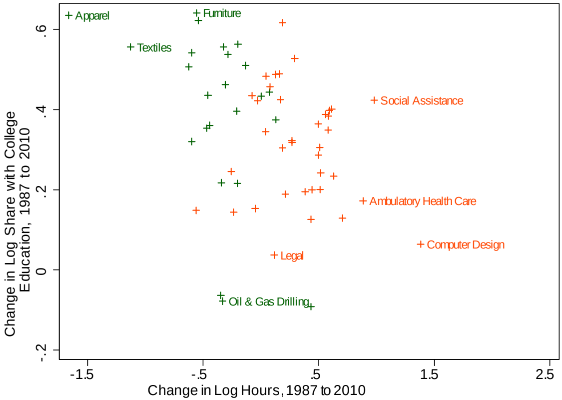
Notes on Young (2015) "Structural Transformation, the Mismeasurement of Productivity Growth, and the Cost Disease of Services"

- Industries' productivities grow at different rates
  - Relative price of services vs. goods increased by 0.8pp each year.
  - If goods and services are complements in consumption$\longrightarrow$ labor demand for services increases
- As expanding sectors' hire additional workers, average worker quality declines
  - Causes measured TFP to decline..

Papers like Ngai and Pissarides focus on the first bullet point. Young focuses on the second.

Proof of concept

Negative Correlation between Industry Growth & Change in Observed Worker Quality



- What about unobserved worker characteristics?

Outline

- Measuring productivity growth
  - Motivating model for why worker quality might decline with industry size.
  - Implications for productivity growth between goods & services.
- Estimating ξ

Workers choose sectors according to their comparative advantage

- Each worker has efficiency levels z_G and z_S in producing in goods/services.
  - Let u index workers
- Each sector offers w_i as the wage per efficiency unit.
- The set of workers working in G are

$$\text{Set}_G = \{u | w_G z_G(u) > w_S z_S(u)\}$$

  - Let π_G denote G's share of workers
- Average efficiency in sector G is

$$\bar{z}_G = \frac{\int_{u \in \text{Set}_G} z_G(u)\, du}{\int_{u \in \text{Set}_G} du} = \frac{\int_{u \in \text{Set}_G} z_G(u)\, du}{L \pi_i}$$

Measured productivity

- Key parameter, elasticity of worker efficiency with industry size:
$$\xi \equiv \frac{d\bar{z}_i}{d\pi_i}\frac{\pi_i}{\bar{z}_i}$$
- Each industry i produces using capital and (effective) labor

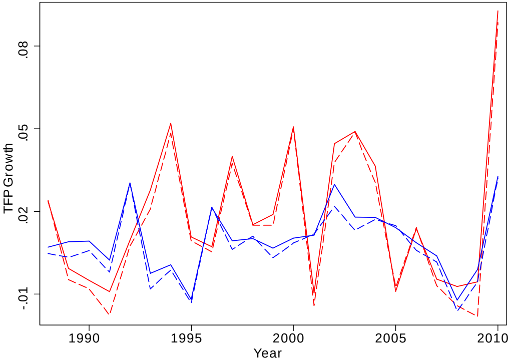
$$Q_i = A_i F_i \left(K_i, L_i \bar{z}_i\right)$$

- Effective labor is the product of hours L_i and (unobserved) average worker efficacy $\bar{z}_i$
- Taking a log-linear approximation (then using the definition of ξ)

$$\begin{aligned}\hat{A}_i &= \hat{Q}_i - \Theta_{K_i}\hat{K}_i - \Theta_{L_i}\hat{L}_i - \Theta_{L_i}\widehat{\bar{z}}_i \\ &= \hat{Q}_i - \Theta_{K_i}\hat{K}_i - \Theta_{L_i}\hat{L}_i - \xi\Theta_{L_i}\hat{\pi}_i\end{aligned}$$

None of what is on this slide depends on why $\bar{z}$ responds to π.

Measured productivity growth



- Difference in TFP growth: 0.94 pp, 0.85 pp when accounting for workers' observable characteristics (sex, age group, education category).

Implications for productivity growth

$$\hat{A}_i\,(\text{true}) - \hat{A}_i\,(\text{est})$$
$$= -\xi \sum_j \underbrace{\Theta^j_{Li}}_{\text{cost share of type j workers}} \times \underbrace{\hat{\pi}^j_i}_{\text{change in industry i share of type j}}$$

ξ	Goods	Services	Aggregate
0.00	1.57	0.73	0.97
-0.25	1.34	0.78	0.94
-0.50	1.10	0.84	0.91
-0.75	0.87	0.90	0.88
-1.00	0.64	0.95	0.85

- Task for the rest of the paper: estimate ξ.

Empirical specification

$$\underbrace{Y_{ict}}_{\text{tfp growth}} = \alpha_{ic} + \delta_{ct} + \gamma_{ic}\hat{U}_{ct} + \xi \cdot X_{ict} + \varepsilon_{ict}$$

$$\underbrace{X_{ict}}_{\text{change in labor share}} = \alpha^X_{ic} + \delta^X_{ct} + \gamma^X_{ic}\hat{U}_{ct} + \beta_{ic} \underbrace{\hat{Z}_{ct}}_{\Delta \text{ in military spending, or other instrument}} + \eta_{ict}$$

Idea: Wars (or other events that shift military spending)

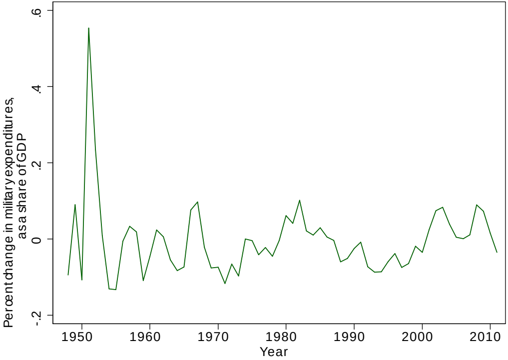
1. Affect labor demand, differentially across industries
2. Do not directly impact tfp growth

Industries' exposure to federal spending differs greatly

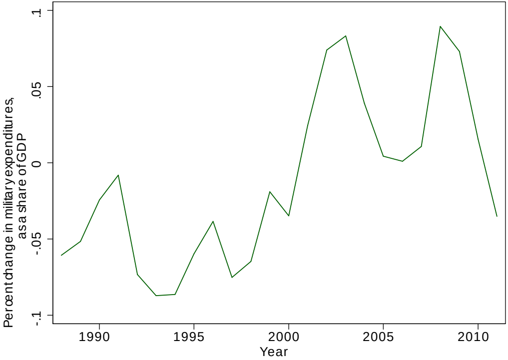
Industry	Sales Share	Industry	Sales Share
Agriculture	0.0%	Other transport	13.9%
Textiles	0.0%	Motor vehicles	2.9%
Chemicals	0.0%	F.I.R.E.	2.4%
Lumber	0.0%	Construction	2.2%
Paper	0.0%	Electrical machinery	1.1%

Note: These figures are taken from the 1997 IO Table, using a slightly different industry classification from what is given in Young (2015).

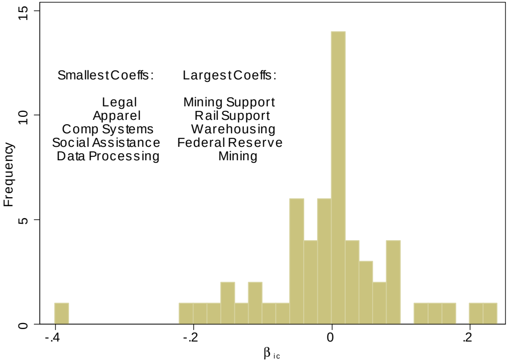
Changes in military spending



Changes in military spending

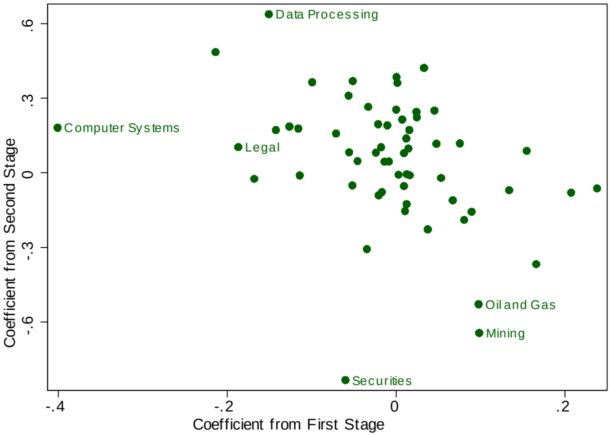


First-stage estimates



$$\underbrace{X_{ict}}_{\Delta \text{ lab. share}} = \alpha^X_{ic} + \delta^X_{ct} + \gamma^X_{ic}\hat{U}_{ct} + \beta_{ic} \cdot \underbrace{\hat{Z}_{ct}}_{\Delta \text{ military spending}} + \eta_{ict}$$

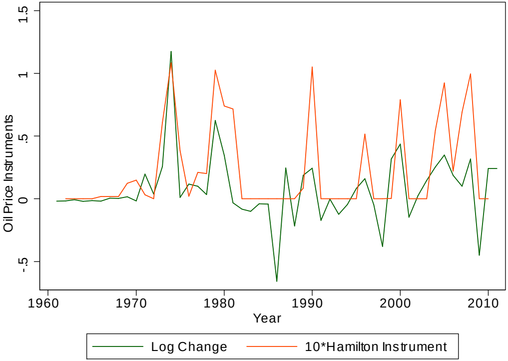
First-stage and second stage estimates



$$1^{\text{st}} \text{ stage: } X_{ict} = \alpha^X_{ic} + \delta^X_{ct} + \gamma^X_{ic} \hat{U}_{ct} + \beta_{ic} \cdot \hat{Z}_{ct} + \eta_{ict}$$

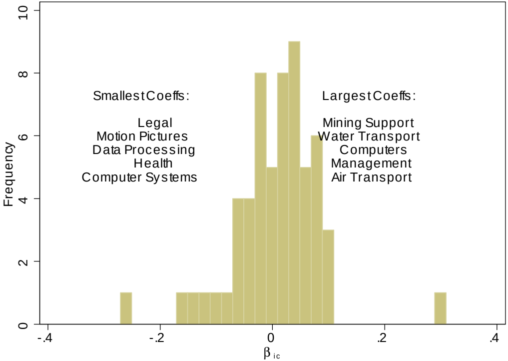
$$2^{\text{nd}} \text{ stage: } Y_{ict} = \alpha_{ic} + \delta_{ct} + \gamma_{ic} \hat{U}_{ct} + \gamma_{ic} \cdot \hat{Z}_{ct} + \varepsilon_{ict}$$

Other instruments: Oil Prices



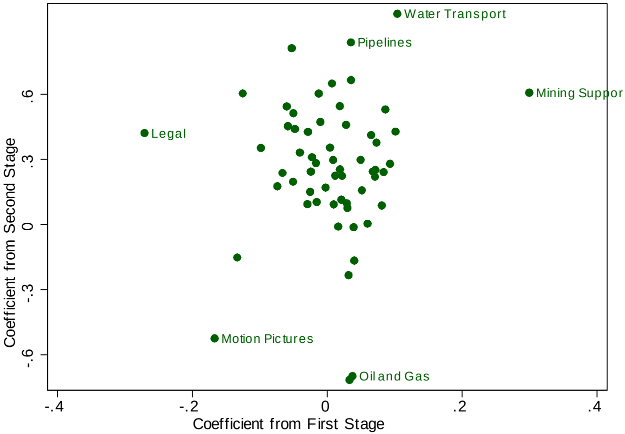
- Hamilton (2003) Instrument:
$$\max\left\{0, \log \frac{\text{max oil price in quarter } t}{\text{max oil price in quarters } t-12 \text{ to } t-1}\right\}$$

First-stage estimates



$$\underbrace{X_{ict}}_{\Delta \text{ lab. share}} = \alpha^X_{ic} + \delta^X_{ct} + \gamma^X_{ic}\hat{U}_{ct} + \beta_{ic} \cdot \underbrace{\hat{Z}_{ct}}_{\text{Oil Price Maximum}} + \eta_{ict}$$

First-stage and second stage estimates



$$1^{\text{st}} \text{ stage: } X_{ict} = \alpha^X_{ic} + \delta^X_{ct} + \gamma^X_{ic} \hat{U}_{ct} + \beta_{ic} \cdot \hat{Z}_{ct} + \eta_{ict}$$

$$2^{\text{nd}} \text{ stage: } Y_{ict} = \alpha_{ic} + \delta_{ct} + \gamma_{ic} \hat{U}_{ct} + \gamma_{ic} \cdot \hat{Z}_{ct} + \varepsilon_{ict}$$

OLS & IV Industry estimates vary quite a bit

Benchmark

	OLS	Δ Defense Spending	Δ Metals Prices	Oil Price Maximum
ξ	-0.22	-0.92	-0.55	0.37
(s.e)	0.11	0.27	0.32	0.38
F-test p.val		0.00	0.00	0.01

Dropping the $\hat{U}_{ct}$ terms

	OLS	Δ Defense Spending	Δ Metals Prices	Oil Price Maximum
ξ	-0.17	-0.36	-0.24	0.36
(s.e)	0.10	0.22	0.45	0.40
F-test p.val		0.00	0.44	0.03

Lessons

1. Productivity is, many times, taken to be an exogeneous process.
   Example: Basu (1996)
   1.1 (Conventionally measured) productivity is highly procyclical and volatile (perhaps implausibly so).
   1.2 Is this (partly) due to procyclical utilization?
   1.3 How to measure changes in utilization?
2. (Industry-specific) factor supply curves slope up.
   Example: Goolsbee (1997, 1998)
   2.1 Physical capital (Scientists' labor) supply is not perfectly elastic
   2.2 Subsidies to investment (R&D) lead to higher investment prices (scientists' wages)
   2.3 Conventional measures of societal value investment (R&D) subsidies may be too high