MEASURING INTANGIBLES

USING REGISTER-BASED DATA AS ADDITIONAL SOURCE TO SURVEY DATA FOR MEASURING R&D, ICT AND ORGANISATIONAL CAPITAL

MARINA RYBALKA, STATISTICS NORWAY

NSM 2022

Background

- Intangible capital has been proven to contribute to economic performance and productivity growth

- Corrado et al. (2006) proposed a definition of intangible capital that is now prevalent in economic literature:
  - (1) computerized information: software, databases
  - (2) innovative property: R&D, IPR, mineral exploration and evaluation
  - (3) economic competencies: brand equity, firm specific human capital, organizational structure

Corrado, C., Hulten, C., & Sichel, D. (2006). *Intangible Capital and Economic Growth* (No. 2006–24; Finance and Economics Discussion Series, Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C.).

Measurment issues

- Measurement remains to be a challenge
  - The lack of (unified) widely accepted definition
  - Data availability
    - Coverage
    - Quality
    - Comparability
- Typically, two types of data sources are used to measure intangibles at firm level
  - Survey based data (from official statistics or one-off surveys)
  - Registry based data

One-off survey data

- Advantages and contribution
  - Flexibility to collect data on aspects that are not covered by official statistics and test new hypothesized links
  - Can adapt the content
  - Important for development of methodological framework
  - Important to researchers and policy-makers

- Challenges
  - Lack international comparability or longitudinal perspective
  - Sample size and structure are not necessarily optimal
  - Data collection represents a notable burden to the businesses
  - Costs of these surveys are high when attempting to achieve sufficient survey quality

Eurostat and National Statistical Institutes (NSI)

- Regular publication of methodologically harmonised indicators
  - A combination of input and output harmonisation approaches
  - The concepts and definitions of variables and the classifications are subject to agreements/legislation in all statistical domains
- Trust that the collection of data at NSIs is of highest quality
  - Data collection is continuously evaluated and revised as needed
  - Expertise on sampling, questionnaire design, data collection, processing and management
- No any standardised survey on intangible investment, but several surveys that gather relevant information on some component of intangibles:
  - R&D survey
  - Community Innovation Survey (CIS)
  - Survey on ICT usage and e-commerce in enterprises (ICT)
  - Continuous Vocational Training Survey (CVTS)

Goal

To investigate wheather occupation based approach to measuring intangibles can be used in NSI?

- Developed in the EUs Horizon 2020 project GLOBALINTO: https://globalinto.eu
- Captures intangibles (R&D, ICT and organizational capital, OC) using register data (based on ISCO08 Occupation classification)
  - Full coverage of firms versus survey data
  - Provide information for the smallest firms that are not represented in the surveys
- Important requirement! Availability of a link between individuals and the companies they are employed at.
  - Of the countries represented by GLOBALINTO, linked employer-employee data (LEED) were available in Denmark, Finland, Norway and Slovenia.

Primary focus on R&D

Are implemented in National Accounts (NA) based on R&D survey

- Check for:
  - Determination whether the company has performed any R&D activity
  - Determination of the scope of R&D activity in the firm

- Methodology:
  - comparison of amounts based on official data with amounts obtained based on GLOBALINTO's measure

Data sources for R&D used in Norwegian NA

- Annual R&D survey (Statistics Norway)
  - 4000-6000 firms per year
  - Selected industries
  - Full coverage of firms with 50+ employees, stratified sampling of firms with 10-49 employees
- Applications for R&D tax credits (Research Council of Norway) and received R&D tax credits (Norwegian Tax authorities)
  - About 4000 firms per year
  - Full coverage of recipients
  - More that 50% are firms with <10 employees

Data used in GLOBALINTO

- Linked employer-employee data (LEED)
  - Full coverage of industries
  - Both private and public sector are represented
  - Apply wage costs as proxy for investment in R&D (corrected for factor multipliers)
  - Harmonized occupational codes are available since 2008 in Norwegian data
    - (from 1999 in Finland and Denmark)

GLOBALINTO definition of intangible labour (R&D, OC, ICT) (based on ISCO08 Occupation classification)

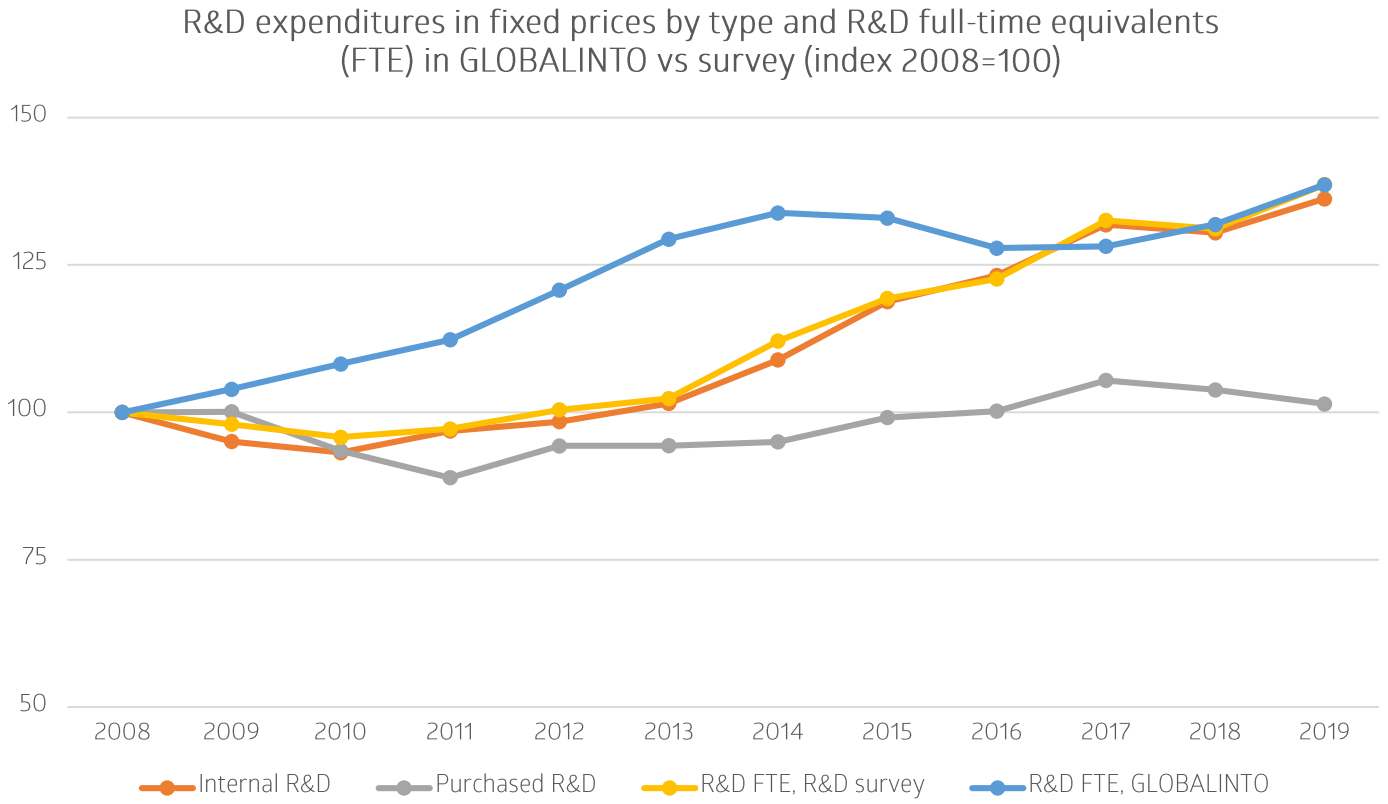
1 Managers	22 Health Professionals
1223 R&D Research and Development Managers	**221 R&D** Medical Doctors
	222 R&D Nursing and Midwifery Professionals
2 Professionals	223 Trad. and Complementary Medicine Professionals
21 Science and Engineering Professionals	224 Paramedical Practitioners
211 R&D Physical and Earth Science Professionals	**226 R&D** Other Health Professionals
212 R&D Mathematicians, Actuaries and Statisticians	
213 R&D Life Science Professionals	3 Technicians and Associate Professionals
214 R&D Engineering Professionals (excluding Electrotechnology)	31 Science and Engineering Associate Professionals
215 Electrotechnology Engineers	**311 R&D** Physical and Engineering Science Technicians
2151 Electrical Engineers	32 Health Associate Professionals
2152 R&D Electronics Engineers R&D	**321 R&D** Medical and Pharmaceutical Technicians
2153 Telecommunications Engineers	
216 R&D Architects, Planners, Surveyors and Designers	

OECD CLASSIFICATON BY TECHNOLOGICAL LEVEL

Technology type	Main industries	Other	Value added shares in 2019, %
Top High technology manufacturing	Electronics 21 and pharmacy 26		1.5
High-middle technology manufacturing	Chemical 20, electrical equipment 27, machinery and equipment 28	Motor vehicles 29, other transport 30	5.1
Low-middle technology manufacturing	Refined petroleum 19, rubber and plastic products 22, basic metals 24	Repair and installation of machinery and equipment 33-34, energy 35	18.6
Low technology manufacturing	Food 10, textile 13, paper 17	Beverages 11, tobacco 12, textiles 13, wearing apparel 14, leather 15, wood and wood product 16, printings 18, furniture. 31, other 32	5.4
KIS market (knowledge-intensive market services)	Transport 50-51 (not land) publishing 58, telecommunication 61, arts, entertainment and recreation R	Motion picture 59 programming, broadcasting 60, other professional activities 74, 75, 78 80	14.1
ICT services	Computer programming, consultancy 62 information service activities 63		4.6
R&D services	Architectural, engineering 71, R&D 72		5.6
OC services	Legal 69, head office 70, advertising, market research 73		4.3
Basic private services	Wholesale trade 45-47, land transport 49, warehouse 52, accommodation, food and beverage 56, real estate 68	Rental and leasing 77, travel agency 79	40.8

Development of R&D measures based on statistical survey data and GLOBALINTO

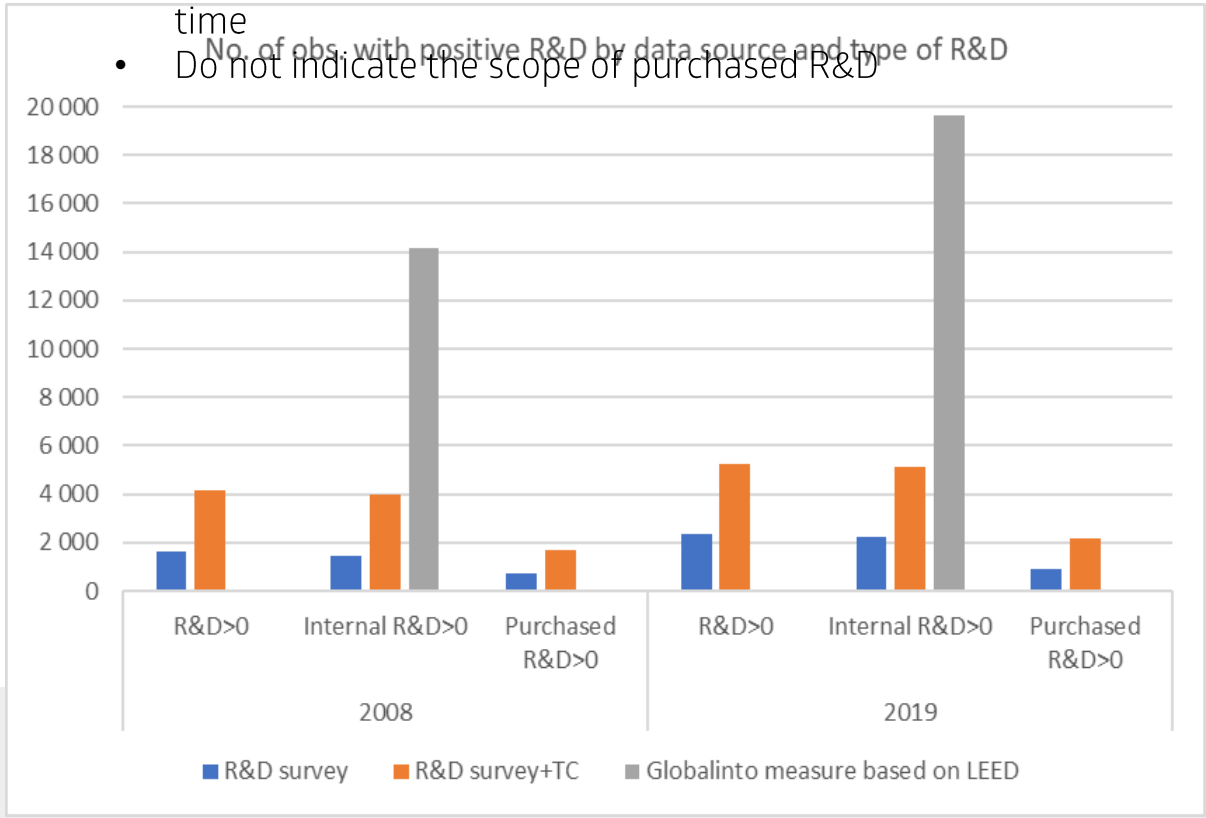
- Amount of purchased R&D is quite stable
- Different responses to the crisis of 2008 and 2014 in FTEs measured in survey vs. GLOBALINTO
- Is it due to the different definitions or to not accounting for the small firms in R&D survey?



Norwegian sample description

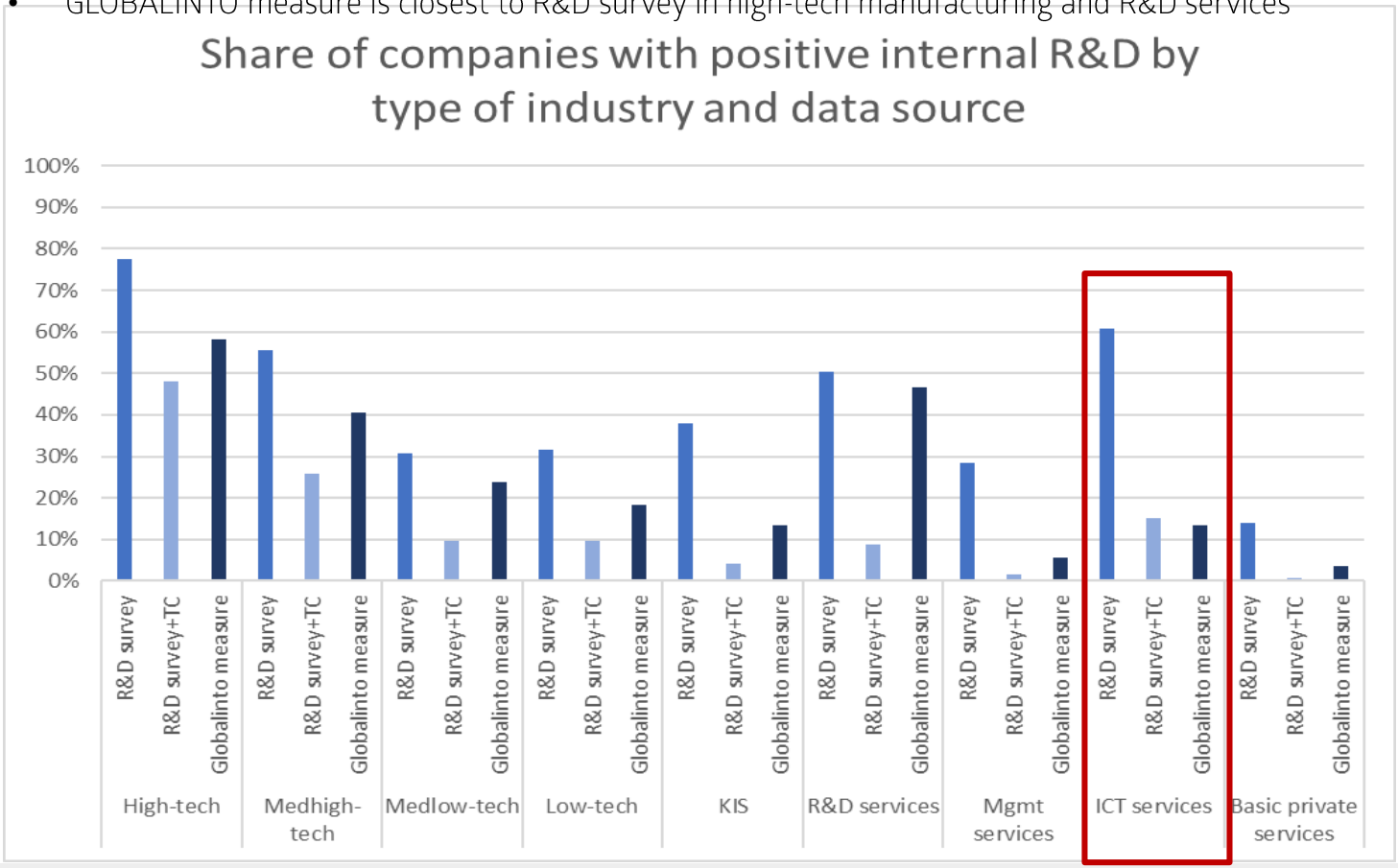
	Number of observations		
Year	R&D survey	R&D survey + TC	LEED data used in GLOBALINTO
2008	5568	8335	140791
2009	4392	7015	147621
2010	6118	8531	145696
2011	4566	7426	151622
2012	5853	8888	159801
2013	4415	7960	167237
2014	4443	8407	173728
2015	5089	9381	190045
2016	4535	8582	196853
2017	5527	8505	202722
2018	4940	8038	205073
2019	5773	8491	215394

- R&D survey+TC (tax credits data) comprise data also for the smallest firms
- Provide more than doubled number of observation with positive R&D
- LEED date used by GLOBALINTO cover all firms
  - Increasing number of firms with positive R&D over time
  - Do not indicate the scope of purchased R&D



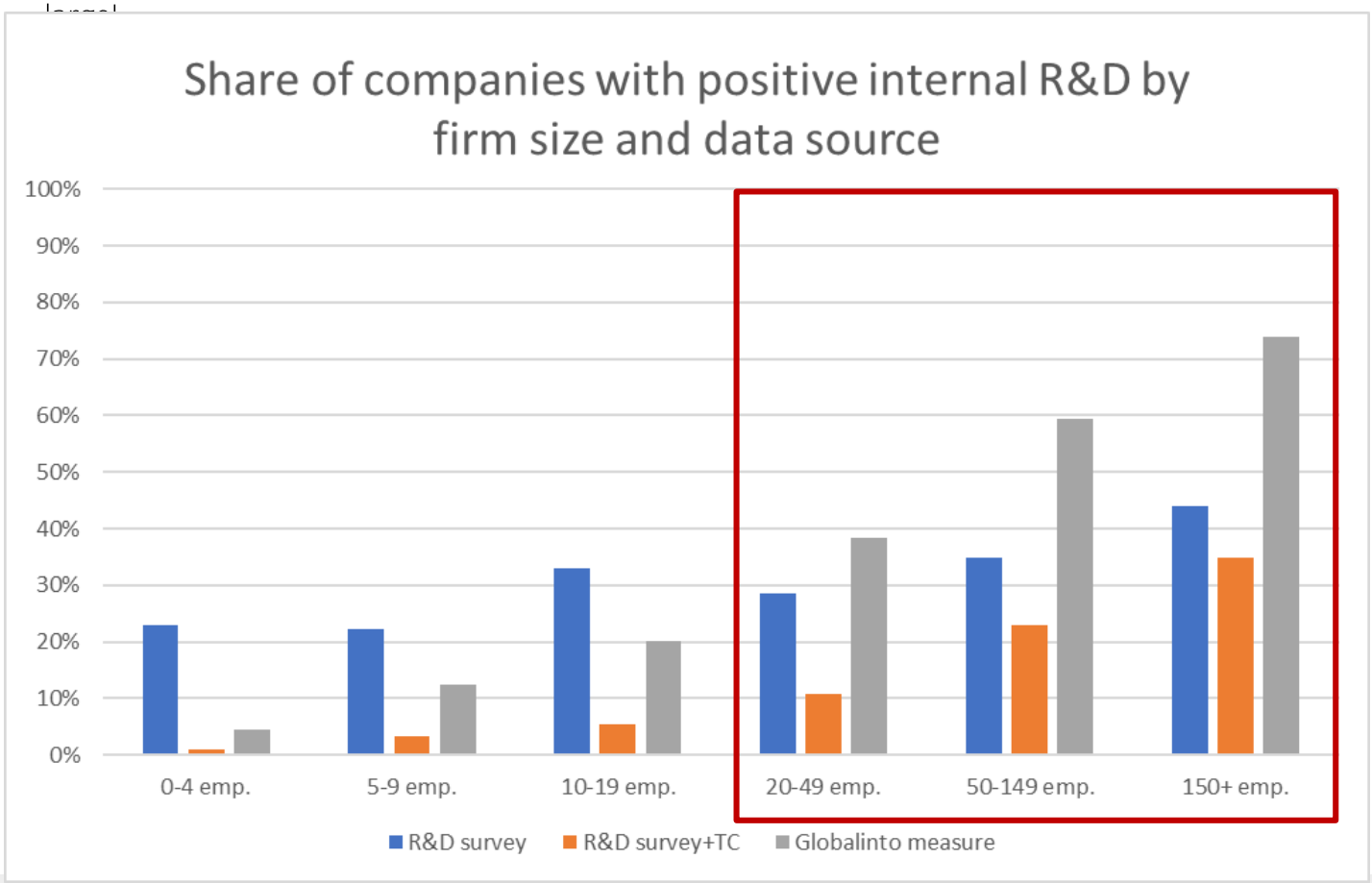
R&D active firms by type of industry

- Higher selection of R&D active firms into survey: the shares based on survey are likely higher than true shares (higher bound)
- Shares based on R&D survey+TC are calculated wrt. the whole population of firms (lower bound)
- Shares based on GLOBALINTO measure are in between these two for most industries, but not for ICT services!
- GLOBALINTO measure is closest to R&D survey in high-tech manufacturing and R&D services



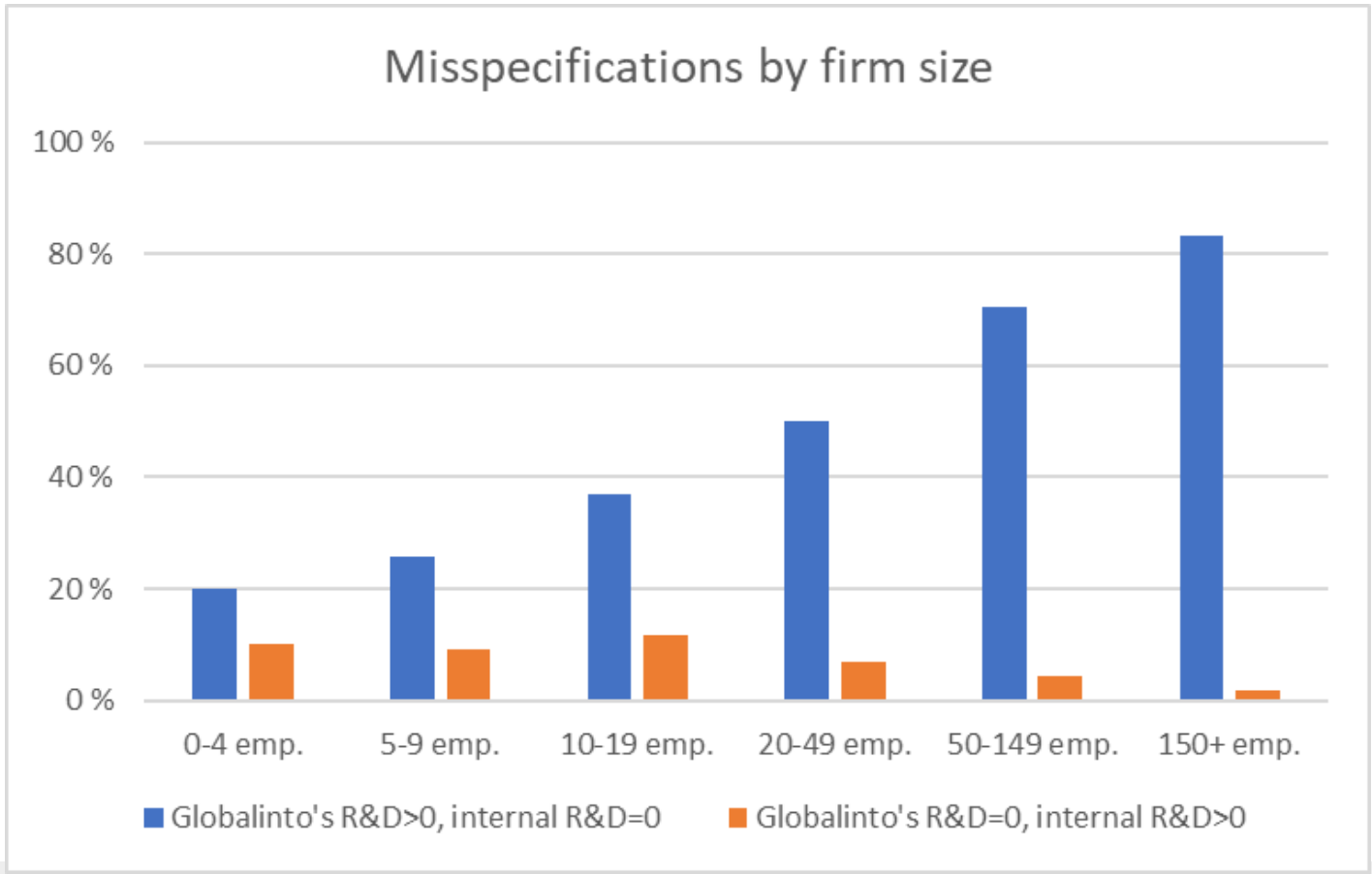
R&D active firms by firm size

- Higher selection of R&D active firms into survey: the shares based on survey are likely higher than true shares (higher bound)
- Shares based on R&D survey+TC are calculated wrt. the whole population of firms (lower bound)
- Shares based on GLOBALINTO measure are in between the R&D survey and R&D survey+TC for small firms, but not

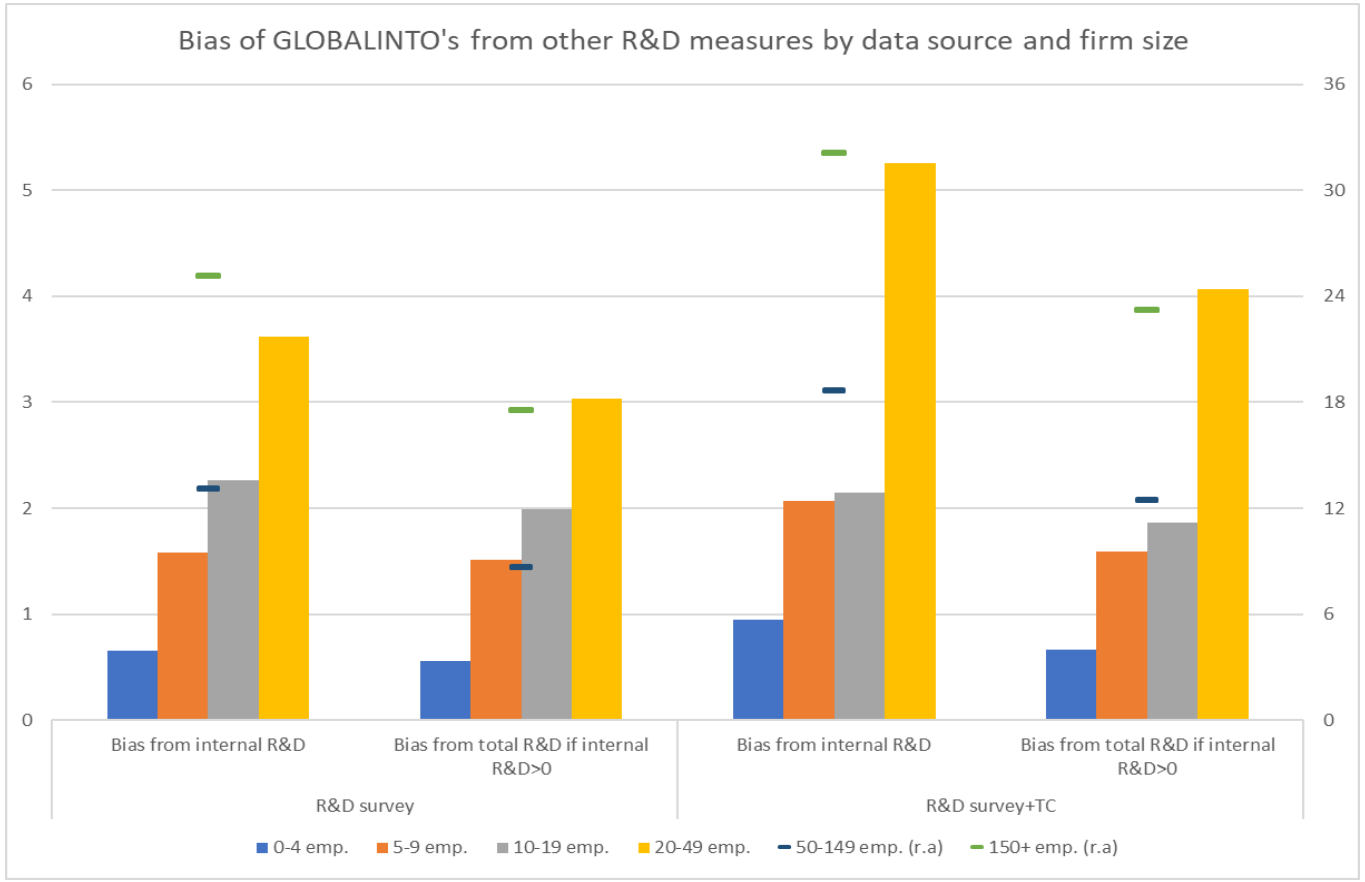


The scope of misspecifications of R&D active firms by firm size

- GLOBALINTO's method is more generous in its R&D definition than R&D survey wrt. internal R&D
- This problem is less important for the small firms, but more serious the larger firms are
- The opposite misspecification in case of positive internal R&D from R&D survey is random



The bias in R&D amounts by firm size



- GLOBALINTO's R&D measure based on labour costs works well for the smallest firms (0-4 employees)
- If to apply factor multiplier of 0.7 for R&D labour costs (as in GLOBALINTO) this measure would be close to the observed R&D amounts for firms with 5-9 and 10-19 employees
- The bias is more serios the larger firms are

Discussion

- The main goal was:
  - To investigate, whether it is possible to use developed by GLOBALINTO measure of R&D investment (and potentially of other intangible assets) in NSI
  - To compare definitions of R&D active firms based on GLOBALINTO with statistical data sources
  - To evaluate sources of bias in the occupation based measure of R&D

Methodological evaluation

- GLOBALINTO's method is restricted to identify the internal R&D activities only

- *Benchmarking the GLOBALINTO values to statistical R&D data*
  - GLOBALINTO's method is more "generous" in its R&D definition than R&D survey wrt. internal R&D
  - It works well for the smallest firms with 0-4 employees without correction for factor multiplier, and for the firms with 5-9 and 10-19 employees with correction for factor multiplier for innovative work shares
  - The bias is more serios the larger firms are

- Main conclusion:
  - GLOBALINTO's measure can be applied as a complementary source to official data on R&D for the analytical purposes
    - Provides full coverage of firms
    - However, the correction of factor multiplies should be considered to minimize the bias problem for the larger firms
  - and partly for statistical purposes
    - when it yields details for the small firms that are not covered by the R&D survey

Underreporting of internal R&D in survey or too high generosity of GLOBALINTO's R&D definition?

Thank you for your attention!

Marina.Rybalka@ssb.no