Reallocation and Technology: Evidence From the U.S. Steel Industry

Allan Collard-Wexler and Jan De Loecker

Presented by: Ricardo Miranda

October 25, 2022

Contents

1. Introduction
2. Measuring productivity
3. Reallocation and Adaptation
4. Entry and Exit
5. Conclusion

Introduction

How does technology adoption increases productivity?

The *direct* effect is to expand the frontier of production possibilities.

However, thinking as economists we can think of other mechanisms such as:

- Technology adoption has an effect on competition.
- Technology might change the players in the market.
- Firms with old technology adapt.

Additionally, the observed changes could potentially be attributed to other factors such as trade or management practices.

Setting: Mini mills (MM), a new techonology that substitutes electric furnaces used by vertically integrated (VI) firms.

Measuring productivity

How to measure productivity?

The authors have data on output, inputs (labor L, capital K and intermediate inputs M), sales s and prices P. This poses three challenges:

1. How are inputs allocated across products?
2. Attenuation and simultaneity bias.
3. Productivity is the *unobserved* part of the production process.

Deflating inputs and assuming that they are allocated proportionally to sales:

$$\frac{R_{it}}{\sum_j s_{ijt} P_{jt}} = L_{it}^{\alpha_l} K_{it}^{\alpha_k} M_{it}^{\alpha_m} exp(\omega_{it}) \tag{1}$$

Then, assuming Cobb-Doublas production:

$$\tilde{q}_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \omega_{it} + \epsilon_{it} \tag{2}$$

- MM are more productive.
- This productivity premium decreases over time

Dep Variable	Panel A: Output Deflated by Steel Price Index			Panel B: Output Deflated by Product Prices			Panel C: Output Deflated by Product and Material Prices		
	I	II	III(GMM)	IV	V	VI (GMM)	VII	VIII	IX (GMM)
Labor	0.329	0.326	0.266	0.326	0.324	0.261	0.332	0.327	0.264
	(0.013)	(0.013)	(0.024)	(0.013)	(0.010)	(0.036)	(0.027)	(0.027)	(0.073)
Materials	0.613	0.616	0.658	0.632	0.634	0.683	0.610	0.631	0.673
	(0.011)	(0.011)	(0.031)	(0.010)	(0.011)	(0.038)	(0.034)	(0.034)	(0.053)
Capital	0.054	0.055	0.093	0.054	0.055	0.091	0.051	0.050	0.086
	(0.009)	(0.009)	(0.020)	(0.009)	(0.009)	(0.020)	(0.034)	(0.033)	(0.021)
VI (alone)	-0.028		-0.080	-0.062		-0.111	0.013		-0.063
	(0.017)		(0.037)	(0.017)		(0.039)	(0.012)		(0.024)
VI		-0.098	-0.198		-0.124	-0.246		-0.012	-0.076
		(0.031)	(0.074)		(0.031)	(0.077)		(0.016)	(0.030)
VI		0.003	0.006		0.003	0.006		0.000	0.001
× Year		(0.001)	(0.003)		(0.001)	(0.003)		(0.000)	(0.000)
Year FE	X	X		X	X		X	X	

What happens to overall industry productivity over time?

Reallocation and Adaptation

Frame Title

Olin-Pakes decomposition (efficient firms should have larger market shares):

$$\Omega_t = \bar{\omega}_t + \sum_i (w_{it} - \bar{\omega}_t)(s_{it} - \bar{s}_t) = \bar{\omega}_t + \Gamma^{OP} \tag{3}$$

Assuming MM and VI have the same share:

$$\Omega_t = \bar{\Omega}_t + \sum_{\psi \in \{MM, VI\}} (s_t(\phi) - \frac{1}{2})(\Omega_t(\phi) - \bar{\Omega}_t) = \bar{\Omega}_t + \Gamma_t^B \tag{4}$$

Decomposing $\bar{\Omega}_t$ across firm types we get:

$$\Omega_t = \underbrace{\frac{1}{2} \sum_{\psi \in \{MM, VI\}} \bar{\omega}_t(\psi)}_{\textit{Average productivity}} + \underbrace{\frac{1}{2} \sum_{\psi \in \{MM, VI\}} \Gamma^{OP}(\psi)}_{\textit{Covariance output-productivity}} + \underbrace{\Gamma_t^B}_{\textit{reallocation}} \tag{5}$$

- Increase in average productivity.
- Reallocation toward more productive plants.

Aggregate TFP $\Delta\Omega$	23.0%
Olley-Pakes Decomposition:	
Unweighted Average: $\Delta\overline{\omega}$	15.5% (0.67)
Covariance: $\Delta\Gamma^{OP}$	7.5% (0.33)

- Displacement of VIs

Between Decomposition:	
Unweighted Average: $\Delta\overline{\overline{\Omega}}$	16.8 % (0.73)
Between Covariance: $\Delta\Gamma^{B}$	6.3 % (0.27)

- *Catching up*

Within Decomposition:	Minimills	Integrated
Aggregate TFP: $\Delta\Omega(\psi)$	10.0%	23.6%
Unweighted Average: $\Delta\overline{\omega}(\psi)$	4.8% (0.48)	18.3% (0.78)
Within Covariance: $\Delta\Gamma^{OP}(\psi)$	5.2% (0.52)	5.3% (0.22)

Entry and Exit

Dynamic decomposition

$$\Delta\hat{\omega}_t = \underbrace{\sum_{\mathcal{A}} s_{it-1}\Delta\omega_{it}}_{\textit{Plant improvement}} + \underbrace{\sum_{\mathcal{A}} \Delta s_{it}\omega_{it-1} + \sum_{\mathcal{A}} \Delta s_{it}\Delta\omega_{it-1}}_{\textit{Reallocation}} + \underbrace{\sum_{\mathcal{B}} s_{it-1}\omega_{it-1}}_{Entry} + \underbrace{\sum_{\mathcal{C}} s_{it-1}\omega_{it-1}}_{Exit} \tag{6}$$

Component	All	Minimill	Integrated
Total Change	23.0%	10.0%	23.6%
		(0.21)	(0.52)
Plant Improvement	10.2%	14.7%	10.2%
		(0.23)	(0.17)
Reallocation	10.6%	-1.5%	11.8%
		(-0.1)	(0.25)
Net Entry	3.9%	-0.8%	3.9%
		(0.0)	(0.10)
Entry-Exit Premium		0.0%	4.4%

Conclusion

Conclusion

Research findings

- Direct effect
- Reallocation
- Competition
- Catching up

Concerns:

- Management and region effects. Addressed
- Trade liberalization. Addressed but constrained by data.

Research lesson:

- Measuring and thinking carefully about the data can be very powerful.