

Labor Market Tightness in U.S. Manufacturing: A Skill Issue?

Andrew Weaver

University of Illinois at Urbana-Champaign

French Ministry of Health and Solidarity

Paris, France

December 18, 2018



What's the Issue?

- Firms/organizations complain they can't find skilled workers
- Claims persist through the business cycle



Wikimedia



Creative Commons/Scott E.

Assertions about Skills

“For too many Americans, the only jobs that are available are those they don’t have the skills and qualifications to fill.”

Senator Robert Portman (2013)

“The American economy rewards skill very well, but the supply hasn’t responded.”

Andreas Schleicher, OECD (NYT 2013)

“...these trends also seem to point toward a gap in what employers want and what employees can offer. Simply put, it seems clear there is a skills gap in the US economy that is nagging the labor market.”

Bloomberg BusinessWeek (2016)

“The skills gap in the U.S. is substantial. The National Federation of Independent Business found that as of first-quarter 2017, 45 percent of small businesses reported that they were unable to find qualified applicants to fill job openings.”

Robert Kaplan, Dallas Federal Reserve in Bloomberg BusinessWeek (2017)

Framing of Issue in Public Debate

- Framing of the skill mismatch issue rests on two assertions:
 - It's a supply-side problem: the problem lies with worker investments in skills and educational institutions that train them
 - The issue is primarily related to technical/STEM skills (and sometimes new soft skills)
 - Simple versions of Skill-Biased Technical Change (SBTC): technological changes increase demand for computer-related skills; workers lack these skills
- Due to lack of data, framing mostly excludes:
 - Organizational characteristics
 - Management strategy
 - Local economic environment/market factors
 - Institutions

Relevance/Impact

- Policymakers need to understand this issue in order to foster economic growth and improve economic outcomes for workers
 - If problem is just structural/skills gap:
 - long-term ed. attainment and worker behavior
 - If other factors matter, there is room for other interventions:
 - making connections with local labor market intermediaries, incentives to alter firm HR strategy, relevance of best practices, etc.

Existing Research

- Lack of detailed data
- Much of debate has been dominated by non-representative trade association surveys
- Existing academic research on skill mismatch uses very general / aggregate data without direct measurement of skills, establishment-level outcomes, or industry/occupational factors
- 2 main methods: quantity and indicator

Limitations to Aggregate Analysis

- Quantity method projects demand and supply of skills and subtracts one from the other (Rothwell 2012; Carnevale et al. 2010)
- Quantity method drawbacks
 - Uses education as proxy for skills
 - Either uses education on both supply and demand side, or uses “expert” projections on one side
 - Very sensitive to small changes in assumptions
- Indicator method: uses wages or vacancies as a sign of friction (Cappelli 2015; Canon, Chen, and Marifian 2013; Lubik 2013)
- Indicator method drawbacks
 - Wages are sensible first step
 - But: interindustry wage differentials, institutional factors, price ceiling for tradable/outsourcable goods and services
 - Beveridge-curve analysis is conditional on aggregate demand (Diamond and Sahin 2014)
 - Vacancy-unemployment methods don't reveal mechanisms

Prior Skill Mismatch Research

- View from above is worth seeing, but . . .



Wikimedia Commons

Research Approach

- To answer questions about skill and mismatch, it's helpful to gather direct evidence on skill demands:
 - What skills do employers demand?
 - Do establishments with high skill demands have trouble finding workers with these skills?
- To really narrow in on skills, important to focus on industries and occupations
- It's important to add organizations, strategy, market conditions, institutions, etc. back into the analysis
- My approach combines more precise measures of skills, org./institutional factors, and frictional vacancies

Rationale for Industry Skill Gap Research Project

- Collect original, nationally representative data on skill demands and hiring outcomes at the establishment level
 - Manufacturing national survey: 2012-13
 - Production workers
 - IT helpdesk national survey: 2015-16
 - Helpdesk/service desk technicians
 - Lab tech national survey: 2015-16
 - Medical technologists

Manufacturing Skill Gap Claims

“Eighty-three percent of companies indicate a moderate to serious shortage of skilled production workers and 69% of companies expect this shortage to worsen over the next three to five years.”

Deloitte / National Association of Manufacturers (2011)

“A shortage of skilled talent exists in the manufacturing industry, and this shortage is likely to become more severe in the coming years More than 75 percent of manufacturers report a moderate to severe shortage of skilled resources”

Accenture / National Association of Manufacturers (2014)

“[M]any companies expect job categories where they have rated the current shortage “very high”—digital talent, skilled production, operational managers—to triple in difficulty in terms of filling positions in the next three years Even at present, many of these jobs are taking longer to fill, stretching out to months of time”

Deloitte / National Association of Manufacturers (2018)

Questions

- Does mismatch/gap exist between employer demands and the supply of skills in the marketplace?
- If so, what mechanisms explain this gap? Is it just inadequate worker skills, or are other factors involved (firm HR strategy, local institutions, etc.)?

Our Survey

- Administered in late 2012, early 2013
- Random sample—Dun & Bradstreet database
- $n=903$
- 36% response rate
- Focus on “core” production workers—62% of estab. employment
- Concrete skill questions: does this job require reading complex technical manuals? algebra? geometry? etc.
- Defined skill gaps as prolonged core worker vacancies (> 3 mos.)

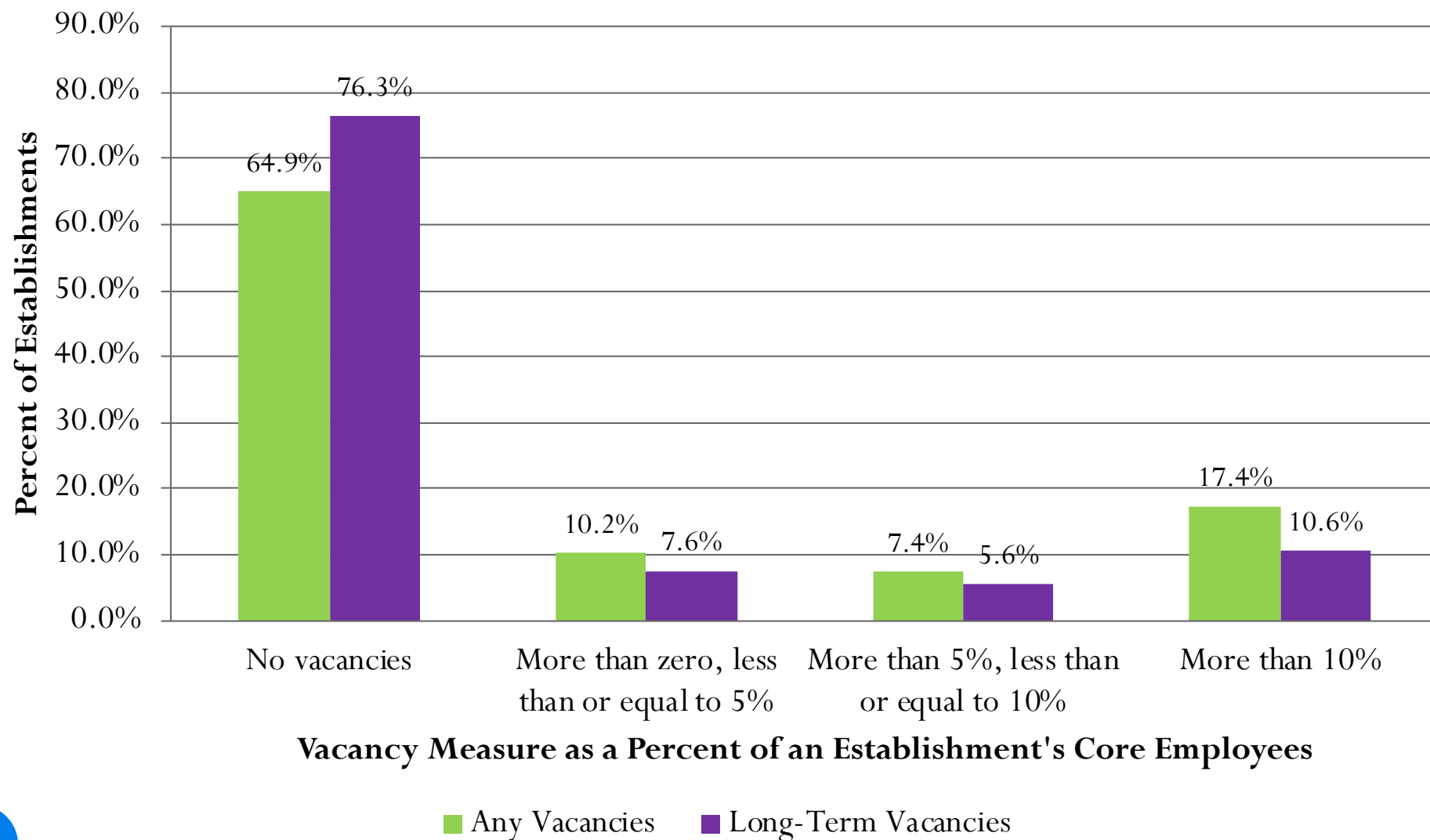
Extended Skill Demands

Extended Skill Demands for Core Production Jobs

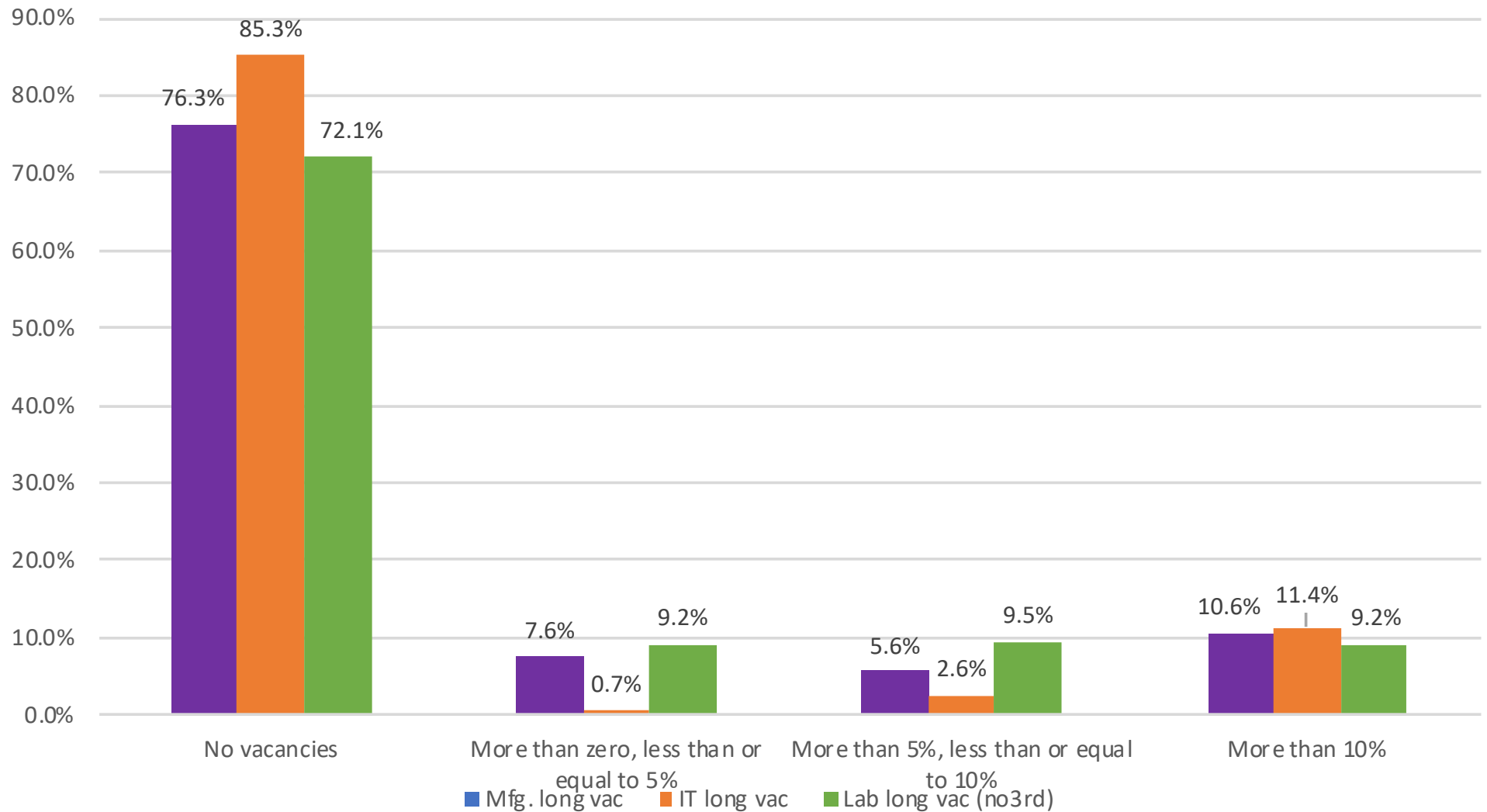
	All Establishments
Extended reading (docs > 5pg.; trade jrn.; tech. docs)	52.6%
Extended writing (>1pg.)	22.1%
Extended math (ability to perform any of three math categories below)	38.0%
Algebra, geometry, or trigonometry	31.5%
Probability or statistics	13.6%
Calculus or other advanced mathematics	7.4%
Extended computer	41.9%
Use CAD/CAM	28.4%
Use other engineering or manufacturing software	29.2%
Ability to write computer programs (such as program a CNC machine for a new piece, etc.)	18.6%
Unique skill	25.9%

Skill Gap Evidence

Vacancies



Comparison: Long-Term Vacancies



Sources: 2012-13 PIE Mfg. Survey; 2015-16 ITHS Survey; 2015-16 LT Survey.

What Skill Demands Are Associated With Hiring Difficulties?

- Higher level math
- Higher level reading
- But not:
 - Computer skills
 - Soft skills/problem-solving/initiative skills
 - Any other measured skills
- So what can we say about mechanisms?

Potential Mechanisms

- We test for many mechanisms associated with different economic and institutional stories about skill gaps
- Fall into 4 categories:
 - **Pure supply side:** local educational institutions, size of local labor market
 - **Pure demand side:** internal HR practices, training, unions
 - **External shocks:** technology, globalization
 - **Factors that complicate the interaction of supply and demand:** industry clusters and unique skills
 - Plant size decline
 - Many disaggregated establishments
 - More potential for communication and coordination failures

Analysis of Hiring Difficulties: Skill Gap Mechanisms

- Dependent variable: skill gap indicator (logit)
- Model includes:
 - Base group of skill variables
 - Controls for establishment size

$$LTVac_i = \alpha + Mech_i\beta_1 + Skills_i\beta_2 + \beta_3 Emp + \varepsilon_i$$

Skill Gap Mechanism Results

- Supply-side labor mkt. size and community college variables not predictive
- Demand-side HR practices and structure not predictive
- Globalization and uncompetitive wages not predictive
- High-tech status and above-avg. plant tech. have negative and insignificant effects

Combined Model: Significant Explanatory Variables

	(6) Any LT Vac.
Extended reading	0.113*** (0.038)
Extended math	0.106** (0.039)
Unique skill	0.082*** (0.030)
Industry cluster	0.119*** (0.037)
<i>Observations</i>	678
Pseudo R-sq.	0.105

Further Exploration: Cluster Effect

- Unclear ex-ante: sophisticated local institutions vs. problems assoc. w/cluster status
- It could be that clusters just imply increased **competition** for a limited supply of general skills (while cluster is not large enough to affect aggregate supply)
 - However, marginal effect of demanding ext. reading and math was almost identical for cluster and non-cluster estab.
- It could be greater **specialization** of skills
 - However, marginal effect of demanding unique skills is large and significant for non-cluster estab. vs. small and insignif. for cluster estab.
- It could be that disaggregation implies comm./coord. challenges in times of growth (**adjustment**)
 - Supportive evidence: doubling of workforce assoc. with zero increase in LTV for non-cluster vs. signif. 13 pct. pt. inc. for cluster

Summary of Results/Implications

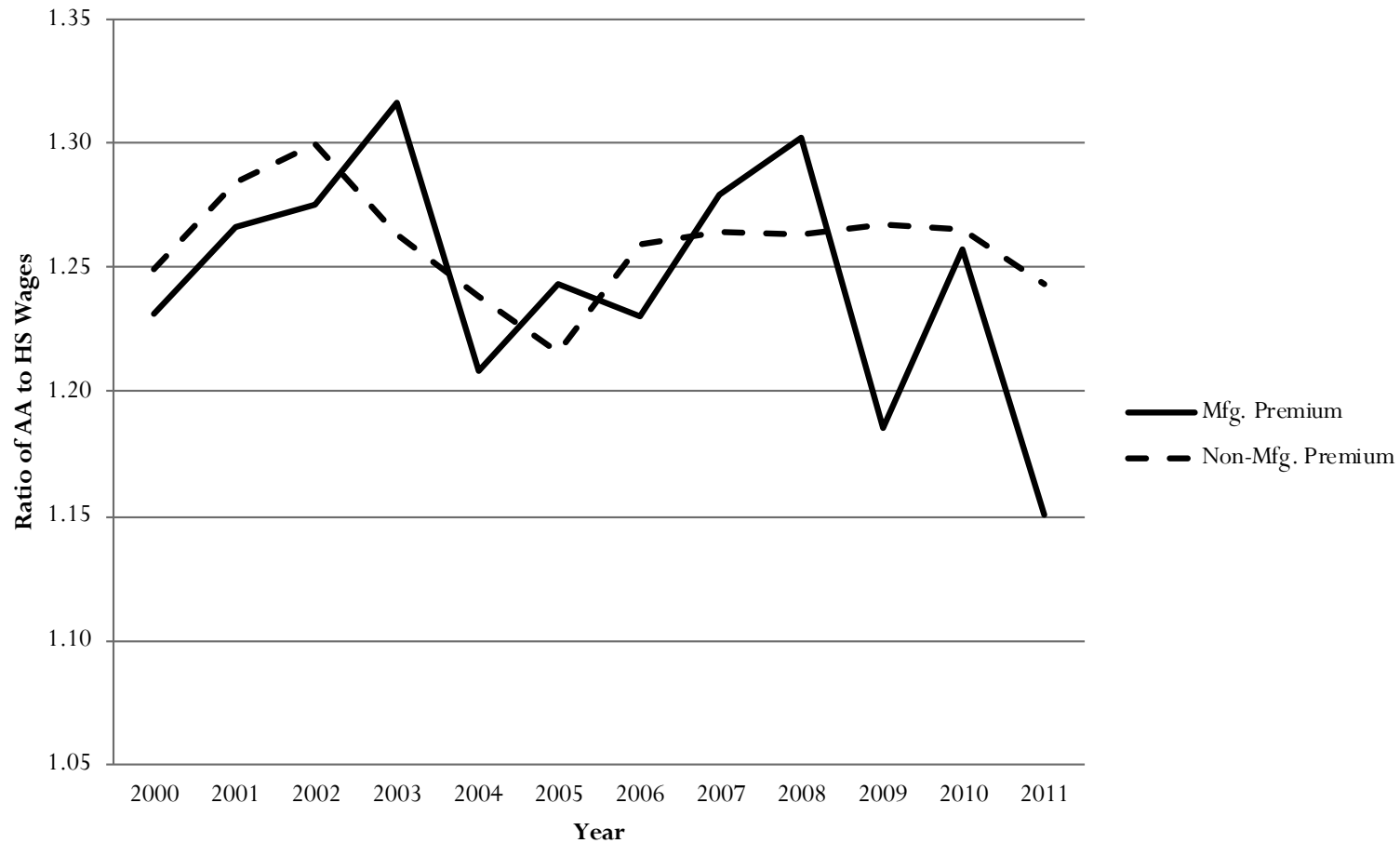
- No widespread problem with skill gaps in manufacturing
- It is worth paying attention to the minority of establishments reporting difficulties
- Skills are important
 - Extended math is key demand
 - Extended reading is surprisingly prominent
- High-tech estab. and computer skill demands are not associated with greater hiring difficulties
- Necessary to pay attention to interaction of demand and supply when raising skill levels
 - Skill gap formulation → too much emphasis on supply side
 - Points to policies that promote communication and coordination among disaggregated firms and external training institutions: intermediaries

Thank You

Andrew Weaver
aweaver5@Illinois.edu

Manufacturing Wage Trends

Community College Wage Premium by Industry Sector



Source: CPS MORG (NBER) data.

Occupational Wage Comparison

Average Hourly Wages by Selected Manufacturing

Occupations

	2008	2011	% change
Production occupations	15.87	16.74	5.5%
Machinists	18.17	19.51	7.4%
Industrial Engineering Technicians	22.89	24.42	6.7%
Mechanical Engineering Technicians	23.74	24.92	5.0%
Industrial Engineers	35.47	37.56	5.9%

Source: BLS Occupational Employment Statistics.

Interpersonal/Problem-Solving/Soft Skill Demands

Percent of Establishments Citing Interpersonal, Problem-Solving, and Other Soft Skills as Very or Moderately Important for Core Jobs

	Very Important	Very or Moderately Important
Cooperation with other employees	81.2%	99.3%
Ability to evaluate quality of output	71.0%	95.8%
Ability to take appropriate action if quality is not acceptable	76.3%	97.7%
Ability to work in teams	64.2%	91.1%
Ability to learn new skills	50.1%	89.3%
Ability to independently organize time or prioritize tasks	45.6%	84.4%
Ability to solve unfamiliar problems	38.8%	83.0%
Ability to critically evaluate different options	35.7%	74.1%
Ability to initiate new tasks without guidance from management	35.2%	80.9%

Long-Term Vacancies and Skill Indices

	(3) Any Long Vac.
Extended reading index	0.137*** (0.042)
Extended math index	0.120** (0.054)
Extended computer index	-0.092** (0.042)
Observations	846
Pseudo R-sq.	0.055

Potential Skill Gap Mechanisms

Mechanism	Variables
Simple cyclical story	County unemployment rate (BLS)
Temporary adjustment problem	Pct. growth in core workers (2 yrs.)
Not competitive: wages or globalization	Mfg. wage differential (QCEW) More foreign competition
Not competitive: internal HR practices	Preference for internal hiring TQM pct. Union Formal training hours
Supply-side frictions	Total county employment (QCEW) Community college—no resources Community college—no help

Potential Skill Gap Mechanisms (2)

Mechanism	Variables
Technology/Innovation	High-tech (BLS) Above avg. tech./capital equip. Frequent product innovation Frequent process innovation
Problems of communication / coordination / disaggregation <ul style="list-style-type: none">• Employer/CC comm. failure• Payoff / coord. failure• Many disagg. estab.	Industry cluster Work with industry cluster Presence of other labor mkt. institutions
Firm-specific skills/transition to new skill production system	Unique skill

Validation with CPS

	PIE	CPS (2012)
Hourly wage	16.95	16.49*
Union	18.1%	13.7%*
Female	26.7%	26.6%
Age 30 or less	20.6%	21.3%
Age 31-40	27.5%	22%*
Age 41-55	35.8%	38.8%*
Age 56 plus	16.1%	17.9%*

*=significant differences at 95 percent level or higher.

Supply-Demand Analysis with PIE & PIAAC Data

Demand

	Pct.	Data Source
Mfg. pct. of workforce	8.9%	2012 CES
Core worker pct. of estab. emp.	62.0%	PIE
Core wkr. pct. of workforce	5.5%	calculation
Core wkrs. with less than BA	93.5%	PIE
Non-BA core wkr. pct. of workforce	5.2%	calculation
PIE survey ext. math demand	38.0%	PIE
Demand for non-BA ext. math core wkrs.	2.0%	calculation

Supply

Pct. of adults with a BA or more	28.2%	2012 CPS
Pct. of BA+ adults with PIAAC level 3 skills (but no higher)	46.3%	2013 PIAAC & 2012 CPS
Pct. to subtract from level 3 supply to net out those with BA or more who have exactly level 3 skills	13.1%	calculation
Pct. of BA+ adults with PIAAC level 4-5 skills	27.1%	2013 PIAAC & 2012 CPS
Pct. to subtract from level 4-5 supply to net out those with BA or more with level 4-5 skills	7.7%	calculation
Total non-BA supply of level 3 and above	13.7%	calculation
Non-BA supply - demand	11.7%	calculation
Demand as pct. of supply	14.3%	calculation

Cluster Interactions

- Marg. effect of demanding:

	Ext. Reading		Ext. Math
<i>Non-cluster</i>	0.110*** (0.038)	<i>Non-cluster</i>	0.103** (0.047)
<i>Cluster</i>	0.118* (0.069)	<i>Cluster</i>	0.102* (0.052)

- Marg. effect of demanding unique skills

<i>Non-cluster</i>	0.114*** (0.044)
<i>Cluster</i>	0.037 (0.044)

- Marg. effect of adjustment to employment growth/decline:

<i>Non-cluster</i>	0.003 (0.022)
<i>Cluster</i>	0.130** (0.051)