

(itapa, Bratislava Slovakia)

Making transitions effective: The Korean approach to Industry 4.0

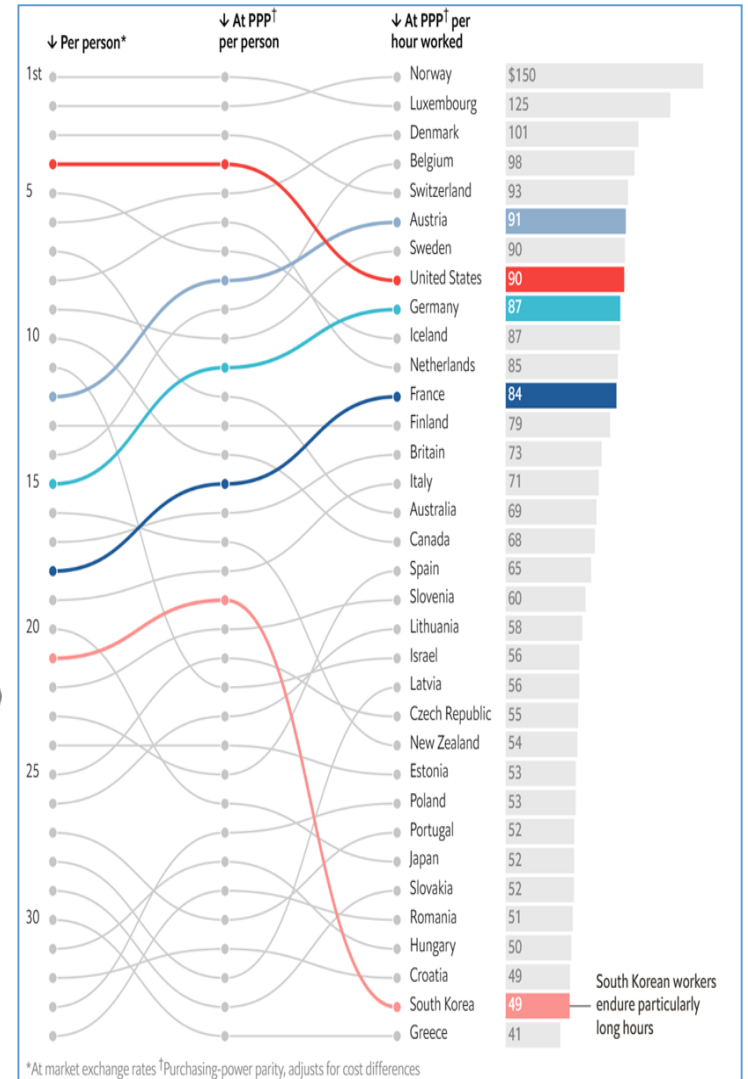
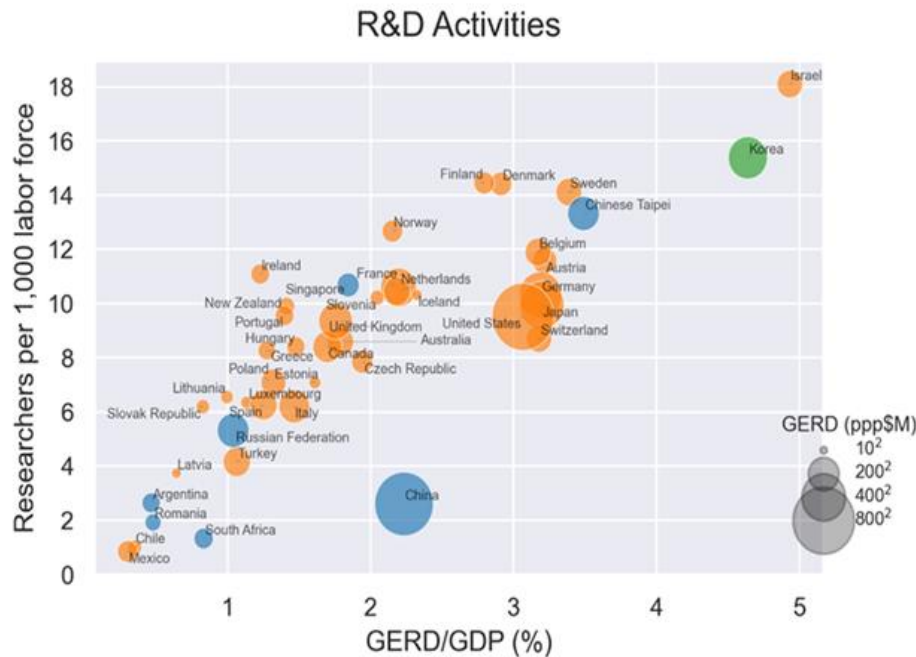
March 12, 2024

Joonghae Suh

World's Leading Think Tank



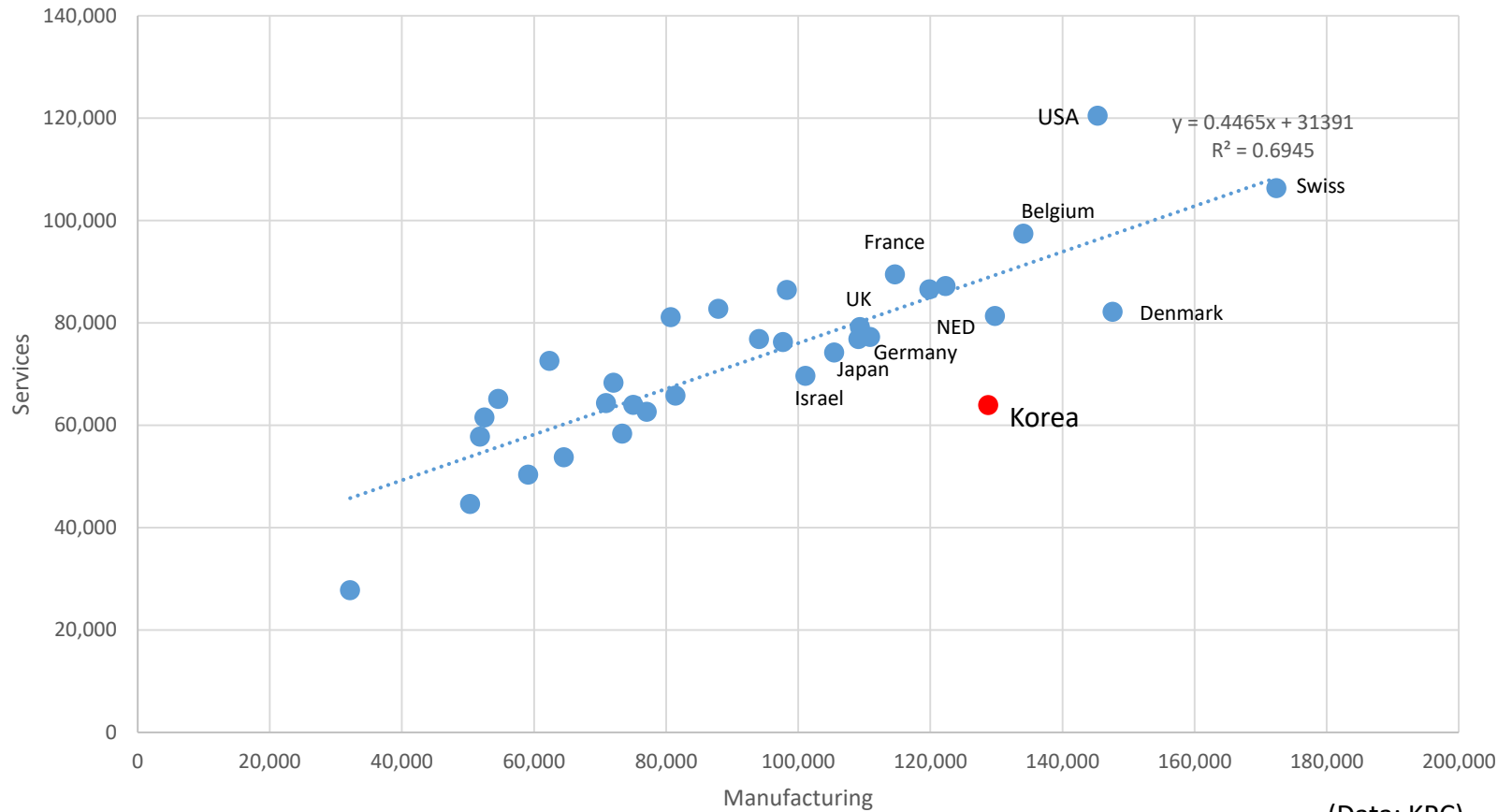
High R&D, sizable gap → Productivity puzzle?



(Data Source: PWT 10.0; OECD stat; *Economist* Oct 4, 2023)

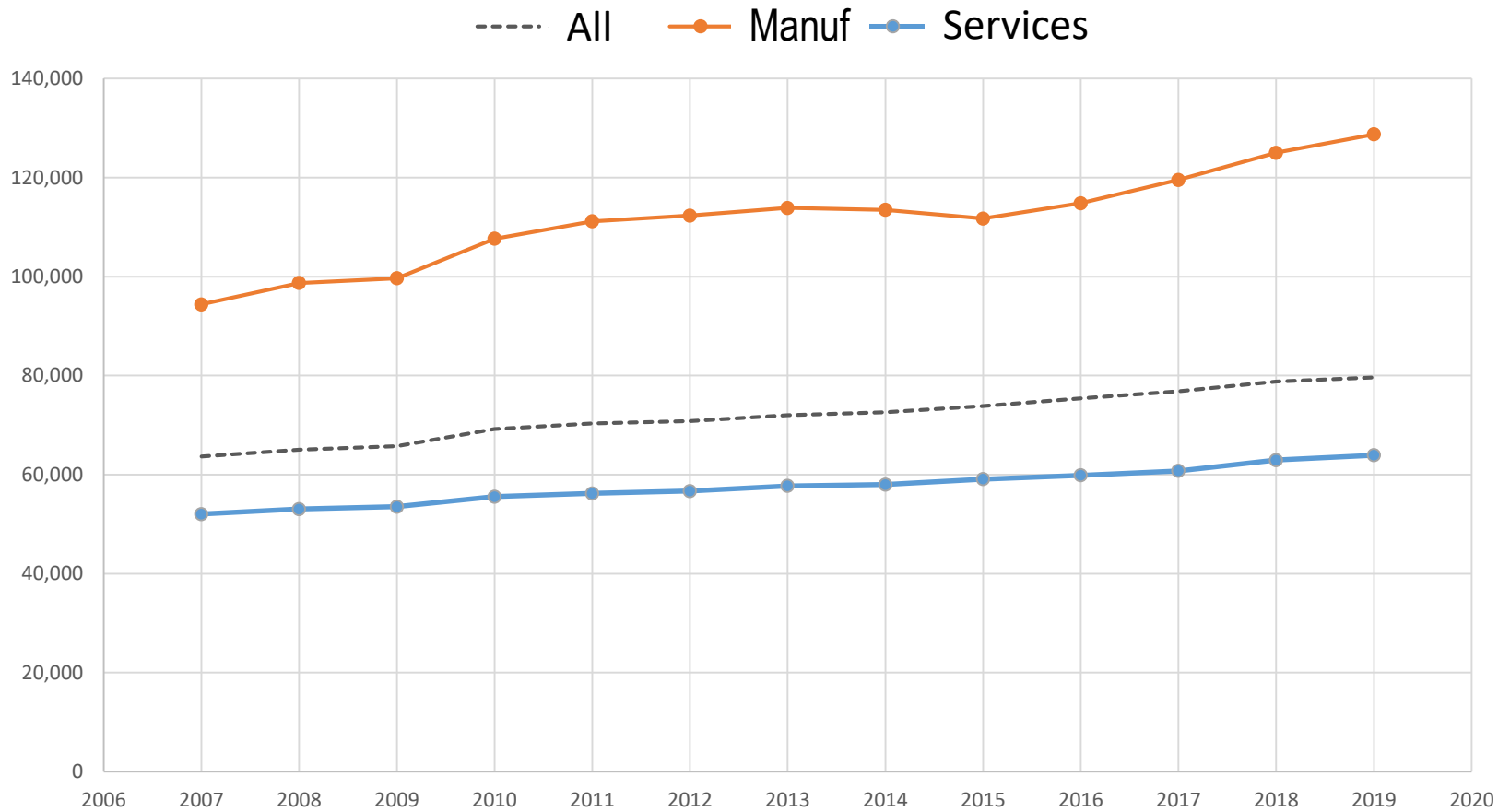
Labor productivity, 2019

(value added per labor in ppp USD)



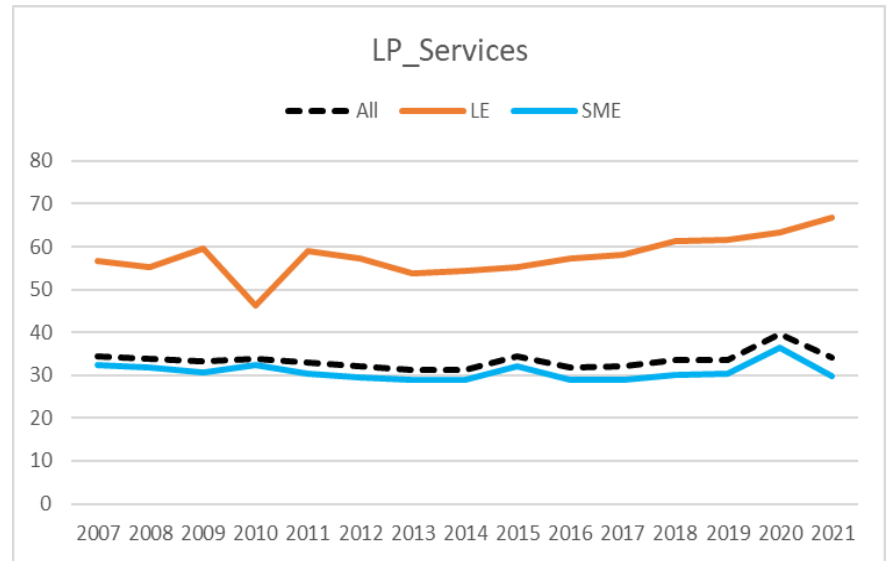
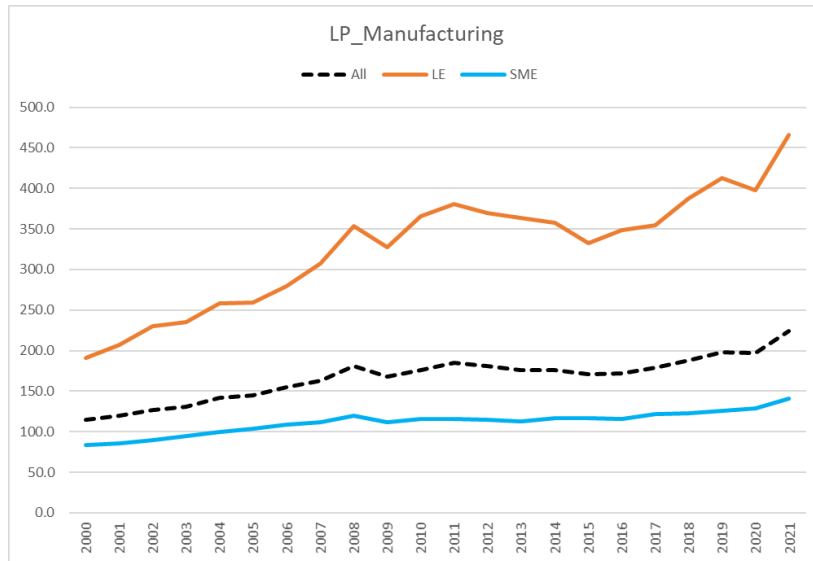
(Data: KPC)

Labor Productivity (2007-2019)



(Data: KPC)

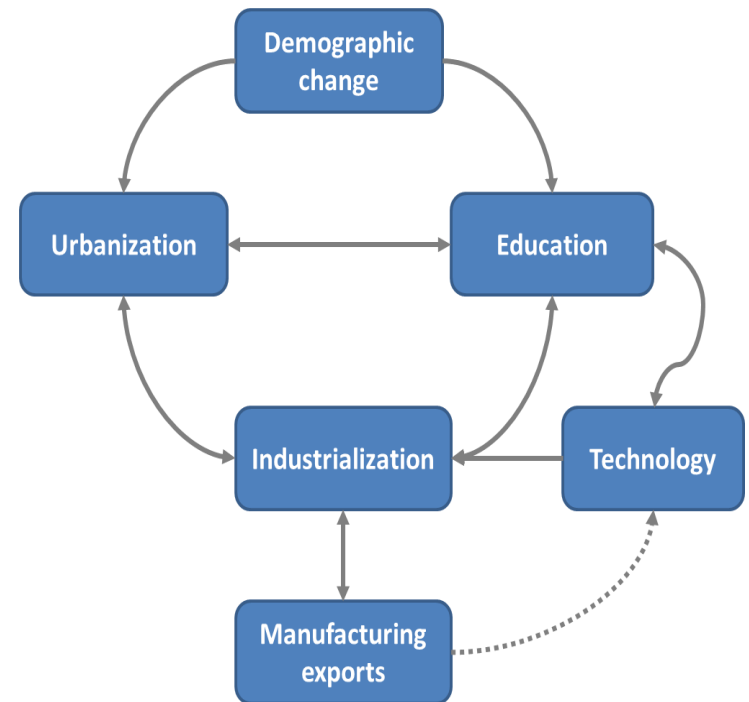
Labor Productivity in manufacturing and services: large enterprises (LE) vs small & medium-sized enterprises (SME)



The Korean Model

Driving forces of economic growth

- ① Government-led “big-push” industrialization and urbanization → **Investment-driven economic growth**
 - ② Manufacturing exports offer scale economies and learning from foreign technologies → **Industrial upgrading and moving-up the technology ladder**
 - ③ Educational expansion & training → **Big pool of cheap/well-trained labor, cost advantage of exports**
 - ④ Population growth and demographic change → **Growing home market and savings, as ultimate source of growth**
- Growing middle class, increasing tax-base → **Expanding welfare system**



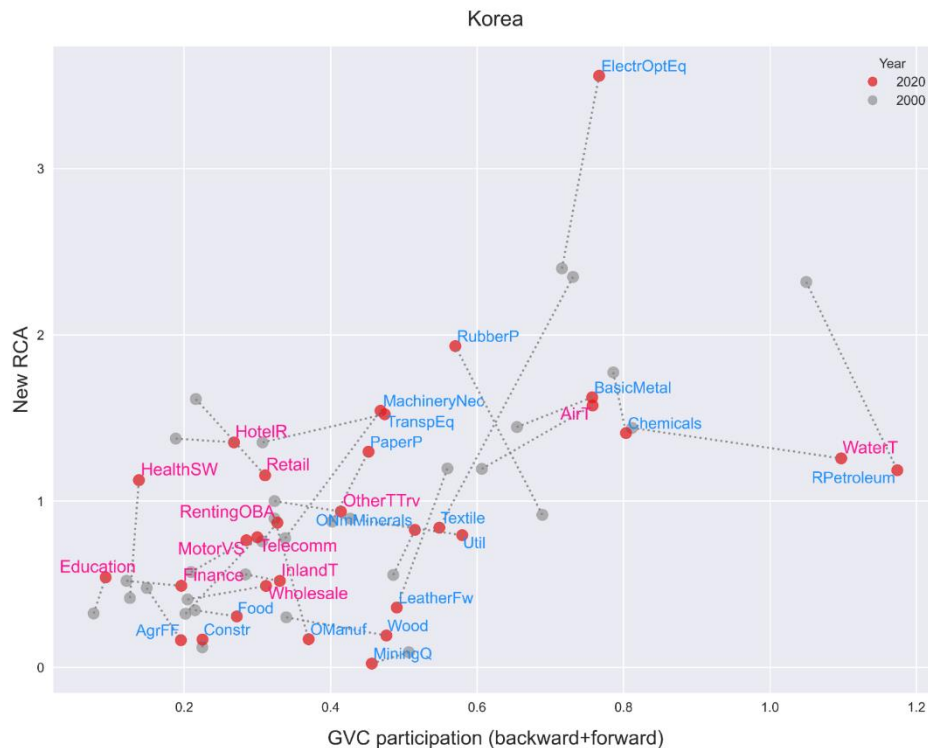
New challenges

- The Korean approach had been highly effective in, for example, mature industries
 - reverse path was effective
 - with a minor role of university
- With unintended consequences (**worsening structural disparities**)
 - LEs vs SMEs, manufacturing vs. services
 - regional unbalance
- At frontiers where uncertainty prevails, we need change from conventional approach
 - New challenges of the 4IR (Industry 4.0) calls for a new approach

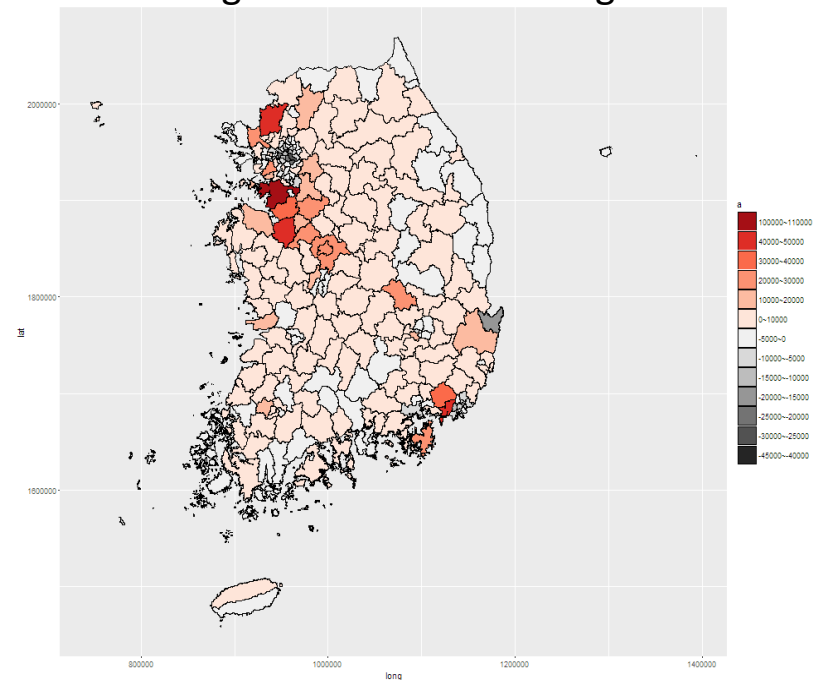
Challenges facing Korea's manufacturing sectors

Manufacturing industries climb up the technology ladder. This corresponds to:

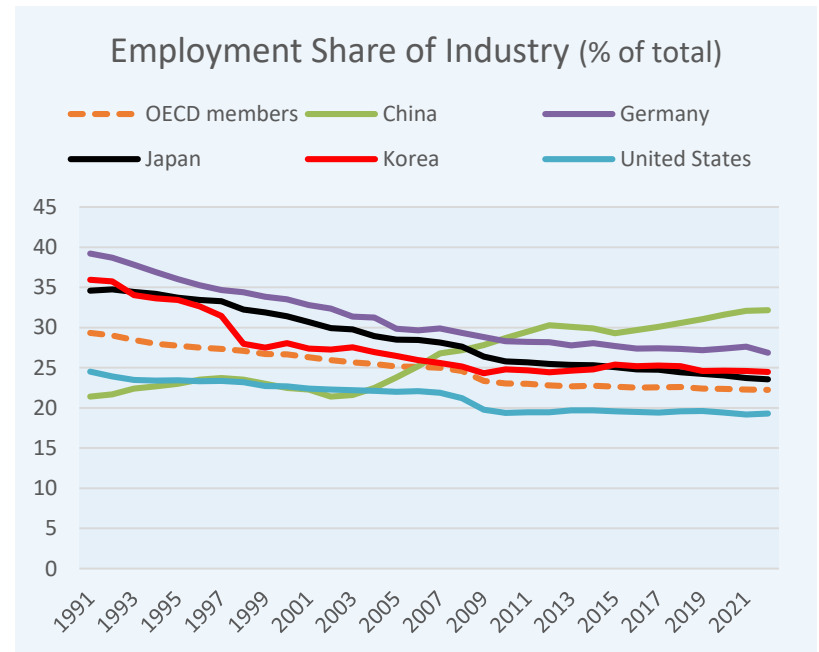
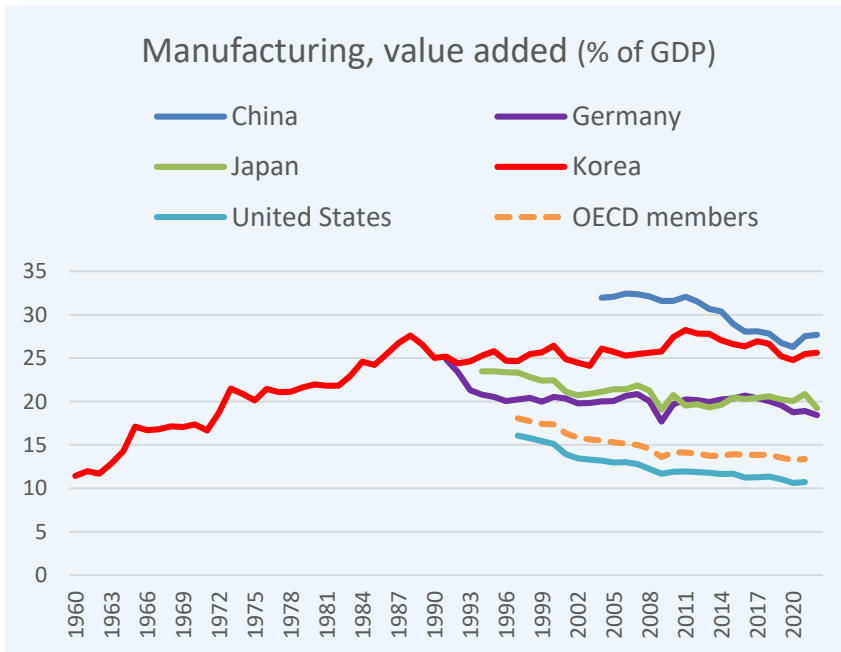
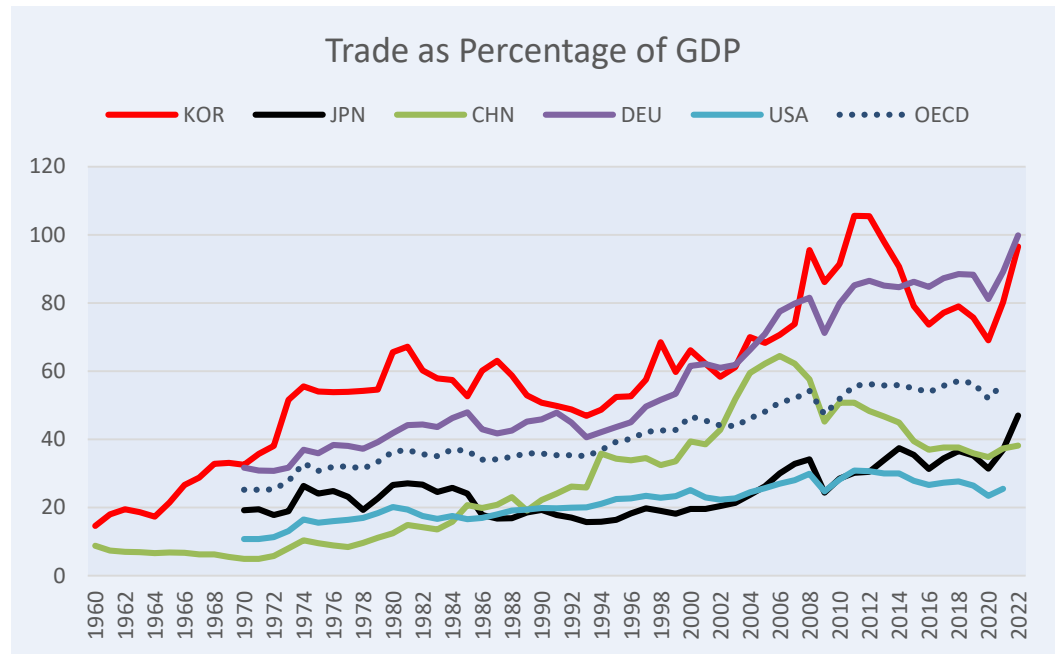
- ① Increasing tendency of hyper-specialization in international trade
- ② The gap between LEs and SMEs is not narrowing
- ③ Regional agglomeration of high-tech sectors (**manufacturing & services**), which in turn encroaches the growth base of many local economies



Regional agglomeration of high-tech manufacturing



1. Policy Consistency with long-term vision & clear policy goals



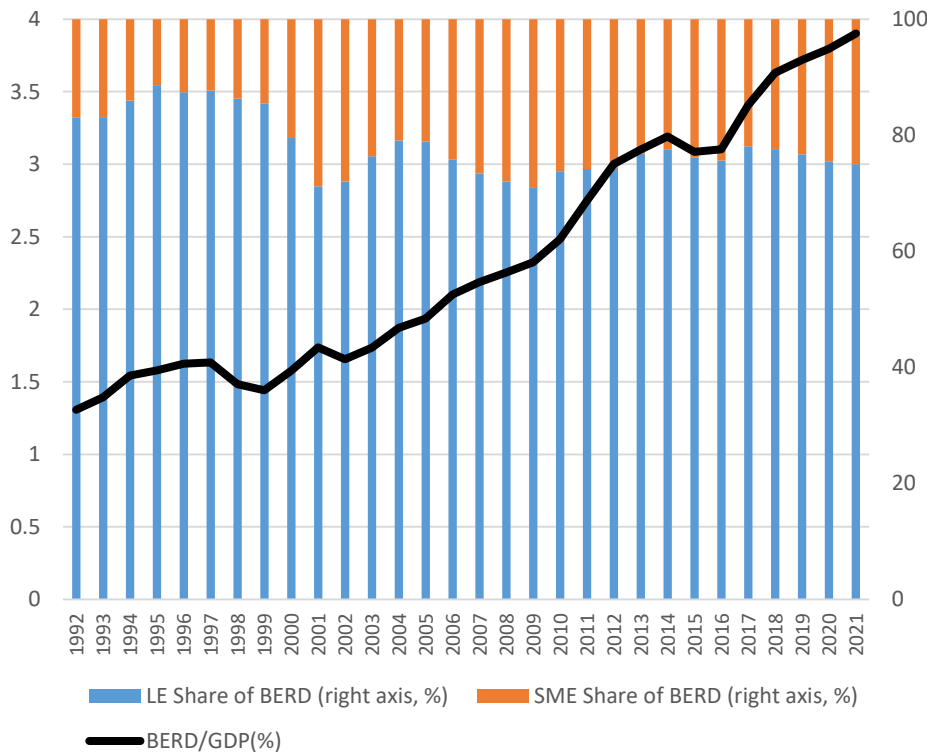
✓ Despite different rhetoric, contents are more or less similar

Governments	National Economic Goal	Policy Tasks
Roh Moo-hyun (Feb 2003 - Feb 2008)	Northeast Asian Era of Peace and Prosperity	<ul style="list-style-type: none"> • Establishing free & fair market order • Economic hub in Northeast Asia • Building a S&T-centered society • Farming/fishing villages for the future
Lee Myung-bak (Feb 2008 - Feb 2013)	Viable market economy	<ul style="list-style-type: none"> • Improve the investment environment • Reduce regulation • Create new jobs with green growth • Develop new growth engine
Park Geun-hye (Feb 2013 - Mar 2017)	Creative economy	<ul style="list-style-type: none"> • Building a creative economy ecosystem • Promoting venture and SMEs • Developing new industries and markets • Cultivating creative talent • Promoting S&T and ICT
Moon Jae-in (May 2017 - May 2022)	People-centered economy (Economy that lives well together)	<ul style="list-style-type: none"> • A job economy for income-led growth • A vibrant fair economy • A livelihood economy for the common and middle class • 4th Industrial Revolution led by S&T development • An innovation-driven economy led by startups, venture businesses and MSEs

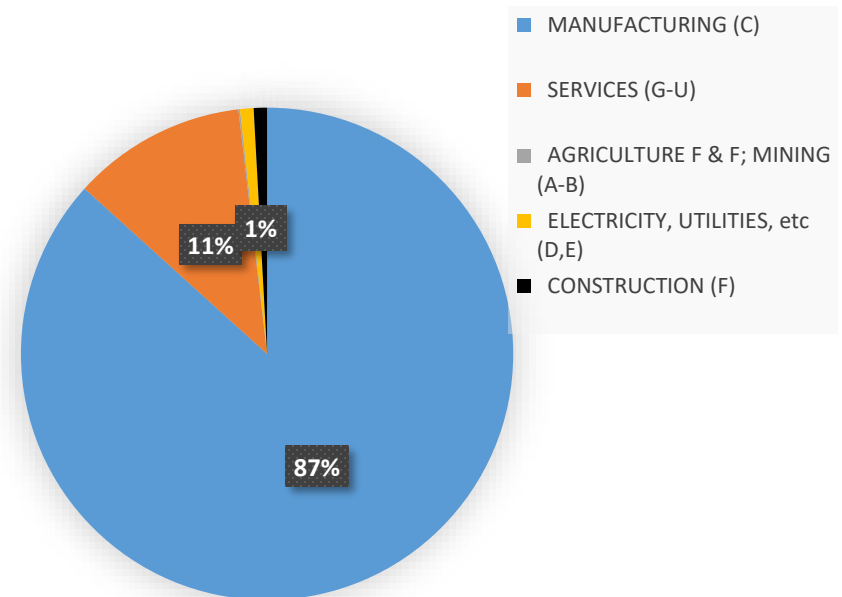
2. Adaptive policy frameworks

- ✓ Manufacturing as engine of growth & innovation

Business R&D Expenditure, 1992-2021



BERD Share by Industry, 2020



Adaptive policy frameworks

- ✓ Broad consensus building becomes essential for success

	Informatization	Digitization
Key factors	Information infrastructure	Data & computing power
Policy tools	Building info-infra Financial support, & others	+ Building system/network
Outcome & Evaluation thereof	Tangible, short-term Easily quantifiable	Intangible, long-term Relational, not easy
Governance	Government leadership, large enterprises	Broad-based: SMEs and VB Civil participation



The Case of Smart Factory Programme

Korea implements the canonical policy framework into the following schemes:

- ① TIPA: Annual Surveys of Informatization of SMEs
 - TIPA (Korea Technology and Informatization Agency for SMEs 중소기업기술정보진흥원)
 - Comparison between SMEs and LEs, inclusion of digitalization
 - Useful indicator for the overall effectiveness of I&D policies
- ② NABO: Review and Evaluation of Government's Industrial Policies
- ③ NABO: Economic Effects of Government's Strategic Investment Programs



① TIPA: Annual Surveys of INF & DX of SMEs

Summary of Annual Survey on the Level of Informatization

	2002	2016	2017	2018	2019	2020	2021
SMES (A)	48.6	59.9	61.1	67.2	68.7	70.8	71.5
LES (B)	65.9	72.8	72.9	75.5	77.4	78.2	79.0
A/B (%)	73.7	82.4	83.7	89.0	88.8	90.6	90.5

Evaluation of SME's Digital Transformation (DT), 2021

	SMES	LES	RATIO (%)
MANUFACTURING	16.2	35.6	45.5
(1) FOOD & BEVERAGE	15.9	27.9	57.0
(2) TEXTILE & CLOTHING	14.3	40.3	35.5
(3) CHEMICALS	17.8	33.2	53.6
(4) MACHINERY	15.7	36.7	42.7
(5) ELECTRICAL/ELECTRONICS	18.0	34.7	51.8
(6) OTHER MANUFACTURING	14.5	66.9	21.6
CONSTRUCTION	11.6	27.9	41.5
INFORMATION & COMM SERVICES	37.0	51.7	71.5
KNOWLEDGE-BASED SERVICES	21.3	44.1	48.2
RETAIL & WHOLESALE TRADE	12.6	28.1	44.9
TRANSPORTATION SERVICES	12.8	38.6	33.0
ALL INDUSTRIES	16.2	34.9	46.4



- Smart Manufacturing Innovation Vision 2025 (April 2017)
- Four Policy Goals of Government's Smart Factory Project:
 - ① The establishment of 30,000 smart factories by 2025
 - ② The establishment of 1,500 leading exemplar smart factories by 2025
 - ③ Intensive support for R&D and creating markets for further development
 - ④ Support for training skilled human resources

- Self-Assessment of MOTIE
 - productivity increased by 23%,
 - product defect rate decreased by 46%,
 - overall cost decreased by 16%, and
 - delivery time shortened by 35%”

✓ NABO (2017) agreed in principle the basic framework of government's smart factory project, but suggested further improvements



Government's initiatives for strategic investment

	BUDGET (IN BILLION KOREAN WON)				NUMBER OF PROJECTS IN 2020
	2018	2019	2020	SUM (2018-2020)	
DATA-AI ECONOMY	218.7	557.6	595.0	1,371.3	25
HYDROGEN ECONOMY	34.5	75.0	111.6	221.1	10
INNOVATIVE HRD	152.7	237.0	295.2	684.9	23
FUTURE CAR	518.8	1,096.3	1,347.7	2,962.8	18
UAV (DRONE)	14.8	81.5	96.0	192.3	13
NEW ENERGY INDUSTRIES	473.5	687.1	743.1	1,903.7	11
BIO-HEALTH	9.8	50.3	62.3	122.4	10
SMART FACTORY	414.1	925.0	1,823.9	3,163.0	6
SMART CITY	17.7	94.6	162.2	274.5	8
SMART FARM	76.0	217.0	298.0	591.0	14
FINTECH	3.6	13.2	22.4	39.2	2
TOTAL SUM OF BUDGET	1,934.2	4,034.6	5,557.7	11,526.5	141



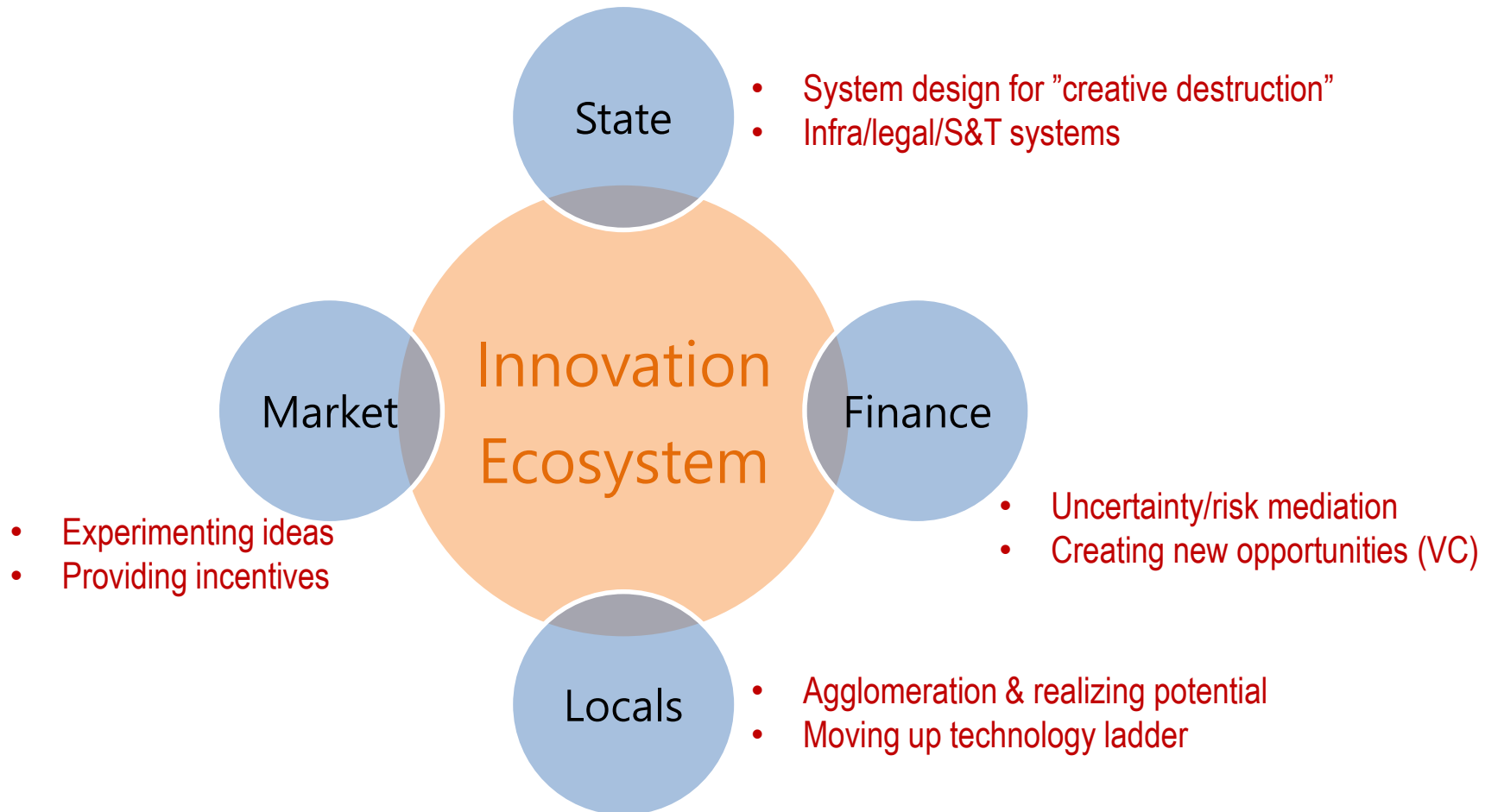
Estimation Results of Economic Effects: Production, VA, Employment

	PRODUCTION INDUCEMENT COEFFICIENT		VALUE-ADDED INDUCEMENT COEFFICIENT		EMPLOYMENT INDUCEMENT COEFFICIENT	
1	FUTURE CAR	2.50	INNOVATIVE HRD	0.93	INNOVATIVE HRD	15.24
2	NEW ENERGY INDUSTRIES	2.41	SMART CITY	0.90	BIO-HEALTH	12.88
3	HYDROGEN ECONOMY	1.94	BIO-HEALTH	0.87	HYDROGEN ECONOMY	12.55
4	SMART FACTORY	1.93	HYDROGEN ECONOMY	0.86	SMART FACTORY	11.49
5	SMART FARM	1.85	DATA-AI ECONOMY	0.86	UAV	10.28
6	UAV	1.85	SMART FACTORY	0.85	DATA-AI ECONOMY	9.78
7	BIO-HEALTH	1.77	SMART FARM	0.84	SMART CITY	9.54
8	FINTECH	1.72	FINTECH	0.84	SMART FARM	9.54
9	DATA-AI ECONOMY	1.69	UAV	0.79	NEW ENERGY INDUSTRIES	8.79
10	INNOVATIVE HRD	1.45	NEW ENERGY INDUSTRIES	0.77	FUTURE CAR	8.38
11	SMART CITY	1.42	FUTURE CAR	0.73	FINTECH	7.73

Inducement Coefficients of Input-Output Tables, 2015-2019

		2015	2016	2017	2018	2019
	PRODUCTION INDUCEMENT	1.813	1.807	1.795	1.79	1.791
	VA INDUCEMENT	0.774	0.791	0.78	0.773	0.78
EMPLOYMENT INDUCEMENT	AGRICULTURE	11.4	11.2	10.6	10.1	10.1
	MANUFACTURE	7.2	7.0	6.5	6.2	6.2
	SERVICES	14.5	14.1	13.5	12.8	12.5

3. Ecosystem perspective



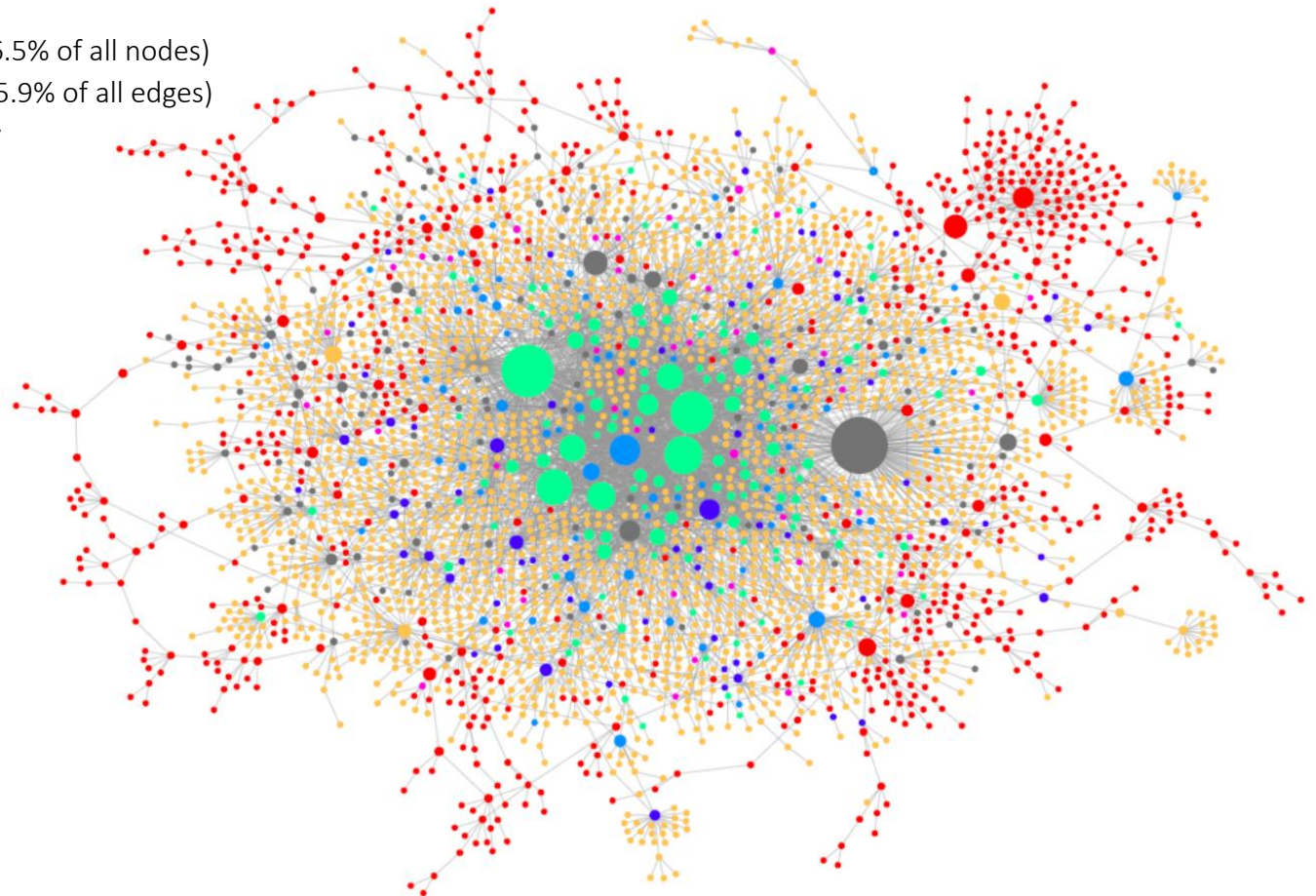
Co-patenting network 2021, the largest component

- Core of network is composed of small number of U, RI, and BG
- Business enterprises are ① majority, ② BGs are a bridge-role, ③ weak link with RIs
- Centrality of universities is high (& increasing); U-B partnership becomes stronger
- Role of research institutes becomes less central
- Foreign entities are ① increasing, but ② at periphery, ③ weak link with domestics

- Number of nodes = 3,545 (46.5% of all nodes)
- Number of edges = 12,692 (75.9% of all edges)

○ size = between-ness centrality

- Private enterprises
- Business groups
- Universities
- Research Inst.
- Public entities
- Other domestic
- Foreign



Changes in B-U-R partnership in co-patenting

- ① B-B is increasing and takes the largest share
- ② Increasing role of universities: with business, & U-U
- ③ Decreasing role of research inst.; very weak in R-R

source	Business Enterprises			Universities			Research Institutes		
	B	U	R	B	U	R	B	U	R
2000	1,070	57	266	68	1	3	316	12	7
2005	2,046	265	245	219	108	44	929	128	24
2010	3,591	891	315	670	249	97	366	236	26
2015	4,130	1,206	322	1,137	424	212	276	242	57
2020	6,943	1,561	278	763	915	244	218	432	118
2021	7,145	1,633	318	878	951	232	294	411	66

Changes in business enterprises

- ① SME – SME
- ② SME – universities
- ③ SME – RI & Public

source	Small & medium enterprises						
target	SME	LE	BG	Univ	Res Inst	Public	Others
2000	451	42	21	29	24	18	19
2010	1497	209	102	264	132	93	73
2020	2072	200	178	625	211	204	135
2021	2197	180	193	664	242	247	159

- ① LE – SME
- ② LE – LE
- ③ LE - universities

source	Large enterprises						
target	SME	LE	BG	Univ	Res Inst	Public	Others
2000	105	36	21	6	17	6	32
2010	237	158	48	84	24	14	14
2020	251	185	54	174	13	4	35
2021	279	138	53	132	23	2	35

- ① BG – BG
- ② BG – universities

✓ RI's role is minor

source	Business Groups						
target	SME	LE	BG	Univ	Res Inst	Public	Others
2000	76	38	280	22	225	11	54
2010	249	199	892	543	159	7	141
2020	345	291	3367	762	54	29	100
2021	363	291	3451	837	53	7	131

4. SMEs: a new policy direction

Chronology of SME policies for tech-dev & innovation

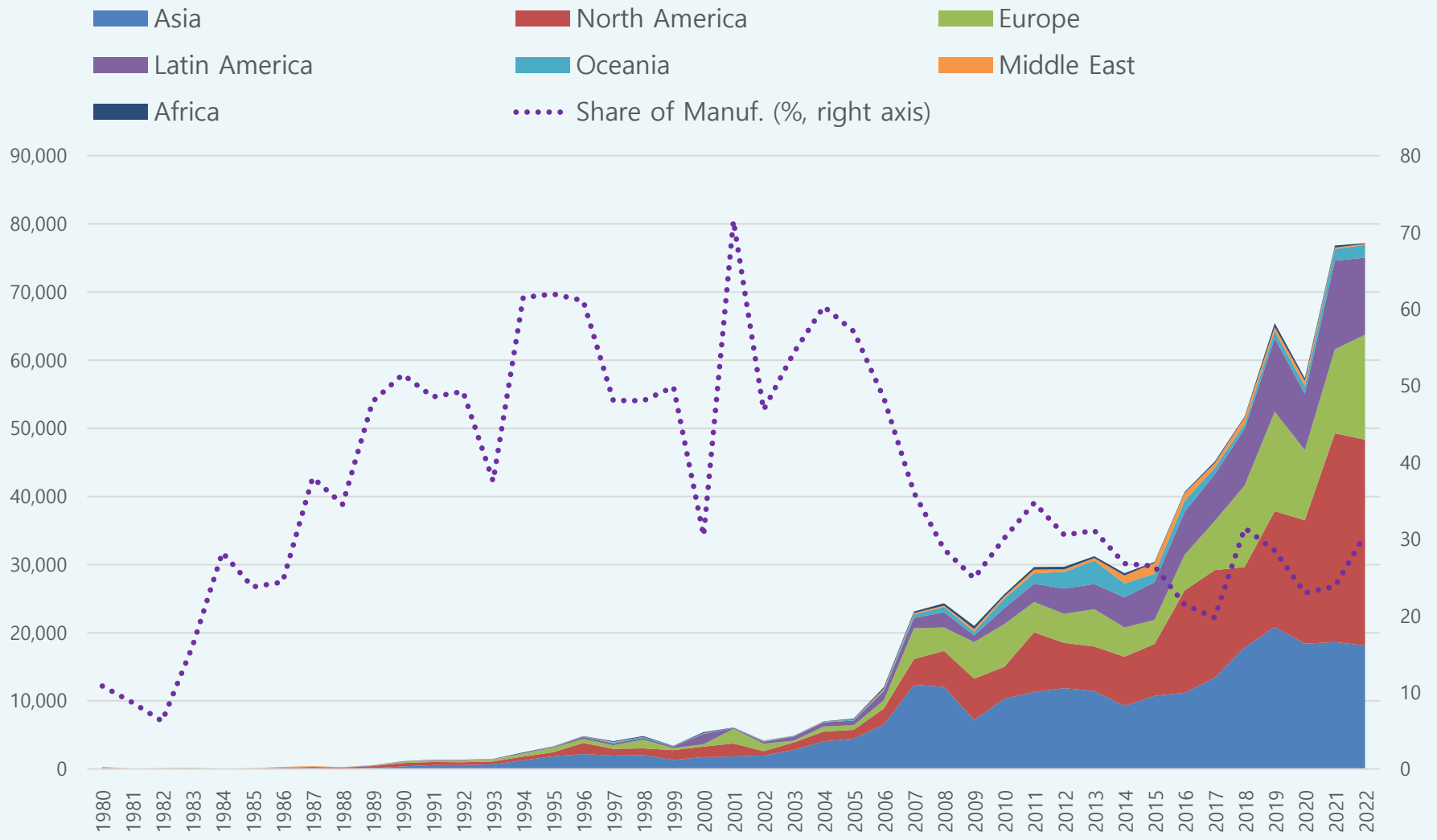
	Stages of economic development	Main focus of SME policies	Key policies and measures
1960s - 1970s	<ul style="list-style-type: none"> • Launch of industrialization • HCI drives 	Basic framework and systems of SME policies	1966: SME Basic Law 1976: Korea Credit Guarantee Fund 1979: Small Business Corporation
1980s - the early 1990s	<ul style="list-style-type: none"> • Industrial maturing • Stabilization 	Balanced development of Industry	1986: Industrial Development Act 1989: Korea Technology Finance Co.
The 2nd half of 1990s	<ul style="list-style-type: none"> • Reform and restructuring 	Venture business	1996: S&M Business Administration 1997: Venture Business Law 1998: KOSBIR
2000s	<ul style="list-style-type: none"> • Advancement of economic structure 	Innovative SMEs	2004: 1 st SME Tech. Innovation Plan 2005: Korea Venture Investment Co.
2010s - to the present	<ul style="list-style-type: none"> • Innovation-driven economic growth 	SME as growth engine	2014: 4 th SME Tech. Innovation Plan 2017: Ministry of SMEs and Startups

Government's SME Support Policies

Agency or Ministry	Policy tools							
	①	②	③	④	⑤	⑥	⑦	⑧
SMBA (MSS)	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
Industry	White	Orange	Orange	Orange	Orange	Orange	Orange	White
Labor	White	Orange	Orange	Orange	White	Orange	Orange	White
Culture	White	Orange	White	Orange	Orange	Orange	White	Orange
Agriculture	White	Orange	White	Orange	Orange	White	White	White
Environment	White	Orange	White	Orange	White	White	White	White
Education	White	White	Orange	White	White	White	White	White
Land	White	Orange	White	White	White	White	Orange	White
Economy	Orange	White	White	Orange	White	White	White	White
Finance	White	White	White	Orange	White	White	White	White
Patent	White	White	White	White	White	White	Orange	White
Customs	White	White	White	White	Orange	White	White	White
Food	White	White	White	Orange	White	White	White	White

- ① Startup venture ② Tech development ③ Human resource development ④ Financial
 ⑤ Exporting ⑥ Shared growth ⑦ Knowledge service ⑧ Traditional market support

Korea's Overseas Investment (in million USD)



(Data source: Korea Statistical Office)

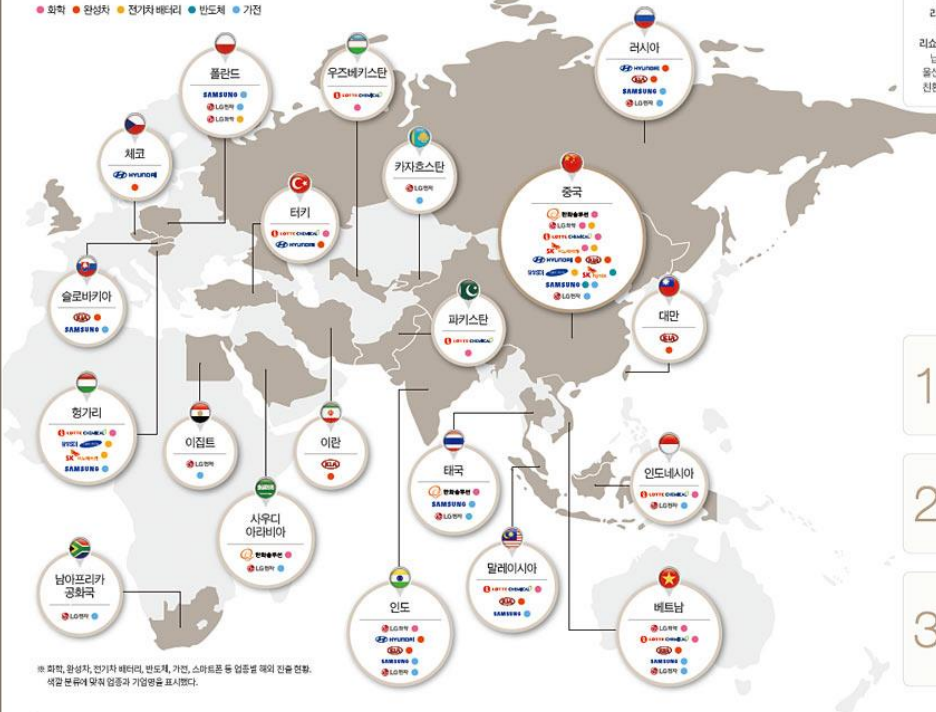
Globalization of Korea's Big Companies

Infographic 한국 기업의 글로벌 가치사슬 구성

구성: 김문관-김소희 기자
오민지 인턴기자
그래픽: 장민정 디자이너

국내 주요 대기업 생산 기지 해외 진출 현황

● 화학 ● 완성차 ● 전자차 배터리 ● 반도체 ● 가전



※ 화학, 완성차, 전자차 배터리, 반도체, 가전, 스마트폰 등 업종별 해외 진출 현황. 색깔 분류에 맞춰 업종과 기업명도 표시했다.

국내 리쇼어링 기업

현대모비스 기업 분류: 대기업 업종: 자동차 부품 리쇼어링 시기: 2019년 장소: 울산광역시 리쇼어링 이유: 부품을 전량 납품하는 현대자동차 울산 공장과 근접성 노림, 친환경차 부품 공력 예정.	동남정밀주 기업 분류: 중견기업 업종: 자동차 부품 리쇼어링 시기: 2019년 장소: 울산광역시 리쇼어링 이유: 현대모비스 협력업체로, 현대모비스 리쇼어링에 맞춰 복귀, 친환경차 부품 공력 예정.	아주스틸 기업 분류: 중견기업 업종: IT, 가전 소재 부품 리쇼어링 시기: 2020년 하반기 예정 장소: 미정 리쇼어링 이유: 원자재 생산하는 필리핀 공장과 가용하는 한국 공장 통합.	LK주얼리주 기업 분류: 중소기업 업종: 주얼리 리쇼어링 시기: 2019년 장소: 전북 익산시 리쇼어링 이유: 미국과 중국의 무역전쟁으로 중국 제조 상용에 대한 리스크 증가, 중국 인건비 상승.	루에오파드 기업 분류: 중소기업 업종: 신발 리쇼어링 시기: 2015년 장소: 부산광역시 리쇼어링 이유: 신발 산업이 발달했던 부산에서 고급 인력 공급과 원단기울 개발이 쉬울 것이라 판단.
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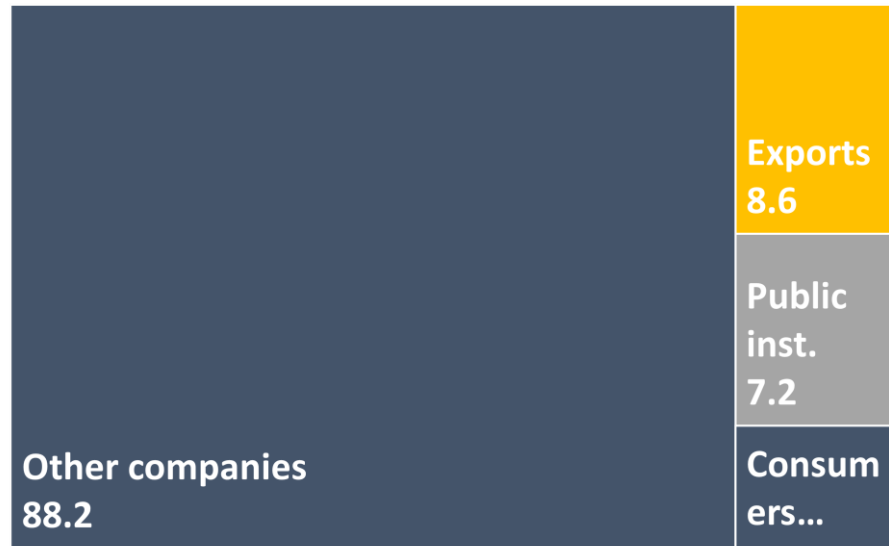
※ 2013년 '해외 진출 기업의 국내 복귀 지원에 관한 법률(유턴법)' 제정 이후 2014년 1월부터 2020년 5월까지 유턴 기업은 총 71개(대기업 1개, 중견기업 6개, 중소기업 64개).

업종별 해외 진출 요인

- 1 자동차(완성차·전자차 배터리)**
 시장 지형 진출, 자동차는 해외 생산 기지 구축 위해 거점 공장 구축, 배터리는 완성차 업체가 많은 유럽으로 진출 러시.
- 2 전자(반도체·가전·스마트폰)**
 시장 지형 및 인건비 절감형 진출, 광역별 시장별로 생산 라인 통합하는 추세, 인건비가 가장 저렴한 곳에 거점 공장 설립.
- 3 화학(석유·섬유·신소재)**
 원료 지형 및 인건비 절감형 진출, 중동은 원료 입지, 동남아는 인건비 이점 활용, 동남아 생산품을 국내서 수입해 가공 후 신진국에 수출하기도.

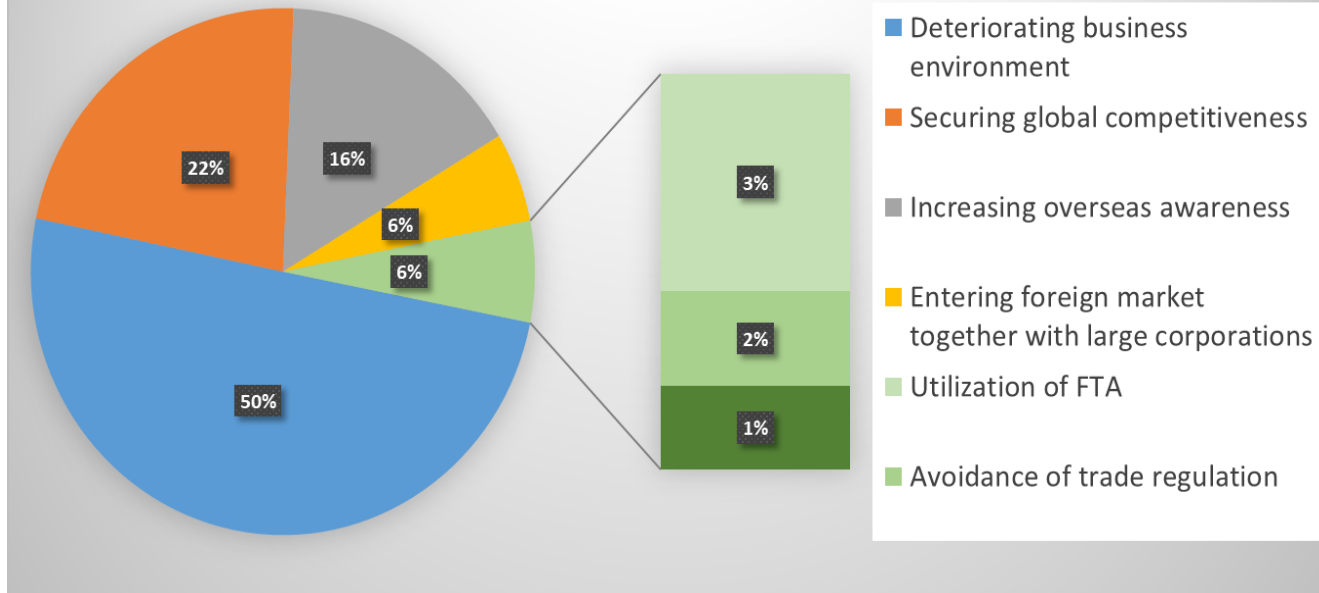
자료: 각사

SHARE OF SME'S CUSTOMERS (%)



Source: MSS (2023)

Motivation for overseas expansion of SMEs



Source: FKI (2018)

SME Policy Directions of the Yoon Government (2023)

	SMEs	Venture & start-ups
Catch Word	“50+ Economic contribution of SMEs and ventures”	“Startup Korea entering the world”
• Globalization	Export promotion	Global business ecosystem
• Digitalization	Manufacturing plants	Tech-intensive new industrial sectors
• Shared growth	Between large firms and SMEs	Creating a new venture-startup model

KDI KDI

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