Technology, Long-Term Growth and Economic Measurement

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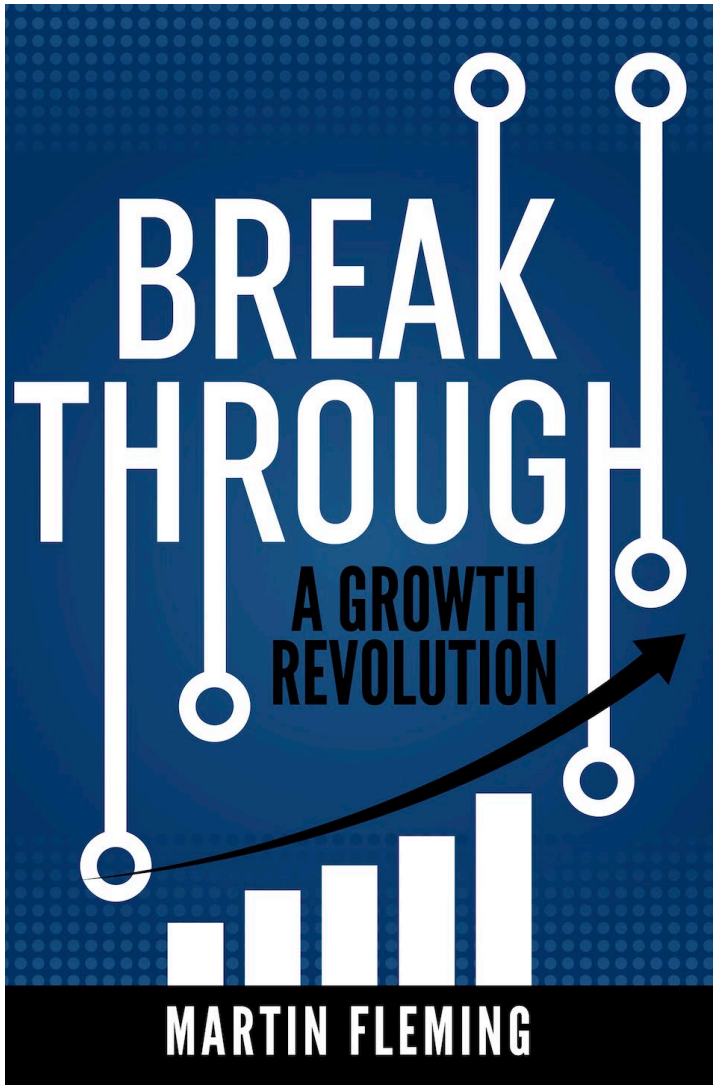


Robust economic and productivity growth will require:

- Capital investment, knowledge diffusion, absorptive capacity
- Widespread transformation => business models, ways of working, and political leadership => including economic measurement
- Experience suggests => only the strongest social and economic pressure will overcome resistance
- New social contract => rising expectations of a new generation with much higher hopes for the future

Table 1.1 Four industrial revolutions

Era	Industrial Revolution	Years	Technology Innovation
1st	Age of Steam and Railways	1829–1873	"Rocket" Steam Engine (1829)
2nd	Age of Steel, Electricity, and Heavy Engineering	1875–1918	Carnegie Bessemer Steel Plan (1875)
3rd	Age of Oil, Automobiles, and Mass Production	1908–1974	Model-T Mass Production (1908)
4th	Age of Information and Telecommunications	1971 and beyond	Intel Microprocessor Announced (1971)

Source: Perez (2002), p. 78.

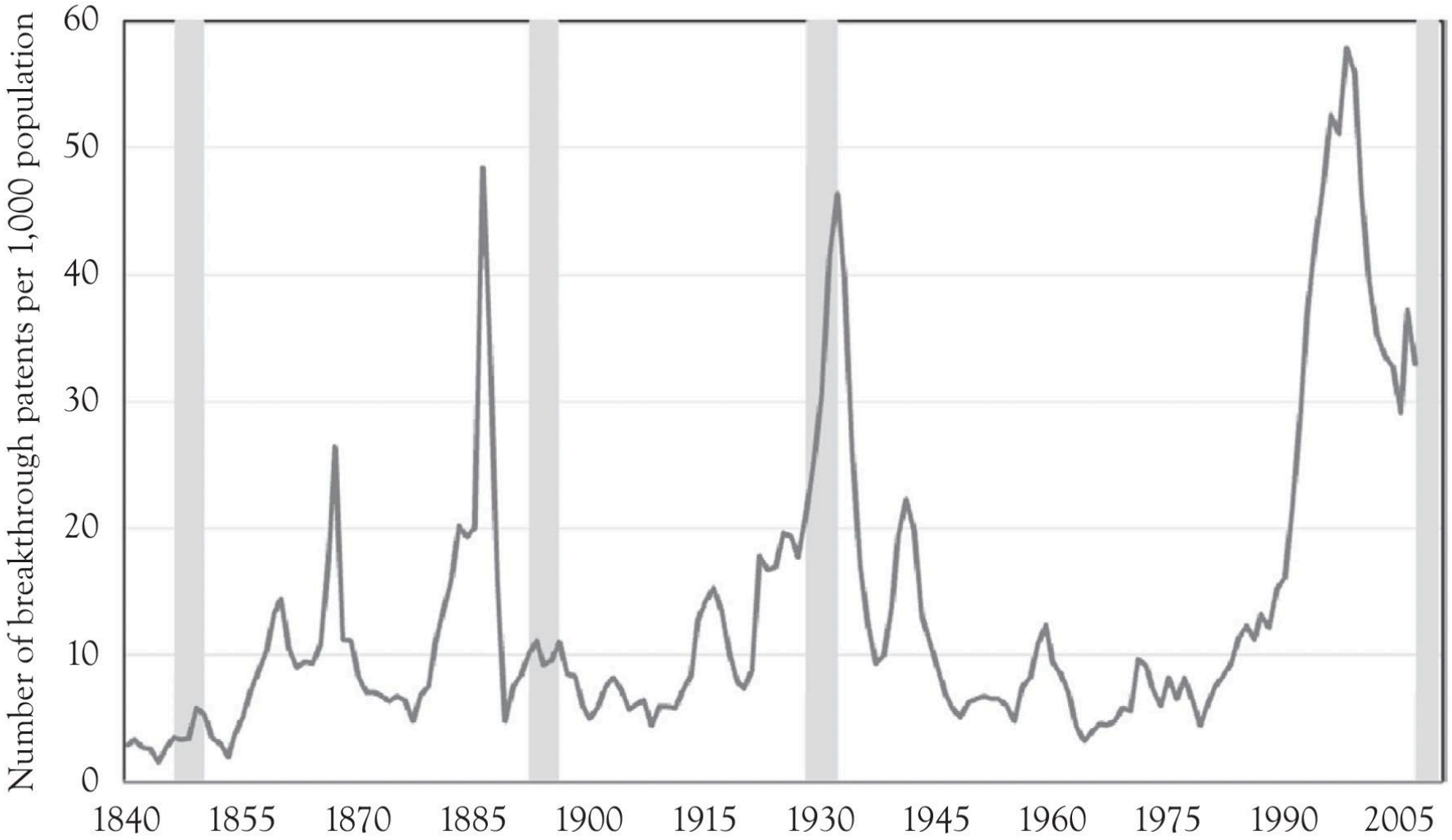
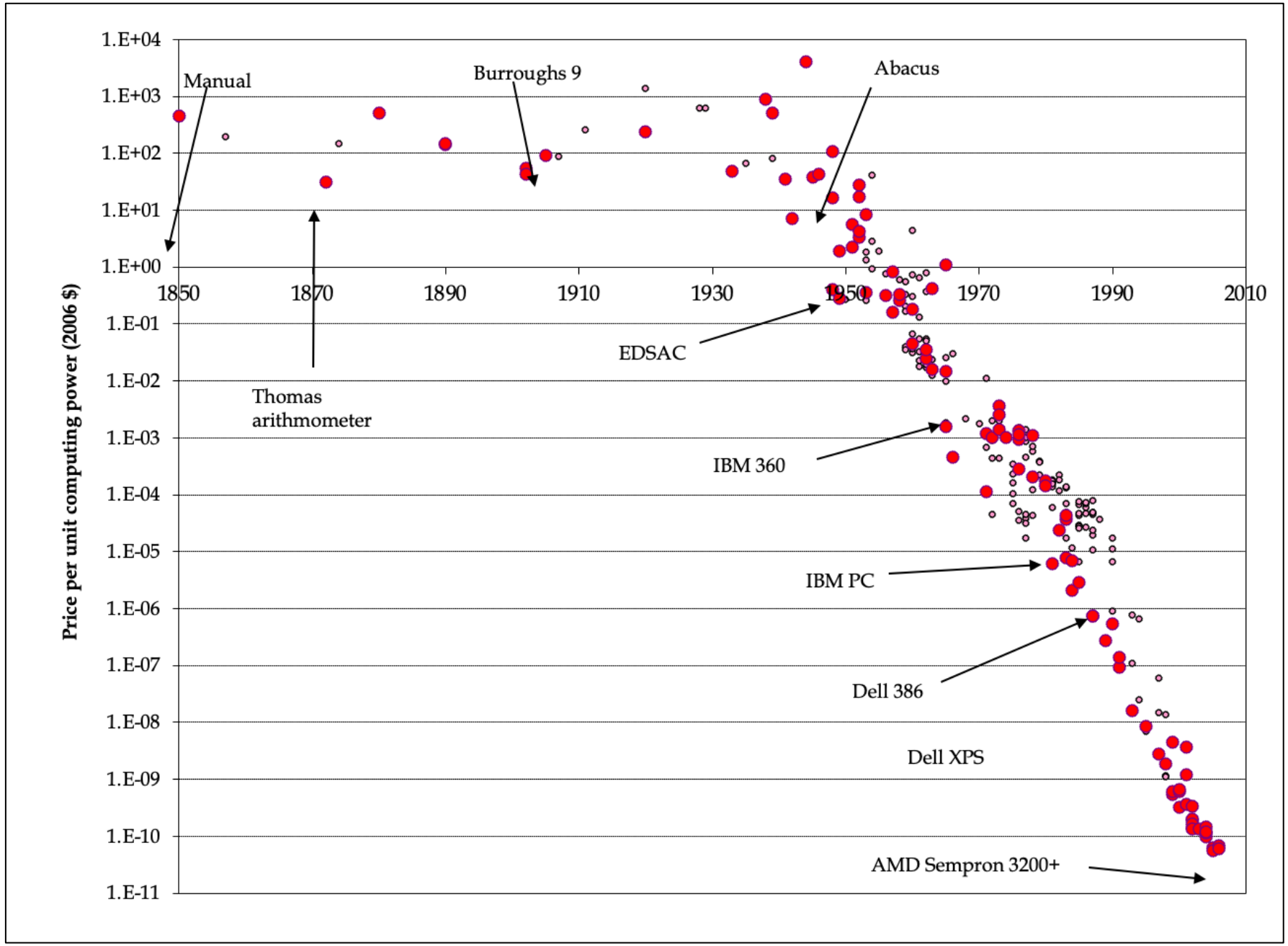


Figure 2.2 Breakthrough patents (top 5 percent significant patents per capita)

Table 1.2 Economic logic of industrial revolution

	Installation Period	Deployment Period
Age of Capital Stock	From Previous Era Embodying Old Technology	Renewed Embodying New Technology
Knowledge Diffusion	Limited	Abundant
Labor Income Share	Declining	Increasing to Stable

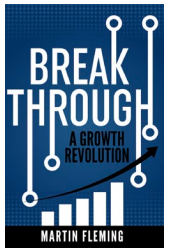

Price per unit computing power (2006 $)
1.E+04
1.E+03
1.E+02
1.E+01
1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
1.E-08
1.E-09
1.E-10
1.E-11
1850
1870
1890
1910
1930
1950
1970
1990
2010
Manual
Burroughs 9
Abacus
EDSAC
Thomas arithmometer
IBM 360
IBM PC
Dell 386
Dell XPS
AMD Sempron 3200+

The Future is Uncertain

- The co-existence of productivity leaders – the Superstars - alongside productivity laggards – often SMBs - creates persistent productivity differences, slowing creative destruction
- Wealth owners from the prior era protect their status and fight transformation
  - *Regime switching requires enormous social and economic pressure*
- Despite powerful forces, workers face a new risk environment, forcing deep, difficult, and painful attitudinal changes, none of which happens easily or quickly
- Experience suggests only the strongest social and economic pressures – encouraged by public policy – have persuaded business leaders, workers and elected officials to undertake and accept fundamental change
  - *The psychology of growth is as important as the economics of growth*

A Growth and Fairness Agenda

- Traditional Policy Initiatives Are Insufficient
  - Capital investment depends on intangible capital, less dependent in the cost of capital
- Support Deeper Worker Engagement
  - As services sectors dominate, workers respond to career progression, work life balance, skill development, as well as compensation
- Promote Confidence Among SMBs
  - With reluctance to transform and limited data science skills, ease of use and low-cost technology is necessary
- Encourage AI Fairness
  - Data become more available, ethics and fairness take on new importance
- Seek New Social Contract
  - Set aside nostalgia for an earlier era, overcome change resistance



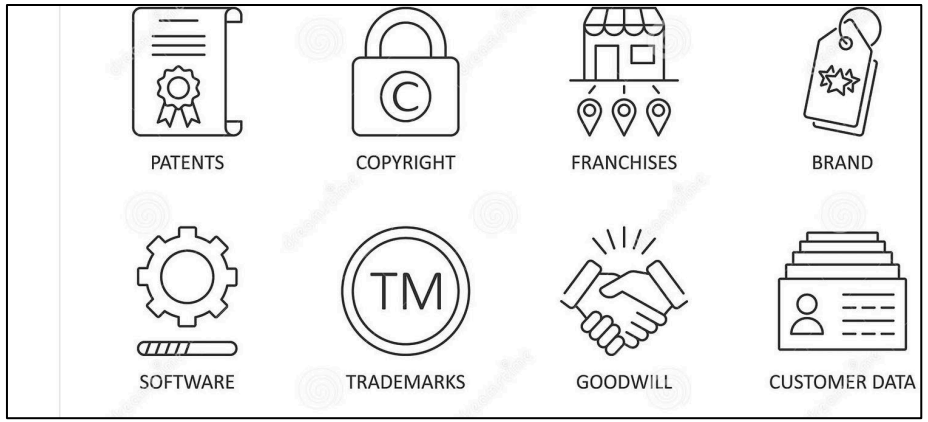
Breakthrough: A Growth Revolution is available on Amazon

Implications for Economic Measurement

Recent Measurement Innovations

Intangible Capital

- Corrado, Haskel among others



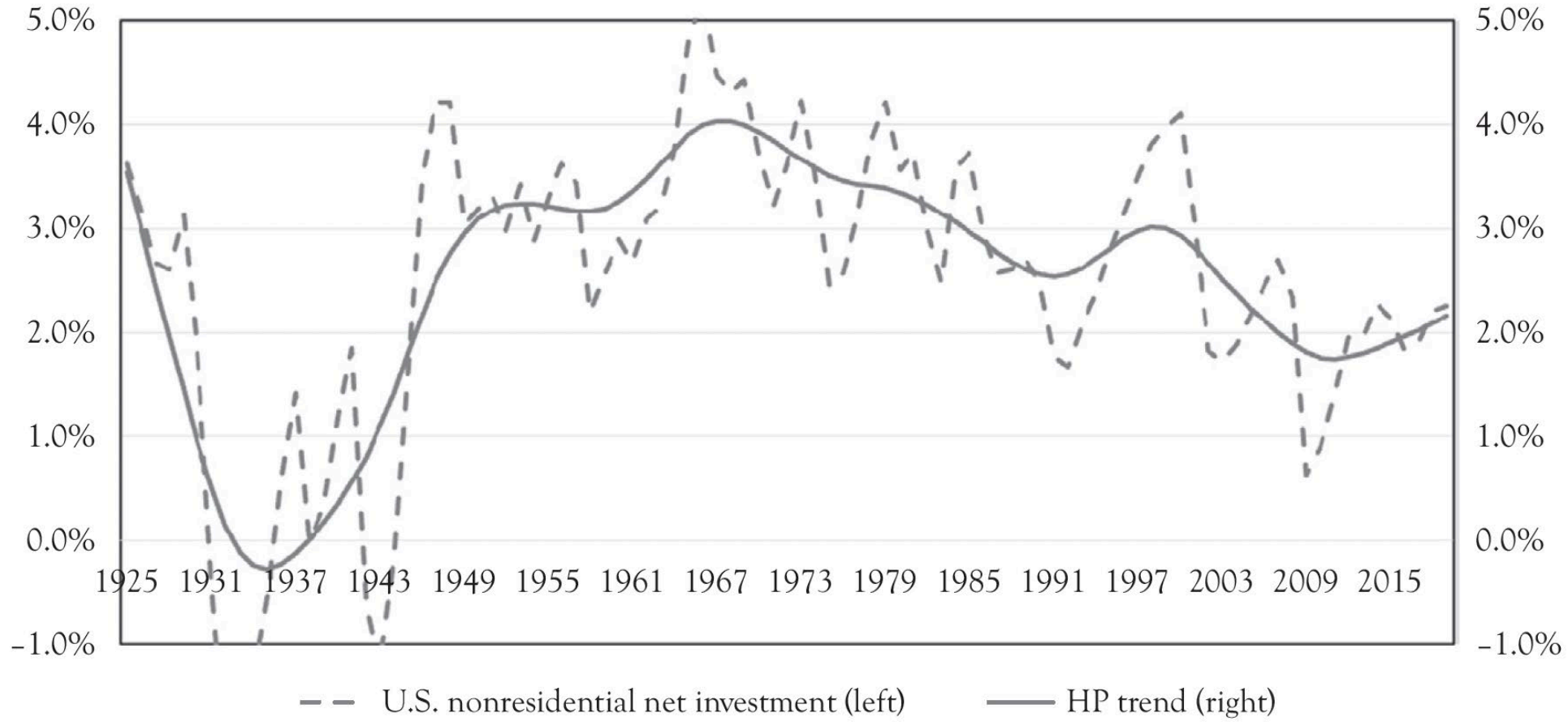


Figure 2.3 U.S. nonresidential investment as a percent of capital stock

Recent Measurement Innovations

Intangible Capital

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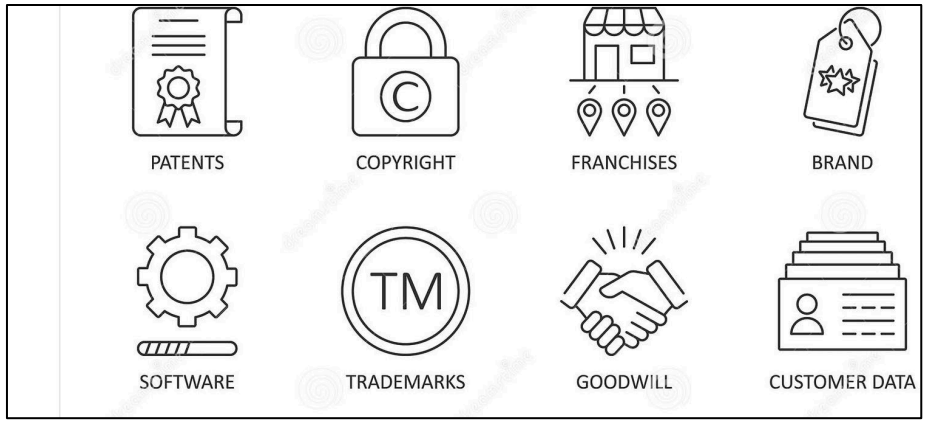
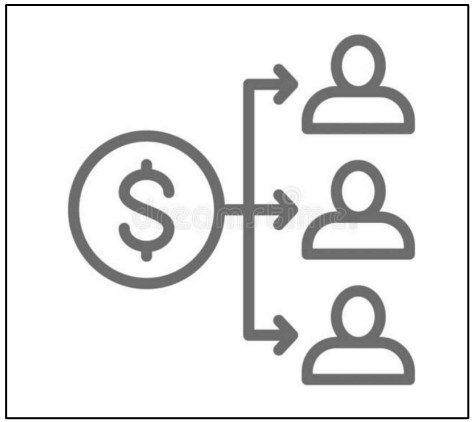


Income Distribution

- Piketty and Saez



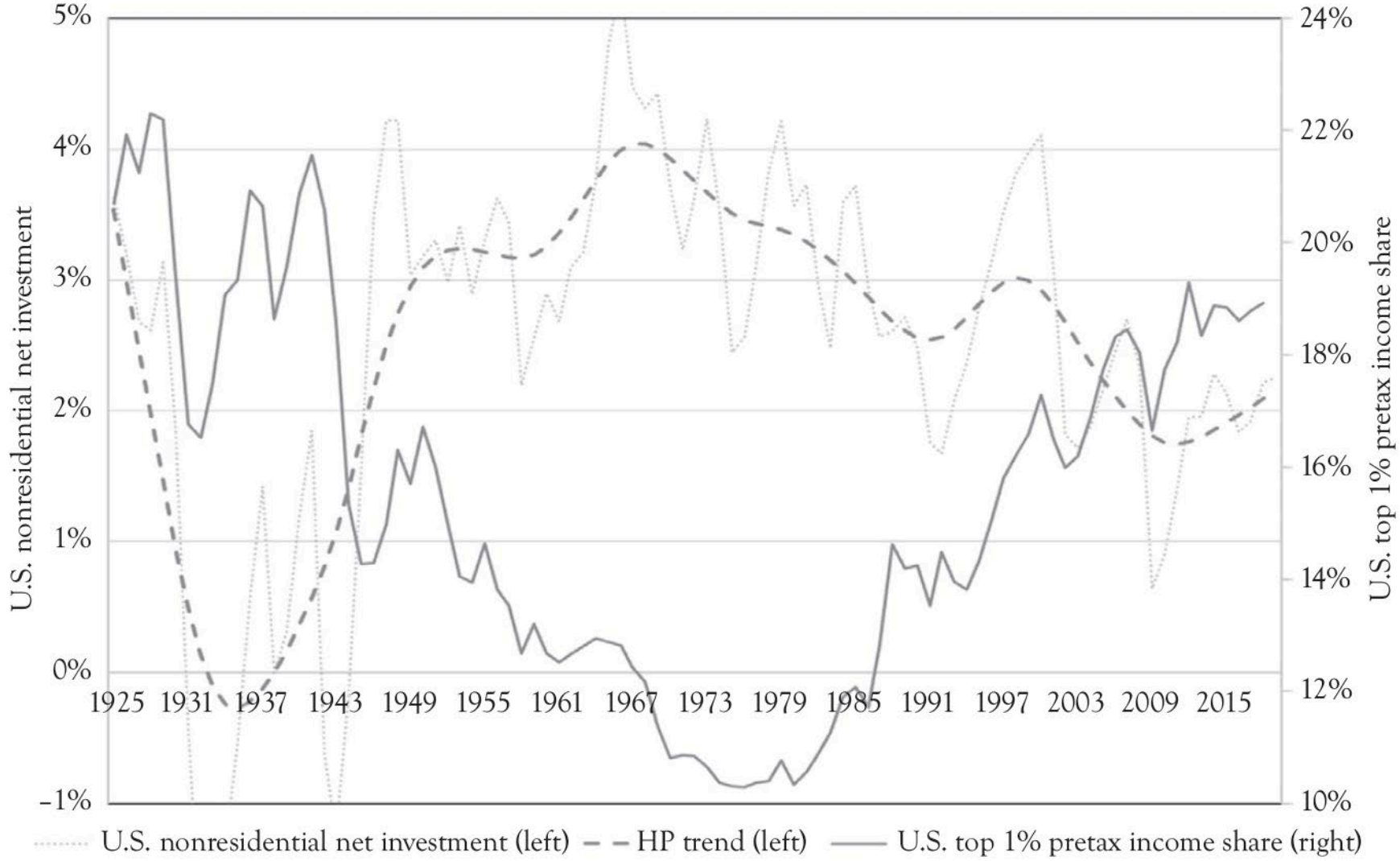
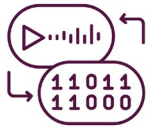


Figure 4.1 U.S. nonresidential investment as a percent of capital and U.S. top 1 percent pretax income share

Tools in Early Development

GDP-B 

- New and free goods are not well-measured
- Brynjolfsson, Collins and others

Natural Language Processing 

- Measuring Technological Innovation Over the Long Run
- Kelly, Papanikolaou, Seru, and Taddy

Online Search Data 

- Estimate unemployment and benefit claims
- Varian, Koenecke, and Choi

Longitudinal Employer-Household Dynamics 

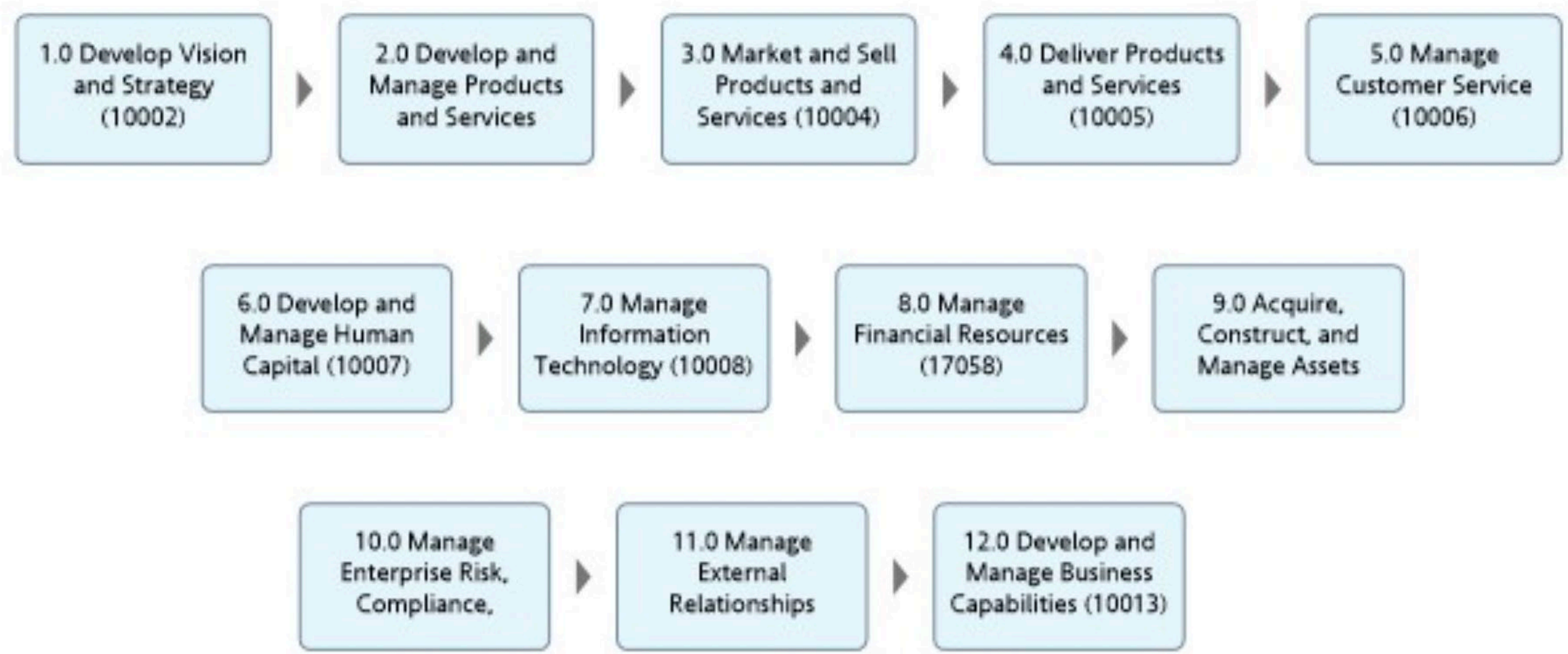
- Public-use information combining federal, state and Census Bureau data
- Abowd, Haltiwanger and Lane

AI-as-a-Service Provides Knowledge Diffusion

- NVIDIA provides an Autonomous Vehicles common data platform
  - *Enables greater model performance, particularly with edge cases*

- Navtech brings advanced computer vision to individual diamond retailers across the globe, by creating a model and delivering it as-a-service
  - *Each retailer maintains a catalogue and supplements it with images of other jewelry as inspiration for customers looking for bespoke pieces*

Business Process Taxonomy



Needs for the 21st Century

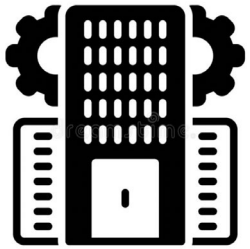
New Tasks

- Occupations are a collection of tasks which can be automated or augmented

Knowledge Diffusion and Absorptive Capacity

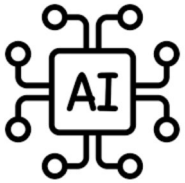
- Tasks exist within business processes for which productivity improvement requires absorptive capacity

Enterprise Size



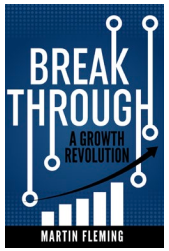
- Larger enterprises are better able to adopt new technology, SMBs require ease of use

AI Adoption



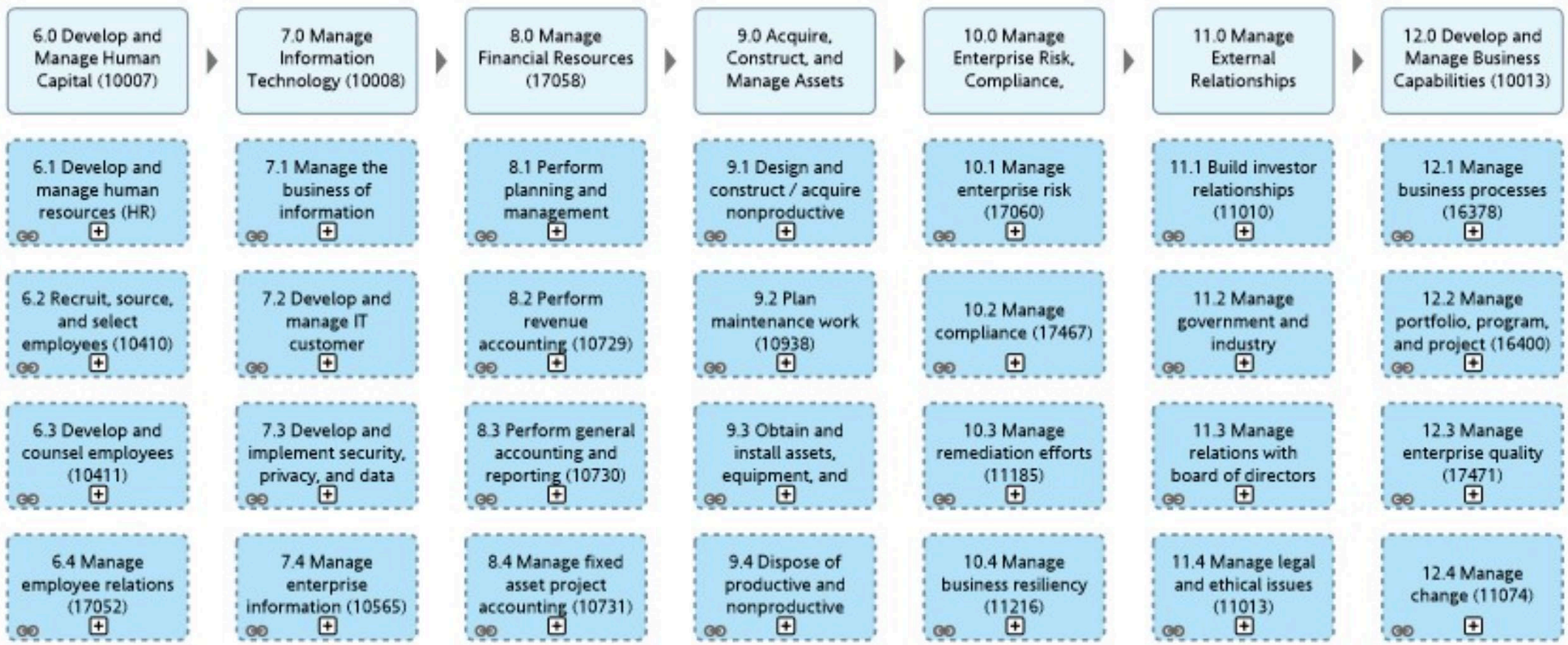
- AI adoption is still in the early stages with digital information ubiquitous, cloud computing take up increasing, and AI adoption trailing

Thank You!!!



Breakthrough: A Growth Revolution is available on Amazon


1.0 Develop Vision and Strategy (10002)
2.0 Develop and Manage Products and Services
3.0 Market and Sell Products and Services (10004)
4.0 Deliver Products and Services (10005)
5.0 Manage Customer Service (10006)
1.1 Define the business concept and long-term
2.1 Manage product and service portfolio
3.1 Understand markets, customers and capabilities
4.1 Plan for and align supply chain resources (10215)
5.1 Develop customer care / customer service
1.2 Develop business strategy (10015)
2.2 Develop products and services (10062)
3.2 Develop marketing strategy (10102)
4.2 Procure materials and services (10216)
5.2 Plan and manage customer service operations
1.3 Manage strategic initiatives (10016)
3.3 Develop sales strategy (10103)
4.3 Produce / Manufacture / Deliver product
5.3 Measure and evaluate customer service operations


6.0 Develop and Manage Human Capital (10007)
7.0 Manage Information Technology (10008)
8.0 Manage Financial Resources (17058)
9.0 Acquire, Construct, and Manage Assets
10.0 Manage Enterprise Risk, Compliance,
11.0 Manage External Relationships
12.0 Develop and Manage Business Capabilities (10013)
6.1 Develop and manage human resources (HR)
7.1 Manage the business of information
8.1 Perform planning and management
9.1 Design and construct / acquire nonproductive
10.1 Manage enterprise risk (17060)
11.1 Build investor relationships (11010)
12.1 Manage business processes (16378)
6.2 Recruit, source, and select employees (10410)
7.2 Develop and manage IT customer
8.2 Perform revenue accounting (10729)
9.2 Plan maintenance work (10938)
10.2 Manage compliance (17467)
11.2 Manage government and industry
12.2 Manage portfolio, program, and project (16400)
6.3 Develop and counsel employees (10411)
7.3 Develop and implement security, privacy, and data
8.3 Perform general accounting and reporting (10730)
9.3 Obtain and install assets, equipment, and
10.3 Manage remediation efforts (11185)
11.3 Manage relations with board of directors
12.3 Manage enterprise quality (17471)
6.4 Manage employee relations (17052)
7.4 Manage enterprise information (10565)
8.4 Manage fixed asset project accounting (10731)
9.4 Dispose of productive and nonproductive
10.4 Manage business resiliency (11216)
11.4 Manage legal and ethical issues (11013)
12.4 Manage change (11074)