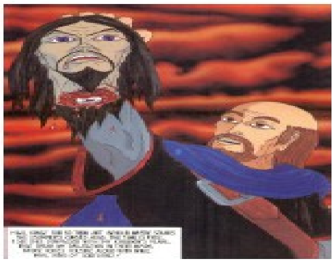
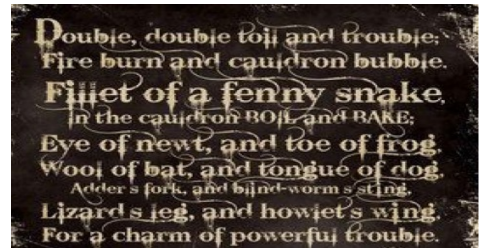
Lecture 8: From R&D to Innovations

There is a missing element in the link from science to productivity and innovation: measures of actual innovations. Estimating payoff to R&D without measuring "innovations" that turn R&D to products, profits, jobs is like MacBeth without blood; Hamlet without Yorick's Skull or three witches without a cauldron





So what is an innovation? Schumpeter (1934, p. 66) defined product innovation as "the introduction of a new good...or a new quality of a good," and process innovation as "the introduction of a new method of production...or a new way of handling a commodity commercially." The *Oslo Manual* (OECD-Eurostat, 2005, p. 46) defines innovation as: implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations.

Innovations can be distinguished from inventions by the criterion that **innovations are implemented/commercialized** in the marketplace. This does not mean that an innovation is widely distributed or diffused. **R&D does not produce a product for sale. It produces knowledge and idea for product.**

TABLE 4-1 R&D Firms Are More Likely to Innovate, but **Most Innovating Firms Do Not Do R&D**

	Percent of All Firms in Scope	Percent of Firms in Row with New or Significantly Improved Products or Processes	Percent of All Firms with New or Significantly Improved Products or Processes
Firms doing R&D	4%	65%	16%
Firms not doing R&D	96%	14%	84%

SOURCE: Tabulations from the 2009 BRDIS.

How do Non-R&D innovators innovate?

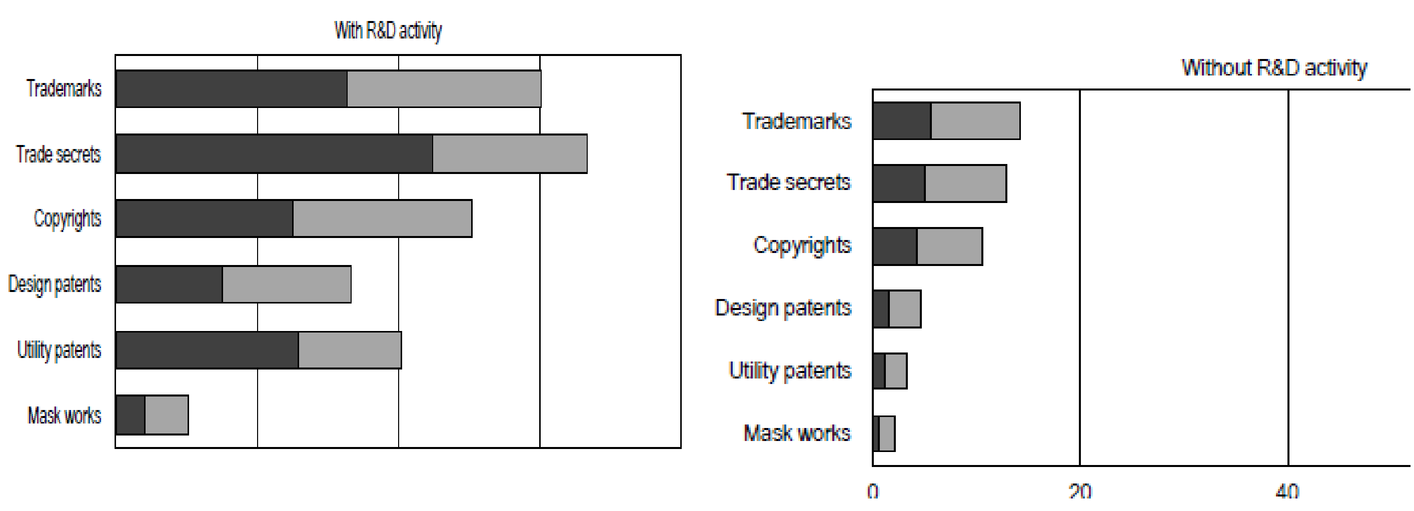
They may use outcomes from R&D elsewhere in their innovations. They "hire" the robot produced by R&D as clerk in store and innovate in that way.

In big firms R&D comes from corporate lab **Innovations at big firms are implemented at non R&D establishments --> Role of non-R&D STEM in innovation. Could be same in non R&D firms**

Many innovations developed and introduced by start-up companies may not be associated with formal R&D, or R&D may not be recorded because start-up has no revenues against which to record expenses.

One in Five U.S. Businesses with R&D Applied for a U.S. Patent in 2008

FIGURE 2. Businesses reporting IPR as very or somewhat important, by presence of R&D activity and type of IPR: 2008



Helper and Kuan WHAT GOES ON UNDER THE HOOD? HOW ENGINEERS INNOVATE IN AUTOMOTIVE SUPPLY CHAIN NBER WP 22552 – look in detail at firms that supply automakers to gain insight into how engineers create innovation. Autos account for 5% of US GDP and in 2011, 70% of auto suppliers contributed design effort, making the auto supply chain an important context in which to study engineering and innovation. Their survey shows barriers to patenting for manufacturing firms that develop process rather than product innovations. Interviews revealed the importance of customers for the innovative efforts of supplier firms. Certain Japanese customers were preferred because they shared expertise and helped suppliers improve, while American customers were viewed as having unreasonable demands for regular, incremental price reductions and did not offer technical or organizational support. Also heterogeneity and weakness of standard NAICS codes to identify what firms do.

Figure 4: What percent of your sales come from products which you did not make 4 years ago?"

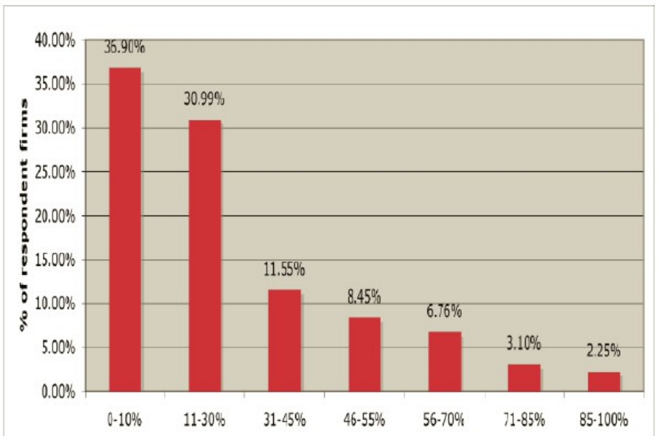


Figure 5: In the past year, roughly what percent of your plant's sales were from jobs where your firm designed the part or assembly?

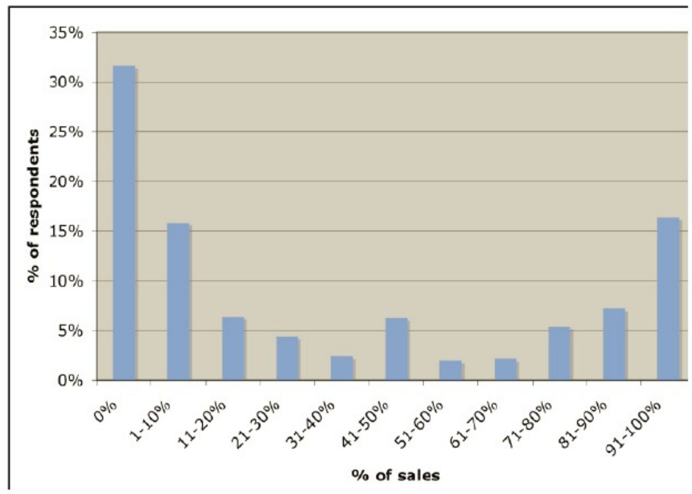


Figure 8: Product and process information from customers

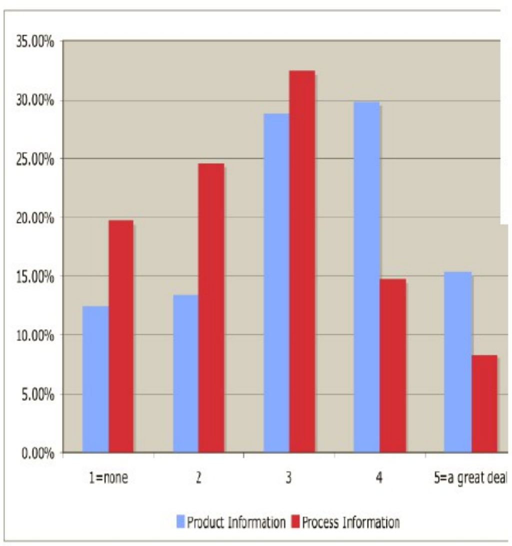


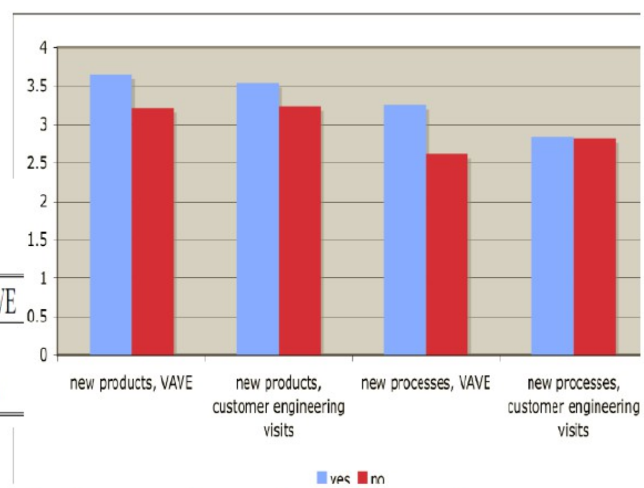
Table 4: Visits with customers

	Customer	Customer's engineers
None	47%	41%
Occasional	22%	28%
Regular	31%	31%

Table 3: Use of FEA and VAVE

	VAVE	No VAVE
FEA	17%	8%
No FEA	15%	59%

Figure 9: Customers as a source of new information for products and process (scale: 1 = no new information – 5 = a lot of new information)



Finite element analysis (FEA) assesses a component's suitability for its operating environment. Engineers use costly specialized software that incorporates scientific knowledge to judge whether the part can withstand the pressure, heat, impact, and perform at the desired level of reliability and durability. Using FEA tools requires specific training, as well as general scientific knowledge BUT can be performed with a minimum of interaction with the customer.

Value analysis/ value engineering (VAVE) involves extensive interaction between customer and supplier on a variety of design and manufacturing decisions. The purpose is for suppliers to improve "value" (= performance/cost) to customers,. Engineers try to learn about their customer's needs broadly, and work with the customer to design a product or process. A more conventional, non-VAVE approach to supplying components takes customer's design as complete; so supplier produces the part without modification or input.

Google's search service, Amazon's e-commerce website, or Apple's iTunes store signal how the nature of innovation has changed, increasingly depending on i**nvestments in innovative assets** (e.g., data, organizational know-how) **with take-up primarily in the service sector** rather than R&D .

Anatomy of a Marketing Innovation

Google's Adsense/Adwords advertising technology is successful marketing innovation. This technology, originally implemented piecemeal from 2000 to 2003, allows Google to automatically place ads on its own webpages or those of partner sites, depending on the webpages' content. Also an advertiser can bid for the right to be included in these placements. A retailer selling umbrellas, for example, can bid for the right to place an advertisement on any webpage using the term "rain." The AdSense/AdWords technology was an innovation that competitors such as Yahoo! and Microsoft did not easily match. Moreover, the technology allows Google to monetize successfully such product innovations as Gmail. SOURCE: NAS Indicators Panel cite Edelman et al. (2007).

1. Current USBRDIS questions on innovation:

A product innovation is the market introduction of a **new** or **significantly** improved good or service with respect to its capabilities, user friendliness, components, or sub-systems.

- Product innovations (new or improved) must be new to your company, but they do not need to be new to your market.
- Product innovations could have been originally developed by your company or by other companies.

1-11 During the three years 2009 to 2011, did your company introduce:

a. New or significantly improved goods (Exclude the simple resale of new goods purchased from other companies and changes of a solely aesthetic nature)? . . . . . ☐ Yes ☐ No

b. New or significantly improved services? . . . . . ☐ Yes ☐ No

1-12 If you answered "yes" to either 1-11, line a, or 1-11, line b, were any of your product innovations during the three years 2009 to 2011:

a. New to your market? . . . . . ☐ Yes ☐ No

Your company introduced a new or significantly improved good or service to your market before your competitors. (It may have been available in other markets.)

b. New only to your company? . . . . . ☐ Yes ☐ No

Your company introduced a new or significantly improved good or service that was already available from your competitors in your market.

1-13 Using the definitions above, please give the percentage of your total sales in 2011 from:

a. New or significantly improved goods and services introduced during 2009 to 2011 that were **new to your market** . . . . . ___ %

b. New or significantly improved goods and services introduced during 2009 to 2011 that were **new only to your company**. . . . . ___ %

c. Goods and services that were **unchanged or only marginally modified** during 2009 to 2011 (include the resale of new goods or services purchased from other companies) . . . . . ___ %

d. **Total sales in 2011** . . . . . 1 0 0 %

Process innovation

A process innovation is the implementation of a **new** or **significantly** improved production process, distribution method, or support activity for your goods or services.

- Process innovations must be new to your company, but they do not need to be new to your market.
- The innovation could have been originally developed by your company or by other companies.
- Exclude purely organizational innovations.

1-14 During the three years 2009 to 2011, did your company introduce:

a. New or significantly improved methods of manufacturing or producing goods or services? . . . . . ☐ Yes ☐ No

b. New or significantly improved logistics, delivery or distribution methods for your inputs, goods, or services? . . . . . ☐ Yes ☐ No

c. New or significantly improved supporting activities for your processes, such as maintenance systems or operations for purchasing, accounting, or computing? . . . . . ☐ Yes ☐ No

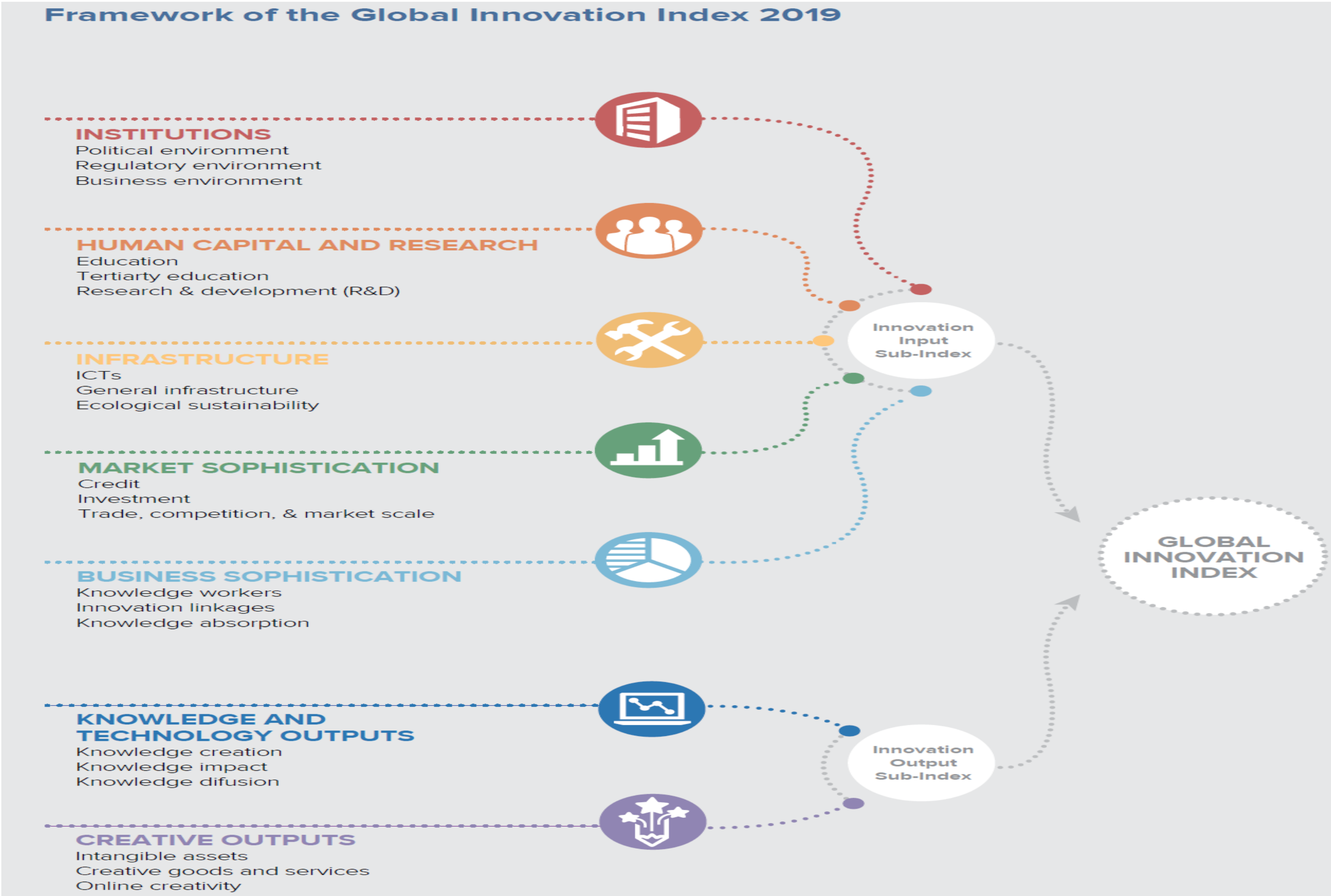
The 2009 BRDIS showed that only 6.4 percent of U.S. firms had introduced new or significantly improved goods in the previous 3 years, while only 10.3 percent reported new or significantly improved services. By contrast, 79.9% of German firms reported themselves as innovative from 2005 through 2007.[1] This disparity almost surely reflects differences in survey methodology and questions. Even within the European Union, Germany reports far higher rates of innovation than the Netherlands (44.9 percent) and the United Kingdom (45.6 percent).
https://www.wipo.int/publications/en/details.jsp?id=4434

Global Innovation Index 2019 rankings

Country/Economy	Score (0–100)	Rank	Income
Switzerland	67.24	1	HI
Sweden	63.65	2	HI
United States of America	61.73	3	HI
Netherlands	61.44	4	HI
United Kingdom	61.30	5	HI
Finland	59.83	6	HI
Denmark	58.44	7	HI
Singapore	58.37	8	HI
Germany	58.19	9	HI
Israel	57.43	10	HI
Republic of Korea	56.55	11	HI
Ireland	56.10	12	HI
Hong Kong, China	55.54	13	HI
China	54.82	14	UM
Japan	54.68	15	HI
France	54.25	16	HI
Canada	53.88	17	HI
Luxembourg	53.47	18	HI
Norway	51.87	19	HI
Iceland	51.53	20	HI

How do you make an innovation index/ratings?   No official statistics on the amount of innovative activity but the Global Innovation index uses 82 *indicators* on the basis of the literature review, expert opinion, country coverage, and timeliness, which fall within the following three categories: quantitative/objective/hard data (58 indicators), composite indicators/index data (19 indicators), and survey/qualitative/subjective/ soft data (5 indicators)•
The overall GII score is the simple average of the Input and Output Sub-Index scores.
• The Innovation Input SubIndex is comprised of five input pillars that capture elements of the national economy that enable innovative activities: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication.
• The Innovation Output SubIndex provides information about outputs that are the results of innovative activities within the economy. There are two output pillars: (6) Knowledge and technology outputs and (7) Creative outputs.
• The Innovation Efficiency Ratio is the ratio of the Output Sub-Index score over the Input Sub-Index score. It shows how much innovation output a given country is getting for its inputs.

1The U.S. statistic was from the NSF summary sheet on the BRDIS. The statistics for German firms are in Eurostat (2010).



Composite indicators

The GII relies on seven pillars, each divided into three sub-pillars,of which include two to five individual indicators. Sub-pillar scores are calculated using the weighted average of its individual indicators. Pillar scores are calculated using the weighted average of its sub-pillar scores.**The notion of weights as important coefficients was revised this year to ensure a greater statistical coherence of the model, following the recommendations of the** JRC-COIN.The weighting is semi-arbitrary but with enough indicators this may not matter due to **"concentration of measure"** phenomenon.

What is concentration of measure? The opposite of fat tails. Thin tails, where **the mass in the tails decays rapidly – exponentially.** Observed possibilities concentrate in a narrow range close to what we want to estimate. With lots of independent dimensions/measures **any** combination (say the average of the measures) has to concentrate in a narrow space around the mean value. If the variables are independent it is nearly impossible for them to "work together" to simultaneously pull the average too far away from its mean. **Independence is the key;** concentration of measure results fail if variables are highly correlated with each other. Thus, just as s**tructure among variables gives fat tails, independence gives thin tails**.

They do principal component analysis. "PCA results confirm the presence of a single latent dimension in each of the seven pillars (one component with an eigenvalue greater than 1.0) that captures between close to 55% (pillar 4: Market sophistication) up to 83% (pillar 1: Institutions) of the total variance in the three underlying sub-pillars. Furthermore,results confirm the expectation that the sub-pillars are more correlated to their own pillar than to any other pillar and that all correlation coefficients are close to or greater than 0.70. (Table A-V.1).The five input pillars share a single statistical dimension that summarizes 82% of the total variance, and the five loadings (correlation coefficients) of these pillars are very similar to each other (0.84–0.93). This similarity suggests that the five pillars make roughly equal contributions to the variation of the Innovation Input Sub-Index scores, as envisaged by the developing team. The reliability of the Input Sub-Index, measured by the Cronbach alpha value, is very high at 0.94—well above the 0.70 threshold for a reliable aggregate. The two output pillars—Knowledge and technology outputs andCreative outputs—are strongly correlated to each other (0.80);they are also both strongly correlated with the Innovation OutputSub-index (0.94 to 0.96).

UNITED STATES OF AMERICA (THE)

GII 2019 rank

3

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2018 rank
6	**3**	**High**	**NAC**	**326.8**	**20,513.0**	**62,605.6**	**6**

		Score/Value	Rank	
	INSTITUTIONS	**89.7**	**11**	
1.1	**Political environment**	**84.2**	**16**	
1.1.1	Political and operational stability*	84.2	25	
1.1.2	Government effectiveness*	84.2	14	
1.2	**Regulatory environment**	**93.9**	**9**	
1.2.1	Regulatory quality*	85.6	15	
1.2.2	Rule of law*	89.9	15	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	**Business environment**	**91.1**	**2**	● ◆
1.3.1	Ease of starting a business*	91.2	47	
1.3.2	Ease of resolving insolvency*	90.9	3	● ◆

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**55.7**	**12**	
2.1	**Education**	**54.5**	**45**	
2.1.1	Expenditure on education, % GDP ⊙	5.0	50	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	22.5	39	
2.1.3	School life expectancy, years	16.3	29	
2.1.4	PISA scales in reading, maths, & science	487.6	29	◇
2.1.5	Pupil-teacher ratio, secondary ⊙	14.7	67	○ ◇
2.2	**Tertiary education**	**34.6**	**53**	
2.2.1	Tertiary enrolment, % gross ⊙	88.8	8	
2.2.2	Graduates in science & engineering, %	17.9	73	○
2.2.3	Tertiary inbound mobility, %	5.0	40	
2.3	**Research & development (R&D)**	**77.9**	**3**	● ◆
2.3.1	Researchers, FTE/mn pop. ⊙	4,256.3	23	
2.3.2	Gross expenditure on R&D, % GDP	2.8	9	
2.3.3	Global R&D companies, avg. exp. top 3, mn US$	100.0	1	● ◆
2.3.4	QS university ranking, average score top 3*	99.0	1	● ◆

		Score/Value	Rank	
	INFRASTRUCTURE	**59.2**	**23**	
3.1	**Information & communication technologies(ICTs)**	**89.7**	**8**	
3.1.1	ICT access*	84.8	14	
3.1.2	ICT use*	77.2	21	
3.1.3	Government's online service*	98.6	2	●
3.1.4	E-participation*	98.3	5	
3.2	**General infrastructure**	**49.4**	**19**	
3.2.1	Electricity output, GWh/mn pop.	13,000.9	9	
3.2.2	Logistics performance*	85.2	14	
3.2.3	Gross capital formation, % GDP	21.1	87	○
3.3	**Ecological sustainability**	**38.4**	**64**	◇
3.3.1	GDP/unit of energy use	8.1	74	○
3.3.2	Environmental performance*	71.2	26	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	106	○ ◇

		Score/Value	Rank	
	MARKET SOPHISTICATION	**87.0**	**1**	● ◆
4.1	**Credit**	**94.6**	**1**	● ◆
4.1.1	Ease of getting credit*	95.0	3	● ◆
4.1.2	Domestic credit to private sector, % GDP ⊙	192.2	3	● ◆
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**73.7**	**7**	◆
4.2.1	Ease of protecting minority investors*	64.7	47	
4.2.2	Market capitalization, % GDP	150.3	5	
4.2.3	Venture capital deals/bn PPP$ GDP	0.4	1	● ◆
4.3	**Trade, competition, & market scale**	**92.7**	**1**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	1.7	18	
4.3.2	Intensity of local competition†	84.3	3	● ◆
4.3.3	Domestic market scale, bn PPP$	20,513.0	2	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**62.7**	**7**	
5.1	**Knowledge workers**	**76.4**	**4**	◆
5.1.1	Knowledge-intensive employment, %	47.3	11	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % GDP	2.0	8	
5.1.4	GERD financed by business, %	63.6	9	
5.1.5	Females employed w/advanced degrees, %	26.3	6	◆
5.2	**Innovation linkages**	**54.3**	**9**	
5.2.1	University/industry research collaboration†	80.9	1	● ◆
5.2.2	State of cluster development†	79.5	1	● ◆
5.2.3	GERD financed by abroad, %	6.2	58	○
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	9	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	3.3	15	
5.3	**Knowledge absorption**	**57.3**	**7**	
5.3.1	Intellectual property payments, % total trade	1.8	15	
5.3.2	High-tech imports, % total trade	17.2	9	◆
5.3.3	ICT services imports, % total trade	1.5	40	
5.3.4	FDI net inflows, % GDP	2.4	72	○
5.3.5	Research talent, % in business enterprise ⊙	71.0	5	◆

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**59.7**	**4**	◆
6.1	**Knowledge creation**	**72.3**	**3**	● ◆
6.1.1	Patents by origin/bn PPP$ GDP	15.1	6	◆
6.1.2	PCT patents by origin/bn PPP$ GDP	2.7	12	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	10.5	44	◇
6.1.5	Citable documents H-index	100.0	1	● ◆
6.2	**Knowledge impact**	**60.4**	**2**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	0.9	64	○
6.2.2	New businesses/th pop. 15-64	n/a	n/a	
6.2.3	Computer software spending, % GDP	1.1	1	● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.5	99	○ ◇
6.2.5	High- & medium-high-tech manufactures, %	0.5	10	
6.3	**Knowledge diffusion**	**46.5**	**15**	
6.3.1	Intellectual property receipts, % total trade	5.0	1	● ◆
6.3.2	High-tech net exports, % total trade	5.8	27	
6.3.3	ICT services exports, % total trade	1.6	65	
6.3.4	FDI net outflows, % GDP	1.8	33	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**45.5**	**15**	
7.1	**Intangible assets**	**50.3**	**32**	
7.1.1	Trademarks by origin/bn PPP$ GDP	22.0	85	○ ◇
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.2	61	
7.1.3	ICTs & business model creation†	81.0	6	
7.1.4	ICTs & organizational model creation†	83.7	1	● ◆
7.2	**Creative goods & services**	**43.8**	**5**	◆
7.2.1	Cultural & creative services exports, % total trade	2.5	5	◆
7.2.2	National feature films/mn pop. 15-69	2.9	58	◇
7.2.3	Entertainment & Media market/th pop. 15-69	100.0	1	● ◆
7.2.4	Printing & other media, % manufacturing	1.5	31	
7.2.5	Creative goods exports, % total trade	3.3	17	
7.3	**Online creativity**	**37.5**	**19**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	100.0	1	● ◆
7.3.2	Country-code TLDs/th pop. 15-69	2.4	62	◇
7.3.3	Wikipedia edits/mn pop. 15-69	26.1	42	◇
7.3.4	Mobile app creation/bn PPP$ GDP	30.1	17	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

Global Innovation Index is Not Only Measurement

2020 Bloomberg Innovation Index

2020 Rank	2019 Rank	YoY Change	Economy	Total Score	R&D Intensity	Manufacturing Value-added	Productivity	High-tech Density	Tertiary Efficiency	Researcher Concentration	Patent Activity
1	2	+1	Germany	88.21	8	4	18	3	26	11	3
2	1	-1	S. Korea	88.16	2	3	29	4	16	5	11
3	6	+3	Singapore	87.01	12	2	4	17	1	13	5
4	4	0	Switzerland	85.67	3	6	14	10	17	3	19
5	7	+2	Sweden	85.50	4	16	19	7	13	7	18
6	5	-1	Israel	85.03	1	31	15	5	32	2	7
7	3	-4	Finland	84.00	10	15	9	14	24	9	10
8	11	+3	Denmark	83.22	7	24	6	8	31	1	24
9	8	-1	U.S.	83.17	9	27	12	1	47	29	1
10	10	0	France	82.75	13	39	16	2	20	17	8
11	12	+1	Austria	82.40	6	11	13	19	12	8	16
12	9	-3	Japan	82.31	5	5	35	9	30	16	12
13	15	+2	Netherlands	81.28	17	28	17	6	36	12	14
14	13	-1	Belgium	79.93	11	25	11	13	49	14	13
15	16	+1	China	78.80	15	14	47	11	5	39	2
16	14	-2	Ireland	78.65	34	1	1	12	39	20	34
17	17	0	Norway	76.93	16	51	5	20	10	10	22
18	18	0	U.K.	76.03	21	44	27	15	6	19	21
19	21	+2	Italy	75.76	24	23	21	16	33	25	20
20	19	-1	Australia	74.13	18	55	8	21	15	31	6
21	31	+10	Slovenia	73.93	19	8	20	40	14	15	26
22	20	-2	Canada	73.11	22	35	26	26	35	21	9

IS China Innovative?

Critics on "left" say no:

within China's education system.[22] In a recent article, he concludes: *"Innovation is driven by open interaction…and by the confidence that the law will back any intellectual property rights that you create and protect your profits. None of these preconditions apply in China…China is the classic bubble economy, its innovative capabilities fatally undermined by the one-party state."*[23] A more nuanced version of this argument is made by Daron Acemoglu and James Robinson in their book *Why Nations Fail,* which analyses the governance and institutional underpinnings of economic success. In their discussion of China's growth, Acemoglu and Robinson suggest that it *"is just another form of growth under extractive political institutions…unlikely to translate into sustained economic development."*[24] Others identify shorter-term, but no less fundamental problems, in China's weak enforcement of IP protection, and in its sclerotic enterprise sector, which has little incentive to innovate.

Critics on the right say China's technology is driven by nationalist govt rather than economics.

tank, the Information Technology and Innovation Foundation, provides a forceful statement of this position: *"China seeks not merely competitive advantage, but absolute advantage. In other words, China's strategy is to win in virtually all industries, especially advanced technology products and services."*[25] It sees China's 2006 MLP as the start of a 'shift to a 'China Inc.' development model focused on helping Chinese firms, often at the expense of foreign firms. This narrative plays into, and is reinforced by concerns about

BUT 1)PER CAPITA MEASURES MAKE SMALL GOOD PERFORMERS LOOK GREAT BUT ARE IRRELEVANT
FOR HUGE COUNTRIES: China is low because some innov measures are per capita … but others are not –
2)National rankings not fit easily with MULTINATIONAL FIRMS AND GLOBAL CHAIN OF KNOWLEDGE

CHINA

GII 2019 rank

14

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2018 rank
5	26	Upper middle	SEAO	1,415.0	25,313.3	18,109.8	17

		Score/Value	Rank	
	INSTITUTIONS	**64.1**	**60**	
1.1	**Political environment**	**63.0**	**47**	◆
1.1.1	Political and operational stability*	75.4	46	
1.1.2	Government effectiveness*	56.8	47	◆
1.2	**Regulatory environment**	**54.6**	**100**	○
1.2.1	Regulatory quality*	38.0	81	
1.2.2	Rule of law*	39.4	77	
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	107	○
1.3	**Business environment**	**74.7**	**48**	
1.3.1	Ease of starting a business*	93.5	25	
1.3.2	Ease of resolving insolvency*	55.8	56	
	HUMAN CAPITAL & RESEARCH	**47.6**	**25**	◆
2.1	**Education**	**63.4**	**[13]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years ⏱	13.5	74	
2.1.4	PISA scales in reading, maths, & science	514.3	8	◆
2.1.5	Pupil-teacher ratio, secondary	13.3	59	
2.2	**Tertiary education**	**20.6**	**94**	○
2.2.1	Tertiary enrolment, % gross	51.0	55	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	0.4	101	○
2.3	**Research & development (R&D)**	**58.8**	**17**	◆
2.3.1	Researchers, FTE/mn pop	1,234.8	46	
2.3.2	Gross expenditure on R&D, % GDP	2.1	15	◆
2.3.3	Global R&D companies, avg. exp. top 3, mn US$	91.7	6	◆
2.3.4	QS university ranking, average score top 3*	82.5	3	● ◆
	INFRASTRUCTURE	**58.7**	**26**	◆
3.1	**Information & communication technologies(ICTs)**	**74.5**	**46**	
3.1.1	ICT access*	60.0	75	
3.1.2	ICT use*	61.5	55	
3.1.3	Government's online service*	86.1	34	
3.1.4	E-participation*	90.5	29	◆
3.2	**General infrastructure**	**63.8**	**2**	● ◆
3.2.1	Electricity output, GWh/mn pop	4,487.7	48	
3.2.2	Logistics performance*	72.1	26	◆
3.2.3	Gross capital formation, % GDP	44.2	4	● ◆
3.3	**Ecological sustainability**	**37.9**	**67**	
3.3.1	GDP/unit of energy use	6.6	94	○
3.3.2	Environmental performance*	50.7	97	○ ◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	7.1	14	◆
	MARKET SOPHISTICATION	**58.6**	**21**	◆
4.1	**Credit**	**45.3**	**43**	◆
4.1.1	Ease of getting credit*	60.0	66	
4.1.2	Domestic credit to private sector, % GDP	155.8	7	◆
4.1.3	Microfinance gross loans, % GDP	0.0	69	○
4.2	**Investment**	**42.2**	**64**	
4.2.1	Ease of protecting minority investors*	60.0	61	
4.2.2	Market capitalization, % GDP	70.2	22	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	22	◆
4.3	**Trade, competition, & market scale**	**88.2**	**2**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	3.8	73	
4.3.2	Intensity of local competition†	74.4	32	
4.3.3	Domestic market scale, bn PPP$	25,313.3	1	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**55.4**	**14**	◆
5.1	**Knowledge workers**	**84.9**	**[1]**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms ⏱	79.2	1	● ◆
5.1.3	GERD performed by business, % GDP	1.7	12	◆
5.1.4	GERD financed by business, %	76.5	2	● ◆
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**27.2**	**58**	
5.2.1	University/industry research collaboration†	56.5	27	◆
5.2.2	State of cluster development†	59.6	28	◆
5.2.3	GERD financed by abroad, %	0.6	93	○
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	57	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.0	27	◆
5.3	**Knowledge absorption**	**54.1**	**13**	◆
5.3.1	Intellectual property payments, % total trade	1.1	30	
5.3.2	High-tech imports, % total trade	23.3	4	● ◆
5.3.3	ICT services imports, % total trade	0.8	85	
5.3.4	FDI net inflows, % GDP	1.7	88	○
5.3.5	Research talent, % in business enterprise	60.7	12	◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**57.2**	**5**	◆
6.1	**Knowledge creation**	**68.1**	**4**	● ◆
6.1.1	Patents by origin/bn PPP$ GDP	53.7	1	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	2.1	17	◆
6.1.3	Utility models by origin/bn PPP$ GDP	72.4	1	● ◆
6.1.4	Scientific & technical articles/bn PPP$ GDP	11.9	42	
6.1.5	Citable documents H-index	54.2	13	◆
6.2	**Knowledge impact**	**66.6**	**1**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	7.1	1	● ◆
6.2.2	New businesses/th pop. 15-64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.4	24	◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	16.9	20	
6.2.5	High- & medium-high-tech manufactures, % ⏱	0.5	12	◆
6.3	**Knowledge diffusion**	**37.0**	**22**	◆
6.3.1	Intellectual property receipts, % total trade	0.1	56	
6.3.2	High-tech net exports, % total trade	27.9	1	● ◆
6.3.3	ICT services exports, % total trade	1.2	75	
6.3.4	FDI net outflows, % GDP	1.4	42	
	CREATIVE OUTPUTS	**48.3**	**12**	◆
7.1	**Intangible assets**	**77.6**	**1**	● ◆
7.1.1	Trademarks by origin/bn PPP$ GDP	238.7	1	● ◆
7.1.2	Industrial designs by origin/bn PPP$ GDP	26.3	1	● ◆
7.1.3	ICTs & business model creation†	61.7	56	
7.1.4	ICTs & organizational model creation†	59.7	46	◆
7.2	**Creative goods & services**	**35.2**	**15**	◆
7.2.1	Cultural & creative services exports, % total trade	0.5	49	
7.2.2	National feature films/mn pop. 15-69	0.8	87	○
7.2.3	Entertainment & Media market/th pop. 15-69	6.9	42	
7.2.4	Printing & other media, % manufacturing ⏱	0.8	79	○
7.2.5	Creative goods exports, % total trade	11.9	1	● ◆
7.3	**Online creativity**	**2.7**	**79**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	2.4	75	
7.3.2	Country-code TLDs/th pop. 15-69	5.4	46	
7.3.3	Wikipedia edits/mn pop. 15-69	0.3	111	○
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

2) Can We Get "Real Measures" of Innovations: BIG DATA Development of Innovations Data-base

1) Use advanced natural language processing to scrape the web for new product announcements
2) OR crowd-source by getting volunteers to search web sites/lists for innovations in given sector
3) Crowd-source to quantify the importance of the innovation; Was it awarded as being among most important by some outside group? how much it contributed to sales? Did it affect exports etc. Who bought it – inter-industry effect on productivity of users?
4) The result: a new data resource on commercial innovations that will update in real time.

Examples of Web-based Data on Innovation

Lists of Top Innovations

- http://www.fastcompany.com/1738506/the-10-most-innovative-companies-in-health-care
- http://www.rdmag.com/Awards/RD-100-Awards/2011/06/R-D-100-2011-Winners-Overview/
- Small Business Administration—http://www.sba.gov/content/sba-announces-winners-2011-tibbetts-awards
- *Technology Review*—http://www.technologyreview.com/tr50/
- http://my.clevelandclinic.org/media_relations/library/2011/2011-10-6-cleveland-clinic-unveils-top-10-medical-innovations-for-2012.aspx

Innovation Data Reported by Companies

- New England BioLabs products—http://www.neb.com/nebecomm/newprod.asp
- GE products—http://www.ge.com/products_services/directory/by_product.html
- Corning—http://www.corning.com/displaytechnologies/en/index.aspx

Sites That Collects Innovation Data ProductDb: http://productdb.org

About New Electronics

Established more than 40 years ago, *New Electronics* is the electronics industry's leading magazine and a central hub for design engineers. With its blend of technology features, news and new product information, *New Electronics* keeps designers and managers up to date with the fastest moving industry in the world.

Microsemi unveils enhanced quantum rubidium miniature atomic clock (/electronics/microsemi-unveils-enhanced-quantum-rubidium-miniature-atomic-clock/75741/)

(/electronics/microsemi-unveils-enhanced-quantum-rubidium-miniature-atomic-clock/75741/)
Microsemi is making available an enhanced Quantum Rubidium Miniature Atomic Clock (MAC) SA.3X family. Based on Microsemi's coherent population trapping (CPT) technology, the MAC SA.3X family is only 25 percent of the volume of the nearest competing clock in the same category.

Read Article (/electronics/microsemi-unveils-enhanced-quantum-rubidium-miniature-atomic-clock/75741/)

Evaluation board strengthens support for software-defined sensor (/electronics/evaluation-board-strengthens-support-for-software-defined-sensor/75729/)

(/electronics/evaluation-board-strengthens-support-for-software-defined-sensor/75729/)
Melexis has introduced an evaluation board (EVB) to strengthen the support available for its

RPM/Columbia/Legacy Recordings Set To Release Bennett & Brubeck - The White House Sessions, Live 1962, An Historic One-Time Musical Summit Of Two American Jazz Masters

Recently Discovered Master Tapes From Sony Music Entertainment Vaults Reveal Impromptu Genius in The White House Seminar Program American Jazz Program

Lost Jazz Treasure Available for the First Time Ever on Tuesday, May 28

NEW YORK, April 1, 2013 /PRNewswire/ -- RPM/Columbia Records/Legacy Recordings, the catalog division of Sony Music Entertainment, is proud to release -- for the first time ever -- the complete Tony Bennett and Dave Brubeck performance from the White House Seminar American Jazz Concert , held on August 28, 1962. With the Washington Monument as the evening's

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Processor Supervisors

Diodes Incorporated announced new 3-PIN Microprocessor Supervisor/Reset Circuit. More

APX803S-31SA-7 — Diodes Incorporated

Datasheet — 03/03/2017

Bluetooth

Dialog Semiconductor today announced the next generation in its SmartBond family - DA14586. More

DA14585-00000AT2 — Dialog Semiconductor (UK) LTD

Datasheet — 03/01/2017

Solid State Relays

Omron announced the new G3VM-31HR MOSFET Relay.

G3VM-31HR — Omron

Datasheet — 03/01/2017

PMIC Solutions

Texas Instruments announced the new TPS650864, Configurable Multi-Rail PMIC for Xilinx MPSoCs and FPGAs. More

TPS65086470RSKT — Texas Instruments

Datasheet — 03/01/2017

Solid State Relays

Broadcom Limited announced the new ASSR-7300, Extreme Temperature(+175C), Hermetically Sealed, Optically Isolated, 60V Solid State Relay. More

ASSR-7300-300 — Broadcom Limited

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Hall Effect Sensors

Allegro MicroSystems, LLC introduces two new 0Degree to 360Degree angle sensor ICs that provide contactless high-resolution angular position information. More

A1337LLETR-T — Allegro MicroSystems

Datasheet — 02/28/2017

LCD Monitors

Advantech announced the new KT-D190, 19"" Monochrome Radiology Monitor. More

KT-D190S4EUA — Advantech

Datasheet — 02/26/2017

Last done by humans in 1982 SBA study – read technology and industry magazines. Data on localization of innovation. Small Business Administration contract study report (Edwards and Gordon, 1984) 8,074 innovations compiled from 46 trade journals where they obtained: Model name, trade name or trademark; Name and description of innovation; Year of introduction; Innovation type (product, process); Innovation significance (new class, new type, significant improvement, updated model); Origin of technology, source of funding

Audretsch, David B; Feldman, Maryann P **R&D spillovers and the geography of innovation and production** *The American Economic Review;* Jun 1996; 86,

TABLE 1—GEOGRAPHIC DISTRIBUTION OF INNOVATIVE ACTIVITY FOR MOST INNOVATIVE INDUSTRIES

SIC[a]	Industry[b]	State	Number of innovations	State share of industry innovations	Industry share of state innovation
3573	Computers (n = 821)	California	342	41.7	35.1
		Massachusetts	78	9.5	21.7
		New York	58	7.1	12.7
		Texas	39	4.8	23.1
		New Jersey	38	4.6	8.9
		Illinois	28	3.4	12.1
3823	Process control instruments (n = 464)	California	80	17.2	8.2
		Massachusetts	61	13.1	16.9
		New York	45	9.7	9.9
		Pennsylvania	40	8.6	16.5
		Illinois	32	6.9	13.9
3662	Radio and TV communications equipment (n = 339)	California	105	31.0	10.8
		New York	40	11.8	8.8
		Massachusetts	32	9.4	8.9
3674	Semiconductors (n = 172)	California	84	48.8	8.6
		Massachusetts	17	9.9	4.7
		Texas	13	7.6	7.7
3842	Surgical appliances (n = 152)	New Jersey	43	28.3	10.1
		California	17	11.2	1.7
		Pennsylvania	10	7.9	4.1
2834	Pharmaceuticals (n = 127)	New Jersey	50	39.4	11.7
		New York	18	14.2	3.9
		Pennsylvania	10	7.9	4.1
		Michigan	8	6.3	7.1
3825	Measuring instruments for electricity (n = 115)	California	37	32.2	3.8
		Massachusetts	22	19.1	16.9
		New York	13	11.3	2.9

Less concentrated geographically than production.

TABLE 2—GEOGRAPHIC CONCENTRATION OF PRODUCTION AND INNOVATIVE ACTIVITY FOR MANUFACTURING SECTORS (MEAN GINI COEFFICIENTS)[a]

Manufacturing sector	Value added	Employment	Innovation
Food and beverages	0.6973 (0.1685)	0.5584 (0.1828)	0.2567 (0.2226)
Tobacco	0.6589 (0.2559)	0.4137 (0.1444)	0.3319 (0.2043)
Textiles	0.7040 (0.1149)	0.5670 (0.1430)	0.1659 (0.2347)
Apparel	0.6179 (0.1589)	0.5160 (0.1687)	0.0583 (0.1469)
Lumber	0.6309 (0.1007)	0.5605 (0.1208)	0.1180 (0.1235)
Furniture	0.5815 (0.1373)	0.4632 (0.1366)	0.4204 (0.2347)
Paper	0.6036 (0.1525)	0.5580 (0.1568)	0.2363 (0.3253)
Printing	0.5977 (0.1491)	0.5325 (0.1485)	0.1762 (0.2220)
Chemicals	0.7003 (0.1612)	0.5987 (0.1790)	0.3881 (0.1945)
Petroleum	0.6786 (0.1512)	0.4766 (0.1493)	0.2598 (0.3674)
Rubber and plastics	0.5771 (0.3089)	0.4569 (0.2434)	0.3932 (0.1952)
Leather	0.7186 (0.1150)	0.5552 (0.1300)	0.0646 (0.1119)

Dispersion of innovations related to Universities not to geog of production.

TABLE 5—OLS REGRESSION RESULTS ESTIMATING GINI COEFFICIENTS ACROSS STATES[a]

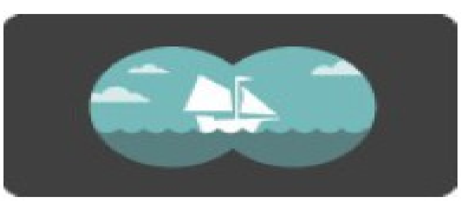
	Gini of production			Gini of innovation		
	(1)	(2)	(3)[b]	(4)	(5)	(6)[b]
Gini of innovation	—	0.768	−0.125	—	—	—
		(0.143)	(−1.741)			
Natural resources	0.326	0.330	0.384	—	—	−0.108
	(4.950)	(5.261)	(5.058)			(−1.228
Scale	−0.137	−0.160	−0.244	—	—	−0.007
	(−4.162)	(−4.173)	(−0.695)			(1.986
Transportation costs	1.223	1.419	1.741	—	—	0.006
	(4.439)	(4.838)	(5.631)			(1.674
Industry R&D/sales	0.455	0.436	0.608	0.469	0.565	0.543
	(7.791)	(7.170)	(2.860)	(2.137)	(2.405)	(2.341
Skilled labor	1.094	1.058	1.318	0.466	0.657	0.645
	(15.044)	(12.483)	(15.031)	(4.910)	(4.581)	(4.686
University research	—	—	0.034	0.108	0.116	0.118
			(2.147)	(7.920)	(8.093)	(8.139
Gini of production	—	—	—	—	−0.119	−0.146
					(−1.587)	(−1.741
Sample size	163	163	163	163	163	163
R^2	0.951	0.952	0.970	0.827	0.908	0.921

Crowd-Sourcing Research

Consider Old Weather (http://www.oldweather.org/),which invites people to assist in digitising weather observations in US log books dating from the mid-19th century onwards. In February 2013, the project was awarded the Royal Meteorological Society IBM Award for Meteorological Innovation that Matters.

Old Weather: Our Weather's Past, the Climate's Future

Help scientists recover Arctic and worldwide weather observations made by United States' ships since the mid-19th century. These transcriptions will contribute to climate model projections and will improve our knowledge of past environmental conditions. Historians will use your work to track past ship movements and tell the stories of the people on board.



Digitise pages

To earn points on each ship. Every page counts

Follow vessels

Choose your voyage by joining a vessel

Get promoted

Work your way up from Cadet to Lieutenant and even become Captain

INNOVATION HUNTER

Follow innovations. Pick your own set and earn points by filling in the innovation profile

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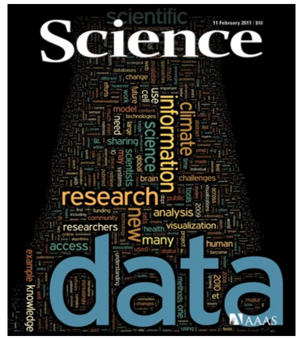
Work your way up from novice to researcher to investor

Learn the science and art of evaluating projects, companies.



Oh, yeahhh!

Studies that Focus on "Innovations" – marketing with announcements

Sood-Tellis, Do Innovations Really Pay Off? Total Stock Market Returns to Innovation (**Marketing Science, Vo 28, No. 3 (May-June 2009), pp. 442-456** --- by assessing the **total market returns to the entire innovation project on 5,481 announcement**s from 69 firms in five markets and 19 technologies between 1977 and 2006.

Table 1 Events During Initiation, Development, and Commercialization Activities of Innovation Projects

Phase	Initiation	Development	Commercialization
Events unique to this study	Funding (grants, advanced order, funded contracts) Expansion (new development or manufacturing facilities)	Prototypes (working prototypes, identification of new materials, processes or equipment, demonstration in exhibitions)	New product Launch (shipments, new applications)
		This research (positive and negative events are recorded separately for announcements of all activities)	
Events covered by prior research	Alliances (joint ventures, acquisitions)	Patents Preannouncements (more than one week ahead of future events)	New product Launches Awards (external recognition of quality)
Prior research	Hirschey (1982) Jaffe (1986) Cockburn and Griliches (1988) Doukas and Switzer (1992) Chan et al. (1992) Hall (1993) Das et al. (1998) Chan et al. (2001) Suárez (2002)	Pakes (1985) Jaffe (1986) Erickson and Jacobson (1992) Kelm et al. (1995)	Eddy and Saunders (1980) Wooldridge and Snow (1990) Chaney et al. (1991) Zantout and Chaganti (1996) Hendricks and Singhal (1996) Koku et al. (1997) Przasnyski and Tai (1999) Nicolau and Sellers (2002) Sorescu et al. (2003) Bayus et al. (2003) Pauwels et al. (2004) Sorescu et al. (2007) Tellis and Johnson (2007)

Initiation activities include events about alliances (including joint ventures and acquisitions), funding (including grants, advanced orders, and funded contracts), and expansions for new innovation projects.

Development activities include events about prototypes (working prototypes, demonstration in exhibitions, and new materials, equipment, and processes), and preannouncements (more than one week ahead of future events)

Commercialization activities include events about new product launch (including launches, initial shipments, and new applications), and awards (external recognition of quality). **Only commercialization activities signal culmination in terms of revenues from sales of the new product**

We measure research productivity by the number of new product launches per year prior to the date of the current event.

$$R_{it} - R_{ft} = \alpha_i + \beta_{1i}(R_{mt} - R_{ft}) + \beta_{2i}SMB_t + \beta_{3i}HML_i + \beta_{4i}UMD_i + \varepsilon_{it} \quad (1)$$
$$E[\varepsilon_{it}] = 0; \quad \mathrm{Var}[\varepsilon_{it}] = \sigma^2_{\varepsilon_i},$$

where

t: Subscript for time of the estimation window, such that $-270 \leq t \leq -6$;
i: Subscript for announcement
R_i: Returns to announcement i on day t;
R_m: Returns to corresponding daily equally weighted S&P 500;
R_f: Theoretical rate of return attributed to an investment with zero risk;
SMB: Returns on a portfolio of small stocks minus returns on large stocks;
HML: Returns on a portfolio of stocks with high book-to-market ratio minus the returns to a portfolio of stocks with low book-to-market ratio;
UMD: Carhart's price-momentum factor that captures one-year momentum in returns.

The sum of returns to all events within an innovation project is the total returns to that project. We exclude firms where data on shares outstanding are not available from CRSP. We then calculate the returns to each project as the sum of returns to all announcements for that project: *Trjp = RALjp +RFNjp +REPjp +RPRjp +RPTjp +RPAjp +RPLjp +RRQjp. But this is not identical to taking price before/after whole period of project?*

They note that firms differ in their announcement strategies: Microsoft announces all events related to the project. Other companies, for example, like Apple, aggregate many events into one big announcement.

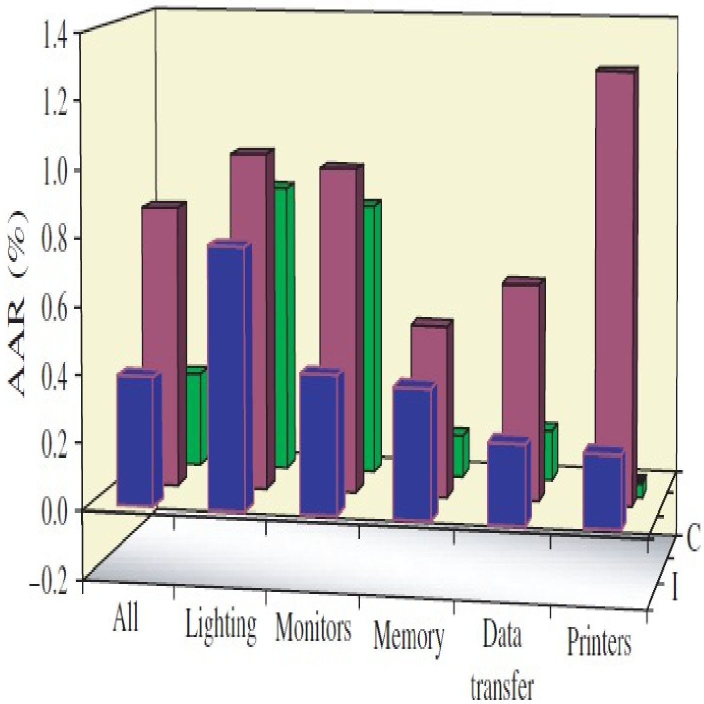
Table 2 Sample Characteristics

Category	External lighting	Display monitors	Desktop memory	Data transfer	Printers
Number of firms	19	17	18	17	11
Total number of announcements	696	1,100	1,239	1,323	1,123
Sample period	1977–2006	1980–2006	1979–2006	1982–2006	1981–2006
Initiation activities	155	278	270	327	117
Development activities	171	305	274	183	126
Commercialization	370	517	695	813	880
Number/type of platform technologies	5	5	5	3	4
	Incandescence, arc-discharge, gas-discharge, LED, MED	CRT, LCD, PDP, OLED	Magnetic, magneto-optical, optical	Copper/aluminum, fiber optics, wireless	Dot matrix, inkjet, laser thermal

Table 3 Descriptive Statistics: Abnormal Returns to an Average Event by Category for Various Windows

		AAR (event day)					CAAR (±1 day)		CAAR (±2 days)	
Category	*N*	Est. (%)	*t*-value	*p*-value[a]	Percentage of positive	*p*-value[b]	Est. (%)	*t*-value	Est. (%)	*t*-value
All	5,481	0.4	7.4	<0.0001	52	<0.0001	0.5	14.7	0.5	3.3
Lighting	696	0.9	6.3	<0.0001	56	<0.0001	1.1	13.7	1.4	3.6
Monitors	1,100	0.8	3.5	<0.0001	51	0.015	0.7	5.7	0.4	0.7
Memory	1,239	0.3	2.7	0.0135	51	0.004	0.5	9.3	0.4	1.4
Data transfer	1,323	0.2	2.8	0.0047	51	0.004	0.2	4.6	0.3	1.5
Printers	1,123	0.1	1.8	0.1301	51	0.026	0.1	1.6	0.3	1.5

Figure 1 Average Abnormal Returns (AAR) in Each Set of Activities of Innovation Project



	All (%)	Lighting (%)	Monitors (%)	Memory (%)	Data transfer (%)	Printers (%)
I	0.4	0.8	0.4	0.4	0.2	0.20
D	0.8	1.0	1.0	0.5	0.6	1.30
C	0.3	0.9	0.8	0.1	0.2	0.04

Table 5 Total Abnormal Returns to Innovatio

Stage	Total abnormal returns (%) (Equation (7))
All	10.3
Lighting	13.1
Monitors	19.8
Memory	7.02
Data transfer	7.4
Printers	3.8

Table 6 Effect of Innovation on Abnormal Returns to Competitors

		Competitors		Difference in abnormal returns to competitors vs. announcing firm	
Category	Phase	Est. (%)	*t*-value	Diff. (%)	*t*-value
All	I	0.1	0.7	−0.3	2.5
	D	0.1	2.5	−0.7	5.1
	C	0.1	2.3	−0.2	2.2
Lighting	I	−0.1	−0.6	−0.9	2.3
	D	0.0	−0.4	−1.1	2.9
	C	0.1	1.6	−0.7	2.4
Monitors	I	0.1	1.1	−0.4	1.3
	D	0.1	0.7	−4.7	3.1
	C	0.1	0.8	−0.8	3.1
Memory	I	0.1	1.6	−0.3	0.9
	D	0.1	1.1	−0.4	1.7
	C	0.0	−0.1	−0.1	0.8
Data transfer	I	0.0	0.3	−0.1	0.6
	D	0.2	1.2	−0.4	1.8
	C	0.1	1.5	−0.1	0.5
Printers	I	−0.2	−1.5	−0.5	1.7
	D	0.5	3.1	−0.9	2.0
	C	0.1	1.5	0.2	−1.5

Note. I, initiation; D, development; C, commercialization.

WHAT IT MISSING FROM THIS ANALYSIS? NON-ANNOUNCEMENT FAILED PROJECTS.

Avagyan et al http://www.uam.es/docencia/degin/catedra/documentos/6_avagyan_cesaroni_yildrim.pdf

Analyze 39 US-based, large chemical companies 1999-2008, measure environmental technologies and marketing actions to promote their environmental concern (includes pharma-- Dow chemical and Genzyme). Claim: Environmental innovations and environmental marketing actions positively affect firms" performance but when firms simultaneously develop environmental technologies and promotetechnological results by means of marketing actions, the financial market misinterprets firms' overall environmental concern and lowers firms' evaluation!.

(1) $$\boldsymbol{P}_{it} = \beta_{0i} + \beta_{1i}\, \boldsymbol{GrPatStockSh}_{it} + \beta_{2i}\, \boldsymbol{GrMktgSh}_{it} + \beta_{3i}\, \boldsymbol{NI}_{it} + \varepsilon_{it}$$

where:

- **i** = firm;
- **t** = year;
- **P** = Performance indicator (Tobin's q);
- **GrPatStockSh** = share of green patents stock (i.e., stock of green patents over total stock of patents);
- **GrMktgSh** = share of green marketing announcements (i.e., green marketing announcements over total marketing announcements);
- **NI** = Net income

Table 4 – Regression results (Fixed-effects (within) – Dep. Variable: Tobin's Q)

	I		II		III		IV	
GrPatStockSh	41.887	**			77.719	**	79.738	***
	(18.170)				(29.803)		(30.368)	
GrMktgSh			0.565	***	0.462	**	1.100	***
			(0.191)		(0.187)		(0.405)	
GrPatStockSh * GrMktgSh							-22.039	**
							(8.633)	
Net Income	2.4E-04	*	2.4E-04	*	2.4E-04	*	2.4E-04	*
	(1.3E-4)		(1.3E-4)		(1.3E-4)		(1.3E-4)	
Employees	-3.2E-05	*	-2.2E-05		-1.9E-05		-2.0E-05	
	(1.7E-5)		(2.0E-5)		(2.0E-5)		(2.0E-5)	
R&D Intensity	5.175	***	5.908	**	5.895	**	5.863	**
	(0.818)		(2.975)		(2.949)		(2.939)	
Intangible Assets	-6.5E-05	***	-6.8E-05	***	-6.8E-05	***	-6.8E-05	***
	(1.9E-5)		(2.0E-5)		(1.9E-5)		(1.9E-5)	
Constant	3.566	***	3.747	***	2.832	***	2.821	***
	(0.517)		(0.630)		(0.721)		(0.724)	
	N. obs = 405		N. obs = 335		N. obs = 335		N. obs = 335	
	F(5,363) = 13.89		F(5,293) = 6.29		F(6,292) = 5.90		F(7,291) = 4.96	

Other: Laforet S. 2009. Effects of size, market and strategic orientation on innovation in non-high-tech manufacturing SMEs. *European Journal of Marketing* **43**(1-2). Sorescu A, Spanjol J. 2008. Innovation's effect on firm value and risk: Insights from consumer packaged goods. *Journal of Marketing* **72**(2): 114-132. Srinivasan S, Pauwels K, Silva-Risso J, Hanssens D. 2009. Product innovations, advertising, and stock returns. *Journal of Marketing* **73**(1): 24-43.

Study that focuses on Patent Announcements

Kogan. Papanikolaou.Seru & Stoffman, 2017. "Technological Innovation, Resource Allocation, and Growth," The Quarterly Journal of Economics, Oxford University Press, vol. 132(2), pages 665-712
" We propose a new measure of the economic importance of each innovation. Our measure uses newly collected data on patents issued to US firms in the 1926 to 2010 period, combined with **the stock market response to news about patents to estimate its private value.** Find: 1) private economic value are positively related to the number of citations that the patent receives in the future; 2) Patents with greater rsponse have substantial growth, reallocation and creative destruction, consistent with the predictions of Schumpeterian growth models.

Getting patent data: Out of the 6.2 million patents granted in or after 1926, we find the presence of an assignee in 4,374,524 patents. After matching the names of the assignees to public firms in CRSP, we obtain a database of 1,928,123 matched patents. Out of these patents, 523,301 (27%) are not included in the NBER data. Overall, our data provides a matched permco for 44.1% of all patents with an assignee and 31% of all granted patents.

On the patent issue date, absent any other news, the firm's stock market reaction ΔV on the day the patent j is granted would be given by $\Delta V_j = (1 - \pi_j)\, \xi_j$, (1) where, π_j is the market's ex-ante probability assessment that the patent application is successful and ξ_j is the dollar value of patent j. The market's reaction to the patent grant (1) understates the total impact of the patent on the firm value, since the information about the probability that a patent will be granted is known to the market before the uncertainty about patent application is resolved

To estimate length of the announcement window examine the pattern of trading volume and choose a three-day announcement window, [t, t + 2].

TABLE I

ESTIMATES OF PATENT VALUE: DESCRIPTIVE STATISTICS

Moment	C	$\frac{C}{\bar{C}}$	R_f (%)	$E[v\|R_f]$ (%)	ξ
Mean	10.26	1.18	0.07	0.32	10.36
Std. dev.	20.13	1.98	3.92	0.20	32.04
Percentiles					
p1	0	0	−9.93	0.11	0.01
p5	0	0	−5.15	0.14	0.04
p10	0	0	−3.55	0.16	0.11
p25	1	0.20	−1.67	0.20	0.73
p50	5	0.62	−0.09	0.27	3.22
p75	11	1.38	1.62	0.37	9.09
p90	24	2.78	3.82	0.53	22.09
p95	38	4.06	5.73	0.68	38.20
p99	90	8.84	11.49	1.07	121.39

Notes. The table reports the distribution of the following variables across the patents in our sample: the number of future citations till the end of our sample period C; the number of citations scaled by the mean number of cites to patents issued in the same year $\bar{C}$; the market-adjusted firm returns R_f on the three-day window following the patent issue date; the filtered component of returns $E[v|R_f]$ related to the value of innovation using equation (4); and the filtered dollar value of innovation ξ using equation (3) deflated to 1982 (million) dollars using the CPI. Patents are always issued on Tuesdays, hence the three-day return is computed as the cumulative market-adjusted return between Tuesday and Thursday. Market adjusted returns are computed as the difference between the firm return (CRSP holding period return) minus the return of the CRSP value-weighted index. We restrict attention to the patents for which we have nonmissing data on three-day announcement return, market capitalization, and return volatilities—inputs needed to compute our $\hat{\Theta}$ measure. The sample contains 1,801,879 patents.

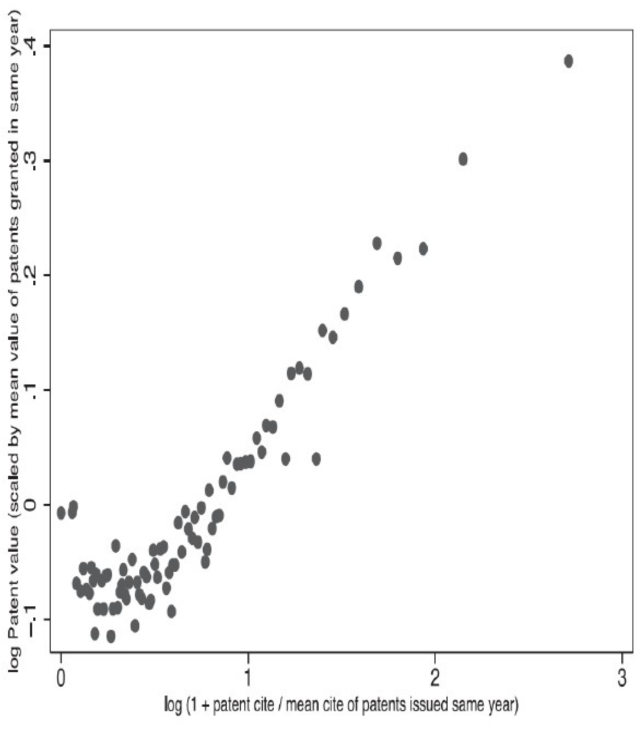


FIGURE II

Forward Citations and Patent Market Value

Figure plots the cross-sectional relation between forward patent citations and the estimated market value of patents. We group the patent data into 100 quantiles based on their cohort adjusted citations $(1 + \frac{C}{\bar{C}})$. The horizontal axis plots the log of average cohort adjusted patent citations in each quantile. The vertical axis plots the log of the average patent value in each quantile (scaled by the average value of patents granted in the same year). Patent values are constructed according to equation (3).

TABLE III

DESCRIPTIVE STATISTICS: FIRM INNOVATION AND GROWTH

	Mean	Std. dev.	p10	p25	p50	p75	p90
Innovation output, SM-weighted (θ_f^{sm}, %)	3.1	12.1	0.0	0.0	0.0	0.6	7.1
Innovation output, C-weighted (θ_f^{cw}, %)	3.8	12.8	0.0	0.0	0.0	0.6	9.4
Profits, growth rate (%)	5.9	42.5	−28.9	−7.6	5.4	19.4	41.5
Output, growth rate (%)	5.0	38.8	−24.9	−6.8	4.7	16.8	35.5
Capital stock, growth rate (%)	9.9	34.8	−9.0	−0.2	6.6	17.3	36.4
Employment, growth rate (%)	3.9	35.0	−20.5	−5.6	2.5	13.4	30.8
TFPR, log (%)	−31.8	40.3	−75.2	−49.9	−30.2	−11.2	11.8

Notes. The table presents descriptive statistics for the firm's innovative output (θ_f, defined in equation [10]) which weigh patents using their stock market reaction (SM, see equation [8]) and citations (CW, see equation [9]). In addition, we report the growth rate in firm gross profits (COMPUSTAT: sale minus COMPUSTAT: cogs, deflated by the CPI); firm output (COMPUSTAT: sale plus change in inventories COMPUSTAT: invt, deflated by the CPI); firm capital stock (COMPUTAT: ppegt, deflated by the NIPA price of equipment); firm employment (COMPUSTAT: emp); and firm TFPR, constructed using the methodology of Olley and Pakes (1996) applied on Compustat data using the procedure in Imrohoroglu and Tuzel (2014). All variables are winsorized at the 1% level using annual breakpoints.