Learning by Doing: Who's Learning, Who's Doing? and Other Production Function Myths

Santiago Gangotena[1] Ryan Safner[2]

[1]Department of Economics
George Mason University

[2]Department of Economics and Business Administration
Hood College

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Outline

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Motivation

- "New Economics" of Increasing Returns to Scale (IRS)
  - Endogenous growth theory (e.g. Romer 1986)
  - Complexity (e.g. Arthur 1989)
  - New Trade Theory (e.g. Krugman 1979)

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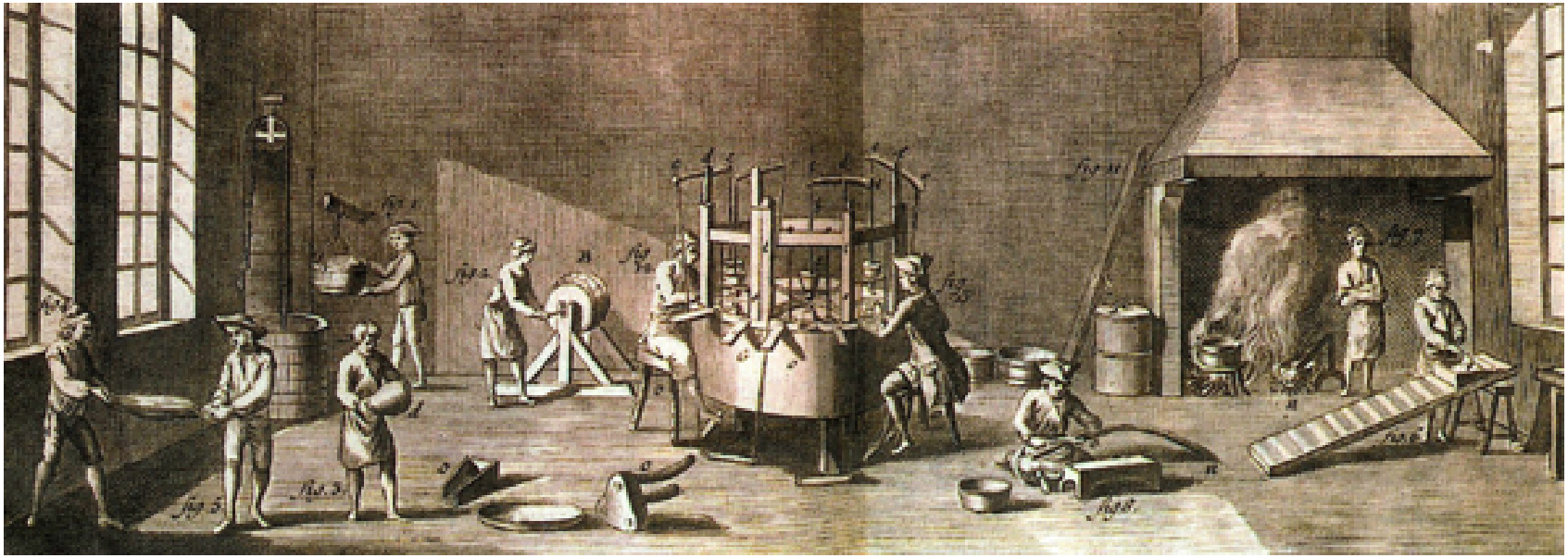
- "Learning by doing" and "knowledge spillovers"
- Justifications for protectionist industrial & trade policies (sophisticated "infant industries" argument)

Intellectual History



- Adam Smith's pin factory

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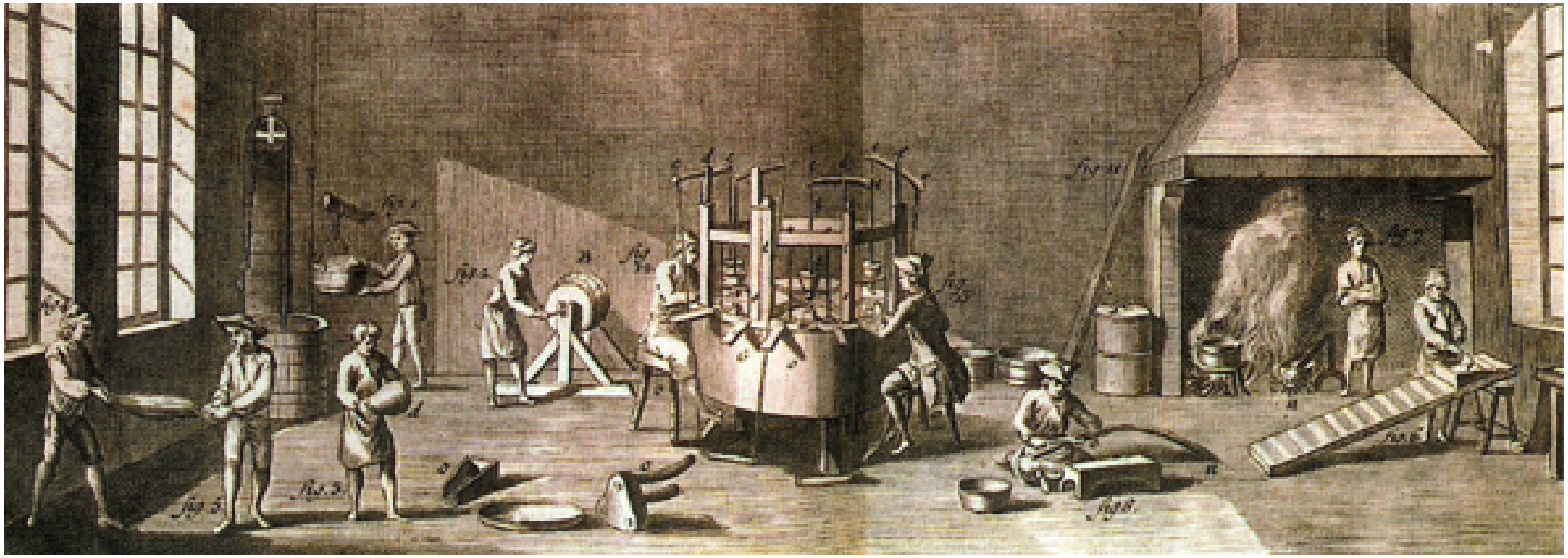

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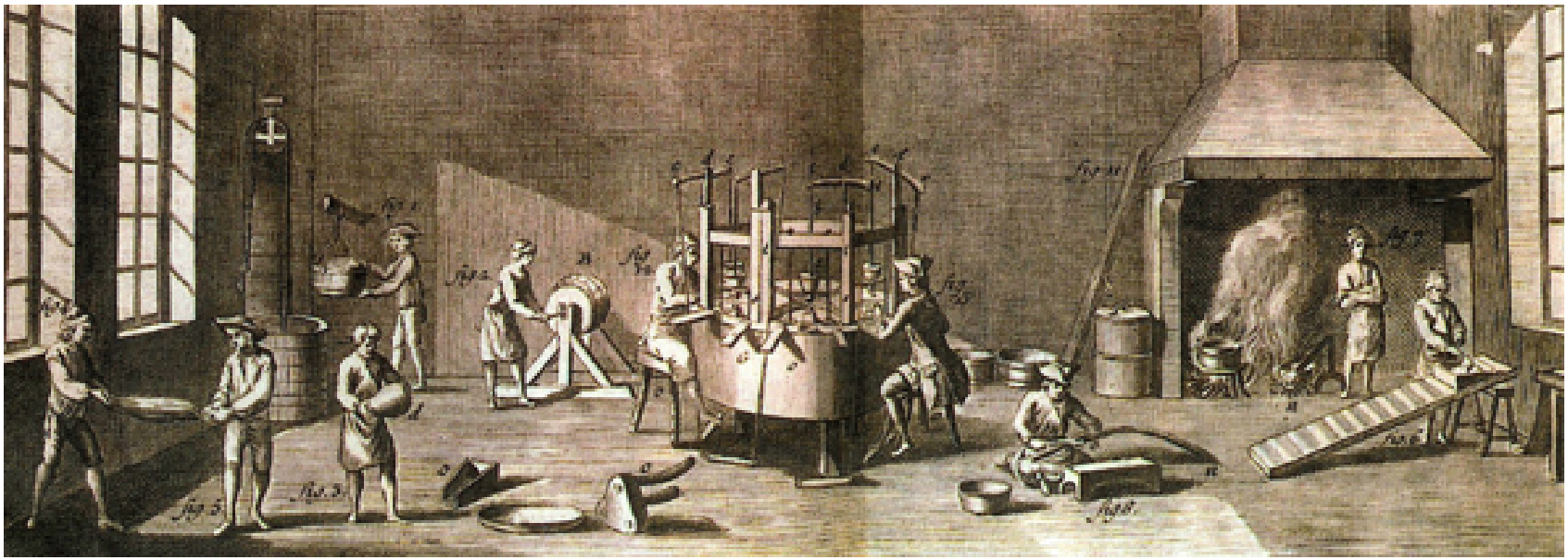

- Adam Smith's pin factory
- Alfred Marshall's "external economies"
- Graham (1923) vs. Knight (1925) on protectionism (what is the *source* of IRS?)

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- Treated as *policy-invariant* feature inherent in the physical process

Motivating Application: Industrial & Trade Policy

- "Industrial policies – in which governments intervene in the allocation of resources among sectors or favor some technologies over others – can help infant economies learn. Learning may be more marked in some sectors (such as industrial manufacturing) than in others, and the benefits of that learning, including the institutional development required for success, may spill over to other economic activities." (Joseph Stiglitz, *"Creating a learning society"*, Project Syndicate, June, 3, 2014.)
- See models in e.g. Matsuyama (1992); Rodriguez and Rodrik (2001); Rodrik (2004a); Rodrik and Subramanian (2005); Greenwald and Stiglitz (2006); Hausmann et. al (2007); Stiglitz and Greenwald (2014)

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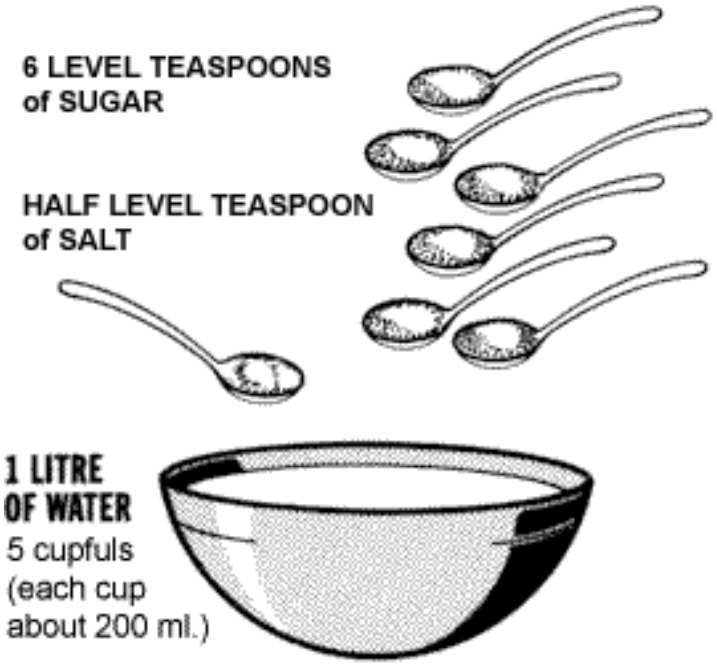
Physical Technology

- Production function relates physical inputs to output.
- Physical technology is the *fully specified* list of inputs and actions that utilize constant and universal physical laws to transform input into output: a recipe.
  - Physical technology can always be replicated (CRS)
  - Physical technology is policy invariant



Physical Technology

Can physical technology exhibit IRS?

- Textbook archetypal "counterexample" of how physical scaling might lead to IRS.
- A good example to differentiate physical from institutional technology.

Physical Technology and IRS?

Oil Pipeline

Inputs
Surface Area
S(r) = 2pi*l*r

Output
Volume
V(r) = pi*r^2

Physical Technology and IRS?

2x Surface Area
4x Volume

Doubling the radius leads to a 4x increase in output, such that there is a physical scaling effect.

$S(2r) = 2S(r)$

$V(2r) = 4V(r)$

Physical Technology and IRS?

2x Surface Area
4x Volume

Is this evidence of physical technology that features IRS?

No.

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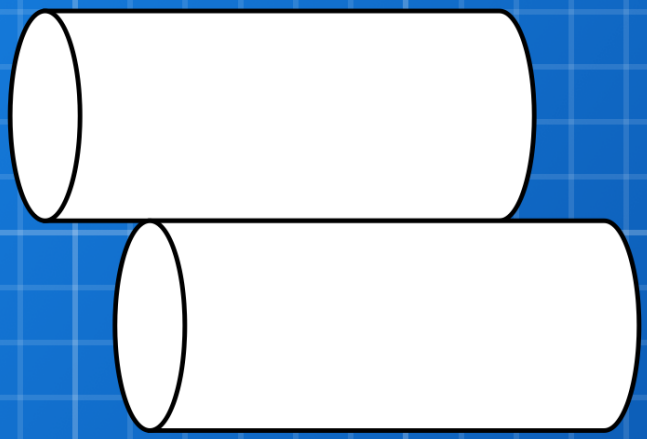

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- What determines whether one large pipeline or two smaller pipelines are built?
- Institutionally contingent entrepreneurial choice
- Physical technology can only feature CRS
- IRS through learning can only come about by successive adoption of more productive physical technology (*different* production functions)

From Profit Max. to Comparative Institutional Analysis

- Shift analysis away from assuming profit maximization and towards examining the process of rivalrous competition (Hayek 1937, 1945; Alchian 1950) and of "learning by doing"

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- Shift analysis away from assuming profit maximization and towards examining the process of rivalrous competition (Hayek 1937, 1945; Alchian 1950) and of "learning by doing"
- The most efficient least-cost physical technologies must be *discovered* with the available institutional technologies

Learning and Institutional Technology

- Production functions are often used to model different production units:
  - Individual
  - Firm
  - Industry
  - Nation
- Institutional technologies that enable learning and thus lead to IRS can be internal or external to production units
- Institutional technologies are interdependent

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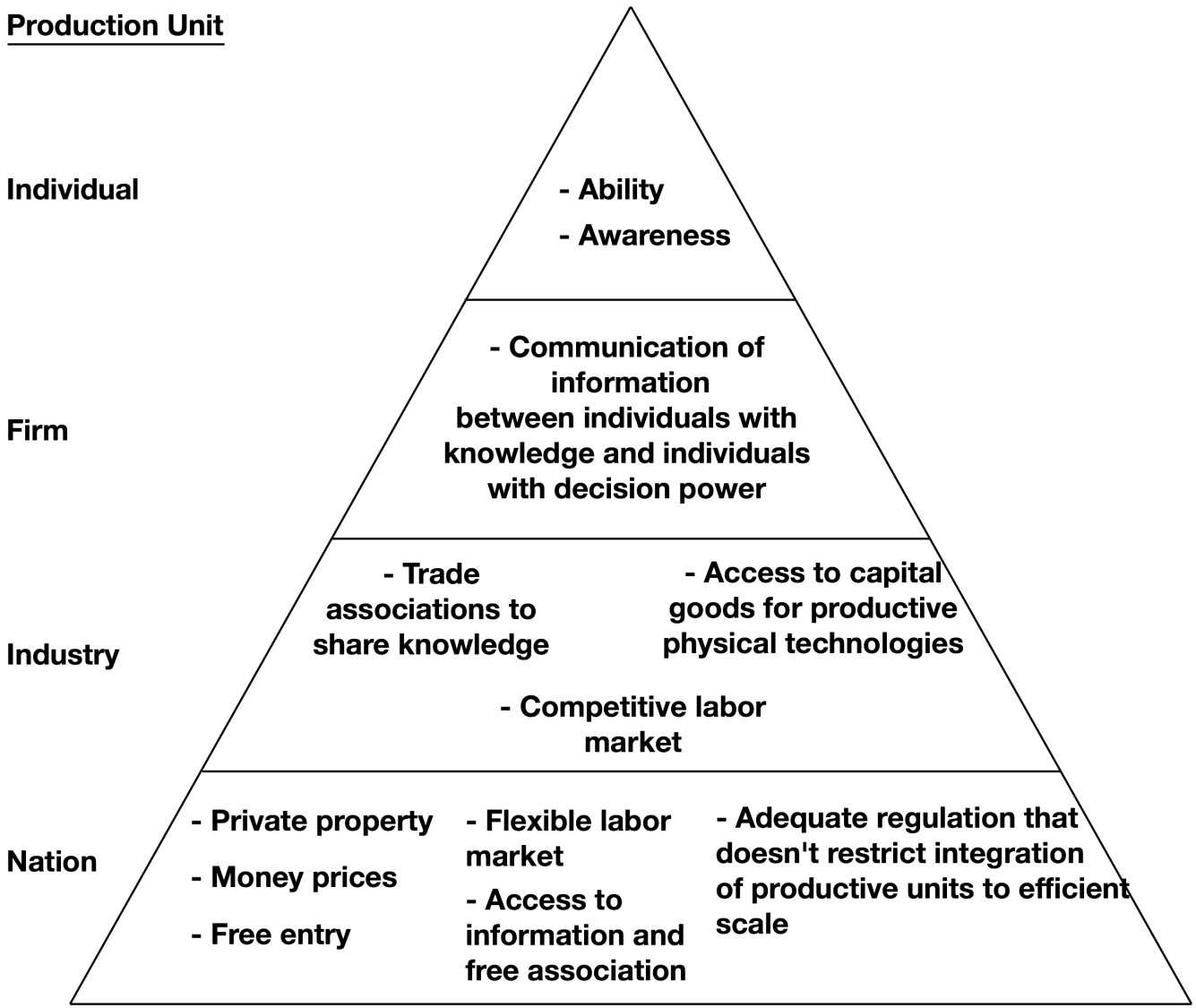

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Back to Policy

- IRS is not a "deep parameter" of production technology to be exploited by policy
- Public policy *changes* the nature of rivalrous competition, which may alter institutional technology necessary for learning to lead to IRS!

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  - Revisit cases of rapid growth attributed to protectionist trade policies
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