Thursday 11 November

14.00-15.00: Session 2B: Measurement Issues in Intangible Capital I

Chair: Marianne Paasi (TU Berlin)

Hannu Piekkola (University of Vaasa and Aarhus University) “Conceptualizing and Measuring Intangible Capital Using Existing Survey Data Sources in the European Statistical System”

Hannu Piekkola (University of Vaasa and Aarhus University) “Intangibles from innovative work – their valuation and technological change”

REPUBLIC OF SLOVENIA
STATISTICAL OFFICE

IARIW-ESCoE Conference on Intangible Assets
11.-12.11.2021 London

CONCEPTUALIZING AND MEASURING INTANGIBLE CAPITAL USING EXISTING SURVEY DATA SOURCES IN THE EUROPEAN STATISTICAL SYSTEM

Mojca Bavdaž Univeristy of Ljubljana, Hannu Piekkola University of Vaasa,
Tjaša Redek, University of Ljubljana

Globalinto 2019-2022

New Intangibles for European Growth

https://globalinto.eu/

Funded by EU Horizon 2020 Programme (3 million €)

Background

- Intangible capital has been proven to contribute to economic performance and productivity growth; at aggregate and firm level
- However, measurement remains a challenge in firm-level which is the basic unit in national accounting
  - (unified) widely accepted definition
  - Data availability
    - Coverage
    - Quality
    - Comparability
- Typically, two types of data sources are used to measure intangibles at firm level
  - Registry based data
  - Survey based data

Surveys on broad intangibles

- Few survey data experiments
  - NESTA&ONS in the UK: Investment in Intangible Assets Survey (UK)
  - Eurobarometer survey on “Investing in Intangibles: Economic Assets and Innovation Drivers for Growth”
  - ISFOL & ISTAT in Italy: “Rilevazione statistica sugli investimenti intangibili” 2013 >500 Branding, R&D, < 500 more ICT
  - EIB »European Investment Survey« 2020_2021: Pandemia ICT up, survival strategies, regularly done
  - Prašnikar et al. (2010-2015) survey of intangible capital in the private and public sector in the Balkans and Slovenia
- Most recently: GLOBALINTO survey 2020-21 in seven European economies (about 1800 obs) to capture the value of intangible investments and also measure the impact of Covid-19 on intangible investment

Value/contribution of (one-off) survey data

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- Offer a benchmark for estimates based on secondary data sources
- Flexibility to collect data on aspects that are not covered in other sources and test new hypothesized links
- Can adapt the content to topics that are relevant in a specific period like pandemia or to explain hard facts on productivity development and technical change induced by intangibles
- Important for development of methodological framework, as the measurement of intangibles is complex and the concept is still evolving.
- Important to researchers and policy-makers, especially in view of increasing importance of intangible capital's contribution to economic performance

Challenges of survey data

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- One-off lack international comparability or longitudinal perspective
  - European Investment Bank *Investment Survey* the only survey with wide (EU) international coverage besides recurring data collection on key variables from 2016 onwards
- Sample size and structure are not necessarily optimal and often do not cover the entire economy or companies by size
- Data collection represents a notable burden to the businesses
- Costs of these surveys are likely to soar when attempting to achieve sufficiently high survey quality, especially when conducted in several countries or at the EU level

But … Eurostat and National Statistical Institutes (NSI…)

- National statistical institutes (NSIs) in Europe regularly publish methodologically harmonised indicators across
  - A combination of input and output harmonisation approaches
  - Input harmonisation strives to standardise all steps of the survey life cycle, that is from questionnaire and sampling design, data collection and post-collection
  - Output harmonisation focuses on the required set of target variables respecting quality criteria
  - The concepts and definitions of variables and the classifications are subject to agreements/legislation in all statistical domains
- Data collection is continuously evaluated and revised as needed
- Expertise that NSIs have (sampling, questionnaire design, access to businesses, data collection, data processing and data management, …), builds trust that the collection of data at NSIs is of highest quality
- While at the moment Eurostat does not conduct a survey on intangible investment and intangible capital, there are several other surveys of Europe-wide character that gather relevant information on some component of intangibles:
  - Community Innovation Survey (CIS),
  - Survey on ICT usage and e-commerce in enterprises (ICT),
  - Continuous Vocational Training Survey (CVTS)

Goal

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What can be measured using existing statistical datasources at Eurostat / EU level (harmonization, existing surveys) ?

- to **develop and propose a methodology**, that follows the Corrado et al. (2006) definition of intangibles, and captures intangibles using several different survey sources, available in all or most EU economies via existing harmonised (Eurostat sources)

- Key questions should focus on (as other surveys do):
  - determine whether the company invested in the selected components of intangible capital (internally and purchased externally) and;
  - what the size of the investment was.

Globalinto intangible survey

1. Investments in a broad range of Intangible Assets (IAs) contributing to the improvement of micro level measurement
2. The factors influencing the IAs investments, the impact of IAs on enterprise performance,
3. Relevant policy measures and the impact of Covid-19 crisis

- Oriented towards the possibility of regular data collection at National Statistical Institutes, or possible integration of core elements into existing survey instruments (i.e. measurement of IAs in a sustainable manner).
- Main bodies in Globalinto: (i) National Technical University of Athens and (ii) University of Ljubljana

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Globalinto Survey Sample: 7 countries and 1796 SMEs and Large Firms from Manufacturing and Services

	Manufacturing SMEs (20-249 employees)	Manufacturing Large (250+ employees)	Services SMEs (20-249 employees)	Services Large (250+ employees)	TOTAL
Denmark	99	30	66	20	215
Finland	99	29	66	21	215
France	145	43	96	30	314
Germany	143	43	95	29	310
Greece	98	30	67	20	215
Slovenia	99	33	66	17	215
UK	144	43	96	29	312
TOTAL	**827**	**251**	**552**	**166**	**1796**

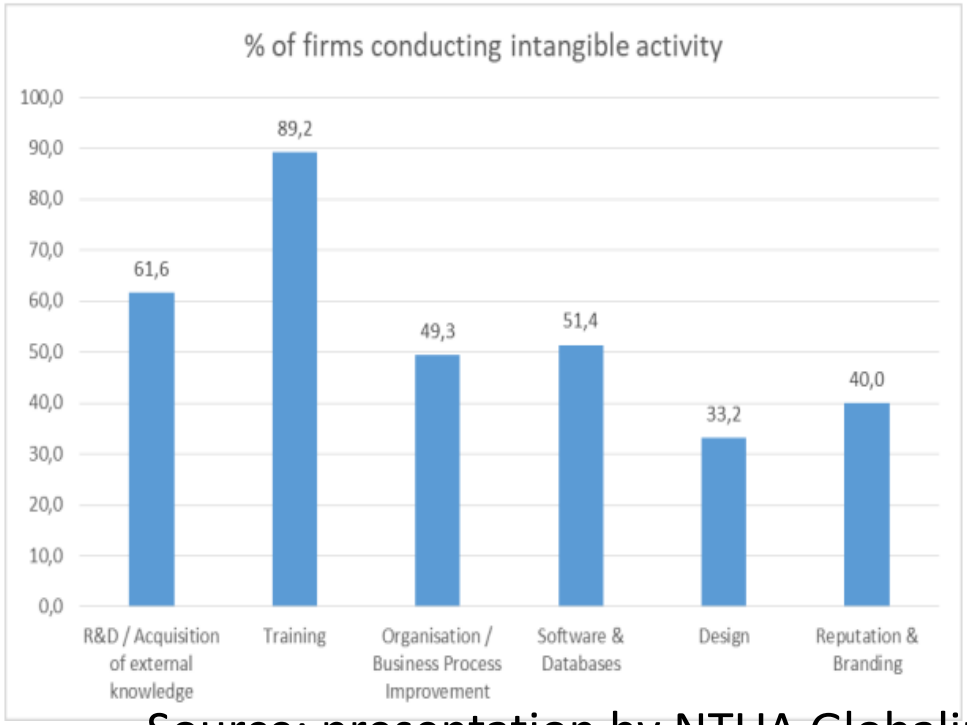
Source: presentation by NTUA Globalinto biannual Zoom Meeting 24.9.2021

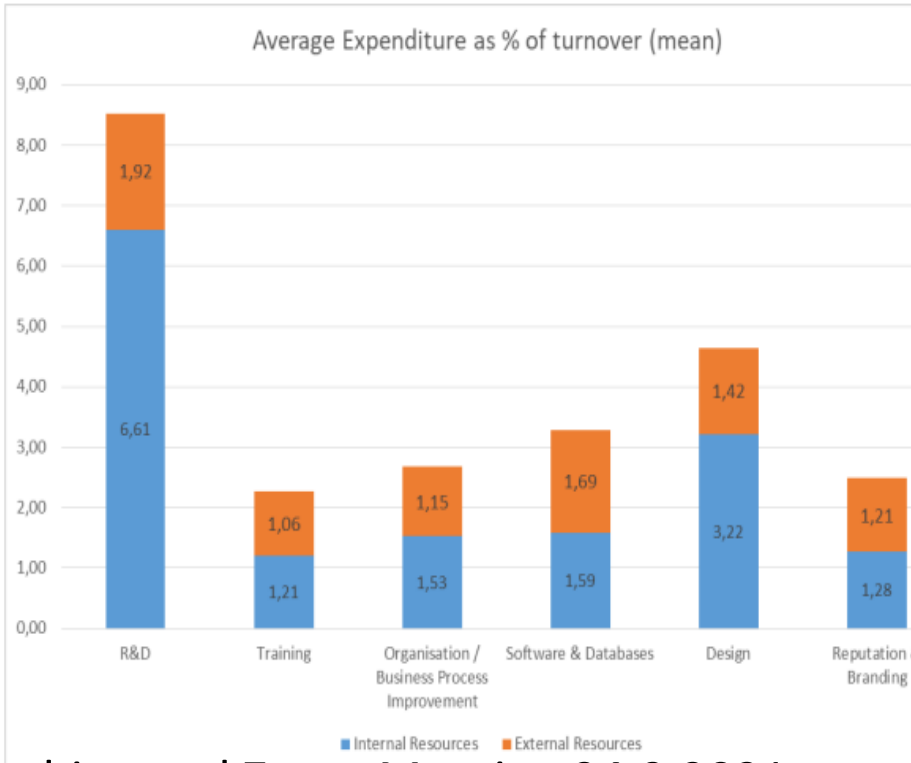
Intangible activity and spending per asset category

The **vast majority** of firms report some **training activity** (9 out of 10 firms)

- The **majority** of firms (over 61%) also **spend on R&D**
- **Design** is characterised by the **lowest percentage of firms** (1 out of 3 firms)
- Only 66 firms (3,7%) report no intangible activity
- **Size matters:** Larger firms exhibit higher intangible activity

- **In-house R&D spending** prevail followed by in-house design expenditures



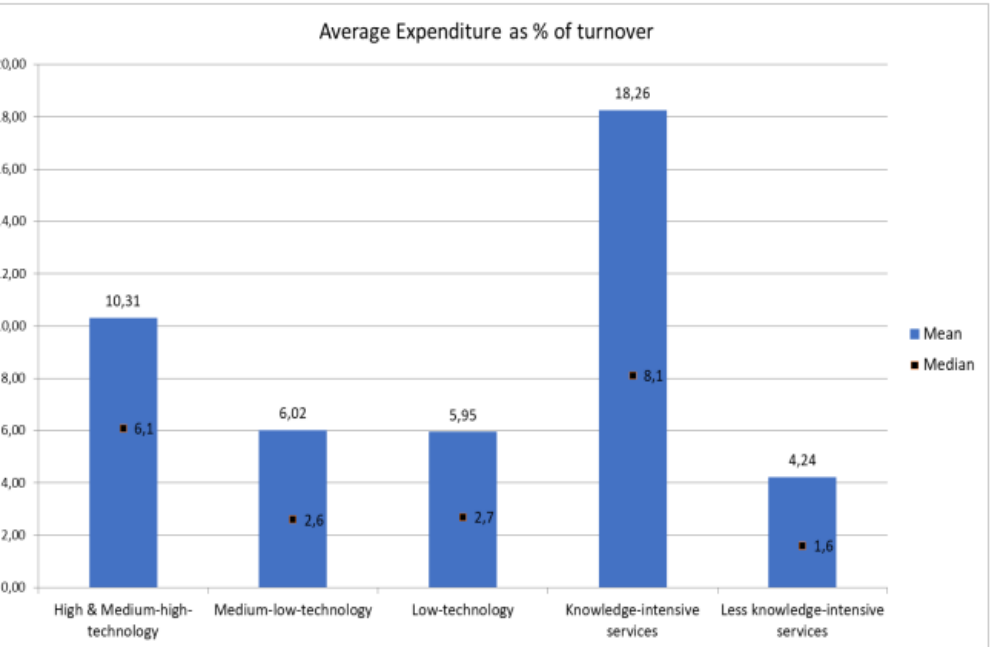


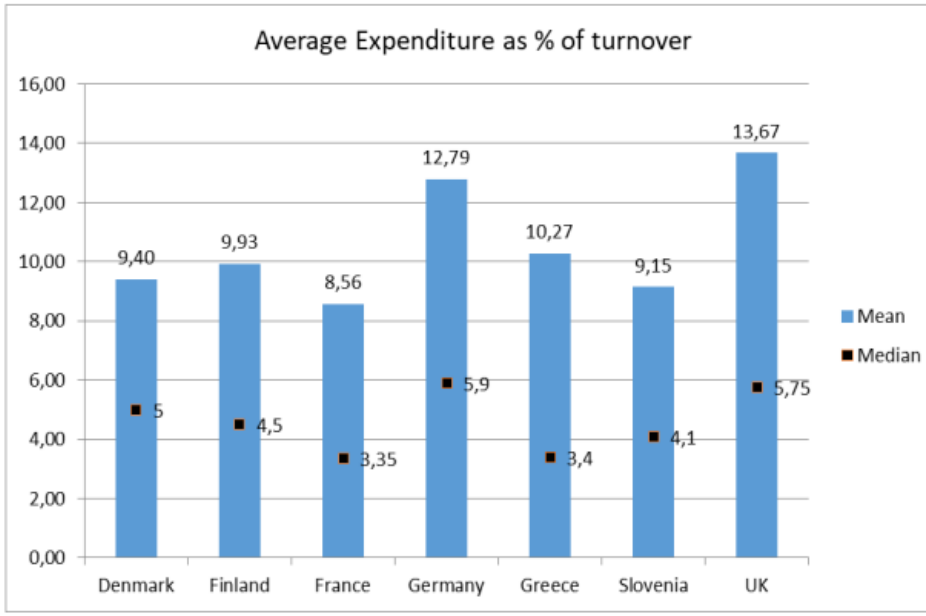
Source: presentation by NTUA Globalinto biannual Zoom Meeting 24.9.2021

Total investment in intangible assets per sector and country

(N = 1351)

- Sector knowledge intensity matters: Knowledge-intensive services (KIS) and High- and medium-high (H&MHT) manufacturing firms invest more
- Large countries invest more (France is an exception)
- Among small countries, DK and FI invest more





Source: presentation by NTUA Globalinto biannual Zoom Meeting 24.9.2021

Slovenia sample descriptions

- **Statistical survey data in Slovenia**:
  - Official statistical survey data sources from questionnaires/ data sources:
    - Innovation activity in industry and selected services (bi-annual)
    - Use of information-communication technology (annual)
    - Continuing vocational training in enterprises (2010, 2015)
    - Firm-level financial statements data (annual)
  - Sample size of combined data-set **(240 companies)**
  - Time: 2016 (again available in 2020)
- Comparison to Slovenian **Globalinto survey data** (sample size, 215 companies, 2020)

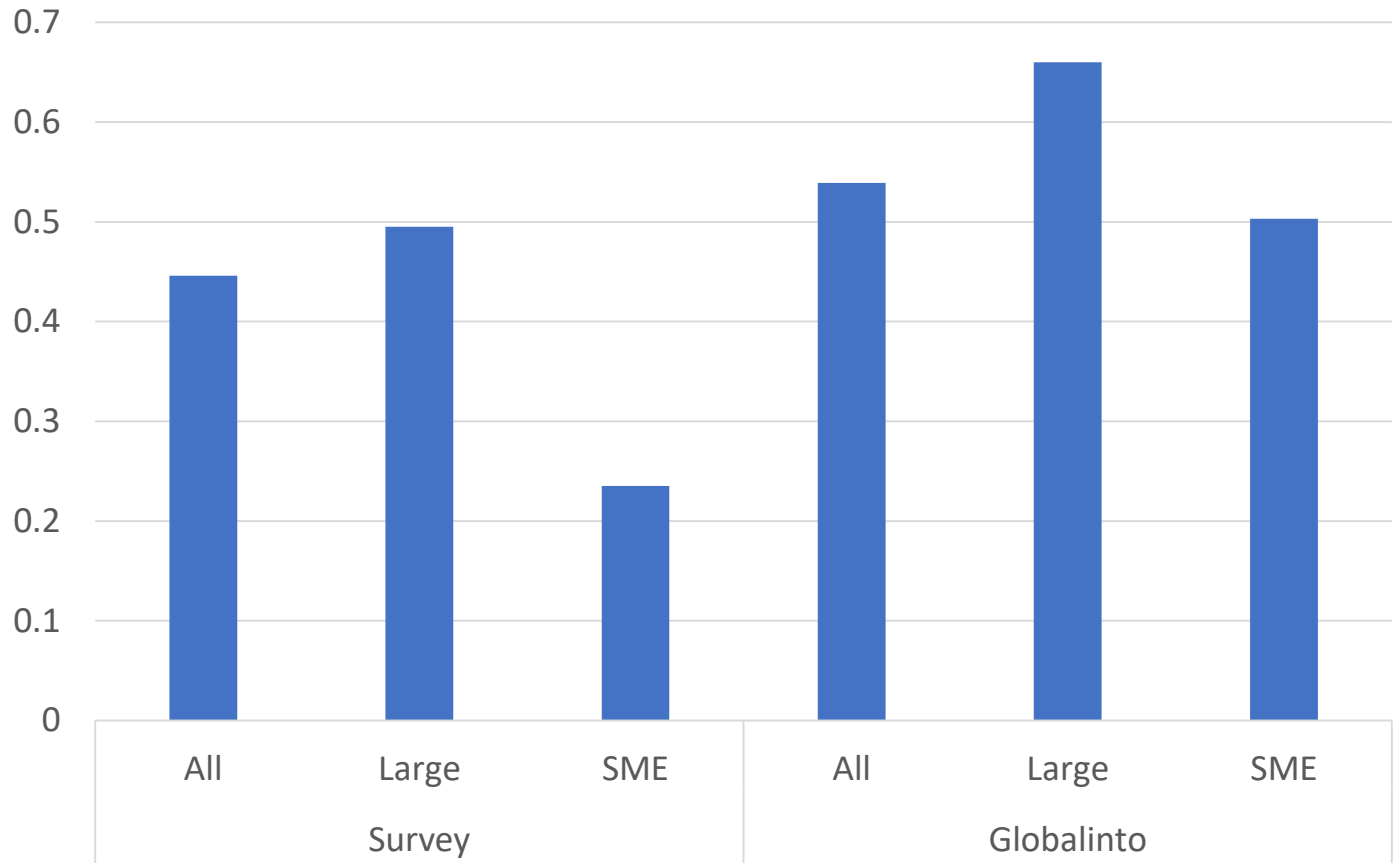
Comparison between survey data and Globalinto data

	ICT system development, Web development/Security development occurence	Hardware purchases as % of revenue	Sofware purchases as % of revenue **(hardware+software)**
	Survey data (N=240)		
All	0.746	0.173	0.267 (**0.440**)
Large	0.750	0.167	0.305 (**0.472**)
Medium*	0.765	0.205	0.124 (**0.329**)
	Globalinto (N=215)		
	System development /database development purchases (share of companies)		System development /database development purchases in % of revenue
All	0.561		**0.574**
Large	0.848		**0.796**
Medium	0.465		**0.507**

Comparison between the estimated results from official innovation survey and Globalinto intangible survey

Share of companies with R&D by R&D type						
	Survey data (N=240)			Globalinto (N=215)		
	Survey all	Large	Medium	Globalinto survey all	Large	SME
Internal R&D	0.9686	0.979	0.9	0.656	0.74	0.63
Internal R&D regularly	0.861	0.852	0.88	0.667	0.757	0.634
External R&D	0.78	0.855	0.4	0.367	0.52	0.321
Knowledge purchase	0.435	0.465	0.267	0.265	0.380	0.230
Innovation cost as share of revenue						
Share of cost for internal R&D	0.0172	0.0163	0.025	0.0414	0.0179	0.0485
Share of cost for external R&D	0.0054	0.0040	0.0156	0.0059	0.0081	0.0053
Share of cost for knowledge purchase	0.000534	0.0006	0.000*	0.0035	0.0023	0.0039

Share of companies that invested in design according to survey data and Globalinto data



N=240

N=215

Economic competencies

Category (Corrado et al.)	Category in data	Data source (Slovenia/Eurostat)
Brand equity (advertising expenditure, market research)	Expenditure on: – C6 studies, project documentation (include research and development work under C8) – C7 trademarks, concessions and goodwill	Survey Investment in fixed assets in enterprises in Slovenia Not available at Eurostat
	Expenditure on: – Market introduction of innovations – Design Additional information provided on marketing innovation, but only Yes/No questions.	Community Innovation Survey (Slovenia and Eurostat)
Organizational structure (purchased, own account)	Very limited information, only data on whether companies invested into organizational structure change (Yes/No questions)	Community Innovation Survey (Slovenia and Eurostat)
Firm specific human capital (continuing vocational training, apprentice training)	Does company provide CVT Internal CVT costs, External CVT costs A lot of additional CVT details No depreciation data	Survey Continuous education and training in companies (Slovenia and Eurostat)

Comparison of data on improved organization and processes in CIS-based survey and Globalinto survey

	Survey data (N=240)			Globalinto (N=215)		
	All	Large	Medium	All	Large	Medium
Share of companies that improved organization (reported at least one organizational change)	0.845	0.878	0.735	0.632	0.780	0.588
Share of revenue for internal advisors	n.a.	n.a.	n.a.	0.00576	0.00968	0.00457
Share of revenue for external advisors	n.a.	n.a.	n.a.	0.00519	0.00163	0.0063

Branding: Investment in marketing and branding in Globalinto and CIS-based questionnaire

	Survey (N=240)		
	All	Large	Medium
Marketing – design (share of companies that reported it)	0.446	0.495	0.235
Marketing – promotion (share of companies that reported it)	0.5	0.536	0.382
Marketing – placement (share of companies that reported it)	0.371	0.398	0.147
Marketing – pricing (share of companies that reported it)	0.3625	0.367	0.323
Cost of introducing new products to the market (% of revenue)	0.719	0.828	0.323
	Globalinto (N=215)		
Branding (share of companies that reported it)	0.442	0.5	0.424
Cost of internal and external branding activities	0.464	0.828	0.354

Discussion

- Goal was:
  - investigate, whether it is possible to construct measures of intangible investment using **existing** official statistical surveys
  - determine which variables (of those, which are standardly included in one-off surveys) are available
  - To evaluate the approach, compare results with existing, one-off surveys that were prepared methodologically with the focus on measurement of intangible assets
    - Globalinto database

Back to Globalinto Intangible survey

	ALL			Finland			Denmark			Slovenia		
Variables	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std
R&D-IBTC	0.157	0.000	0.340	0.188	0.000	0.020	0.172	0.000	0.376	0.193	0.030	0.347
R&D-IBTC predicted	0.317	0.433	0.280	0.369	0.065	0.503	0.339	0.458	0.277	0.405	0.516	0.271
R&D inhouse share	0.13	0.00	0.27	0.158	0.000	0.015	0.137	0.000	0.294	0.159	0.030	0.275
R&D share of output	0.09	0.03	0.17	0.105	0.000	0.029	0.105	0.037	0.196	0.122	0.059	0.189
Digital	4.96	4.00	2.10	4.746	3.000	4.000	5.225	5.000	2.140	5.846	6.000	2.212
Design share of output	0.07	0.00	0.21	0.027	0.000	0.000	0.085	0.000	0.235	0.087	0.000	0.216
Branding share of output	0.18	0.00	0.40	0.167	0.000	0.000	0.265	0.000	0.478	0.190	0.000	0.375
Product innovation	0.60	1.00	0.49	0.478	0.000	0.000	0.593	1.000	0.492	0.702	1.000	0.459
Process innovation	0.53	1.00	0.50	0.627	0.000	1.000	0.517	1.000	0.501	0.620	1.000	0.487
Market innovation	0.39	0.00	0.49	0.488	0.000	0.000	0.368	0.000	0.484	0.452	0.000	0.499
External knowledge (patents etc.)	0.18	0.00	0.38	0.330	0.000	0.000	0.225	0.000	0.419	0.269	0.000	0.445
Employee	245	60	940	252	35	58	194	56	387	365	71	1561
Skilled employee	50	10	510	57	4	13	35	10	148	73	15	388
Market share domestic	68.8	80.0	33.6	73.0	50.0	95.0	57.2	60.0	36.9	50.8	49.8	37.6
Market share world	11.1	1.0	19.2	9.0	0.0	0.0	15.2	5.0	22.5	10.2	1.0	18.8
Innovator	0.43	0.00	0.50	0.455	0.000	0.000	0.445	0.000	0.498	0.538	1.000	0.500
Later adopter	0.39	0.00	0.49	0.435	0.000	0.000	0.407	0.000	0.492	0.308	0.000	0.463
Other	0.18	0.00	0.38	0.110	0.000	0.000	0.148	0.000	0.356	0.154	0.000	0.362
Agile: reactive	11.24	11.00	2.38	10.938	10.000	11.000	10.708	11.000	2.399	11.663	12.000	2.167
Agile: organization	14.38	14.00	2.90	13.756	12.000	14.000	14.110	14.000	2.739	15.433	16.000	2.734
Covid crises: R&D change	-0.02	0.00	0.21	0.015	0.000	0.000	-0.029	0.000	0.172	0.015	0.000	0.226
Covid crises: branding change	-0.92	-1.00	1.16	-0.966	-1.000	-1.000	-0.945	-1.000	0.625	-1.084	-1.000	1.357
Covid crises: ict change	-0.87	-1.00	0.94	-0.933	-1.000	-1.000	-0.954	-1.000	0.718	-0.838	-1.000	1.111
Covid crises: rapid adjustment	0.36	0.00	0.48	0.483	0.000	0.000	0.321	0.000	0.468	0.413	0.000	0.494
Covid crises: decreasing production costs	0.49	0.00	0.50	0.531	0.000	1.000	0.507	1.000	0.501	0.385	0.000	0.488
Manufacturing	0.14	0.00	0.35	0.086	0.000	0.000	0.110	0.000	0.314	0.139	0.000	0.347

All N=1731, Finland, Denmark N=208, Slovenia N=209

Source: Hannu Piekkola Road to technical advance: Finland, Denmark and Slovenia in focus mimeo

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Back to Globalinto Intangible survey

	High growth firms top 10% Logit				Labor productivity OLS	
	Sales 2020/2019		Employment 2020/2018			
	All	FDS	All	FDS	All	FDS
R&D-IBTC	5.161***	6.403**	3.702***	7.272**	0.21	0.480*
	-1.451	-1.982	-1.116	-2.352	-0.175	-0.237
Late adopter	-0.738	-1.739	0.922	1.525	0.195	0.268
	-1.651	-1.939	-1.373	-2.014	-0.234	-0.247
Innovator	1.907	6.166**	-1.017	4.108	-0.34	-0.12
	-1.667	-2.338	-1.401	-3.056	-0.214	-0.443
Denmark	0.825	**2.341****	-0.987*	-0.244	0.684	**1.266****
	-0.514	**-0.777**	-0.5	-0.653	-0.483	**-0.408**
Finland	-0.251	**1.372***	-0.268	0.398	-0.076	**0.435*****
	-0.465	**-0.66**	-0.43	-0.583	-0.072	**-0.058**
France	-0.247		0.614		-0.091	
	-0.458		-0.362		-0.064	
Greece	-0.559		-0.028		-0.239	
	-0.613		-0.496		-0.225	
Slovenia	**-1.684***		-0.567		**-0.523*****	
	-0.696		-0.498		**-0.073**	
UK	-10.627		0.263		-0.306***	
	-647.686		-0.346		-0.073	
Low-tech manufacturing	0.396*	0.029	0.131	-0.043	-0.023	-0.195*
	-0.171	-0.307	-0.16	-0.314	-0.055	-0.094
KIS	0.156	0.164	0.376**	0.579**	0.09	0.111
	-0.166	-0.229	-0.126	-0.2	-0.057	-0.069
Other services	0.83		1.191		0.053	
	-0.863		-0.925		-0.219	
Constant	4.230***	6.316***	4.176***	7.312***	4.214***	3.557***
	-1.175	-1.649	-0.92	-1.942	-0.154	-0.165
Observations	755	298	1296	425	572	198
R-Squared					0.13	0.30
Pseudo R-Squared	0.08	0.16	0.04	0.08		

In generalized logit techtype is considered as causing heterogeneity. OLS pass Breush-Pagan testing for heteroskedasticiy (p=0.20). R&D-IBTC is predicted from earlier logit estimation, late adopter and innovation are predicted from earlier multinomial logit estimation.

Data: Globalinto intangible survey linked to Orbis (FDE=Fin,Den,Slo)

Note: Slovenia is number one in Nordic context based on survey, but here performance is inferior to Finland and Denmark

Microdata (also with remote access): linked data on performance needed in future study

Source: Hannu Piekkola Road to technical advance: Finland, Denmark and Slovenia in focus mimeo

Methodological evaluation

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Assessing the fit with the (Corrado et al.) definition.

- Eurostat model questionnaires provide many relevant variables
- use of model questionnaires is a key part of input harmonization, which makes national microdata highly comparable
- collected data of high overall quality.

Problems

1. **surveys have different implementation characteristics**
   - periodicity varies
   - coverage is more similar and ranges from the broadest in ICT to more selective in CIS
2. **some urgently needed variables are only available through statistical areas where harmonization in the ESS leans towards output**
   - many countries collect data on investment as part of the structural business statistics (SBS) surveys while some countries (e.g. Slovenia) have separate data collection
   - data are collected, but their availability and comparability at micro level might be challenging
3. **after considering these extra sources, some variable gaps remain**
4. **gathering data from different sources is likely to open the question about data consistency**
   - differences in seemingly the same variables may appear in separate surveys even for the same company as a result of different procedures of data collector and different procedures within company

Methodological evaluation

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- *Lack of unified and widely accepted statistical definition of intangible investment*
  - this exercise thereby a one-off experiment
- this is true also of other concepts
  - questionnaires on the "Use of ICT in companies" have changed significantly in the past 10 years
- *Mapping intangibles definition into the questionnaires*.
  - the overlap of the intangibles' categories and the official statistical questionnaires

Methodological evaluation

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- *Benchmarking the values to register-data and performance*
  - large firms with more reliable data
  - missing details on the values of investments like separation to own and purchased
- lack of the data on some categories (e.g. brands) and depreciation
- official statistical surveys offer abundance of data on other relevant factors, such as motives, obstacles, state support.

Recommendations to be able to use questionnaires nonetheless

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	Computerized information	Innovative property	Economic competencies
Database / Survey	ICT usage in enterprises	Community Innovation Survey	Community Innovation Survey Continuous Vocational Training Survey
Problems	Comparability- lack of information on expenditure Changing survey structure Depreciation rates	Depreciation rates Alignment with definition	Lack of data on expenditure Lack of data on depreciation rates
Recommendation	Extending ICT questionnaire with questions on expenditure values of purchased software and databases, and internal expenditure Adding questions on depreciation period	Harmonizing the intangible investment categories and extending existing surveys to fit the new definition Adding questions on depreciation period	Adding organizational innovation expenditure and brand expenditure / marketing innovation expenditure in CIS Clearly separating brand investment in CIS and also dividing costs into external and internal

Evaluation, Slovenian case

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	Surveys and Globalinto	Challenges in comparison
Sample	Focus on **manufacturing** and selected services Large(er) companies	Official surveys **significantly more manufacturing** Official surveys predominantly large companies
Innovative activity	Expenditure on internal and external R&D, purchased knowledge Share of those with R&D expenditure as proxy for those that are investing in innovative capital	In Globalinto focus on internal/ external R&D and not innovation types Lack of a clear definition of what the purpose of this internal and external R&D should be
Organizational improvements	Possible to assess whether companies improved organization rather than intangible input	Definition of the types of improvements that represent »organizational capital« investment Lack of cost data in CIS questionnaire Few attempts using management and marketing occupational data (Innodrive, Globalinto, OECD)
Training drop	Internal and external training provision Expenditure on internal and external training	Differences in the definition of relevant training or the lack of very clear specification in Globalinto
Use of ICT	Evaluation of the share of companies that developed/purchased ICT	Lack of data on value of purchases and own ICT development in CIS Evolving definition/ not unified definition of what consists relevant ICT spending Proxies using ICT occupational data
Design	Share of companies investing in design	Unclear definition of »which« design is relevant Lack of expenditure data for design in CIS
Branding	Poor overlap	CIS provides data on marketing innovation, not the same as branding Lack of data on branding expenditure, Possibility to use »Structural business statistics data«
Comparison of results	If samples were similar by structure, results would show a much more consistent picture (which is visible in particular when comparing	Timing of surveys Different definitions Big differences in selected variables

Thank you for your attention.

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Discussant comments on:

Conceptualizing and Measuring Intangible Capital Using Existing Survey Data Sources in the European Statistical System

by Mojca Bavdaž (University of Ljubljana)
Hannu Piekkola (University of Vaasa)
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Paper Overview

Important contributions: i) assessment of suitability of existing surveys to record intangibles, ii) attempt to define intangibles

Categories covered: software, databases, R&D (including social sciences and humanities), copyright and license cost, mineral exploration and evaluation, development costs in financial industry, new architectural and engineering designs, brand equity, *organizational structure*, firm specific human capital

Interesting results (for 2016): almost 94% of companies reported some sort of innovation, 97% of companies reported internal R&D…

→ **Strong case for agreement on definitions across countries**

Further developments

- Clarity on definitions of intangibles
- Understanding the potential of double-counting due to conceptual overlap, e.g. with “in house R&D”
- Measuring depreciation of intangibles
- Overcoming the obstacle of not capturing investment in organisational structure change- potential alternatives?
- Scalability of approach

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IARIW-ESCoE Conference on Intangible Assets 11.-12.11.2021 London

Intangibles from innovative work – their valuation and technological change
Delivery D5.3 in www.globalinto.eu

Hannu Piekkola University of Vaasa, Carter Bloch Aarhus university,
Marina Rybalka Statistics Norway, Tjaša Derek University of Ljubljana

Globalinto 2019-2022
New Intangibles for European Growth
https://globalinto.eu/
Funded by EU Horizon 2020 Programme (3 million €)

GLOBALINTO FIRM-LEVEL

- **Broad measures of intangibles (IAs)** using full register-based occupational data approach that originates from Innodrive (EU FP 7th framework project 2008-2011)
  - Globalinto, Innodrive: Organizational capital (OC) such as management and marketing 1/3 of R&D,
  - **Structural capital: OC and R&D** crucial in Innovation-labor-biased technological change.
- Paper examines ingredients of total factor productivity:

1) Quality of intangible (IA) workers causing **innovation-labor biased technical change IBTC**, an extension to Hellerstein et al. (1999) and Ilmakunnas and Piekkola (2014)*

2) **Markups**

*Piekkola (2020) Intangibles and Innovation-labor-biased technological change IBTC submitted to Journal of Intellectual Capital

**Finland 1995-2013 in Piekkola (2019) Innovative growth the role of market power and negative selection Economics of Innovation and New Technology Doi 10.1080/10438599.2019.1655878

Register-based occupational data Finland, Denmark, Norway, Slovenia linked to financial and other data

- Innovative labor IC=OC, R&D, ICT,

  OC: Organisational workers in management and marketing

  R&D: personnel is defined by technicians, engineers, and similar

  ICT: personnel is defined by information and communication experts

Table 1. Multiplier for related intermediates and capital services for one unit of labor in intangible investment in GLOBALINTO evaluated on how value added divides to labor, capital and intermediate inputs knowledge intensive services

	ICT	R&D	OC
Investment multiplier for IA labor costs= use of intermediates and capital services X shares of investment-type IA work (40% in OC, 70% in R&D and 60% in ICT work)	1.48	1.55	1.76
Depreciation to accumulate investment into stocks	33%	15%	20%

OECD CLASSIFICATON BY TECHNOLOGICAL LEVEL + IA PRODUCING SERVICES (using Nace)

1 HIGH-TECHNOLOGY MANUFACTURING

Hightech=Manufacture pharmacy 21, computer, electronic and optical products 26 Medhtech=Manufacture chemical 20, electrical equipment 27, machineryand equipment 28,
motor vehicles 29, other transport 30

2 LOW-TECHNOLOGY MANUFACTURING

Medltech=Manufacture coke and refined petroleum products 19, rubber and plastic products 22,
other non-metallic mineral 23, basic metals 24, fabricated metal products repair and installation of machinery and equipment 33-35, energy

Lowtech=Manufacture food 10 beverages 11 tobacco 12 textiles 13 wearing apparel 14 leather 15 wood and wood product 16, paper, paper products 17, printings 18, furniture 31, other manufacturing 32

3 KNOWLEDGE INTENSIVE SERVICES (KIS)

OC services= legal M69 head office M70 advertising, market research M73

ICT services= computer programming, consultancy 62 information services 63

R&D (incl. engineering) services= R&D M72, architectural, engineering M71

Other KIS=water transport 50, air transport 51, publishing 58, motion picture 59, programming, broadcasting 60, telecommunication 61, finance 64-66, other professional activities 74, veterinary activities 75, employment 78, security and investigation 80, public administration O, education P, human health Q, arts, entertainment and recreation R

4 SERVICES OTHER wholesale trade 45-47, land transport 49, warehouse and support activities 52, postal 53, accommodation 55, food and beverage 56, real estate 68, rental and leasing 77, travel agency 79, services to buildings, landscape 81, office administrative support 82, other service activities S

Box 1 GLOBALINTO Intangibles Assets occupations (based on ISCO08 Occupation classification)

1 Managers

112 OC Managing Directors and Chief Executives

12 OC Administrative and Commercial Managers

121 OC Business Services and Administration Managers

122 Sales, Marketing and Development Managers

1221 OC Sales and Marketing Managers

1222 OC Advertising and Public Relations Managers

1223 R&D Research and Development Managers

13 Production and Specialized Services Managers

131 OC Production Managers in Agriculture, Forestry and Fisheries

132 OC Manufacturing, Mining, Construction and Distribution Managers

133 ICT Information and Communications Technology Services Managers

134 OC Professional Services Managers

14 Hospitality, Retail and Other Services Managers

2 Professionals

21 Science and Engineering Professionals

211 R&D Physical and Earth Science Professionals

212 R&D Mathematicians, Actuaries and Statisticians

213 R&D Life Science Professionals

214 R&D Engineering Professionals (excluding Electrotechnology)

215 R&D Electrotechnology Engineers

2151 Electrical Engineers

2152 R&D Electronics Engineers R&D

2153 ICT Telecommunications Engineers

216 R&D Architects, Planners, Surveyors and Designers

22 Health Professionals

221 R&D Medical Doctors

222 R&D Nursing and Midwifery Professionals

223 Trad. and Complementary Medicine Professionals; 224 Paramedical Practitioners

226 R&D Other Health Professionals

23 Teaching Professionals

24 Business and Administration Professionals

241 OC Finance Professionals

242 OC Administration Professionals

243 Sales, Marketing and Public Relations Professionals

25 ICT Information and Communications Technology Professionals

26 Legal, Social and Cultural Professionals

3 Technicians and Associate Professionals

31 Science and Engineering Associate Professionals

311 R&D Physical and Engineering Science Technicians

312 Mining, Manufacturing and Construction Supervisors; 313 Process Control Technicians

314 R&D Life Science Technicians and Related Associate Professionals

315 Ship and Aircraft Controllers and Technicians

32 Health Associate Professionals

321 R&D Medical and Pharmaceutical Technicians

33 Business and Adm. Associate Professionals;

34 Legal, Social, Cultural Associate Professionals;

35 ICT Information and Communications Technicians

Table 1. Intangile-worker occupation shares of total employment
(include only the share of time devoted to innovative work: 40% for OC, 70% for R&D and 50% for ICT)

Year	OC emp. share	R&D emp. share	ICT emp. share	All	OC emp. share	R&D emp. share	ICT emp. share	All
	Finland				Denmark			
2000	1.7	7.8	1.6	11.2	2.0	7.1	1.9	11.0
2002	1.8	8.3	1.7	11.7	1.8	6.8	1.9	10.5
2004	1.6	7.6	1.7	10.9	1.9	6.6	2.0	10.5
2006	1.7	7.1	1.7	10.6	2.0	7.0	2.0	11.0
2008	1.8	7.2	1.7	10.7	2.0	6.4	2.1	10.5
2010	1.3	7.2	2.4	11.0	2.6	8.3	3.2	14.2
2012	1.3	7.2	2.5	11.0	2.5	8.2	3.3	14.0
2014	1.3	7.1	2.4	10.8	2.4	8.1	3.2	13.7
2016	1.3	7.1	2.3	10.7	2.6	8.7	3.4	14.7
2018	1.5	7.4	2.0	11.0				
	Norway				Slovenia			
2000					1.02	6.00	0.84	7.87
2002					0.96	5.54	0.92	7.43
2004					1.13	5.26	1.10	7.50
2006					1.27	5.38	1.23	7.89
2008	2.82	5.78	2.62	11.21	1.37	5.57	1.38	8.32
2010	2.98	6.58	2.59	12.15	1.67	5.95	1.52	9.14
2012	3.20	7.57	2.87	13.64	1.76	6.23	1.58	9.56
2014	3.18	8.07	2.90	14.15	1.78	6.47	1.60	9.85
2016	3.33	7.70	2.99	14.01	1.75	6.63	1.56	9.95
2018	3.20	7.47	3.10	13.78				

OC worker shares 2016-2018:
Norway 3.2%,
Denmark 2.6%,
Slovenia 1.8%
Finland 1.5%.

R&D worker shares 2016-2018:
Denmark 8.7%,
Norway 7.5%,
Finland 7.1%,
Slovenia 6.6%

Downside trend in OC, R&D shares in Finland, while the shares have been on rise in Denmark and Slovenia

Table 2. Intangible stocks per employee, thousand 2015€

Year	OC/L	R&D/L	ICT/L	All	OC/L	R&D/L	ICT/L	All
		Finland				Denmark		
2000	16.6	43.8	5.1	65.6	8.0	50.1	2.1	60.2
2002	16.4	42.6	5.0	63.9	9.1	48.6	2.2	60.0
2004	16.1	44.3	5.4	65.8	9.6	51.1	2.4	63.1
2006	16.0	43.9	5.6	65.5	10.5	52.7	2.3	65.6
2008	16.0	45.5	5.3	66.8	11.3	54.1	2.2	67.6
2010	14.8	47.0	6.8	68.6	11.1	52.4	5.0	68.5
2012	13.4	47.0	7.6	67.9	10.6	47.8	7.2	65.7
2014	13.0	48.3	7.9	69.2	10.5	46.7	8.3	65.5
2016	12.1	47.4	7.9	67.4	9.7	43.4	8.3	61.5
2018	10.8	45.9	7.7	64.3				
		Norway				Slovenia		
2000					7.3	46.6	2.1	56.1
2002					8.7	46.9	1.9	57.5
2004					8.6	50.6	2.4	61.7
2006					9.7	53.0	2.4	65.1
2008	20.2	54.2	10.9	85.2	11.3	54.8	2.2	68.4
2010	22.3	64.5	10.5	97.3	11.6	55.6	2.5	69.7
2012	25.3	71.2	11.7	108.2	10.8	49.8	6.4	66.9
2014	27.1	74.8	12.2	114.0	10.9	47.5	8.0	66.4
2016	28.1	77.4	12.8	118.3	10.2	45.2	8.4	63.8
2018	26.8	76.2	12.8	115.8				

11.11.2021

R&D per employee highest 76.2 thousand € in Norway 2018. Other countries around 43-45 thousand € in 2016-18, covers about 80% of firms

Finland has higher OC intensity than Denmark or Slovenia despite lower share of OC workers, but in Norway OC per employee are highest around 27 thousand € in 2018.

Firm-specific human capital (incl. OC here) would be the largest subcategories of intangible investment in many other studies (Bloom and Van Reenen, 2010, Piekkola, 2016), here narrow definition

Note: these measure intangible input not innovativenes that depends on fishing out, stepping on stones, leaning on shoulder in IBTC+absorptive capacity+ closeness to steady state

Innovation-labor biased technical change IBTC*

Y value added, A quality, L labor, R^{IA} intangible of type IA=R&D, OC in firm i

$$Y_{it} = b_0 \left(A(L_{OC}, L_{RD}) L_{it} \right)^{b_L} \prod_{IA} \left(R_{it}^{IA} \right)^{b_{IA}} K_{it}^{b_K} \exp(e_{it})$$ so that in estimation

$$\ln Y_{it} = \ln b_{0j} + b_L A L_{it} + b_{IA+K} \ln \left(\sum_{IA} R_{it}^{IA} + K_{it} \right) + b_Z' \ln Z_{it} + \ln e_{it}$$

$$A(L_{OC}, L_{RD}) L_Y = \left(\left(\frac{a_{RD} L_{RD}}{\bar{a}_L L} + \frac{a_{OC} L_{OC}}{\bar{a}_L L} \right) + \frac{L_Y}{L} \right) L$$ where

$$A = \frac{a_{RDt} L_{RDt}}{\bar{a}_{Lt} L_t} + \frac{a_{OCt} L_{OCt}}{\bar{a}_{Lt} L_t} + \frac{L_{Yt}}{L_t} = \left(\frac{a_{RDt}}{\bar{a}_{Lt}} - 1 \right) \frac{L_{RDt}}{L_t} + \left(\frac{a_{OCt}}{\bar{a}_{Lt}} - 1 \right) \frac{L_{OCt}}{L_t} + 1$$ so that in estimation

$$ln(AL)^{b_L} = b_L \left[ln \left[(a_{RDt} / \bar{a}_{Lt} - 1) L_{RDt} / L_t + (a_{OCt} / \bar{a}_{Lt} - 1) L_{OCt} / L_t + 1 \right] + ln L \right] \approx$$ where

$$b_{L_{RD}} (a_{RDt} / a_{Lt} - 1) L_{RDt} / L_t + b_{L_{OC}} (a_{OCt} / a_{Lt} - 1) L_{OCt} / L_t + b_L \ln L$$

$a_{RDt} / \bar{a}_{Lt}$ is approximated by R&D wages relative to the average in i
Lower $b_{L_{RD}}$ than b_L means that true productivity is lower than the wage ratio (should be $b_{L_{RD}} = b_L$). Estimates of relative productivity $a_{RDt} / \bar{a}_{Lt}$ are adjusted accordingly (same for OC)

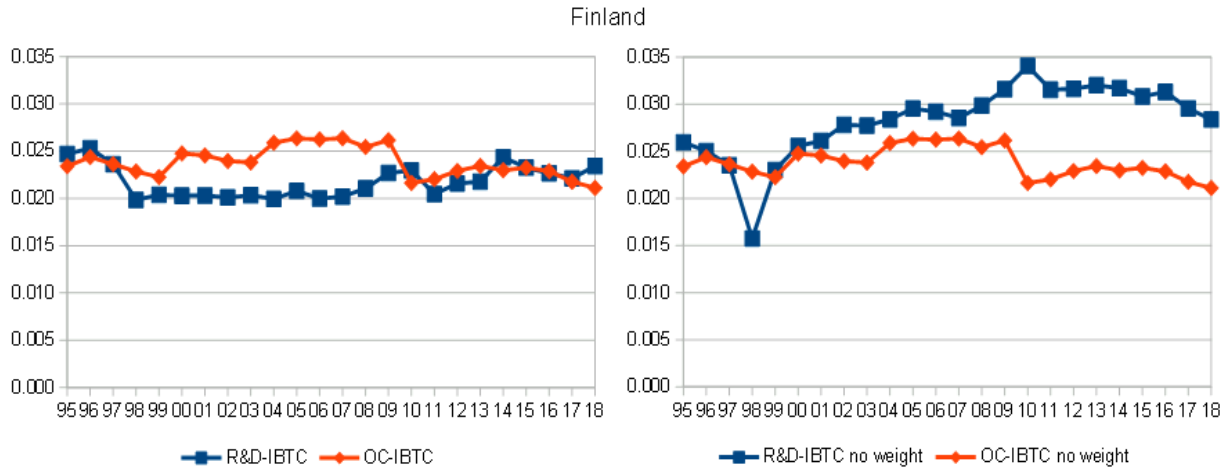
*PIEKKOLA, H. 2020. Intangibles and innovation-labor-biased technical change. Journal of Intellectual Capital, 21, 649-669.

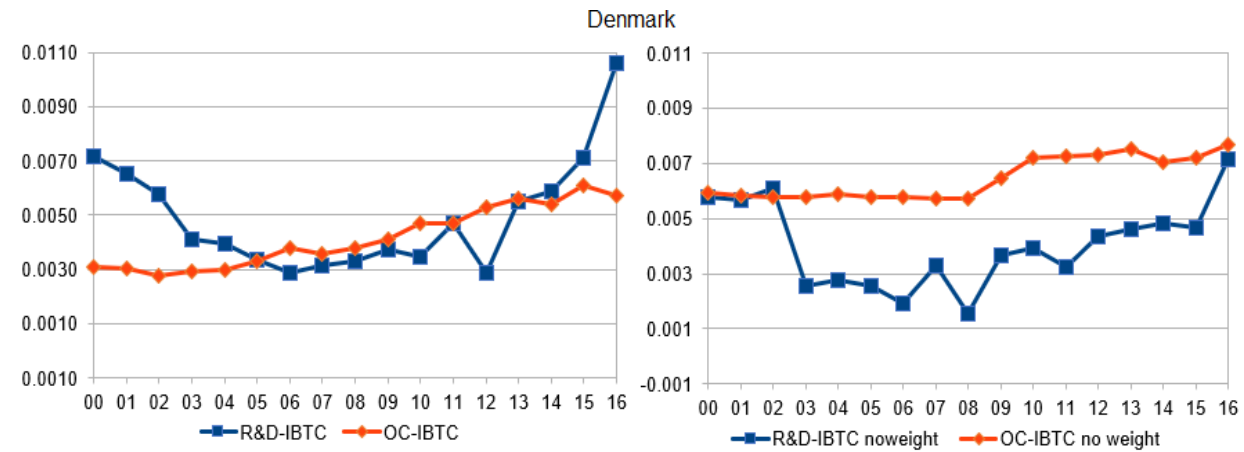
Example Table Summary for Finland 1995-2018

Variable	Mean	Median	Std	N
Value added/L	81.2	58.7	531.0	530155
Employee	38.4	11.0	227.0	530155
OC/L	31.5	17.9	67.3	192193
R&D/L	54.2	30.8	146.0	305665
ICT/L	17	5	66	82718
Total Capital/L	247	127	1226	530155
Output elasticity of employment (excl. IA work)	0.76	0.80	0.14	530155
Output elasticity of relative quality of R&D work	0.18	0.15	0.11	530155
Output elasticity of relative quality of OC work	1.46	1.50	1.72	225718
Output elasticity of total capital	1.80	1.85	0.97	131618
Initial relative quality (wages) of R&D work	1.23	1.22	0.28	225731
Initial relative quality (wages) of OC work	1.84	1.77	0.47	131618
Relative quality of R&D work	1.120	1.040	0.245	210675
Relative quality of OC work	1.180	1.110	0.263	131616
R&D-IBTC	0.028	0.004	0.063	210675
OC-IBTC	0.024	0.008	0.037	131616

R&D-IBTC is the result of multiplying 1-relatively quality of R&D by the share of R&D workers. For example, in Finland the median R&D work share is 0.1 with standard deviation 0.168. Within one standard deviation around the median the relative value of R&D work is 1.038 and the total of these two median values yield (1.038-1)*0.1=0.0038. In the same range median R&D-ibtc is higher 0.0066 as the share of R&D and the relative value of R&D work have positive correlation of 0.33. R&D-ibtc therefore also accounts for the complementarity between the share of R&D and their relative value of the R&D work.

Figure 4. R&D-IBTC and OC-IBTC: RHS with no turnover weight reflect SMEs (all firms with at least 5 workers are included)



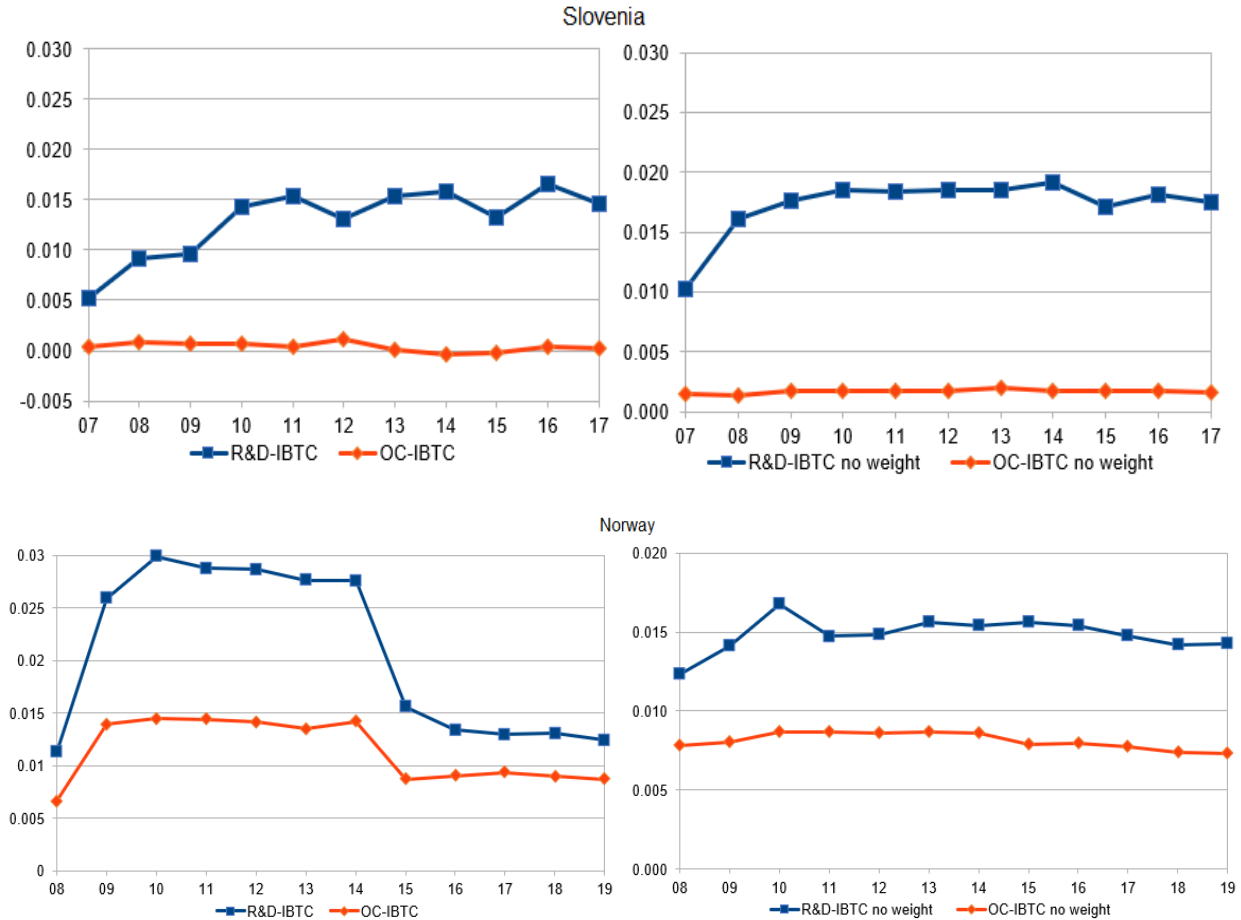


R&D-IBTC
FIN, NOR, SLO at around 1.5-2.5% per year
NOR from high 2.5% to 1.5% since 2015
DEN low 0.6% 2007-2015 (low w_{RD}/w_{avg} ratio 1.2) but higher 1.1 in 2016

OC-IBTC
FIN and DEN highest and about the same level than R&D-IBTC;
SLO and NOR at least double lower than R&D-IBTC

SMEs (RHS figures)
R&D-IBTC
FIN increasing
DEN, SLO follow general trend
OC-IBTC
DEN leading role

Figure 4. R&D-IBTC and OC-IBTC



Financial crises:
no downward shifts, NOR and SLO rather increase

Markups*

- Markup: output elasticity of flexible labor / flexible labor costs share of value added
- Markups (with firm revenue weights) vary over time using the preferred time-varying output elasticity

  Finland 1.8 2007- (lower 1.5 in 2010-14)

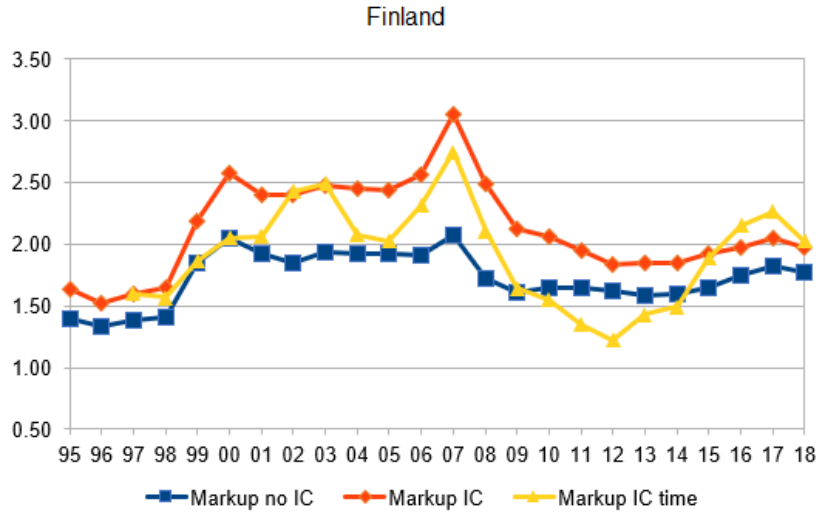
  Slovenia 1.6 2009-

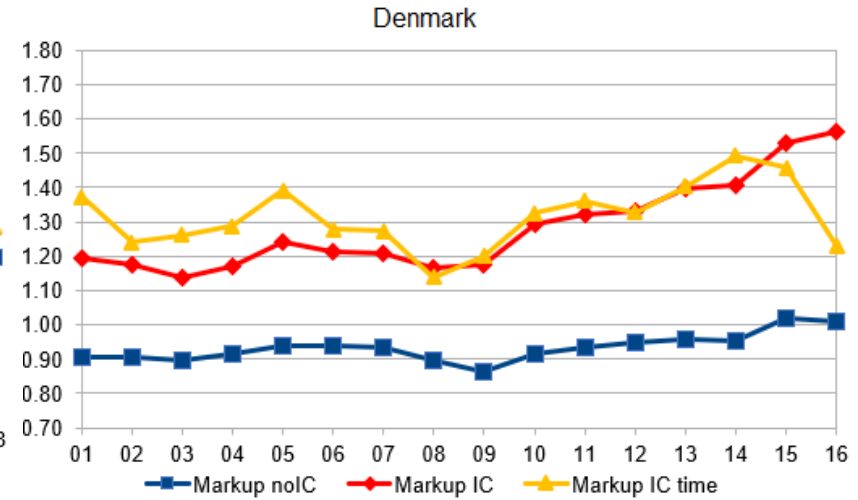
  Denmark 1.3 2007-

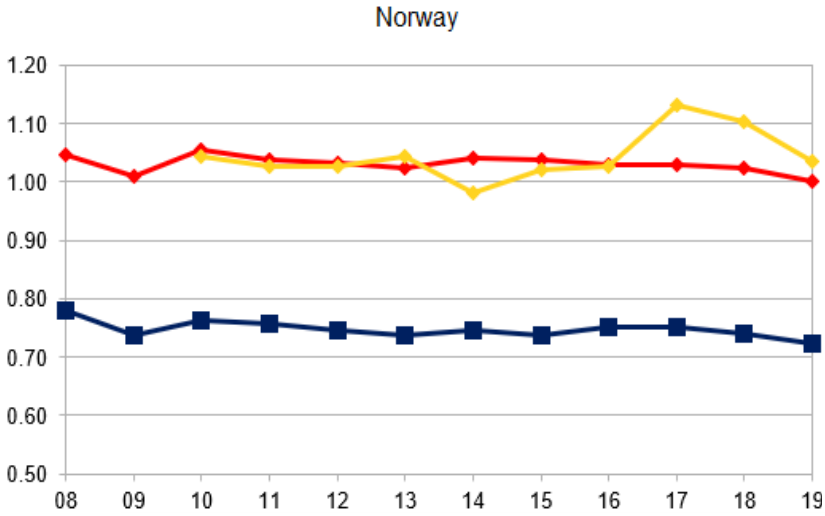
  Norway 1.04 2010-
- KIS: markups FIN 3.1, SLO 1.5, DEN 1.5, NOR 0.8, increase over time
- High-tech manufacturing: markups lower in later years, but in SLO improving
- Low-tech production: markups low but increasing
- Services other than KIS: markup low 1-1.3

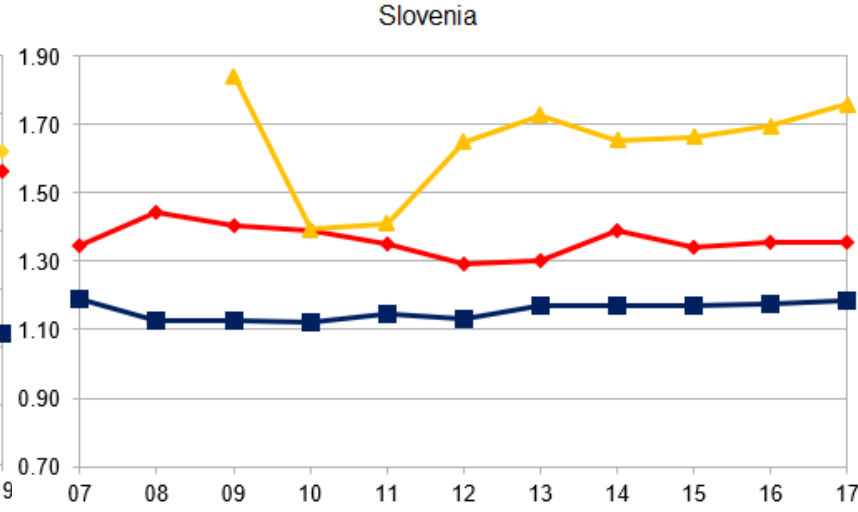
*DE LOECKER, J., EECKHOUT, J. & UNGER, G. 2020. The rise of market power and the macroeconomic implications. The Quarterly Journal of Economics, 135, 561-644.
DE LOECKER, J. & WARZYNSKI, F. 2012. Markups and firm-level export status. American economic review, 102, 2437-71.

Markup: output elasticity of flexible labor / flexible labor costs per value added









Yellow lines preferred having time varying output elasticity

Technical change and markup

- Productivity puzzle of low labor productivity:
  TFP division to IBTC and markups
  - Finland markup highest 1.8 (moderate in 2010-2014) and R&D-IBTC at high level 2% or above

    R&D-IBTC very high in KIS
  - Denmark markup flat 1.3
    - R&D-IBTC low 0.6% with recent improvement
      high KIS, SMEs rely on OC-IBTC
  - Norway markup lowest, R&D-IBTC from 2% until 2014 to 1.3% as of 2015 due to high-tech and other services
  - Slovenia
    - Markup 1.6
    - R&D-IBTC goes up tp 1.5%, little in KIS
  - OC-IBTC follows the level of R&D-IBTC in FIN and DEN, otherwise lower

	Technology type production				Services			Technology type production				Services		
	All	High-High Middle	Low-Middle	Low	KIS	R&D	Other services	All	High-High Middle	Low-Middle	Low	KIS	R&D	Other services
	Finland							**Norway**						
Education	0.054***	0.033**	0.040**	0.048**	0.109***	0.052***	0.058***	0.152***	0.173***	0.157**	0.148*	0.117***	0.101***	0.117***
	(0.005)	(0.012)	(0.012)	(0.015)	(0.011)	(0.013)	(0.010)	(0.011)	(0.034)	(0.049)	(0.059)	(0.019)	(0.029)	(0.018)
Employee	0.772***	0.820***	0.830***	0.772***	0.717***	0.686***	0.766***	0.896***	0.842***	1.121***	0.802***	0.770***	1.115***	0.737***
	(0.006)	(0.018)	(0.015)	(0.017)	(0.014)	(0.020)	(0.011)	(0.015)	(0.057)	(0.044)	(0.048)	(0.026)	(0.058)	(0.021)
OC	0.110***	0.093***	0.109***	0.049**	0.203***	0.052*	0.115***	0.016	0.056	-0.029	0.179***	0.04	-0.151**	0.071**
	(0.006)	(0.016)	(0.014)	(0.016)	(0.016)	(0.021)	(0.012)	(0.014)	(0.047)	(0.040)	(0.041)	(0.028)	(0.047)	(0.023)
R&D	0.123***	0.103***	0.092***	0.161***	0.119***	0.252***	0.096***	0.088***	0.143***	0.049	0.015	0.110***	0.138**	0.080***
	(0.005)	(0.016)	(0.013)	(0.015)	(0.013)	(0.017)	(0.009)	(0.010)	(0.042)	(0.030)	(0.031)	(0.018)	(0.052)	(0.016)
ICT	0.010***	0.009**	0.004	0.008*	0.025***	0.012**	0.006*	0.010***	0.005	-0.004	0.004	0.048***	0.007	0.018***
	(0.001)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.009)	(0.008)	(0.009)	(0.008)	(0.011)	(0.004)
Tangibles	0.036***	0.015	0.033***	0.034***	0.032***	0.043***	0.033***	0.041***	0.056**	0.009	0.068***	0.042***	0.007	0.063***
	(0.002)	(0.008)	(0.007)	(0.007)	(0.005)	(0.009)	(0.005)	(0.006)	(0.019)	(0.017)	(0.020)	(0.011)	(0.023)	(0.010)
R&D-IBTC	1.131***	1.336***	1.903***	0.635	1.350***	0.415	0.941***	3.139***	0.388	4.403***	0.234	0.423	5.551**	3.353***
	(0.095)	(0.258)	(0.155)	(0.398)	(0.198)	(0.289)	(0.246)	(0.465)	(1.093)	(1.261)	(2.632)	(1.155)	(1.911)	(0.730)
OC-IBTC	0.787***	2.028***	-0.138	2.189***	0.083	-2.034**	0.426	3.906***	-1.021	2.019	-2.319	4.766**	1.986	4.410**
	(0.142)	(0.476)	(0.444)	(0.406)	(0.293)	(0.673)	(0.231)	(0.985)	(2.841)	(3.481)	(2.867)	(1.791)	(6.607)	(1.414)
Markup	0.014***	-0.062***	-0.004	-0.045***	0.023***	0.063*	0.052***	-0.01	-0.111	-0.016	-0.065	0.048	0.01	0.028
	(0.003)	(0.005)	(0.010)	(0.013)	(0.006)	(0.026)	(0.012)	(0.025)	(0.074)	(0.068)	(0.066)	(0.060)	(0.114)	(0.036)
Observations	44853	8424	7664	6767	7004	2866	12128	8083	1170	1189	981	1239	562	2942
R^2 within	0.43	0.349	0.483	0.39	0.447	0.501	0.442	0.275	0.159	0.388	0.274	0.352	0.433	0.273
Rho	0.65	0.548	0.621	0.617	0.734	0.55	0.719	0.526	0.416	0.461	0.453	0.564	0.565	0.748
Scalability	1.05	1.04	1.07	1.02	1.10	1.05	1.02	1.05	1.10	1.16	1.07	1.01	1.12	0.97
IA total	0.24	0.21	0.21	0.22	0.35	0.32	0.22	0.11	0.20	0.03	0.20	0.20	0.00	0.17
	Denmark							**Slovenia**						
Education	0.096***	0.111***	0.082***	0.181***	0.034	0.029*	0.113***	0.116***	0.138***	0.168***	0.120***	0.113***	-0.131	0.102***
	-0.004	-0.012	-0.018	-0.019	-0.017	-0.013	-0.015	0.01	0.019	0.017	0.021	0.024	0.087	0.024
Employee	0.887***	0.883***	0.934***	0.964***	0.907***	0.798***	0.878***	0.712***	0.798***	0.711***	0.784***	0.727***	-0.044	0.616***
	-0.005	-0.012	-0.014	-0.014	-0.021	-0.023	-0.024	0.014	0.028	0.025	0.028	0.032	0.208	0.034
OC	0.022***	0.020***	0.009	0.016**	0.008	0.022**	0.01	0.109***	0.115***	0.100***	0.104***	0.082*	0.244	0.121***
	-0.002	-0.004	-0.005	-0.006	-0.01	-0.007	-0.01	0.012	0.021	0.02	0.024	0.035	0.164	0.028
R&D	0.027***	0.042***	0.008	0.025***	0.025**	0.147***	0.019**	0.064***	0.078***	0.043**	0.060**	0.085***	0.375***	0.061***
	-0.002	-0.006	-0.005	-0.004	-0.008	-0.015	-0.007	0.008	0.021	0.015	0.021	0.024	0.109	0.017
ICT	0.021***	0.014***	0.013**	0.004	0.023**	0.025**	0.041***	0.006**	-0.003	0.004	0.009*	0.027***	-0.014	0.008
	-0.002	-0.004	-0.005	-0.005	-0.007	-0.009	-0.007	0.002	0.003	0.003	0.004	0.007	0.021	0.004
Tangibles	0.007***	0.009***	0.021***	0.029***	0.016***	-0.003	0.003	0.076***	0.085***	0.102***	0.081***	0.048***	0.012	0.092***
	-0.001	-0.003	-0.003	-0.004	-0.004	-0.004	-0.005	0.004	0.01	0.006	0.01	0.013	0.03	0.012
R&D-IBTC	1.853***	0.721*	5.309***	2.883***	1.673*	-1.895***	-3.089*	0.060***	0.03	0.087***	0.099*	0.082***	0.892	0.169***
	-0.136	-0.284	-0.455	-0.53	-0.68	-0.447	-1.249	0.013	0.017	0.022	0.038	0.025	0.488	0.026
OC-IBTC	1.793***	2.494**	4.471***	4.859**	6.582***	0.728	3.963***	2.254***	1.413**	2.065***	1.650*	1.713*	-2.064	2.452***
	-0.342	-0.92	-1.062	-1.641	-1.26	-1.069	-1.2	0.286	0.46	0.519	0.647	0.779	2.277	0.672
Markup	0.050***	0.123***	0.102***	0.039**	-0.029*	0.049*	0.591***	3.618**	-0.245	-0.892	3.085	6.476**	-10.333	8.909**
	-0.007	-0.015	-0.014	-0.013	-0.015	-0.024	-0.091	1.144	2.256	1.963	2.095	2.248	18.594	2.894
Constant	3.471***	3.229***	3.581***	2.330***	4.336***	3.917***	2.643***	6.872***	5.861***	6.304***	6.284***	7.107***	5.613**	6.965***
	-0.068	-0.129	-0.177	-0.201	-0.228	-0.201	-0.225	0.172	0.315	0.272	0.344	0.422	2.118	0.365
Observations	32999	8172	5347	4028	1821	2266	1000	7969	1659	2269	1529	533	56	1923
R^2 within	0.367	0.331	0.367	0.363	0.352	0.374	0.347	0.288	0.451	0.37	0.417	0.676	0.534	0.294
Rho	0.557	0.57	0.628	0.571	0.636	0.568	0.538	0.668	0.705	0.726	0.675	0.887	0.744	0.639
Scalability	0.96	0.97	0.99	1.04	0.98	0.99	0.95	0.97	1.08	0.96	1.04	0.97	0.58	0.90
IA total	0.07	0.08	0.03	0.05	0.06	0.19	0.07	0.18	0.19	0.15	0.17	0.19	0.61	0.19

Note. Firms with at least 20 employees. R Squared all is about 0.8-0.89. *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Production function estimates of value added (VA), random effects

R&D and OC increase VA FIN, SLO especially in KIS
One year more education: VA up 9-14%, or FIN 5%

Markup: DEN, in other countries more through IAs

R&D-IBTC
Significant, least in SLO

OC-IBTC
Significant, in NOR positive for all services while markups were low

Policy considerations

Broad intantibles play signicant role but performance also depends on their effect on IBTC

- Norway is rich in intangibles
  - since 2015 IBTC has decreased considerably among large firms
  - Pure profits do not show up as high productivity of flexible work, thereby markups are close to 1
- Intangible workers are not relatively well paid compared to average wage level in Denmark and R&D-IBTC is lower than in Finland or Norway

Increasing role of knowledge intensive services (KIS)

- KIS is linked to intangibles of manufacturing and other industries.
- Expansion of KIS with technical advance (but R&D-IBTC small in SLO), markups are increasing
- Markups are increasing and already very high near 3 in FIN

Policy considerations

Techinal change IBTC

- R&D-IBTC: FIN, NOR, SLO around 1.5-2 per year, NOR from high 2.5 to 1.5 since 2015
- OC-IBTC equally important in FIN and DEN
- "Productivity puzzle" relates to other things than decreased technical change"
  - IBTC continued also during financial and sovereign debt crises
  - Markups (pure profits) have rather increasing trend albeit were lower e.g. in low growth period 2011-2015 in Finland

Policies to foster growth of SMEs.

- SMEs rely on their growth to IBTC and are dependent on knowledge spillovers in their industry (Piekkola, 2020)

Tangible investment and growth

– too little or misallocation across sectors like in Finland?

I.A.R.I.W

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