What does the new technology story imply for growth strategies and development outcomes?

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What will the future bring?

• New General Purpose Technologies
• 3D printing
• Artificial Intelligence
• The Internet of Things
How will new technologies change development possibilities?

• “It is very hard to predict, especially the future.”
  • Niels Bohr

• It is actually very hard to explain the impact that technology has been having in the recent past

• We may be exaggerating the novelty of the new technologies vis a vis what is already happening

• And explaining what is currently happening may help ask the right questions about what aspects of the new technologies actually matter for development
The puzzle of economic development

• The Romer theory of endogenous growth is based on the role of ideas
• Ideas cause increasing returns to scale
• ...but ideas have public-good characteristics
  • Non-rivalrous and non-excludable
• Hence, at the technological frontier, markets provide insufficient incentives for innovation
• But this logic should make catch-up fairly easy
  • You just have to use the ideas created by others
• So, why don’t countries catch up?
• Conventional answer: Institutions
  • They don’t have incentives to adopt the right technology
• My answer: technology does not diffuse because of the nature of technology itself
The Great Divergence
The new convergence? US GDPpc relative to country

![Graph showing the convergence of US GDPpc relative to India, China, and Korea over time. The graph indicates a decrease in the relative GDPpc of India and China, while Korea shows a consistent decrease.](image-url)
If you change your institutions, you catch up
THAILAND

...not only in China

Market share

Electronics

Machinery

Garments and textiles

Year

1960 1980 2000 2020

THAILAND

mktsgartext
mktselettronics
mktsmachinery
...but sometimes countries get a bit stuck
…or completely stuck
Is this technology or trade?

Figure 1.1: Relative Gain in Real per Capita Income by Global Income Level, 1988–2008

Branko Milanovic (2016)
Industry (employment)
Industry
(employment)
Countries have been de-industrializing at a time when rising incomes would have predicted more industry.
Services
(employment)
They have been moving into services, but without the concomitant rise in incomes that would have been predicted by the cross section.
Lift (force)

From Wikipedia, the free encyclopedia

For other uses, see Lift (disambiguation).

A fluid flowing past the surface of a body exerts a force on it. Lift is the component of this force that is perpendicular to the oncoming flow direction. It contrasts with the drag force, which is the component of the surface force parallel to the flow direction. If the fluid is air, the force is called an aerodynamic force. In water, it is called a hydrodynamic force.

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   3.3 Airfoil shape
   3.4 Air speed and density
   3.5 Lift coefficient
   3.6 Pressure integration
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What do you do when your tooth hurts?

Search the web and fix it yourself?  ...or look for a dentist
Knowhow needs to be in brains
Division of knowledge now
Knowhow is not schooling
Years of schooling

Years of Schooling

GDP per capita (constant 2000 US$, log)
YEARS OF SCHOOLING

Years of Schooling

GDP per capita (constant 2000 US$, log)
Years of schooling

- 1970
- 2010

GDP per capita (constant 2000 US$, log)
Years of schooling

- Increased schooling is not generating the expected income pay-off
- Decreasing returns to human capital accumulation?
Societal knowhow does not depend on people knowing more on average but on people knowing different
Products differ in the amount of knowhow they require
Division of knowledge *then*

Butcher  
Baker  
Candlestick maker
The **Scrabble** Theory of Economic Development
With 1 letter,

You can make 1 word, of 1 letter
With 3 letters,

You can make 4 words, of up to 3 letters
With 4 letters,

You can make 9 words, of up to 4 letters
You can make 595 words, of up to 10 letters
What explains these differences in productivity?
Some technologies diffuse quickly
INTUITION

Countries that have more letters will be able to make more products.
They would be more diversified.

Products that require more letters will be made by fewer countries.
Products will be less ubiquitous.

Countries that have more letters will be able to make products that require more personbytes.

Products that are less ubiquitous will be made by countries that are more diversified.

Countries that have more letters should be more diversified and able to make less ubiquitous products.
1) Which country is more diversified?
2) Which is the most ubiquitous product?
3) Which is the least ubiquitous product?
4) Who makes it?
Country-Product Pairs

SITC-4 Rev 2: 772 Products, 129 Countries (Year 2000)
This pattern also holds subnationally:
Municipalities in Chile

Diversification vs. Ubiquity

FOR CHILE 2008
Municipalities in Chile

Municipality-Product Pairs

Industries (Sorted by Ubiquity)
Locations (Sorted by Diversity)
Cities in Turkey

Diversification vs. Ubiquity

Diversity and average ubiquity of Turkey's cities

k0 (diversification) vs. k1 (average ubiquity)
States in Mexico

Diversification vs. Ubiquity

Diversity of industrial composition ($k_{c,0}$) vs. Average ubiquity of industrial composition ($k_{c,1}$)
Departments in Colombia

Diversification vs. Ubiquity

Average Ubiquity vs. Diversity

2012 - Total Wages

Country Diversity

av_ubq

Fitted values
And Districts in Sri Lanka

Diversification vs. Ubiquity
How are new letters accumulated?
Mapping out the Forest
The Product Space
Community characteristics: Complexity, Connectedness and Market Size
Where are the monkeys?
Venezuela 2010
Mexico 1979
How close are monkeys to empty trees?
How close are you to other good products?

- Few letters: Hard to add more
- Many letters: Easy to add more
- More letters: Hard to add more by just copying others

How many letters do you have?
The position in the product space affects the growth of complexity

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<td>Long run effect, θ</td>
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Relationship between letters and words

\[ k^P_{c,0}/N_p = N_p \left( q \frac{k^a_{c,0}}{N_a} + 1 - q \right)^{N_{ps}} \]

Fraction of \textbf{Capabilities/Personbytes} Available

Hausmann and Hidalgo (2011) JOEG
The deep cause of the Great Divergence

Fraction of Capabilities Available
1978
1988

Economic Complexity

Opportunity Value

Countries plotted on the graph include:
- CHN
- ESP
- IRL
- USA
- ITA
- AUT
- GBR
- GRC
- TUN
- SVN
- MUS
- TZA
- ZAF
- PHL
- THA
- MRT
- MNG
- MYS
- NGA
- NIC
- NLD
- NOR
- NZL
- OMN
- PAK
- PAN
- PHE
- TTO
- TUN
- TUR
2008

Economic Complexity

Opportunity Value

-2 -1 0 1 2

-2 -1 0 1 2

Economic Complexity
Is it because of:
the accumulation of country capabilities,
or
a change in product technology?
Is it country capabilities or product technologies?

The Product Space has changed over time.
The role of global value chains

• Products may be getting more complex
  • Longer words
• ...but value chains are becoming more global
• Each location needs to have fewer capabilities
  • Trade in syllables
• Industries become easier to get in
  • Lenovo
• What do the following cities have in common?
  • Huntsville, Alabama; Blue Spring, Mississippi, Princeton, Indiana; Buffalo, West Virginia; Greer, South Carolina
Implications and Questions

• New technologies (new letters) do not diffuse when they are used in long words
  • In products that require many complementary technologies that must have previously diffused
  • The TV remote control
Internet penetration
Access to electricity

Graph showing the increase in access to electricity (% of population) from 1990 to 2015 for USA, China, and India.
Implications and Questions

- Will new technologies go into shorter words
  - Will 3D printing make manufacturing more accessible?
  - Will the IOT require more demanding infrastructure?
  - Will AI, by facilitating the substitution of tacit knowledge for embodied knowledge, help it diffuse faster?

- What will the new technologies do to the shape of the product space
  - Will it bring trees closer? Will it create more parsimonious paths to development?
    - E.g. Apparel, textiles, electronics, cars
Implications and Questions

• What new products or tasks will developing countries export to the world?
  • So that they can participate in the global economy and pay for their imports of new technologies?

• What does reshoring imply?
  • More concentrated or more distributed production?
Thank you!

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