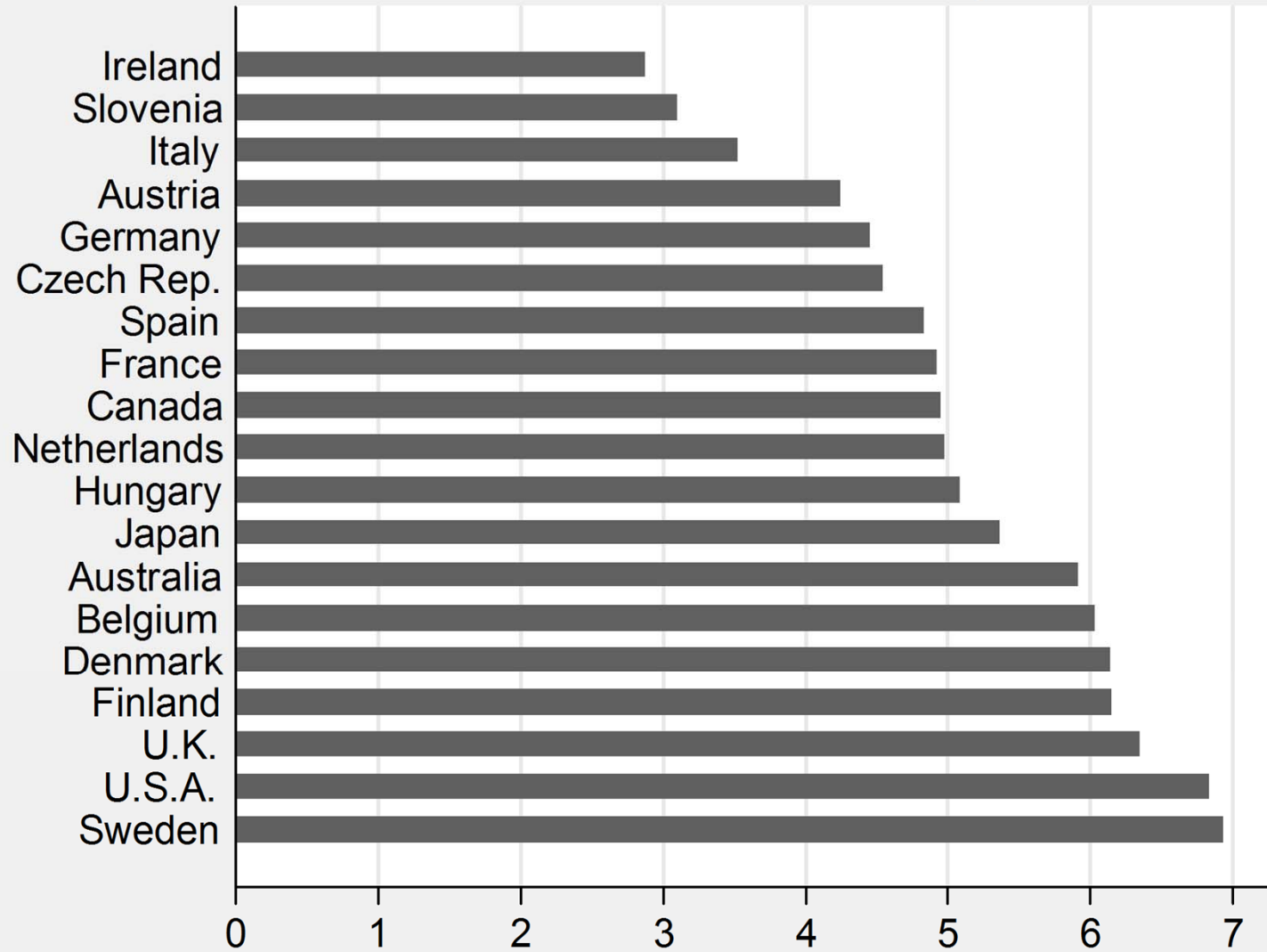
Profits attributable to ICT capital divided by current price value added in the market sector. ICT capital comprises computers, software and communications equipment. Profits attributable to a particular type of ICT capital equal the rental price of that type times the real stock of that type.

ICT output shares

1. for 15 EU countries, the sum of value added in “Office accounting and computing machinery” (division 30 of NACE Rev. 1.1), “Electrical machinery and apparatus” (division 31), “Radio, television and communication equipment” (division 32), and “Computer and related activities” (division 72), all divided by value added in the market sector.
2. For 4 Non-EU countries, value added in “Electrical and optical equipment” (NACE divisions 30-33) divided by value added in the market sector.

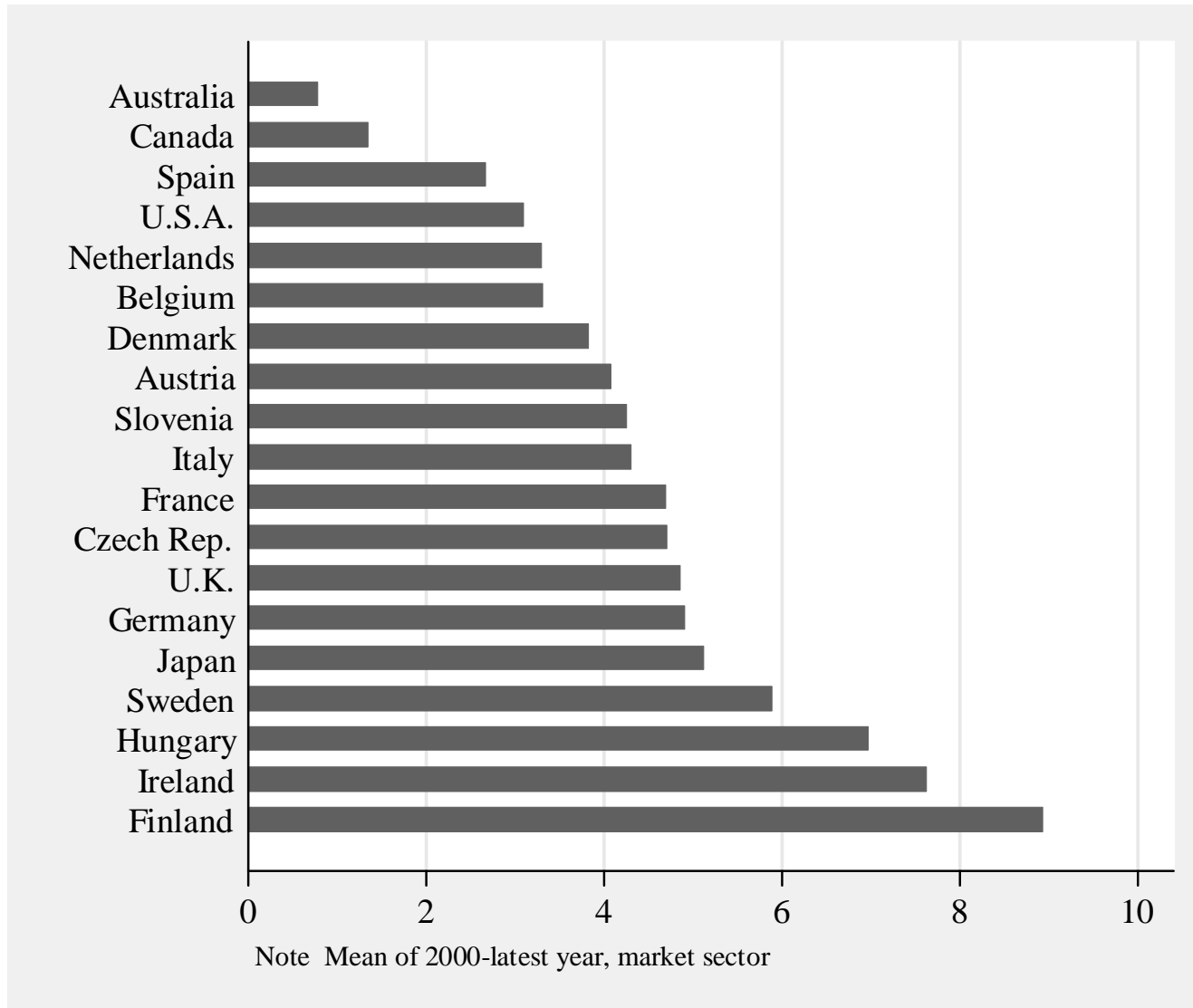
First definition corresponds better to the income shares.

Income share of ICT, %

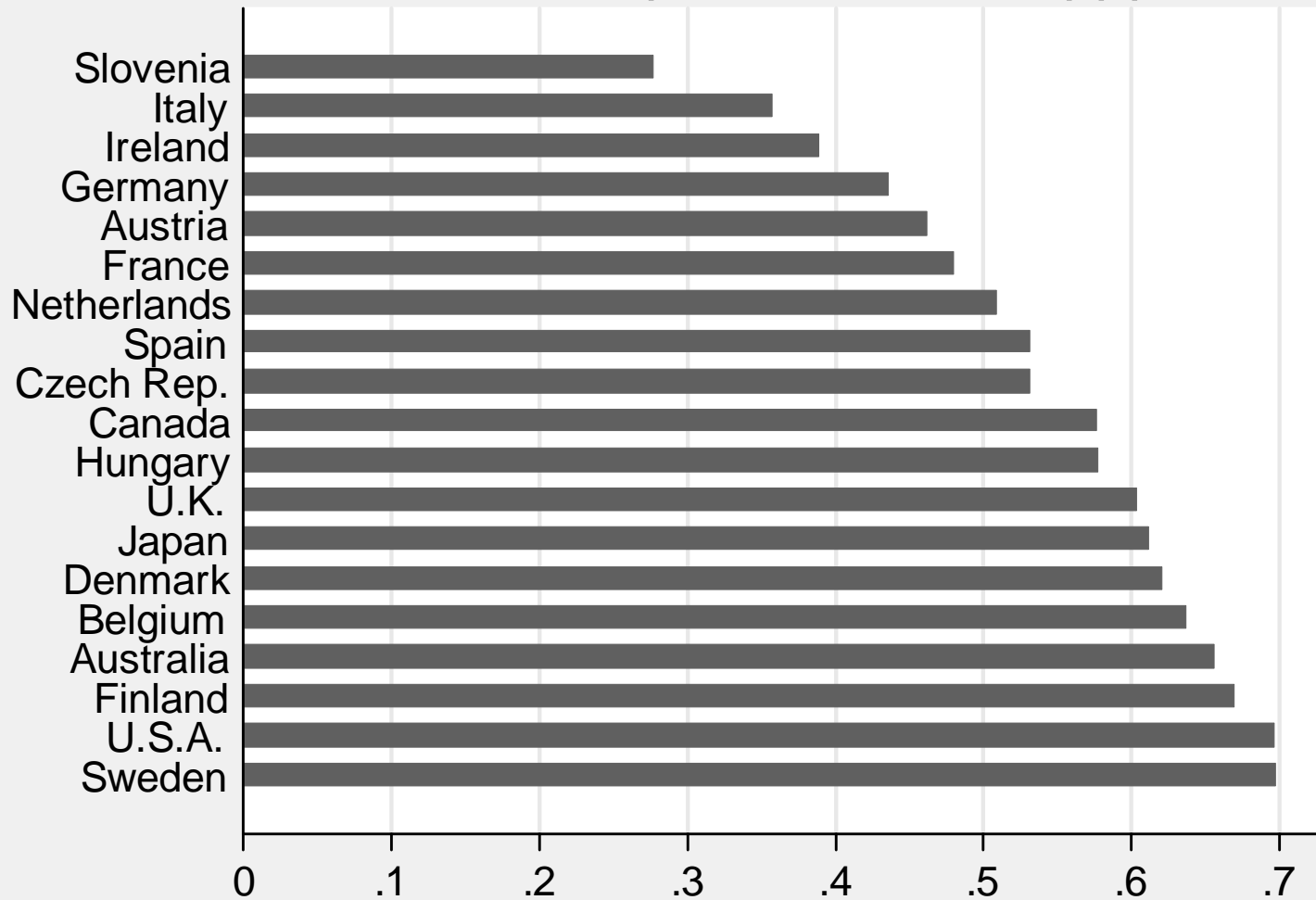


Note Mean of 2000-latest year, market sector

ICT output shares, % of market sector

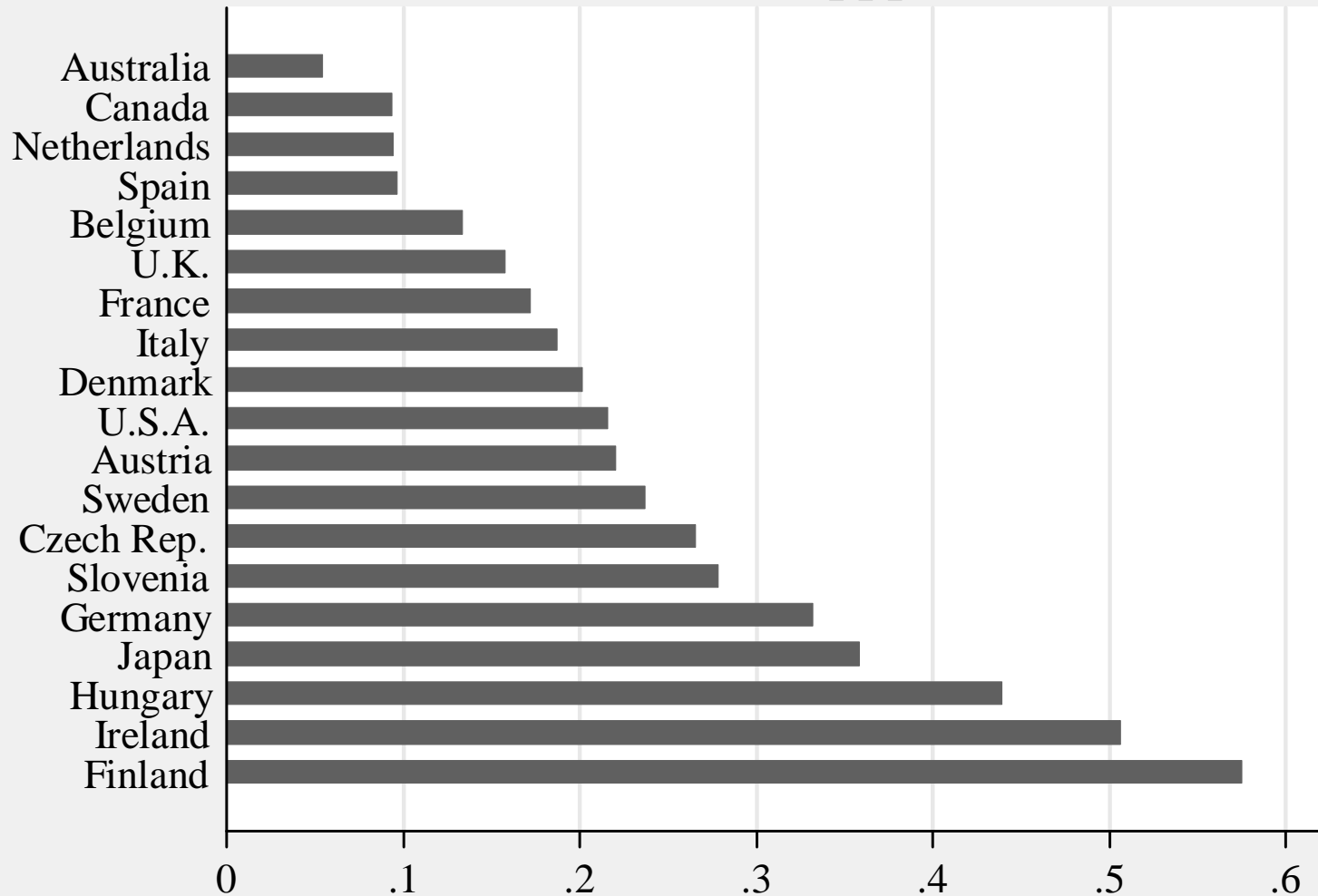


ICT use effect on long run growth of consumption and GDP, pppa



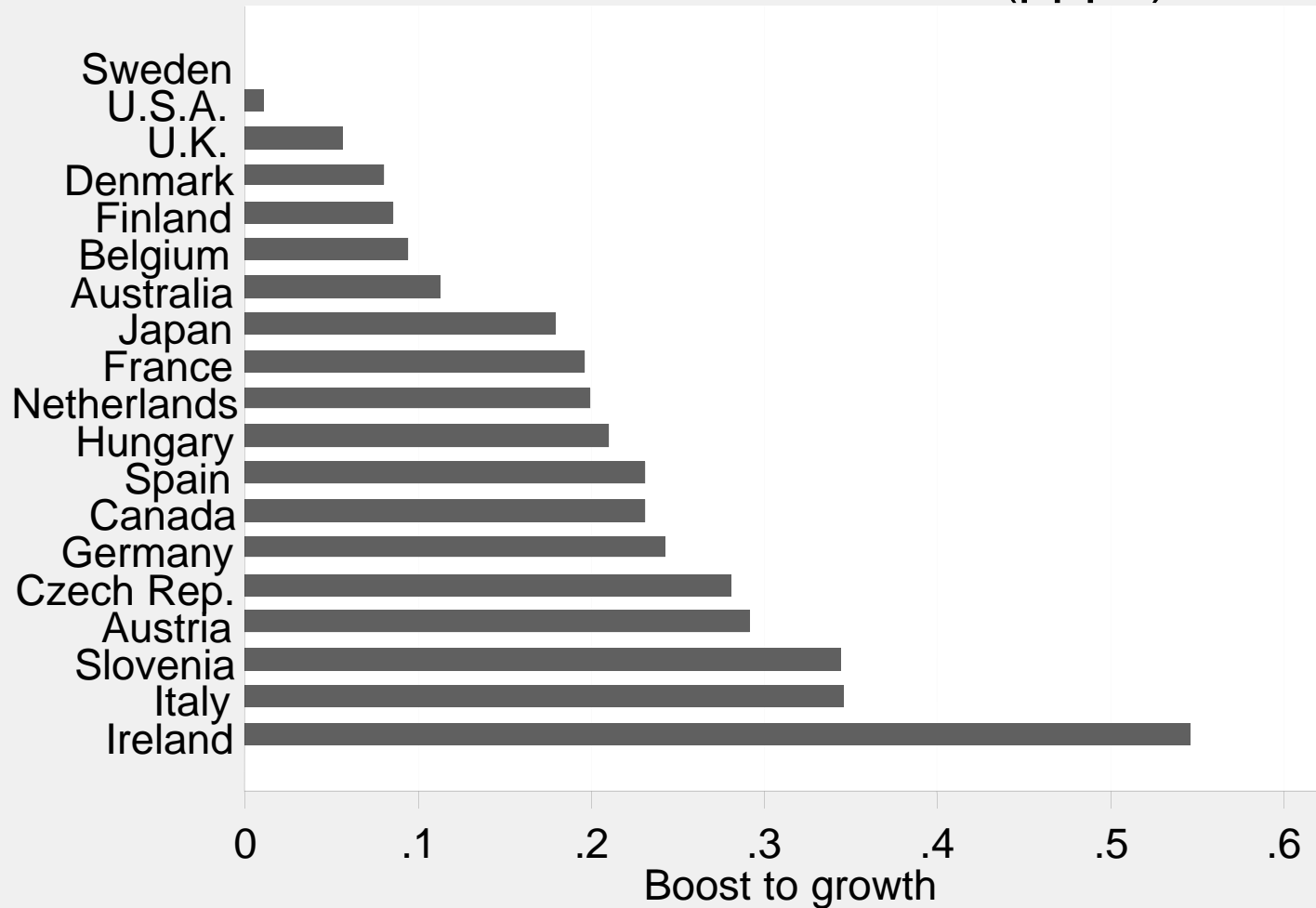
Note: Calculated using shares averaged over 2000-latest year; ICT relative prices assumed falling at 7% p.a.

ICT output effect on long run growth of GDP, pppa



Note Calculated using shares averaged over 2000-latest year;
ICT relative prices assumed falling at 7% p.a.

Boost to growth if ICT income shares were at Swedish level (pppa)



Note Calculated using shares averaged over 2000-latest year;
ICT relative prices assumed falling at 7% p.a.; market sector

Projected long run effects on growth, pppa: averages across 19 countries

ICT output effect 0.24

ICT use effect

(a) with current ICT intensity (β)	0.54
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(b) with Swedish ICT intensity	0.74
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Use effect: additional growth of GDP resulting from TFP growth being faster in ICT than in non-ICT.

Conclusions

- Most of the gains in productivity growth come from *ICT use*, not *ICT production*.
- The impact of ICT on long run growth in the EU, even at the present level of ICT intensity, is large: about 0.54 percentage points per annum.
- If ICT intensity reached the Swedish level, this effect would increase to about 0.74 percentage points per annum.
- Policy should focus on removing barriers to ICT use (Cette and Lopez, 2008).

THE END

Long run effects on growth, pppa

<i>Country</i>	<i>(a) own β</i>	<i>(b) Swedish β</i>	<i>Difference</i>
Australia	0.66	0.77	0.11
Austria	0.46	0.76	0.29
Belgium	0.64	0.73	0.09
Canada	0.58	0.81	0.23
Czech Rep.	0.53	0.81	0.28
Denmark	0.62	0.70	0.08
Spain	0.53	0.76	0.23
Finland	0.67	0.76	0.09
France	0.48	0.68	0.20
Germany	0.44	0.68	0.24
Hungary	0.58	0.79	0.21
Ireland	0.39	0.94	0.55
Italy	0.36	0.70	0.35
Japan	0.61	0.79	0.18
Netherlands	0.51	0.71	0.20
Slovenia	0.28	0.62	0.35
Sweden	0.70	0.70	0.00
U.K.	0.60	0.66	0.06
U.S.A.	0.70	0.71	0.01
Average	0.54	0.74	0.20

Issues

- What limits the uptake of ICT technology?
[Cette and Lopez, 2008]
- How fast will ICT prices decline in future?
What about *software* prices?
- What will determine the income share of ICT
in the future?