

Survey-based approaches to measuring innovation: Two approaches

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Agenda

- Two survey-based measures of innovation
 - Community Innovation Survey (CIS)
 - The “Division of Innovative Labor” (DoIL) innovation survey by **Arora, Cohen and Walsh**
- Question: Innovation?
 - What do respondents mean?
 - How can we achieve greater interpretability and precision?
 - Suggestions from the Arora, Cohen and Walsh’s survey on the Division of Innovative Labor (DoIL) in U.S. mfg.
- What are we learning about innovation from these surveys (focusing mostly on DoIL survey)

“Innovation” per the Community Innovation Survey (CIS)

Key CIS questions (CIS, harmonized, July 2014)

- During the prior three years, 2012-2014, “did your enterprise introduce”:
 - Product innovations: “New or significantly improved goods”
 - Were any of your product innovations:
 - “New to your market”
 - “Only to your enterprise”
 - A “first” in your country, Europe or the world?”

Selected CIS estimates of innovation rates (~2007-2009) among mfg. firms, and DoIL survey estimates for U.S.

- **New-to-the-firm**
 - Germany: 49%
 - UK: 34%
 - France: 28%
 - DoIL for U.S.: 42%
- **New-to-the-market innovation**
 - Germany: 23%
 - UK: 17%
 - France: 19%
 - DoIL for U.S.: 16%

CIS framing

- CIS asks questions about innovation at the firm level
- Revenues and innovation
 - What percent of the firm's total turnover in 2014 was from world-first product innovations intro'd between 2012 and 2014”?
- Examples of other questions
 - Types of partners
 - Licensing
 - Barriers to innovation

A concern

- What do respondents mean by “New or significantly improved goods”?
 - Trivial?
 - A new color toothpaste or the first 3-D printer?
- What respondents mean will affect interpretation of findings

Arora, Cohen and Walsh (2016) Survey on the Division of Innovative Labor

DoIL project objective

- More special purpose than the CIS
- Objective: To characterize contours of the “division of innovative labor” (DoIL)
 - Starting from distinction between invention and innovation, DoIL survey examines extent to which **innovators** acquire inventions from external sources and channels employed
 - Which sources? Which channels?
 - Allowed comparison of value of externally acquired inventions by source
 - Estimates importance of external sourcing for innovative performance
 - **First needed to identify innovating firms**

Definitions of innovation

- Innovators
 - “In 2009, have you earned revenue from any new or significantly improved goods or services in [INDUSTRY] introduced since 2007, **where “new” means new to your firm?**”
- FOCUS: Respondent’s most important innovation
 - “Of all the new or significantly improved products or services you brought to market in [RESPONDENT INDUSTRY] during the three years, 2007-2009, **think of the one that accounts for the most revenue.**”
 - “Did you introduce this innovation in your industry before any other company?” =>
- We identify these respondents as “new to the market” (**NTM**) innovators

Comparison with CIS

- Both surveys start from similar definition of innovation
- **But** rather than focus on firm as a whole, DoIL survey focuses:
 - On single line of business
 - Single, most important innovation
- Follow-on questions concern this most important innovation.
- Benefits
 - Precision
 - Allows for calibration, mitigating concerns over interpretation of what “innovation” means, at least economically

Table 2. Rates of innovation and imitation, patenting and % sales for U.S. mfg. industries.

INDUSTRY (Number of respondents)	% NOSI a	% NTM b	%Imitator a-b	% sales from NOSI	% sales from focal NTM innovation	% NTM patented
Food/Bev (362)	40%	13%	27%	16%	9%	24%
Textiles (210)	37%	15%	22%	19%	15%	51%
Wood (385)	33%	8%	25%	15%	7%	11%
Chemicals (365)	49%	24%	25%	17%	9%	42%
Pharma (128)	62%	28%	33%	23%	13%	61%
Plastics (340)	47%	16%	31%	14%	6%	42%
Minerals (323)	30%	9%	21%	21%	14%	35%
Metals (324)	38%	9%	29%	14%	5%	23%
Fab Metals (424)	38%	10%	28%	28%	8%	35%
Machinery (384)	44%	20%	24%	24%	14%	52%
Electronics (146)	76%	33%	43%	38%	9%	58%
Semicond (302)	60%	27%	33%	29%	18%	59%
Instruments (135)	59%	37%	22%	17%	7%	54%
Elec Equip (344)	54%	26%	28%	25%	13%	53%
Auto (339)	50%	27%	23%	25%	11%	34%
Med Equip (136)	55%	22%	33%	37%	31%	72%
Misc. (510)	47%	19%	29%	30%	10%	45%
All manuf. (5157)	42%	16%	27%	22%	11%	42%
Large firms (1268)	65%	38%	27%	24%	10%	63%
Med. firms(945)	54%	23%	31%	20%	15%	47%
Small firms (2944)	39%	13%	26%	19%	12%	36%

Selected findings from DoIL survey

- NTM innovation rate for manufacturing, 2007-2009: **16%**
- 27% imitate
 - Imitation much more stable across industries than innovation rate
- Sales of new products highly skewed
 - For NTM innovators, the most important new to market innovation accounts for bulk of sales from all new to firm sales (about 70%)

Sources and channels for the underlying inventions

- **“Did any of the following originate this [most important] innovation, that is, create the overall design, develop the prototype or conceptualize the technology?”**
 - **49% externally source the invention**
 - **Most pervasive source: customers**
 - **Most valuable originate from tech specialists**
 - **How acquired?**
 - **Market channels (e.g., lic’ing, contract, equity acquisition): 37%**
 - **Market only: 16%**
 - **Non-market channels account for almost two thirds, with cooperative efforts at 61%**

But is the product innovation
“important”?

Along what dimension(s)?

How can we tell?

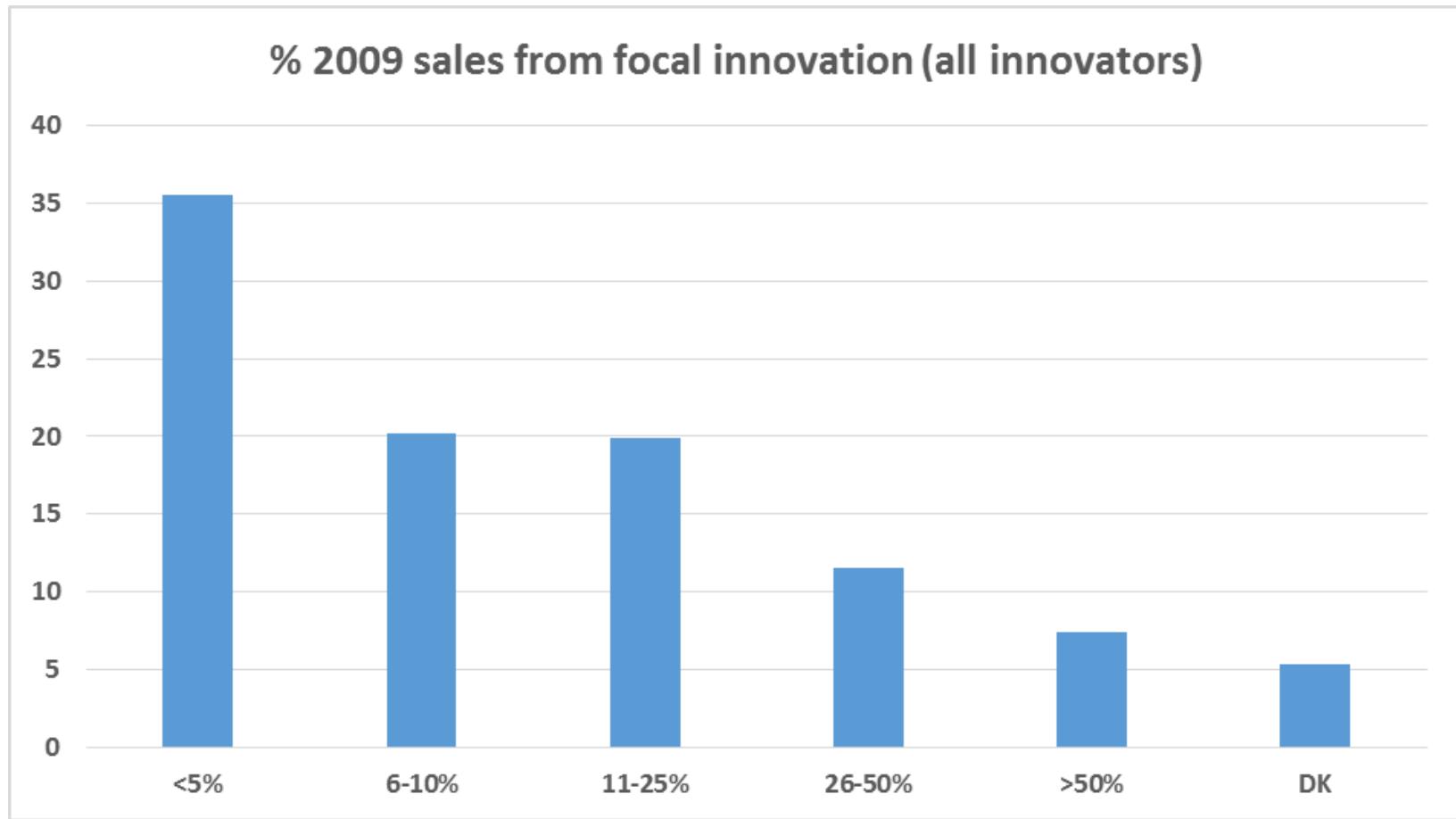
Wheat from chaff

- Indicators of economic and technical importance of focal innovation mitigate concerns that the measure reflects trivial innovations
- Supplementary indicators of economic value and technical significance permit a an assessment of significance of the innovations reported by respondents.

Indicators of economic value and technical significance

- Percentage of business unit sales due to the focal innovation
- To commercialize focal innovation, did the innovator:
 - Develop new sales and distribution channels
 - Invest in new types of equipment or hired employees with skills different from existing employees
- Whether the focal innovation is patented
 - By the innovator
 - By an external source

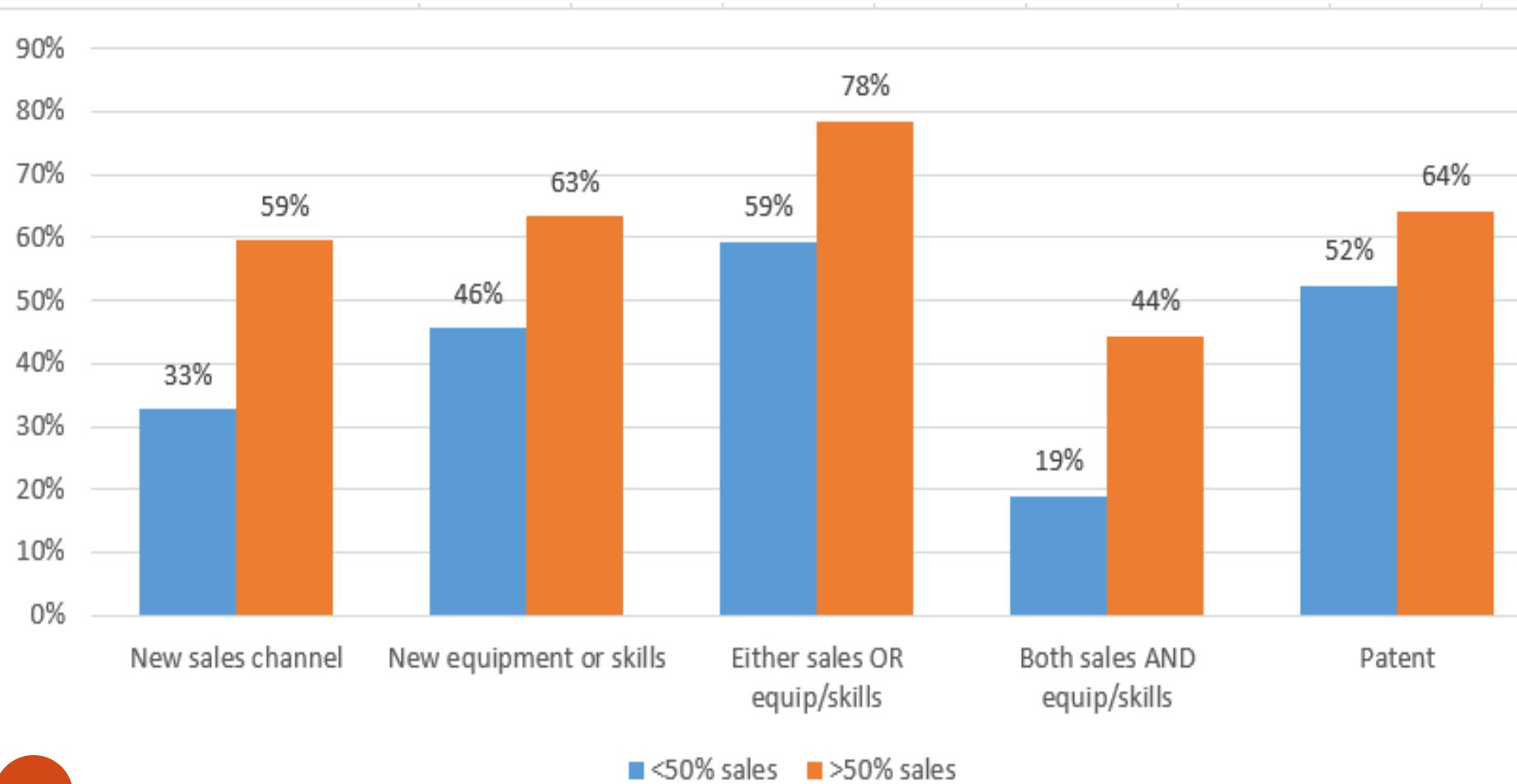
% business unit sales from focal innovation (n=1,062 NTM innovators)



Investment in commercializing focal innovation and patenting

- Complementary investments to commercialize the innovation?
 - In new sales/distribution channels: 42%
 - In equipment or personnel: 47%
 - In equipment/personnel **and** sales/distn: 25%
 - In equipment/personnel **or** sales/distn: 64%
- Patent rate among (NTM) innovators in manufacturing: 42%
 - Patenting by source for externally acquired innovations: 24%

Correspondence between % of sales due to focal innovation and other indicators

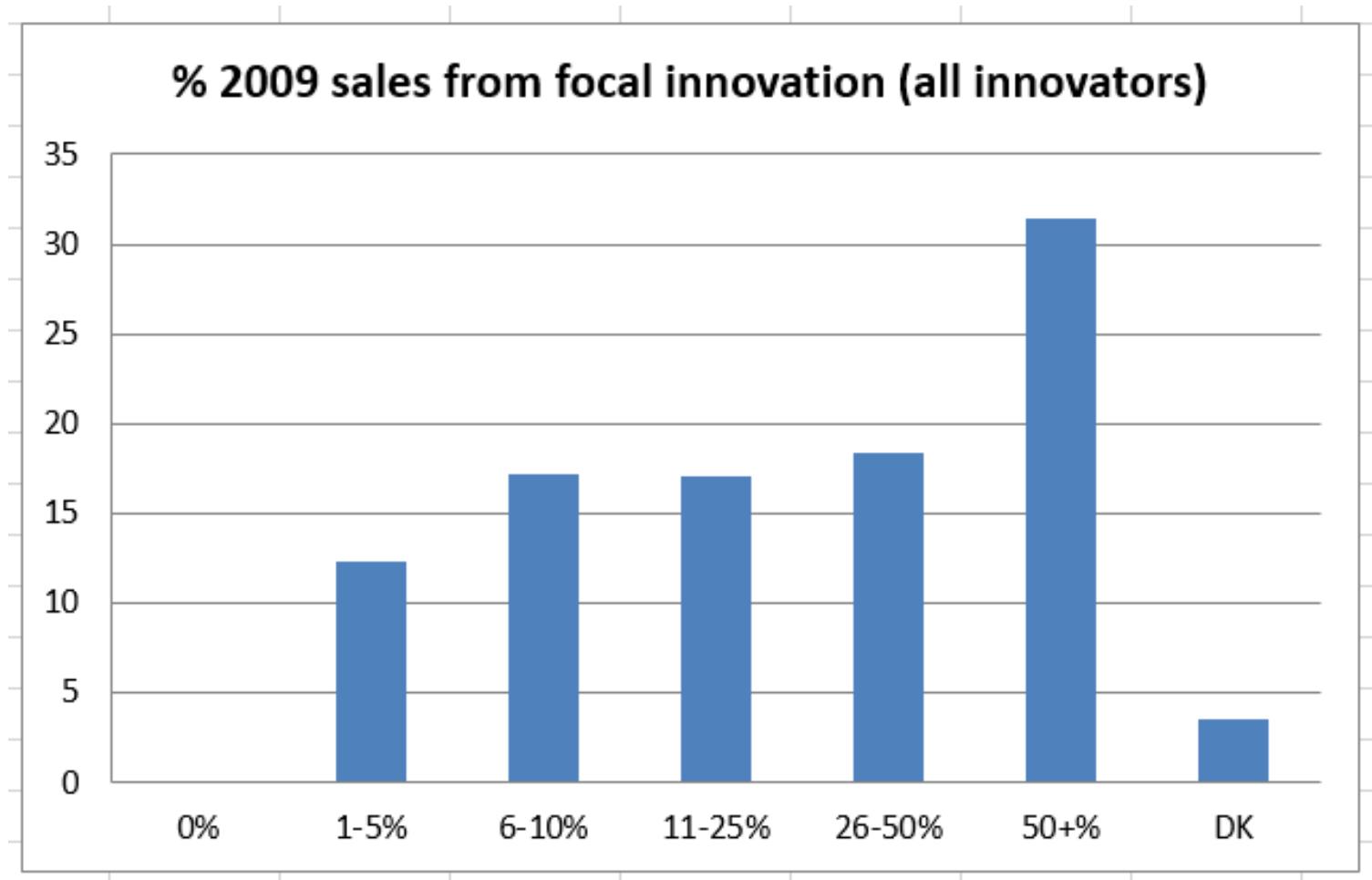


Conclusions

- Substantive
 - 49% innovator reliance on external sources for invention suggests that, to understand drivers of innovation, need to consider extent and implications of the “division of innovative labor.”
- Methodological
 - Innovation measures focusing on a specific innovation offer accuracy and interpretability
 - Multiple measures tied to a specific innovation can reflect dimensions of economic and technical importance, mitigating ambiguity surrounding term “innovation” or “new or significantly improved”

Thank you

Importance of innovation, SW: % of business unit sales from focal innovation (n=75 innovators, of 274 SW firms, NAIC's 5112, 5180, 5415)



Additional measures of importance of the focal innovation in SW

- Patent rate among (the 75 NTM) innovators (of 274 respondents) in SW: 32.3%
- Complementary investments to commercialize the innovation in SW?
 - In new sales/distribution channels: 63%
 - In equipment or personnel: 58%
 - In equipment/personnel **and** sales/distn: 42%
 - In equipment/personnel **or** sales/distn: 79%

Innovation rates across surveys: % of resps. introducing NTF or NTM innovs. (mfg only)

Survey	NTF %	NTM/NTF %
DoIL (2010)	42	38
UK CIS (2009)	34	51
German CIS (2009)	49	45

- *NTF – New to the Firm
- **NTM – New to the Market

Validating Innovation Measures: Industry Correlations across Measures

External Indicators	ACS NTF	ACS NTM
BRDIS NTF	.72	.76
Europe-wide CIS NTM	.71	.72
BRDIS R&D Performers	.72	.72
CIS Innovative Activity	.70	.68
BRDIS RDI*	.59	.52
Rs' any patent application (PATSTAT)	.72	.74
Rs' patent count (PATSTAT)	.54	.47
Rs' forward citation count (PATSTAT)	.56	.49