



ICT and productivity growth a macro-data analysis by Georg Erber, DIW Berlin

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Presentation Outline

- Key Hypotheses
- Descriptive Analysis of Growth and Labour Productivity Development
- Growth Accounting
- Econometric Analysis using Stochastic Possibility Frontiers
- Conclusions

ICT impact on productivity

- Hypothesis 1: ICT-capital investment is a key element in productivity growth in particular service industries while non-ICT-capital has diminished in their importance.
- Hypothesis 2: Total Factor Productivity (TFP) growth accelerated combined with increased investment in ICT (especially in retailing, wholesale and banking).

Hypothesis 3: Capital-Skill-Complementarity

- Griliches (1969) was the first to consider a strong capital-skill-complementarity:

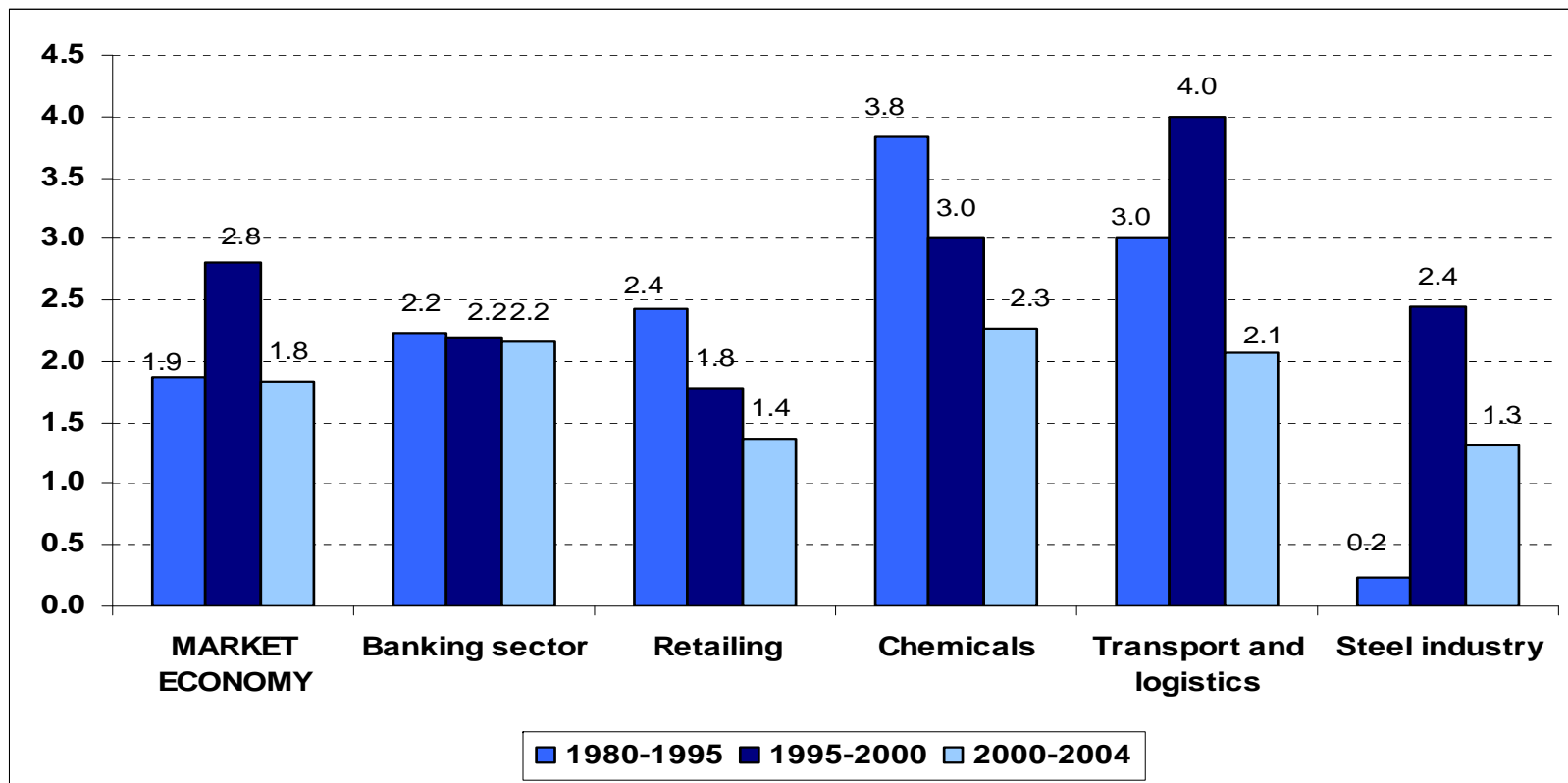
Capital can only increase productivity to its full potential when complementary skills of the labour force are used

- Erber, Hagemann (2005) modified this to a particular ICT-capital-ICT-skill-complementarity:

ICT-capital investments only increase productivity if the necessary complementary ICT-skill are used (need for hiring additional ICT-professional and staff training)

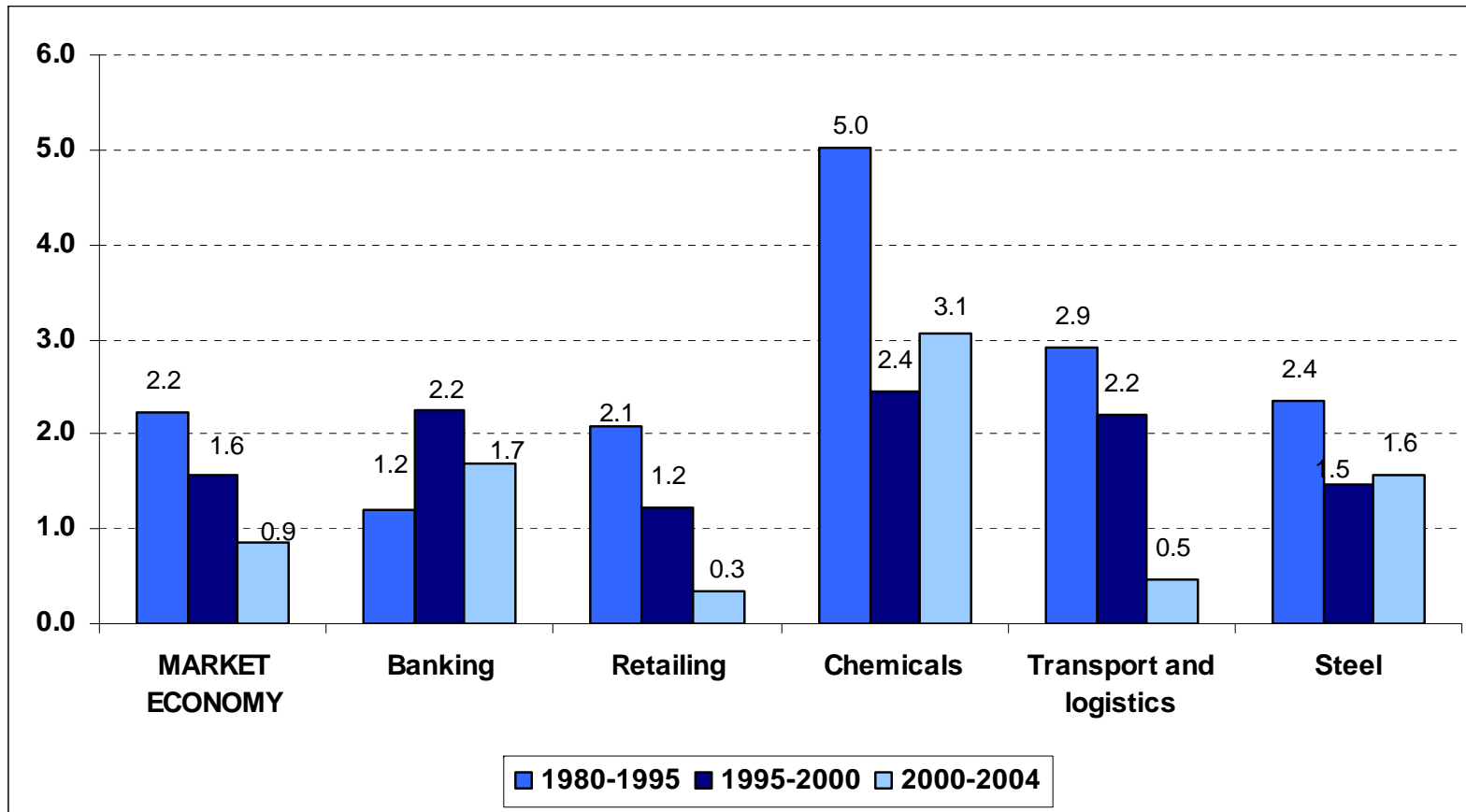
- Industries studied by EU KLEMS dataset
 - **Financial Intermediation**
 - **Retailing**
 - **Chemicals**
 - **Transport & Logistics**
 - **Metals**

Gross value added growth in the EU-15
(annual average volume growth rates for different time periods, in %)



Source: EUKLEMS data base, GGDC; own calculation

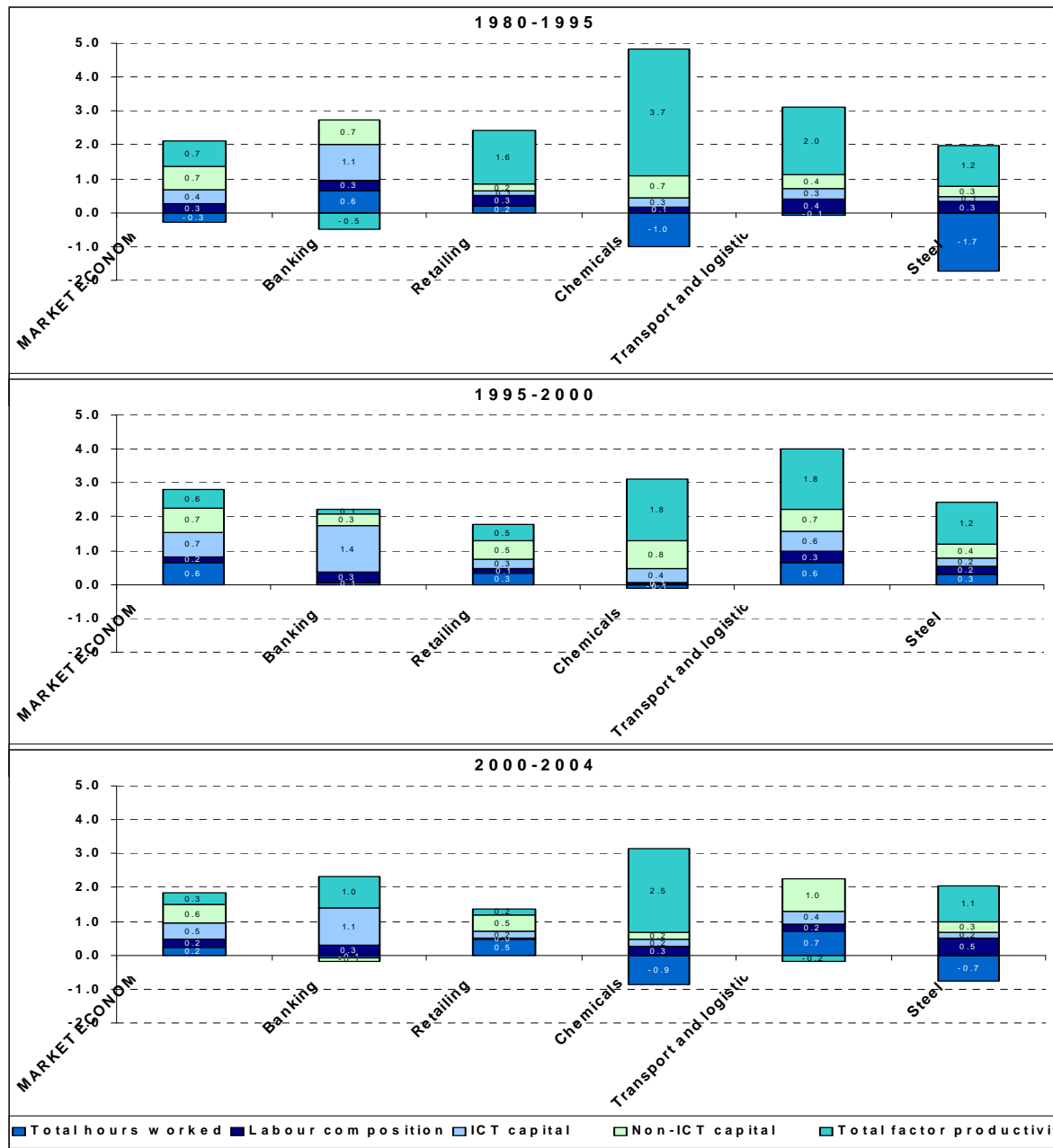
Labour productivity growth in the EU-15 (in %, different periods)



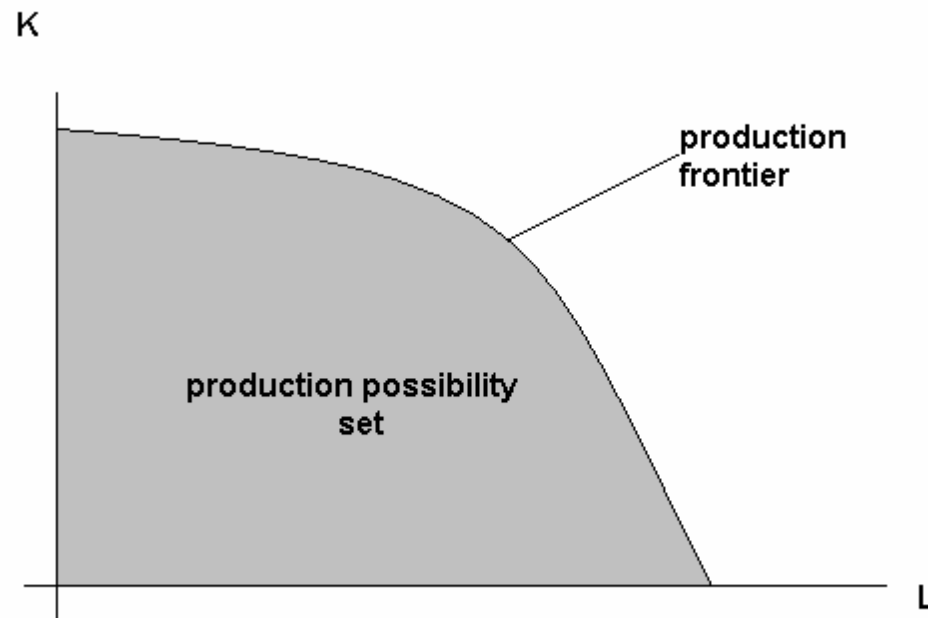
Source: EUKLEMS data base, GGDC; own calculation

Growth Accounting

- Decomposition of overall output growth into the contributions of individual factor inputs and the TFP-growth rate (Solow residual)
- EU KLEMS offers as two output measures
 - gross value added
 - gross production values (gross value added plus intermediate inputs)
- Following results are based on the gross value added



Stochastic Production Possibility Frontiers (SPF)



SPF-Model Specification

$$\ln(gp v_i) = \beta_0 + \sum_{j=1}^m \ln x_{ij} \cdot \beta_j + v_i - u_i \quad \text{for } i=1, \dots, 6$$

with $x_j \in \{imi, ict, nict, hsw h, msw h, lsw h\}$

Parameter Estimates of a Stochastic Production Possibility Frontier by Industries (Error Component Models)

Explanatory variables	financial intermediation	retailing	chemicals	transport and logistics	metals
Constant	0.55 (+) ¹	0.16 (+)	0.22 (+)	0.03 (+)	0.03 (+)
Intermediate Input per TWH ²	0.27 (+)	0.87 (+)	0.84 (+)	0.22 (+)	0.51 (+)
ICT-Capital Stock per TWH ²	0.06 (n.s.)	0.04 (+)	0.02 (+)	0.03 (n.s.)	0.07 (+)
Non-ICT-Capital Stock per TWH ²	0.17 (+)	-0.03 (n.s.)	-	-	0.17 (+)
High-Skilled-WH per TWH ²	0.15 (+)	-	-	0.21 (+)	-
Medium-Skilled-WH per TWH ²	0.32 (+)	0.04 (+)	0.16 (n.s.)	-0.05 (n.s.)	-0.10 (n.s.)
Low-Skilled-WH per TWH ²	0.03 (+)	-	0.04 (+)	-	-
Time	0.02 (+)	-	-	-	0.01 (+)
sigma square	0.04 (+)	0.16 (+)	0.15 (+)	0.02 (+)	0.02 (+)
gamma	0.93 (+)	0.98 (+)	0.98 (+)	0.96 (+)	0.98 (+)
eta	-0.08 (n.s.)	-0.02 (+)	-0.01 (+)	-0.14 (+)	-0.09 (+)
Countries included	EU-12 - Austria, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, UK	EU-16 - Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Luxembourg, Netherlands, Poland, Slovenia, Spain, Sweden, UK	EU-16 - Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Luxembourg, Netherlands, Poland, Slovenia, Spain, Sweden, UK	EU-14 - Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Slovenia, Spain, Sweden, UK	EU-14 - Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Slovenia, Spain, Sweden, UK

¹ brackets: + = significant at 95%-level, n.s. = insignificant at 95%-level

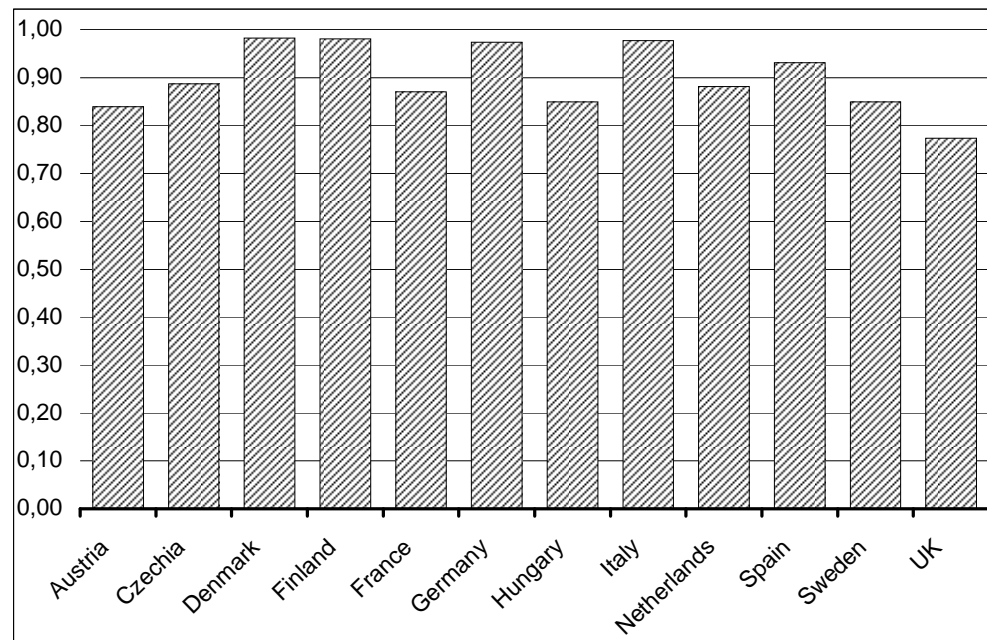
² TWH - total working hours

Source: EUKLEMS database of GGDC, own calculations.

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Financial Services Technical Efficiencies

Figure 1. Average technical efficiencies, financial service sector, EU-12*



* EU-12 - Austria, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, UK

Conclusions

- ICT-capital is an important enabler for higher labour productivity growth
- There are significant complementarities between ICT-capital and medium-skilled labour
- Organizational changes embodied in our analysis in the Solow residual play as well an important role
- Therefore it needs at least three components to enjoy the full benefits of higher productivity growth from ICT:
- higher ICT-capital investments
- higher investments in the complementary skills
- adjustment of the organizational structure

Conclusions

- There is significant heterogeneity across industries, countries and time periods present in the data
- Social capability to calibrate the three key factors for improving labour productivity growth differ between countries and industries
- The benefits of ICT-investments are not immediately acquired but need significant adjustment times