

Understanding Production Technology

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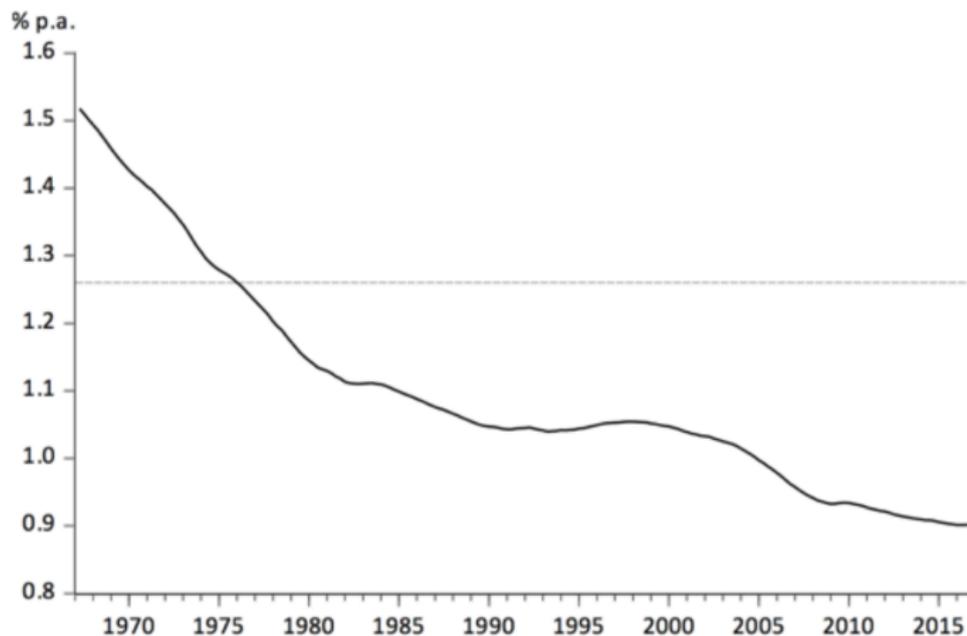
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Declining Trend TFP Growth (US)

Figure 1 'Smoothed' trend TFP growth using complete sample



source: Crafts and Mills (2017)

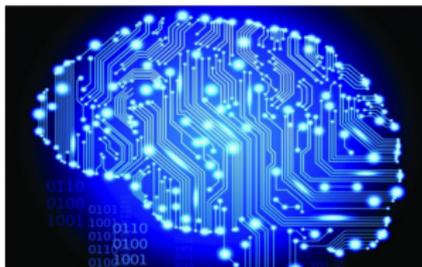
...juxtaposed with new technologies



Public-Private Technology



Embodied Technology



Learning Technology



Harvesting Technology

...and other puzzling trends

- Continued weak investment in EU (to lesser extent in US)
- Labor share of income declining
- Return to tangible capital remains low
- Mark-ups are on the increase
- Profit distribution among firms more skewed
- Global frontier growth appears robust

Is there an explanation?

- Rapidly Changing Technology!
- Not just upward shift of production possibilities or interactions between factors.
- The familiar neoclassical 'production technology' $AF(K, L)$ no longer matches facts.
- Romer-style aggregate growth models also have trouble explaining recent trends
- Lucas/Hopenhayn/Melitz production with fixed intangible investment, stochastic productivity and firm dynamics (entry, optimal size, exit) match facts better.
- The new production technologies have implications for economic and legal institutions and for individual and societal choices

- Features of Hopenhayn (1992) production technology:
 - Initial intangible investment generates productivity draw
 - Ex-ante expected profit is zero, and profit among incumbents is skewed
 - Equilibrium has entry/exit of firms and heterogeneous productivity among incumbent firms
- With change to this new production technology, we are observing:
 - Volatility of firm outcomes increase with use of new technology
 - Share of intangibles in total investment increases
 - Income share of flexible factors decrease
 - Total rents increase and distribution of income becomes more skewed

Will measured TFP growth remain low?

- Crafts: This question fits into the 'too difficult' box.
- Technology for the coming decade is mostly available now
- Its productivity impact may be mismeasured
 - Relationship between producer and consumer surplus shifting
 - Blurring of GDP-production and asset boundaries
- Allocation and selection mechanisms are key
 - Wellbeing doubling in a generation: 2.5% per annum growth. But, could be higher or lower.
 - Do we observe innovative entrants?
 - Do markets allow strong reallocation to highly productive firms

Example: Productivity Enhancing Reallocation in Europe

- Bartelsman, Lopez-Garcia, Presidente (2018) using CompNet data:
- $\Delta x_{i,c,s,t} = \beta_1 \Delta \text{cycle}_{c,s,t} + \beta_2 \text{Rel.prod}_{i,c,s,t-3} + \gamma \text{FE} + \varepsilon_{i,c,s,t}$
- Do resources flow to more productive firms?
 - Δ gives 3 year growth; x is either capital or labor
 - Rel.prod gives log of productivity relative to industry mean in initial year.
 - Cycle is an exogenous 'downstream demand indicator'
 - i , denotes a 'representative firm' (one of the 25 transition cells); c : country; s : sector; t : year
 - FE are fixed effects: CxSxSz₋₃, CxT, SxT

Baseline estimates of PER

$$\Delta x_{i,c,s,t} = \beta_1 \Delta \text{cycle}_{c,s,t} + \beta_2 \text{Rel.prod}_{i,c,s,t-3} + \gamma \text{FE} + \varepsilon_{i,c,s,t}$$

VARIABLES	(1) ΔL	(2) ΔK
Δ Cycle	0.039 (0.0304)	0.185*** (0.0465)
Rel. prod _{t-3}	0.815*** (0.0845)	0.483*** (0.0616)
Observations	8,064	8,064
Adjusted R-squared	0.489	0.503
Fixed Effects	YES	YES

FE: Country*Sector*Size₋₃; Country*Year; Sector*Year

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

... + β_3 Rel.prod $_{i,c,s,t-3}$ Regulatory Indicator $_{c,s,t-3}$...

Regulatory Indicator*	ΔL	ΔK
Concentration of sales, top-10	-0.231*	-0.175**
Price-cost margin	-0.211*	-0.133
Employment Protection (OECD)	-0.659**	-0.003

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

- Stimulate the production of new ideas and new technology: *IP and market power vs open source+*
- Encourage firms to invest in (adopt) welfare enhancing technology: *carrot and stick; flexible markets*
- Keep circular flow of consumption and production going smoothly: *income distribution, watch for winner-take-all*
- Allay societal fears about jobs, income, future: *clear narrative about future potential of technology*
- Encourage socially beneficial aspects of new technologies: *well regulated platforms and directed innovation*

- Beware of hypes: AI is not yet 'general', but solves very specific problems
- Don't worry unduly about 'singularity', or machines taking over human work.
- Positive spillovers often are balanced by negatives
- Consider long adoption lags
- Don't overestimate the near future, but don't underestimate the longer horizon

see: Rodney Brooks (2017)