The Demand for Older Workers: The Role Of Technology And Skill

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Demand for Older Workers and Technology

- Demand for older workers is “demand for composition of skills embodied in older workers”
- Some questions to answer along the way:
  - How does skill mix differ across older/younger workers?
  - How does technology differ across businesses with greater share of older workers?

Basic Approach

- Production relationship at firm level as function of skill composition for firm *j* with technology Z:

$$y_{jt} = F(Z_{jt}, L_{1jt}, ..., L_{Hjt})$$

- Treating Z as quasi-fixed, cost minimization (Shepherd's lemma) yields for workers of type s (where S is share of type s workers):

$$S_{sjt} = S(Z_{jt}, y_{jt}, w_{1jt} / w_{Hjt}, ..., w_{sjt} / w_{Hjt}, ...)$$

Joint Distribution of Skill and Age

- Aggregating across firms yields:

$$S_{st} = \sum_j (L_{jt} / L_t) S_{sjt}$$

- The accounting relationship between share of workers of age a (λ_{at}), the demand for type s workers, and the share of age a workers with type s skills (λ_{ast}), is given by:

$$\lambda_{at} = \sum_s \lambda_{ast} S_{st}$$

- We can characterize both the firm level relationships and the joint distribution:
  - The latter depends upon both supply and demand factors.

Theoretical Framework

- The general human capital of an employee is represented by *h,* which is estimated from the portable part of the individual's wage rate.
- The firm-specific part of the wage rate is used to model compensation design issues.
- The un-normalized distribution f*(h)* measures the firm's human capital choices.
- We estimate the normalized distribution of human capital, g(*h*).
- For details see Abowd, Lengermann and McKinney (2003).

Measuring of Human Capital: Estimation

$$\ln w_{it} = \theta_i + x_{it}\beta + \psi_{J(i,t)} + \varepsilon_{it}$$

- We use a decomposition of the log real annualized full-time, full-year wage rate (ln *w*) into person and firm effects.
- The person effect is *θ.*
- The firm effect is *ψ*, where J(*i,t*) is the employer of *i* at *t*.
- Continuous, time-varying effects are in *xβ*, where some of the *x* variables are human capital measures (labor force experience) and some correct for differential quality in our measure of full-time, full-year wage rate.

Human Capital: Individual Measure

$$\hat{h}_{it} = \hat{\theta}_i + \text{labor force experience part of } x_{it}\hat{\beta}$$

- Individual human capital*, h,* is the part associated with the person effect and the measurable time-varying personal characteristics (labor force experience).
- Our human capital measure is not a simple ranking by wage rate because of the removal of the firm effect and residual.
- In what follows, we exploit overall h but also components.
- Firm human capital measures, *H*, are based on statistics computed from the distribution of g(*h*).

Data: Workforce Composition

- Two time periods: 1992 and 1997
- LEHD infrastructure dataset for three states
- Human capital measure: overall h
- Create shares of workforce in each skill quartile (1992 base)
- Linked to businesses at the pseudo-establishment level
- Summarized by kernel density estimate for each time period at each establishment

Data: Technology Measures

- Physical capital intensity (capital per worker) 1992/1997 ASM, 1992 BES
- Expenditures on computer investment as a fraction of total equipment investment, 1992 ASM/BES
- Ratio of inventories to sales 1992/1997 ASM/BES
- Ratio of purchases of computer software to sales 1992/1997 ASM/BES
- Two principal components of technology measures estimated for 1992
  - First component increases in each type of IT investment
  - Second component is increasing in software and decreasing in hardware
- Firm effect

Data: Selection Equation

- Log labor productivity (Sales/Employment)
- Log change in population of the county in which the business is located between 1992 and 1997
- Log change in sales in the two digit SIC industry in that county between 1992 and 1997
- Establishment size, location, legal form of organization (business)

Key Findings on Technology and Demand for Skills

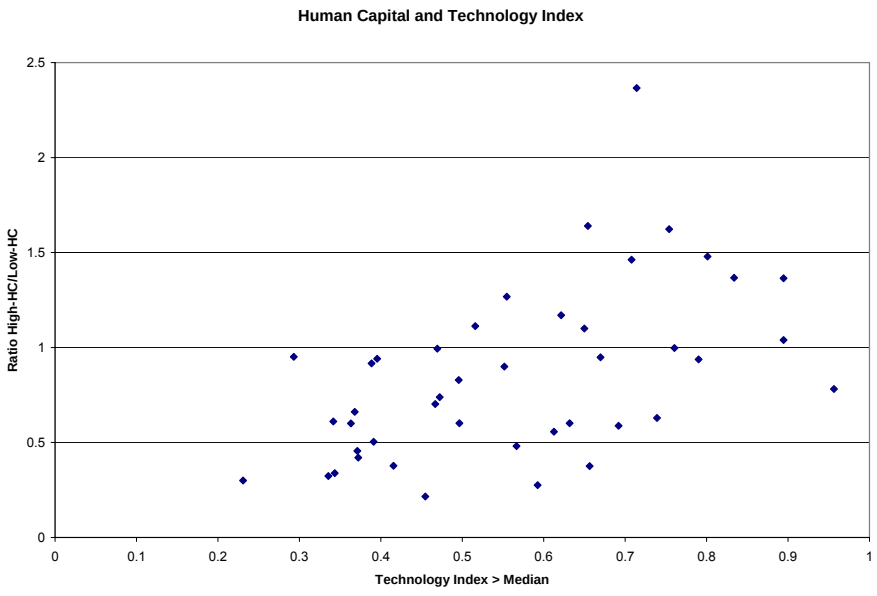
- Technology principal component implies higher *h*
- Software relative to hardware component implies mixed effects on h, generally favors lower *h*
- Higher capital intensity implies higher *h*
- Higher inventory/sales implies higher *h*
- Higher firm effect implies higher *h*
- Higher probability of surviving (selection control) implies higher *h*
- All of above controls for establishment age, output of firm (scale) and local county relative wages

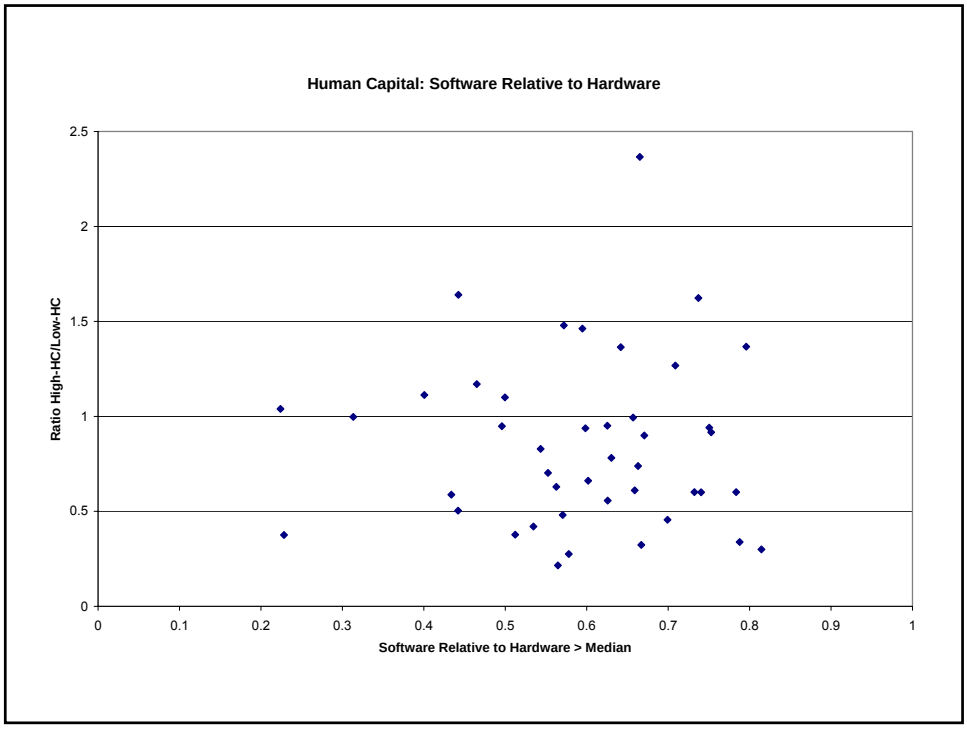
Demand Estimation Results

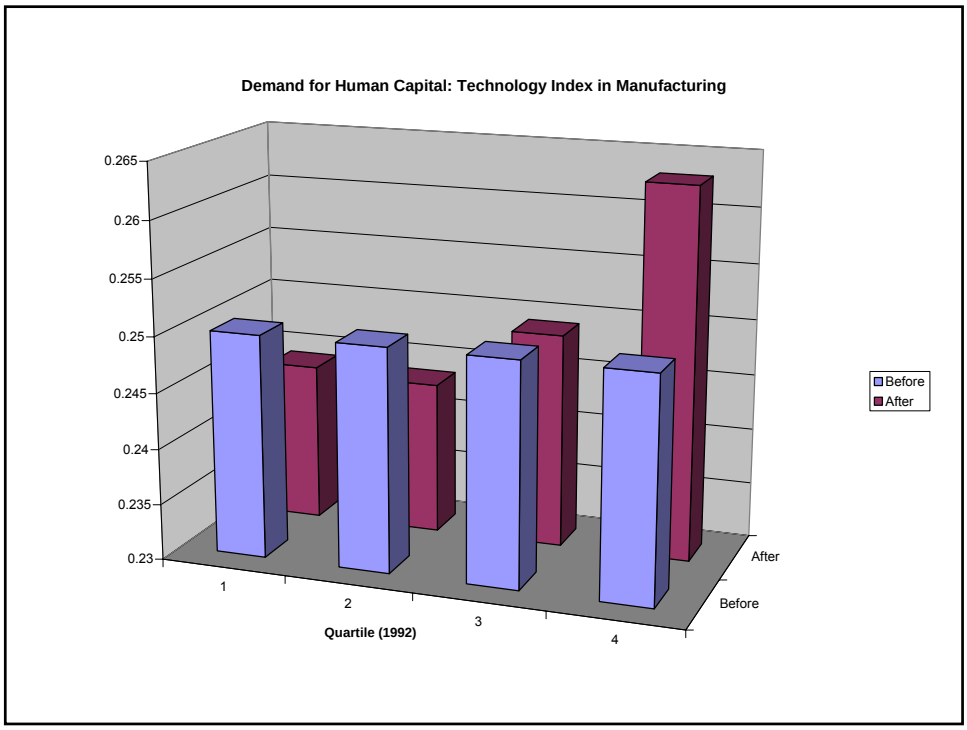
labelname	vartype	first_quartile_asm	first_quartile_bes	second_quartile_asm	second_quartile_bes	third_quartile_asm	third_quartile_bes	fourth_quartile_asm	fourth_quartile_bes
Technology Index	param	-0.0098	-0.0468	-0.0109	-0.0075	0.0003	0.0161	0.0282	0.0374
Technology Index	std. err.	0.0077	0.0066	0.0055	0.0039	0.0060	0.0039	0.0082	0.0063
Software Relative to Hardware	param	0.0062	0.0062	0.0007	0.0046	0.0006	-0.0110	-0.0022	0.0018
Software Relative to Hard	std. err.	0.0050	0.0057	0.0036	0.0034	0.0039	0.0034	0.0053	0.0055
Capital Intensity	param	-0.0533	-0.0076	-0.0142	-0.0009	0.0281	0.0014	0.0366	0.0075
Capital Intensity	std. err.	0.0034	0.0041	0.0024	0.0024	0.0026	0.0024	0.0036	0.0039
Inventory/Sales	param	-0.0406	-0.0905	-0.0039	0.0186	-0.0101	0.0699	0.0282	0.0029
Inventory/Sales	std. err.	0.0043	0.0047	0.0031	0.0028	0.0033	0.0028	0.0046	0.0045
Mills Ratio	param	-0.0146	-0.0091	-0.0001	0.0014	0.0015	0.0021	0.0172	0.0055
Mills Ratio	std. err.	0.0073	0.0113	0.0053	0.0067	0.0057	0.0068	0.0078	0.0108
psi	param	-0.1350	-0.2298	0.0490	-0.0011	0.1103	0.1010	0.0116	0.1403
psi	std. err.	0.0292	0.0176	0.0122	0.0051	0.0128	0.0053	0.0378	0.0193

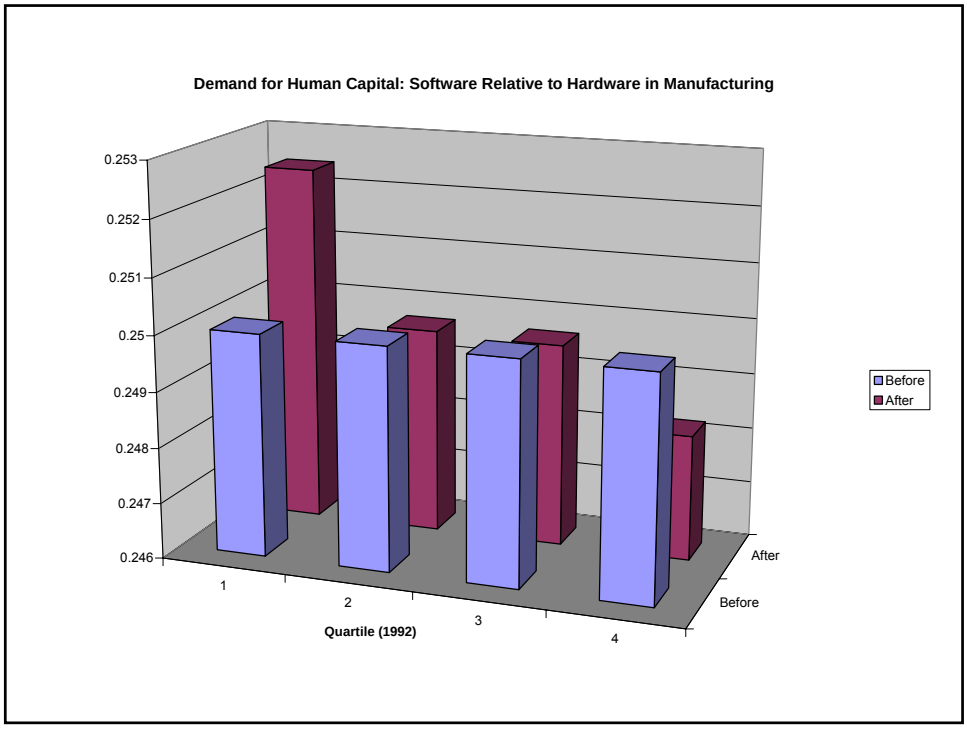
Explanation of Graphs

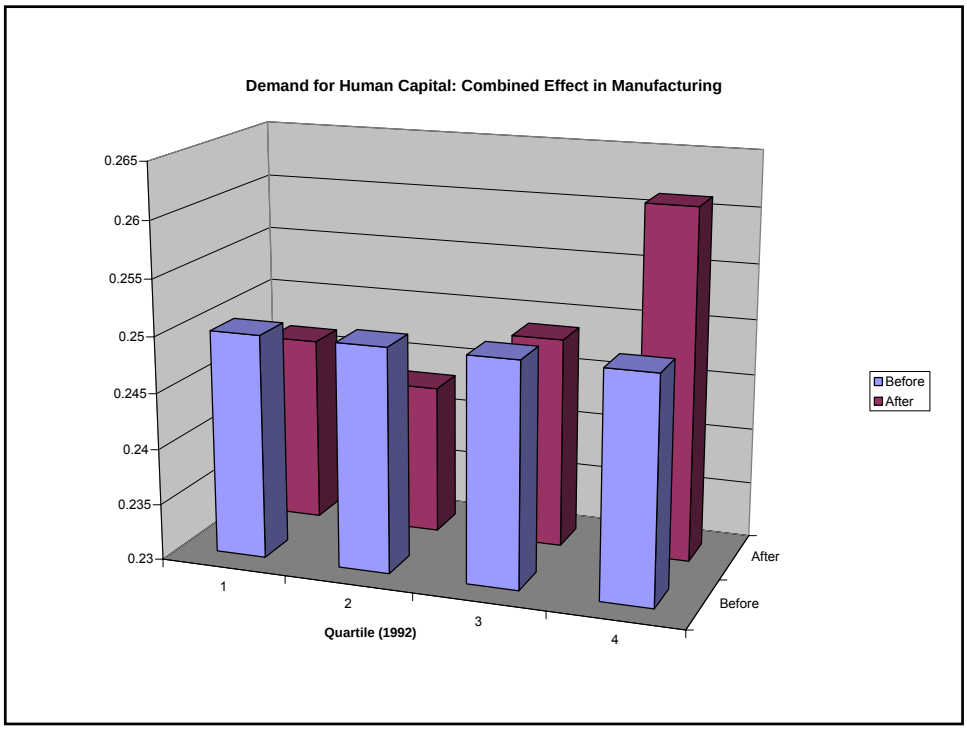
- Scatter plots by 2-digit industry (1992)
  - X-axis: proportion of individuals in industry who work at an establishment above median for the technology variable
  - Y-axis: (Proportion Human Capital > median) / (Proportion Human Capital < median)
- Human capital demand distributions
  - Effect of one standard deviation increase in the two technology components

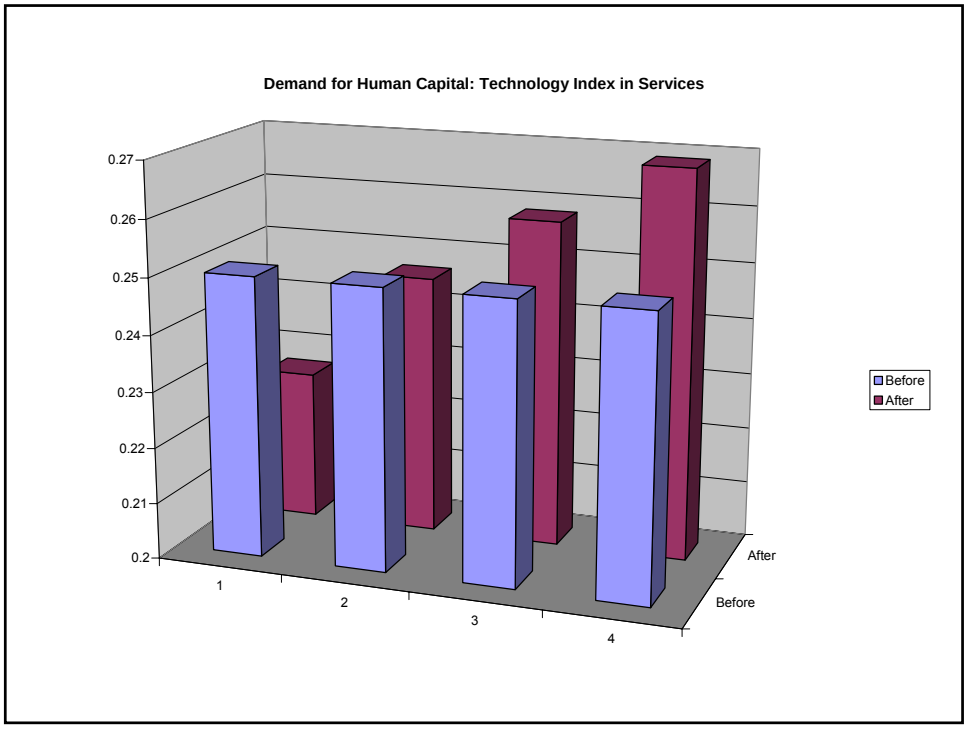


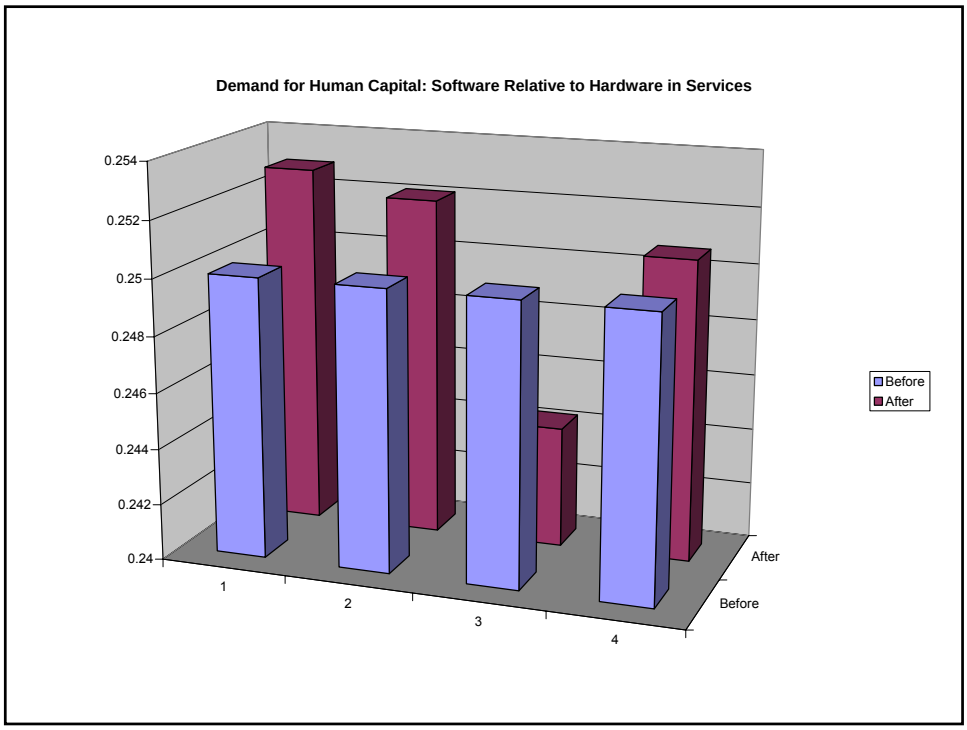

Human Capital: Software Relative to Hardware
Ratio High-HC/Low-HC
2.5
2
1.5
1
0.5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Software Relative to Hardware > Median

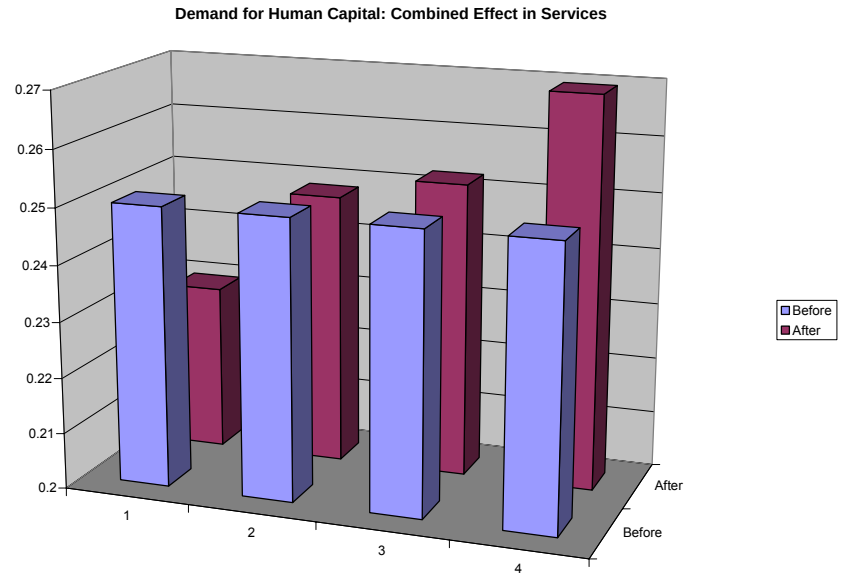

Demand for Human Capital: Technology Index in Manufacturing
0.265
0.26
0.255
0.25
0.245
0.24
0.235
0.23
1
2
3
4
Quartile (1992)
After
Before
Before
After


Demand for Human Capital: Software Relative to Hardware in Manufacturing
0.253
0.252
0.251
0.25
0.249
0.248
0.247
0.246
1
2
3
4
Quartile (1992)
After
Before
Before
After


Demand for Human Capital: Combined Effect in Manufacturing
0.265
0.26
0.255
0.25
0.245
0.24
0.235
0.23
1
2
3
4
Quartile (1992)
After
Before
Before
After


Demand for Human Capital: Technology Index in Services
0.27
0.26
0.25
0.24
0.23
0.22
0.21
0.2
1
2
3
4
After
Before
Before
After


Demand for Human Capital: Software Relative to Hardware in Services
0.254
0.252
0.25
0.248
0.246
0.244
0.242
0.24
1
2
3
4
After
Before
Before
After



Older Workers in Our Data

- Workers age 50+ account for about 17 percent of sample employment in 1992 and 18 percent in 1997.
- 10 percent of workers are at firms with no older workers in 1992 and about 9 percent of workers are at firms with no older workers in 1997
  - This percent varies substantially across industries with more than 25 percent of workers in personal services or misc. repair services working at a firm with no older workers.
  - The zero older worker firms pose an interesting measurement/estimation challenge given non-trivial fraction of zeroes.

Older Workers and Skill Mix

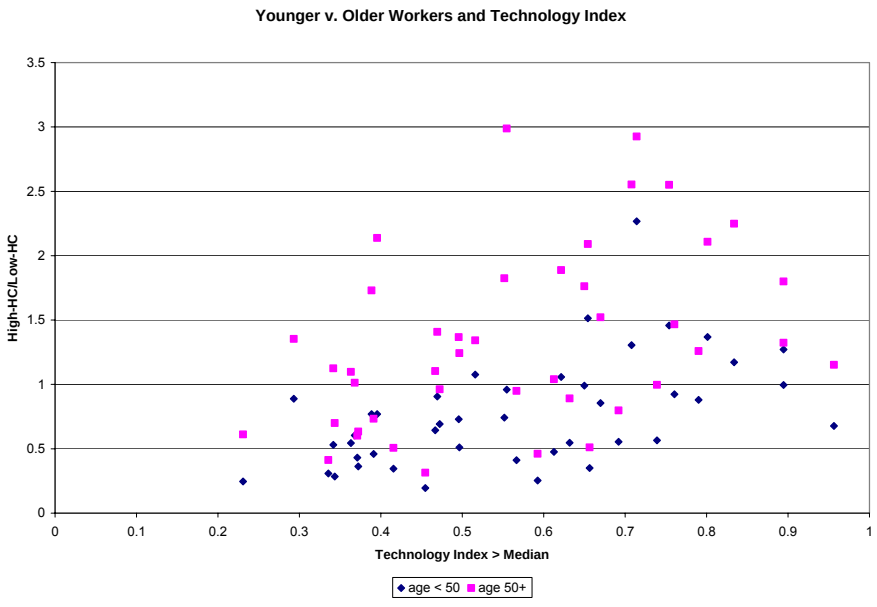
- Older workers have higher measured *h*
  - In 1992, 56% of older workers above median *h* (1992 based median) and 44% of younger workers above median *h*
  - In 1997, 66% of older workers above median *h* (1992 based median) and 54% of younger workers above median h
  - Older workers have higher *h* in every 2-digit industry but gap varies considerably:
    - Relatively high gap in air transportation (SIC 45)
    - Relatively low in legal services (SIC 81)
    - Gap in 1997 in SIC 45 is 24% and 6% in SIC 81

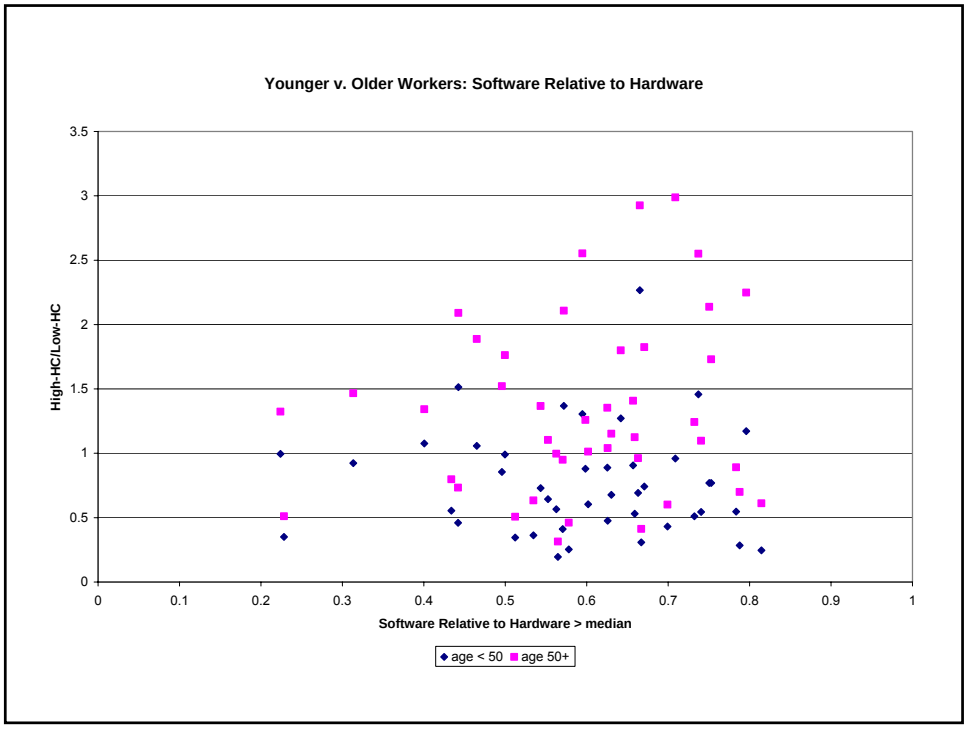
Older Workers and Technology

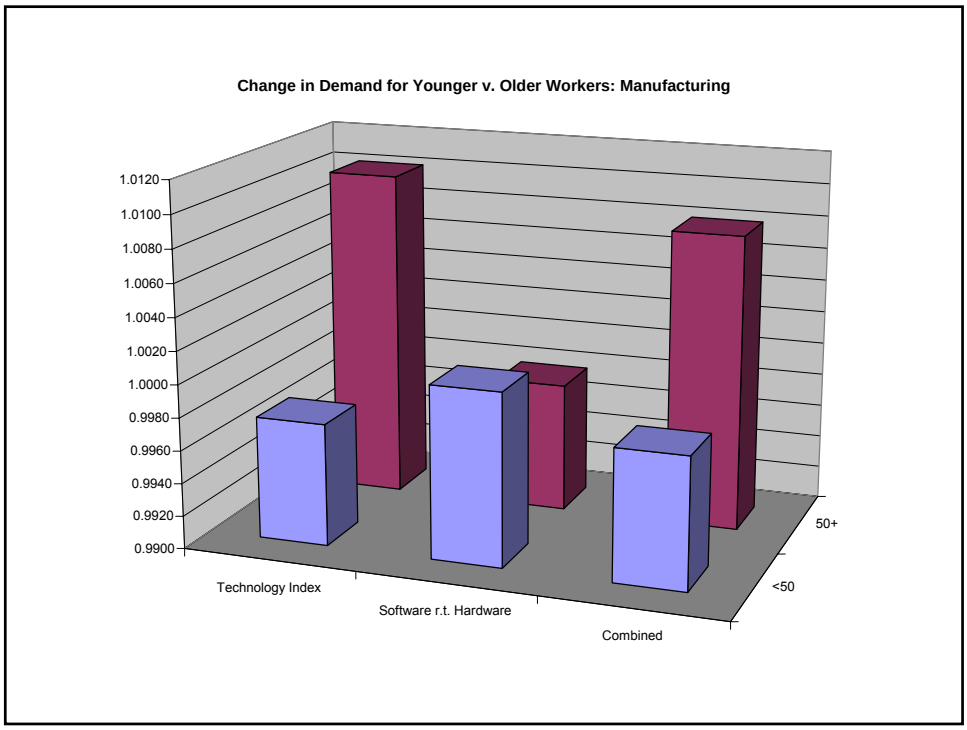
- Workers at businesses with at least some older workers have:
  - Greater computer intensity (58% of workers at businesses with at least one older worker have computer intensity above median in 1992 vs. 47% for workers with no older co-workers)
  - Greater software intensity (45% of workers at “older co-worker” businesses have software intensity above median vs. 25% for workers with no older co-workers)
  - Greater capital intensity (51% above median for older coworker businesses vs. 43%)

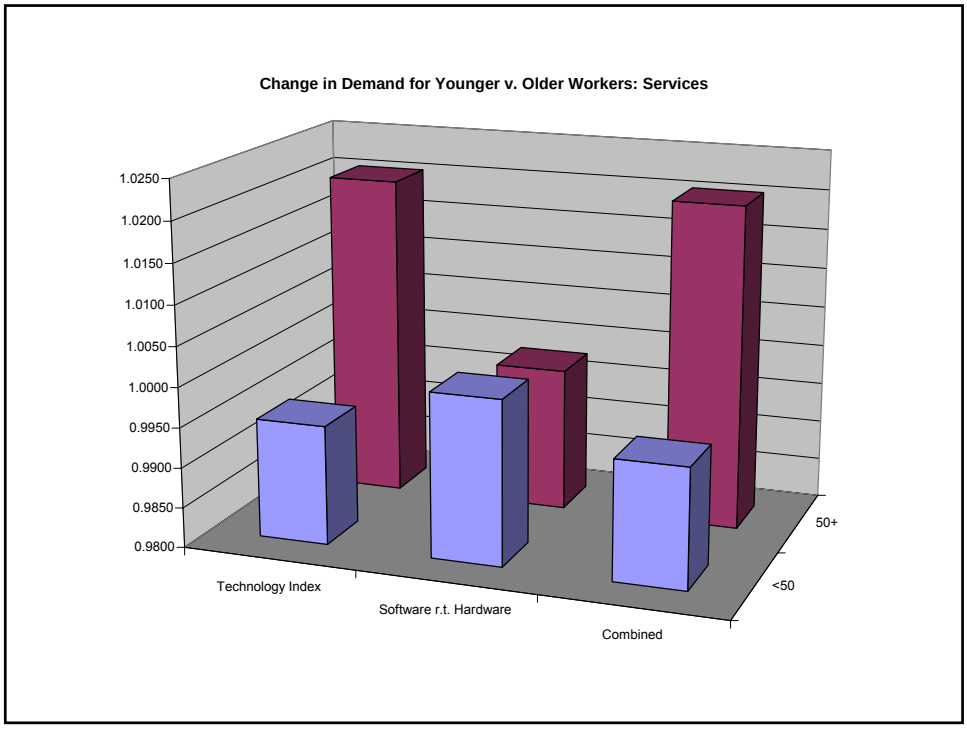
Older Workers and Technology: Industry Variation

- These patterns vary greatly by industries:
  - Industries where workers with zero older coworkers are more computer intensive include:
    - Textile Mills (22), Transportation equipment (37), Instruments (38), Furniture and Equipment Stores (57)
  - Industries where workers with zero older coworkers are more software intensive include:
    - Chemicals (28), Instruments (37), Furniture and Equipment Stores (57), Business services (73)
  - Industries where workers with zero older coworkers are more capital intensive include:
    - Chemicals (28), Instruments (38), Business Services (73)




Younger v. Older Workers: Software Relative to Hardware
High-HC/Low-HC
3.5
3
2.5
2
1.5
1
0.5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Software Relative to Hardware > median
age < 50
age 50+


Change in Demand for Younger v. Older Workers: Manufacturing
1.0120
1.0100
1.0080
1.0060
1.0040
1.0020
1.0000
0.9980
0.9960
0.9940
0.9920
0.9900
Technology Index
Software r.t. Hardware
Combined
50+
<50


Change in Demand for Younger v. Older Workers: Services
1.0250
1.0200
1.0150
1.0100
1.0050
1.0000
0.9950
0.9900
0.9850
0.9800
Technology Index
Software r.t. Hardware
Combined
50+
<50