

ECONOMIC DEVELOPMENT OF TAIWAN

EE482 Industrialization: Role of Public and Private Sectors
(Section 046401)

Semester 1 / 2023

Faculty of Economics, Thammasat University

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Evolution of main export products

1971~1980	1981~ 1990	1991 ~ 1999	2000 ~ 2004	2005 ~ 2006	2007 ~ 2008	2009 ~ 2012
• Decoration • Ship dismantling • Footwear • Electric fans	• Gourmet powder • Umbrella • Hat • Tennis rackets • Bicycle • ABS resin • Mini electronics • Sewing machines • Yachts • Monitors	• Scanners • Mother boards • Notebook • Computers • IC packaging • Wafer foundry	• Hub • Record Optical Disk • Mother Board • Foundry • Notebook PC • SOHO Router • LCD Monitor • WLAN • Cable Modem • DSL Modem • Optical Disk Driver • IC Packaging • Glass Fiber • Network Interface Card • ABS Copolymer • Switch • CDT Monitor	• PDA • Servers (System & Pure MB) • Mother Board • IP Phones • Notebook PC • SOHO Router • LCD Monitor • WLAN • WLAN NIC • SOHO Routers • DSL Modem • VoIP Routers • Blank Optical Disks • IC Packaging • LAN Switches • IC Foundry • Mask ROM • ABS Copolymer • Switch • Diving Suits	• Netbook • Mother Board • WLAN NIC • Servers • Notebook PC • DSL CPE • Cable CPE • LCD Monitor • PDA • IP Phone • CDT Monitor • LCD Panel • VoIP Routers • VoIP TA	• Notebook • PC • Mother Board • LCD • CDT Monitor • WLAN NIC • Digital Line (DSL) • Cable Modem • IP Phone • VoIP Gateway

Economic Miracle of Last Century

How does Taiwan create economic miracles

Since the 1960's, hard work by **small and medium enterprises**, coupled with forward looking government policies, have helped Taiwan's economy to perform brilliantly.

Strategies of import substitution and export expansion have enabled Taiwan to spread its wings and soar. Taiwan has been the world's biggest supplier of many products, creating a strong image for the Made-in-Taiwan label.

Powered by **industrial transition and upgrades**, Taiwan's foreign trade has soared to a series of record levels, **increasing 1,531-fold from 1955 to 2012.**

The Development of Taiwan Economy and Trade

Export
Expansion
Policy
(light industry)



Import
Substitution
Policy
(light industry)



1950s

1960s

1970s

1980s

1990s

2000 ~ present

Globalized operations
(developing knowledge-
based economy)



Era of Import
Replacement and
Export Expansion
(heavy industry)



Liberalization,
Internationalization, and
Systematization Policies
(strategic industries, Hsinchu
Science Park)



Era of high-tech
industry
(10 major emerging
industries)



Era of Import Replacement (1953 ~ 1960) - Development of Light Industry

Background

Taiwan was facing a shortage of funds, high unemployment, trade deficits, lack of echnology, shortage of foreign exchange, a mall domestic market, and a shortage of capital.

Target

To replace imports with domestic production to stabilize domestic prices and save on foreign exchange expenditures.

Important Policies

Implementation of export tax rebates, low-interest export loans, foreign exchange and trade reforms; highly restrictive import policy changed to one of encouraging imports.

Main Industries

Textiles, cement, glass, fertilizer, food, plywood, bicycles, motorcycles, household appliances, plastic products

Key Economic Indicators

. The average economic growth rate: 7.7%	
. CPI growth rate: 18.51% (1960)	
. GDPratio (1960)	
— Agriculture: 28.5%	Trade Value (1960)
— Manufacturing: 26.9%	- Exports: US\$0.164 billion
— Services: 44.6%	- Imports: US\$0.297 billion
	- Trade Balance: -US\$0.133 billion

Era of Export Promotion (1961~1972) - Development of Light Industry

Background In the 1960s, light industrial goods substituting imports gradually saturated the domestic market, so it became necessary to export these products in order enable Taiwan's industries to develop further.

Target To change the passive protectionist policy to a strategy of developing competitiveness and expanding exports. Replacing agricultural and fishery exports with consumer items.

Key Economic Indicators

. The average economic growth rate: 10.2%	
. CPI growth rate: 3.32%	
. GDP ratio (1972)	
— Agriculture: 12.2%	Trade Value (1972)
— Manufacturing: 41.6%	- Exports: US\$2.988 billion
— Services: 34.3%	- Imports: US\$2.514 billion
	- Trade Balance: US\$0.475 billion

Important Policies

The implementation of “Regulations to Encourage Investment”, a single exchange rate, export tax rebate, depreciation of the NT dollar, set up export processing zones, export low-interest loans, local content regulation, elimination of plant set-up restrictions.

Main Industries

Textiles, plastic products, plywood industry, electronics (assembly)

Era of Import Replacement and Export Expansion (1973~1983) - Development of Heavy Industry

Background The machinery, components and materials needed to feed the rapid expansion of light industry exports still depended on imports, which restricted the development of Taiwan's companies and industries.

Target Replace imports a second time, and develop the production of light industrial capital goods, raw materials, and components.

Key Economic Indicators

. The average economic growth rate: 8.2%	
. CPI growth rate: 11.2%	
. GDP ratio (1983)	
— Agriculture: 7.6%	Trade Value (1983)
— Manufacturing: 45.0%	- Exports: US\$25.123billion
— Services: 47.8%	-Imports: US\$20.287billion
	-Trade Balance: US\$4.836 billion

Important Policies

Expand scope of export incentives, reduce oil import tariffs and taxes on petroleum products, coordinate petrochemical production and marketing, develop industrial zones, and undertake the Ten Major Construction Projects.

Main Industries

Iron and steel, copper, aluminum and other basic metal industries; shipbuilding; automobiles; motorcycles and other means of transport; plastics; intermediate raw materials required for manmade fibers; ethylene, propylene and other petrochemical industries

Era of Liberalization, Internationalization, and Systematization Targets — The Development of Strategic Industry(1984~1990)

Background

Long-term foreign trade surplus, surging foreign exchange reserves, and sharp appreciation of the NT dollar in the second half of 1986 weakened export competitiveness.

Meanwhile, a nascent labor movement, increasing wages, and strength of the environmental protection movement forced traditional industries to shift production overseas.

Target

Develop strategic industries and enhance export competitiveness.

Key Economic Indicators

- **The average economic growth rate: 8.8%**
- **CPI growth rate: 1.55%**
- **GDP ratio (1990)**

— Agriculture: 4.2%	Trade Value (1990)
— Manufacturing: 41.2%	- Exports: US\$67.214billion
— Services: 54.6%	- Imports: US\$54.716billion
	- Trade Balance: US\$12.498billion

Important Policies

Development of high-tech, high added-value and low-power strategic industries; establishment of Science-Based Industrial Park to develop high-tech industry; enterprises encouraged to strengthen R&D and to improve productivity, quality and international competitiveness.

Main Industries

Industries with market potential; those with large add-on effects; high value-added, technology-intensive, low energy, low polluting industries: e.g., ITC, precision instruments, metals, and biotechnology.

Era of High-tech Industries (1991~2000) — Promotion of Ten Major Emerging Industries

Background

Taiwan's traditional industries continued to relocated overseas, while the competition from newly developing nations increased.

Target

Upgrade industry and strengthen international competitiveness.

Important Policies

Statute for upgrading industries to replace investment incentives; strengthen guidance on technical R&D; promotion of automation and personnel training; upgrade quality; develop more industrial zones.

Main Industries

Communications, IT, consumer electronics, semiconductors, precision instruments and automation equipment, aerospace, advanced materials, chemicals, biotechnology and pharmaceuticals, healthcare, and pollution prevention.

Key Economic Indicators

- The average economic growth rate: 6.5%
- CPI growth rate: 2.59%
- GDP ratio (2000)

— Agriculture: 2.0%	Trade Value (2000)
— Manufacturing: 29.1%	- Exports: US\$151.950billion
— Services: 68.9%	- Imports: US\$140.732billion
	- Trade Balance: US\$11.218billion

Knowledge-Based Economy (2000 ~ present) — The Development of Knowledge-Based Industry

Background

International competition becomes more intense due to globalization, development of knowledge-based economy, and the acceleration of regional economic integration.

Target

Promote knowledge-based economic activities and create an environment conducive to the development of knowledge-based industries.

Important Policies

Implemented the knowledge-based economy development project, global logistics development plan, Challenge 2008: National Development Plan, New Ten Major Construction Projects, Guidelines and Action Plans for Service Industry Development, etc.

Main Industries

The “two trillion double-star industries” (semiconductors, visual displays, digital content, and bio-technology).

Key Economic Indicators

- The average economic growth rate: 3.88% (2001-2012)
- CPI growth rate: 1.07% (2001-2012)
- GDP ratio (2012)

— Agriculture: 1.2%	Trade Value (2012)
— Manufacturing: 24.6%	- Exports: US\$301.1billion
— Services: 73.6%	- Imports: US\$270.4billion
	- Trade Balance: US\$30.7billion

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Faculty Publications: Agricultural Economics

Agricultural Economics Department

5-17-2007

Accounting for Taiwan GDP Growth: Parametric and Nonparametric Estimates

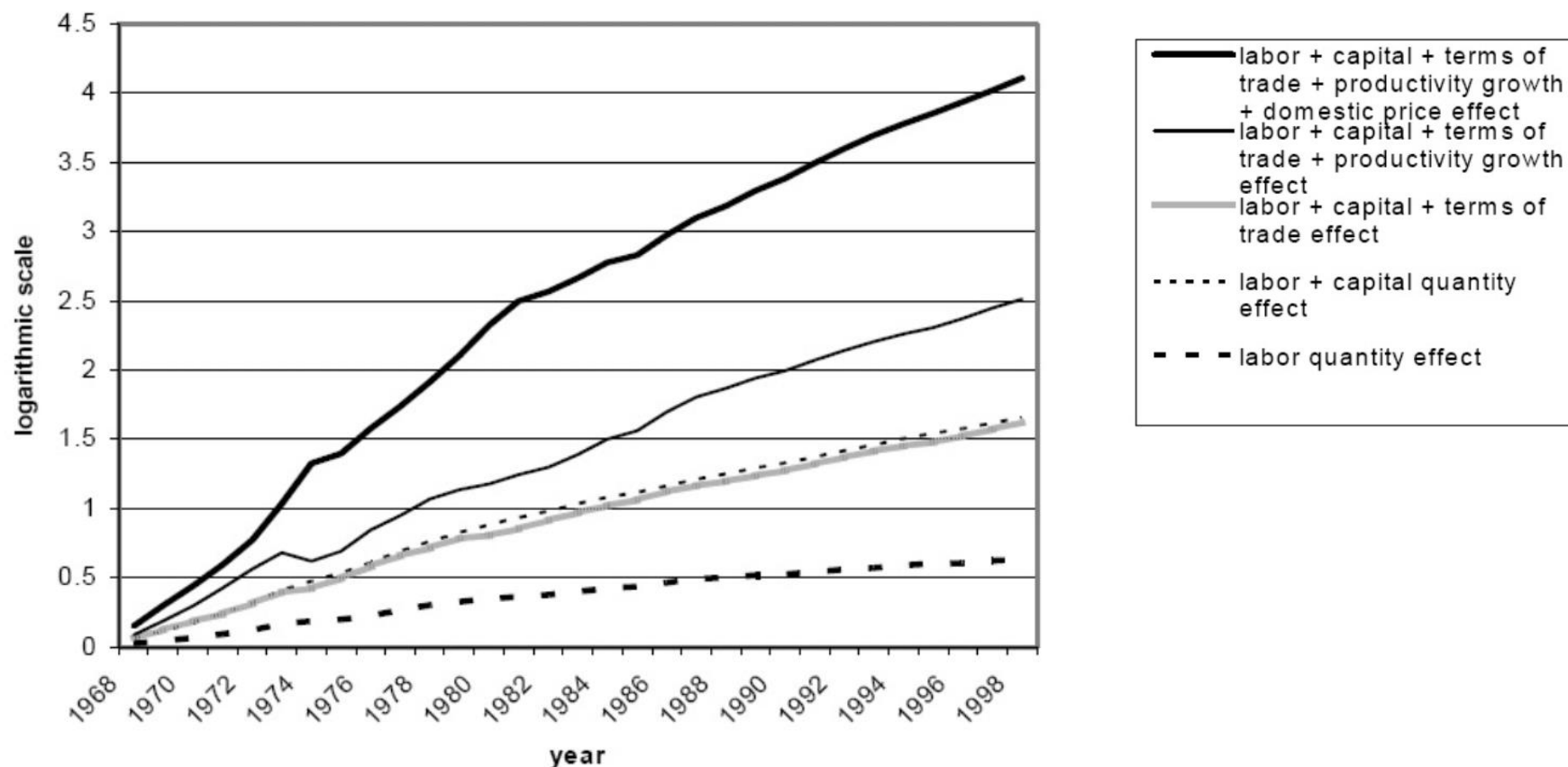
Ling Sun

Providence University, slwang@ers.usda.gov

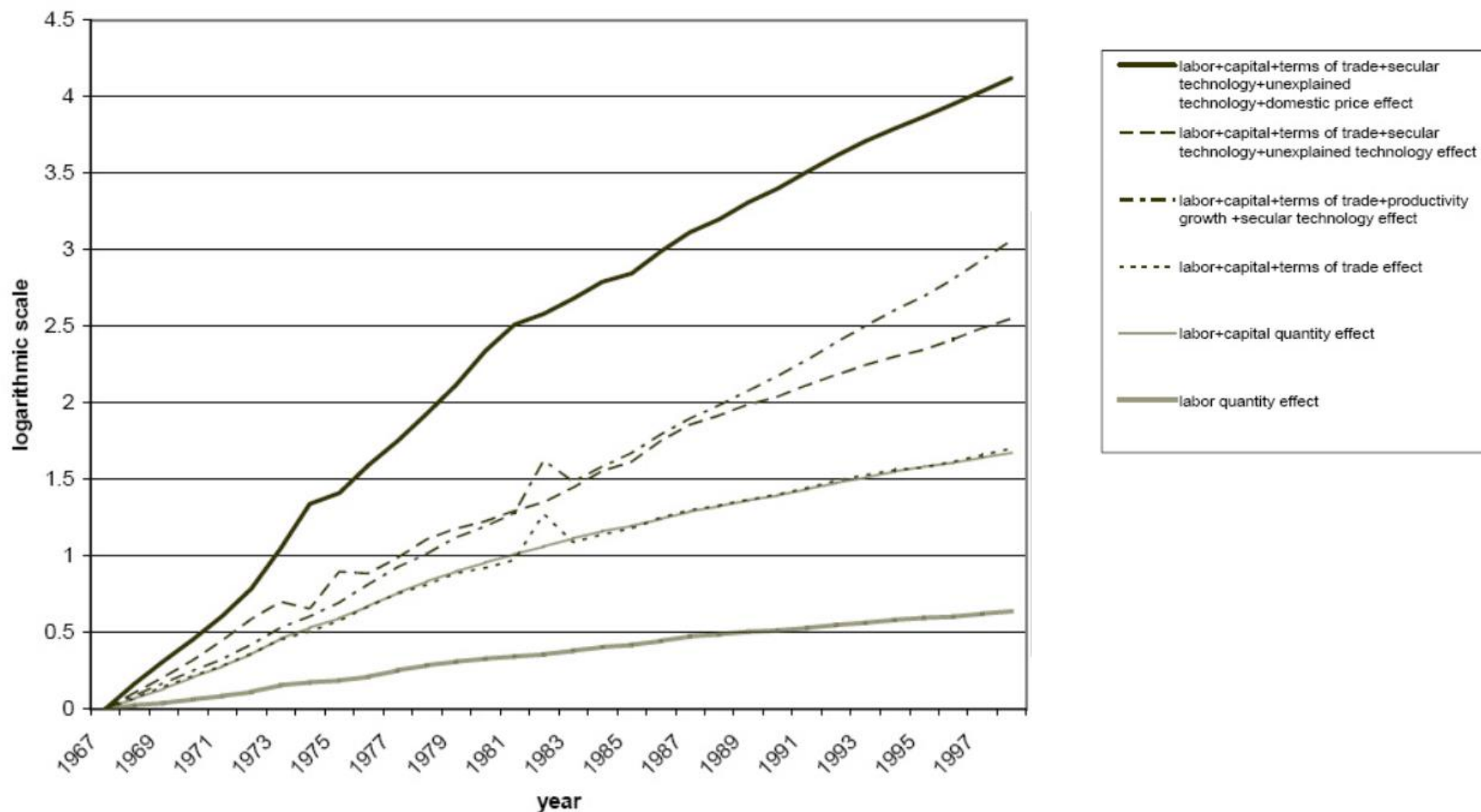
LILYAN FULGINITI

University of Nebraska, lfulginiti1@unl.edu

Growth Accounting for Taiwanese Nominal GDP Growth (Non-stochastic indexes)



Growth Accounting for nominal GDP growth in Taiwan (Indexes using parametric estimates)



Source: Sun, J. & Fulginiti, L. (2007). Accounting for Taiwan GDP Growth: Parametric and Nonparametric Estimates. Faculty Publication: Agricultural Economics. University of Nebraska - Lincoln.

Taiwan's GDP and Employment by Sector, 1905–1998

	<i>GDP</i>			<i>Employment</i>		
	<i>Primary</i>	<i>Secondary</i>	<i>Tertiary</i>	<i>Primary</i>	<i>Secondary</i>	<i>Tertiary</i>
1905	–	–	–	72.7	6.1	21.1
1910	36.4 (42.1)	28.1 (23.5)	35.5 (34.4)	–	–	–
1915	32.5 (41.4)	31.7 (24.5)	35.7 (34.1)	73.4	7.4	19.1
1920	30.0 (39.0)	29.3 (22.9)	40.7 (38.1)	71.1	9.2	19.7
1925	40.3 (39.6)	22.7 (23.1)	36.9 (37.3)	–	–	–
1930	33.9 (37.3)	28.3 (25.7)	37.7 (37.0)	71.4	9.4	19.4
1935	34.5 (32.0)	27.2 (29.0)	38.3 (38.9)	–	–	–
1940	29.1 (32.5)	31.5 (30.0)	39.4 (38.6)	63.2	12.3	24.7
1945	26.8 (23.4)	25.8 (29.5)	47.4 (47.1)	–	–	–
1950	36.0 (36.8)	15.6 (15.0)	48.3 (48.1)	–	–	–
1952	32.2	19.7	48.1	56.0	16.9	27.0
1960	28.5	26.9	44.6	50.2	20.5	29.3
1970	15.5	36.8	47.7	36.7	28.0	35.3
1980	7.7	45.7	46.6	19.5	42.5	38.0
1990	4.2	41.2	54.6	12.5	40.8	46.3
1998	2.7	34.9	62.3	8.8	37.9	53.2

Source: Cheng, T.J. (2001). Transforming Taiwan's Economic Structure in the 20th Century. *The China Quarterly*, 165, 19-36.

Production and Ownership Structure in Post-war Taiwan's Manufacturing Sector, 1952–1998

	<i>Light</i>	<i>Heavy and chemical</i>	<i>Private</i>	<i>State-owned</i>
1952	n.a.	n.a.	43.8	56.2
1960	76.0	24.0	56.2	43.8
1970	65.7*	34.3*	72.3	27.0
1980	53.8	46.2	85.5	14.5
1990	33.6	66.4	89.7	10.6
1998	28.5	71.5	92.1	7.9

Source: Cheng, T.J. (2001). Transforming Taiwan's Economic Structure in the 20th Century. *The China Quarterly*, 165. 19-36.

Post-war Taiwan's Export Structure, 1952–1998

	<i>Agriculture (raw and processed)</i>	<i>Industrial</i>	<i>Heavy and chemical</i>	<i>Others</i>
1952	91.9	8.1	4.7	95.3
1960	67.7	32.3	10.2	89.8
1972	16.7	83.3	26.6	73.4
1980	9.2	90.8	35.6	64.4
1990	4.5	95.5	46.7	53.3
1998	1.8	98.2	64.3	23.9

Source: Cheng, T.J. (2001). Transforming Taiwan's Economic Structure in the 20th Century. *The China Quarterly*, 165. 19-36.

Export Commodities by Intensity of Input Factor for Taiwan, 1982 - 1997

	<i>Degree of labour intensity</i>			<i>Degree of capital intensity</i>			<i>Degree of tech intensity</i>		
	<i>High</i>	<i>Mid</i>	<i>Low</i>	<i>High</i>	<i>Mid</i>	<i>Low</i>	<i>High</i>	<i>Mid</i>	<i>Low</i>
1982	47.2	30.8	21.9	26.9	45.4	27.6	18.3	32.6	49.1
1985	45.9	35.6	18.5	24.5	48.7	26.8	18.8	33.6	47.6
1990	41.0	38.3	20.7	28.9	50.5	20.5	26.7	38.6	34.7
1995	36.4	40.6	23.0	31.9	56.5	11.6	36.5	41.4	22.0
1997	34.9	43.1	22.1	30.3	60.6	9.1	39.7	41.1	19.2

Source: Cheng, T.J. (2001). Transforming Taiwan's Economic Structure in the 20th Century. *The China Quarterly*, 165. 19-36.

Growth Rates of GDP and Total Factor Productivity (TFP) in Taiwan (per annum)

	<i>GDP (real)</i>	<i>TFP</i>
1961–73	10.80	0.47
1973–82	7.97	– 0.14
1982–87	9.29	4.31
1987–93	6.63	2.74

Source: Cheng, T.J. (2001). Transforming Taiwan's Economic Structure in the 20th Century. *The China Quarterly*, 165. 19-36.

Industrial Technology Research Institute (ITRI)



Industrial Technology Research Institute

Update: 2018.04.30

ITRI

Industrial Technology Investment Corporation

ITRI College

Technology Transfer Center

Commercialization and Industry Service Center

ITRI International Center

Office of Strategy and R&D Planning

Office of Marketing Communications

Administrative Service Center

Accounting Resource Center

IT Service and Development Center

Human Resources Office

ITRI Southern Region Campus

ITRI Central Region Campus

Biomedical Technology and Device Research Laboratories

Green Energy and Environment Research Laboratories

Material and Chemical Research Laboratories

Mechanical and Mechatronics Systems Research Laboratories

Information and Communications Research Laboratories

Electronics and Optoelectronics Research Laboratories

Center for Measurement Standards

Service Systems Technology Center

Industrial Economics and Knowledge Center

Computational Intelligence Technology Center

Intelligent Machinery Technology Center

Smart Microsystems Technology Center

Laser and Additive Manufacturing Technology Center

Total Staff: 6,121

Ph.D: 1,416

Master: 3,564

Bachelor: 1,141

Alumni: 24,768

Total Patents

27,020

Startups & Spinoffs (~2017)

273

Industry Services (~2017)

Provided Services : 17,939

Transferred Technologies : 614

Source: ITRI (2018)

Taiwan's High-Tech Industry Clusters

1.5 Hours From North to South

Contribute to Economic Growth

The industry-academia-research institute technology networks are well established and located surrounding the research parks

- Hsinchu Science Park
- Central Science Park
- Southern Taiwan Science Park

These supporting networks build up Taiwan's high-tech industry clusters and contribute to Taiwan's economic development

- Semiconductor
- IT Hardware
- IT Software
- Biotech



Many Innovation Research Centers in Taiwan

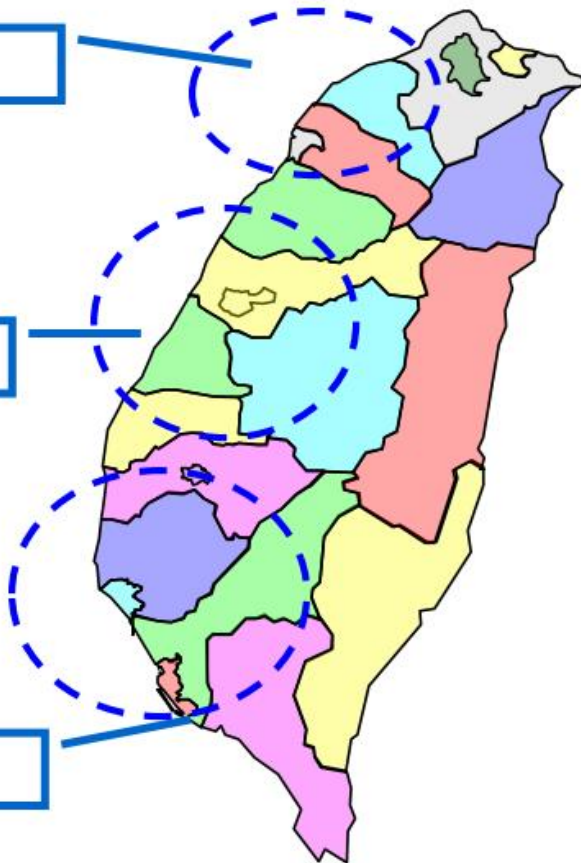
◆ 189 domestic R&D centers

◆ 63 international R&D centers

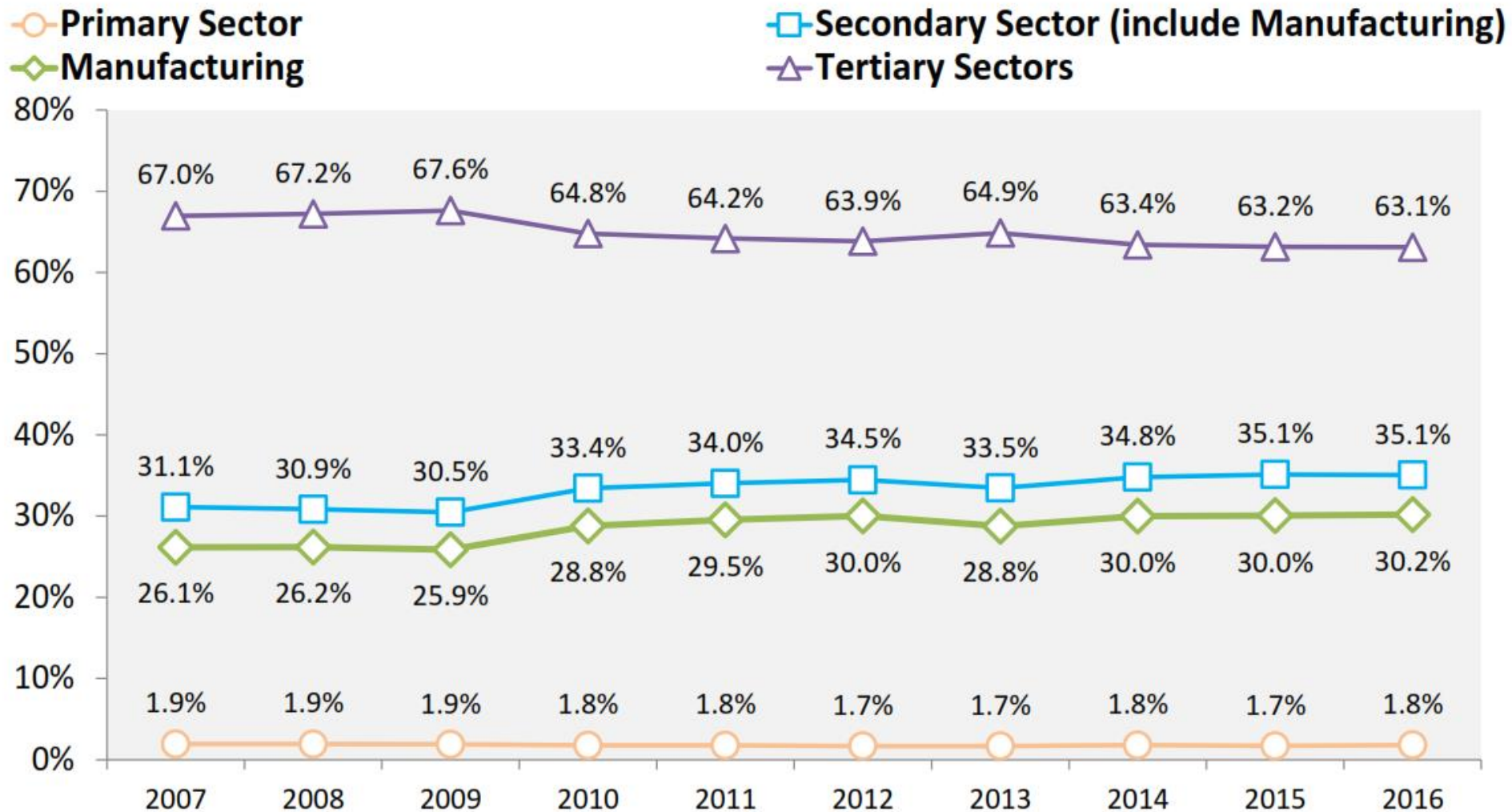
North: 136

Central: 18

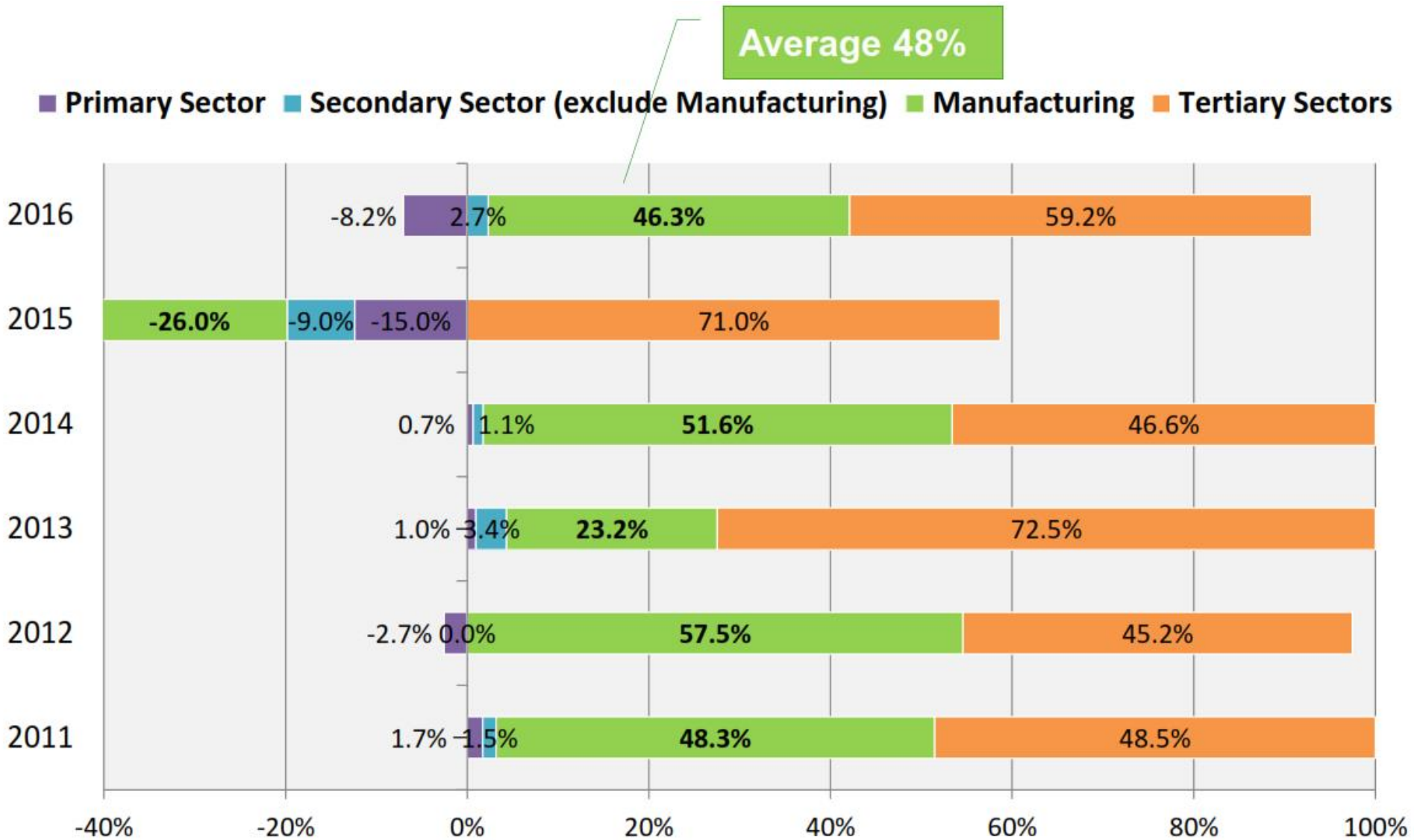
South: 35



Manufacturing Accounts for About 30% of Taiwan's GDP

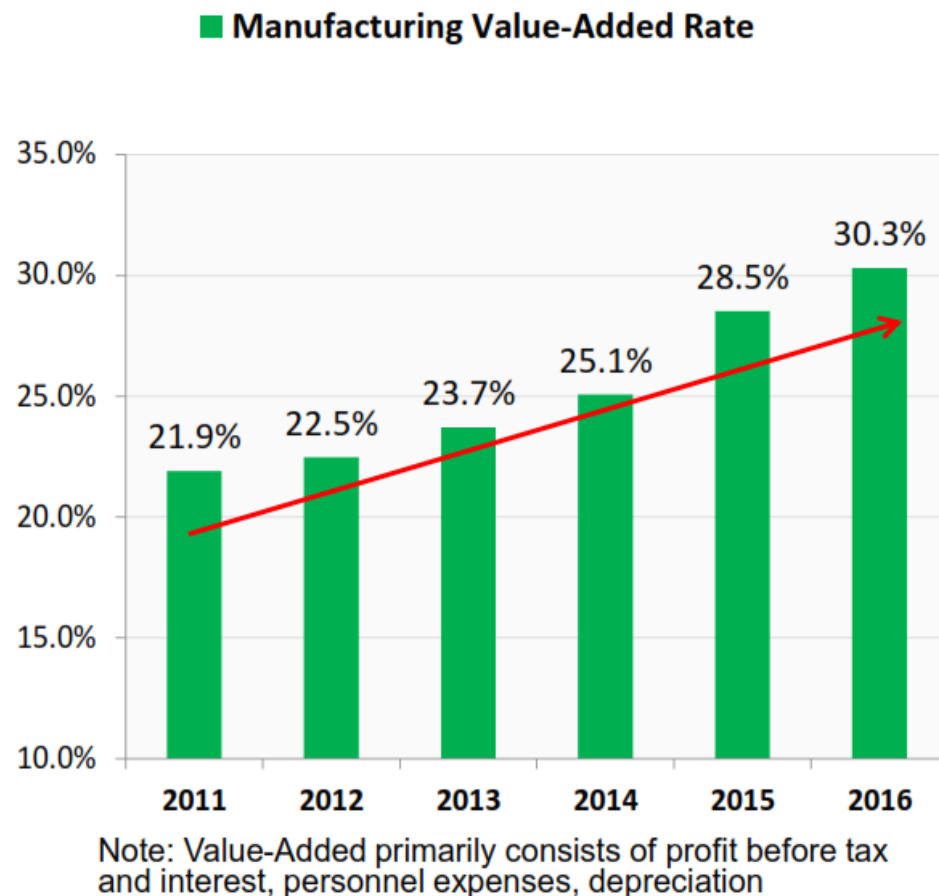
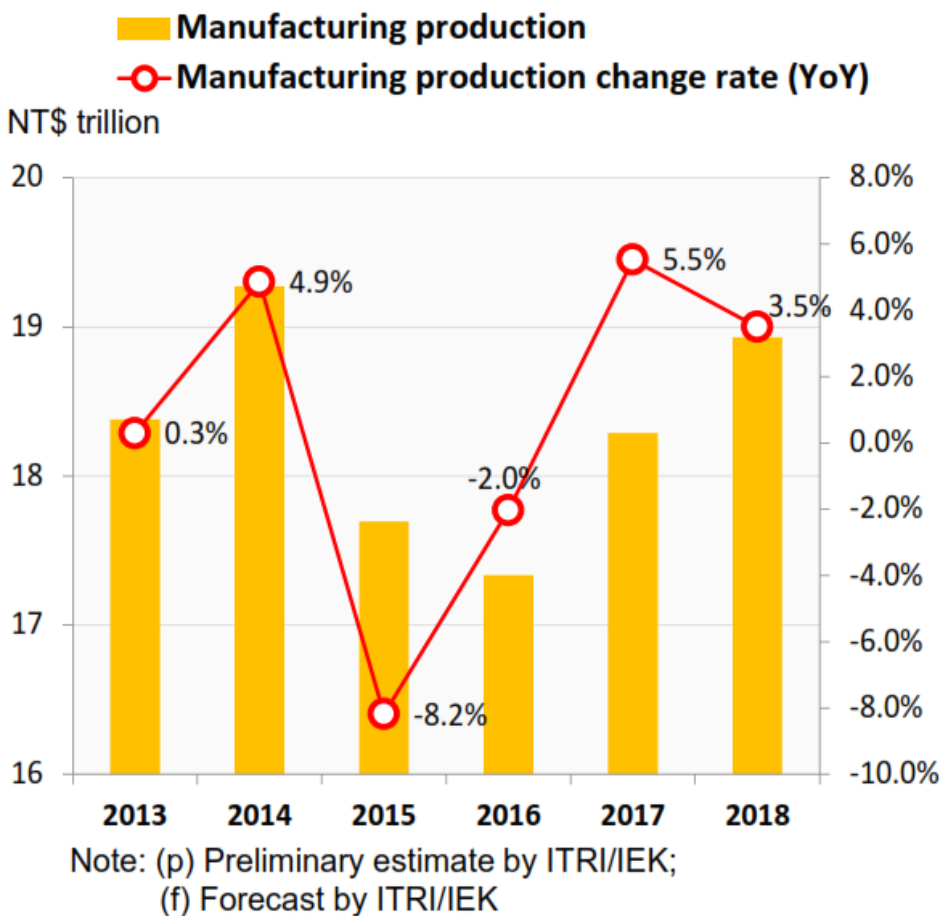


Manufacturing Contributes Significant Share of Taiwan's Economic Growth



Source: Patrick Liou (2018). Industrial Economics and Knowledge Center.

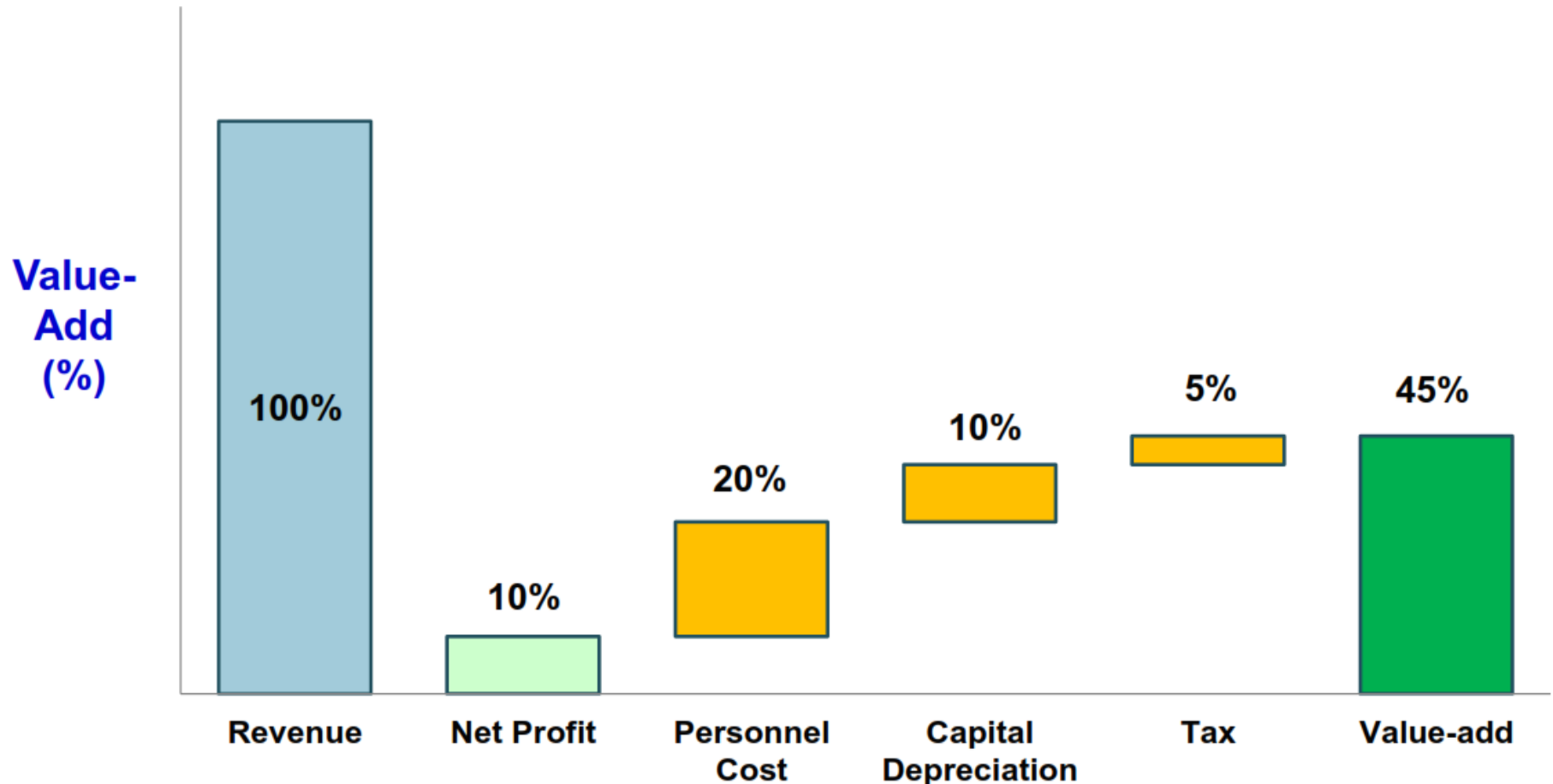
Manufacturing Production Grows Steadily, Value-add Continues to Improve



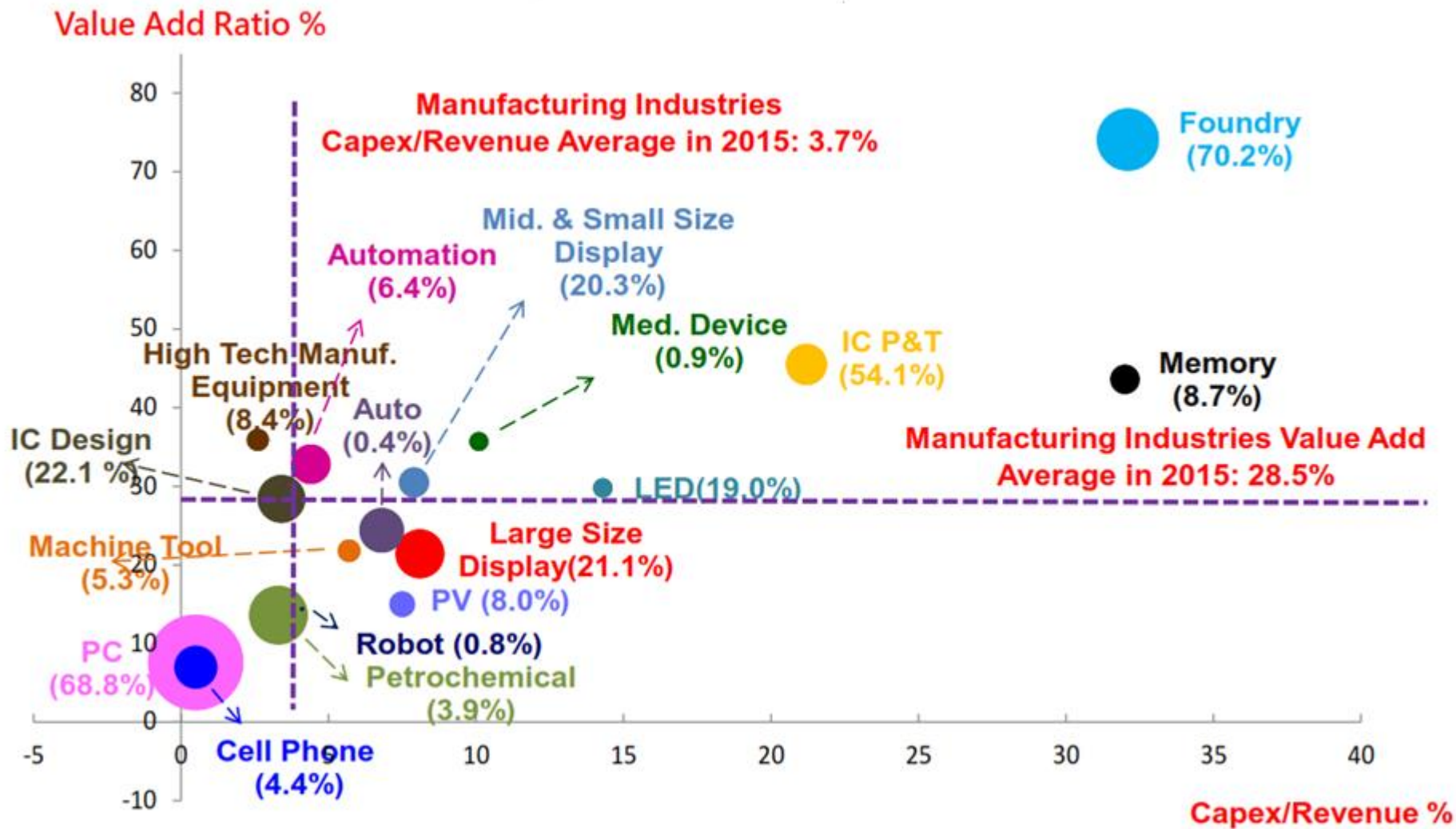
Average Value-added rate is 45% in 2016

Value-add = Net Profit + Personnel Cost + Capital Depreciation + Tax

Value-add % = Value-add / Revenue



Taiwan Manufacturing Industry Portfolio by Value-Added



Note 1: x-axis (Capex/Revenue Ratio %) and y-axis (Value Add Ratio %) @2015

Note 2 : () 2015 Taiwan industry market share worldwide

Note 3 : Manufacturing Industries Value Add Ratio in 2015 calculated based on GDP/gross sum of manufacturing value

Source: Patrick Liou (2018). Industrial Economics and Knowledge Center.



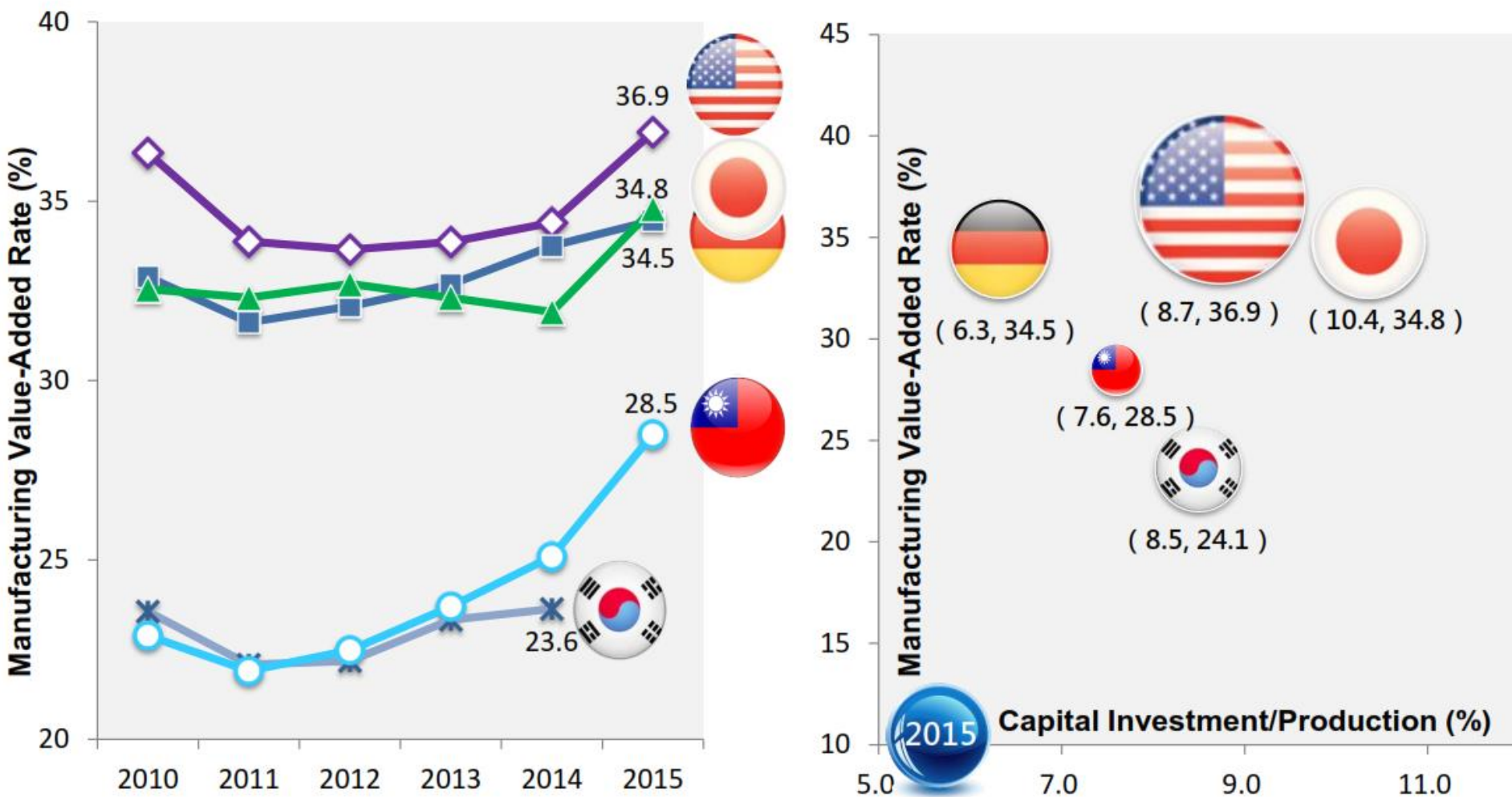
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Taiwan's Manufacturing Strives Towards Upgrade in Value-added vs. Leading Countries



Taiwan's IC Industry in Global Position

- Taiwan IC Industry output value ranked No.2 in the world 23.3% of global market in 2016. The worldwide leader is US
- Taiwan IC Design Industry ranked No.2 in the world 19.8% of global revenue in 2016, The worldwide leader is US
- Taiwan Foundry service ranked No.1 in the world 75.9% of global revenue in 2016
- Taiwan Memory Industry ranked No.4 in the world 7.9% of global revenue in 2016, The worldwide leaders are Korea, US and Japan
- Taiwan IC Packaging and Testing service ranked No.1 in the world 56.4% of global revenue in 2016
- Taiwan Brand IC Product Revenue ranked No.4 in the world 8.1% of global market in 2016. The worldwide leaders are US, Korea and Japan

	Taiwan (US\$ Billion)	Worldwide (US\$ Billion)	Taiwan Market Share (%)	Rank 2016	Taiwan Leaders	Worldwide Leaders
IC industry Production value	76.5	327.2	23.3%	No.2	TSMC	Intel, Samsung
IC design	20.8	105.0	19.8%	No.2	MTK	Qualcomm
IC Manufacturing	-	-	-	-	-	-
Foundry	35.6	46.9	75.9%	No.1	TSMC	Global Foundries
Memory	5.6	70.9	7.9%	No.4	NANYA	Samsung, Micron
IC Packaging and Testing	14.5	25.7	56.4%	No.1	ASE	Amkor
IC Product Value	26.4	327	8.1%	No.4	MTK	Intel, Samsung

Taiwan's ICT Industry Strengths

- Completed clusters encompassing ICT industrial value chains
- Center of high-end IT, IC manufacturing and service

World top-2 products/services made by Taiwan

World No. 1 in 2017*

- NB PC (81.00%)
- Desktop PC (27.34%)
- Motherboards (85.30%)
- Foundry (73.73%)
- IC Packaging & Testing(55.84%)
- Cable CPE (77.11%)
- DSL CPE (65.4%)
- WLAN (67.14%)
- PND (79.7%)
- PCB (30.7%)
- Mobile Lens (50.0%)

World No. 2 in 2017*

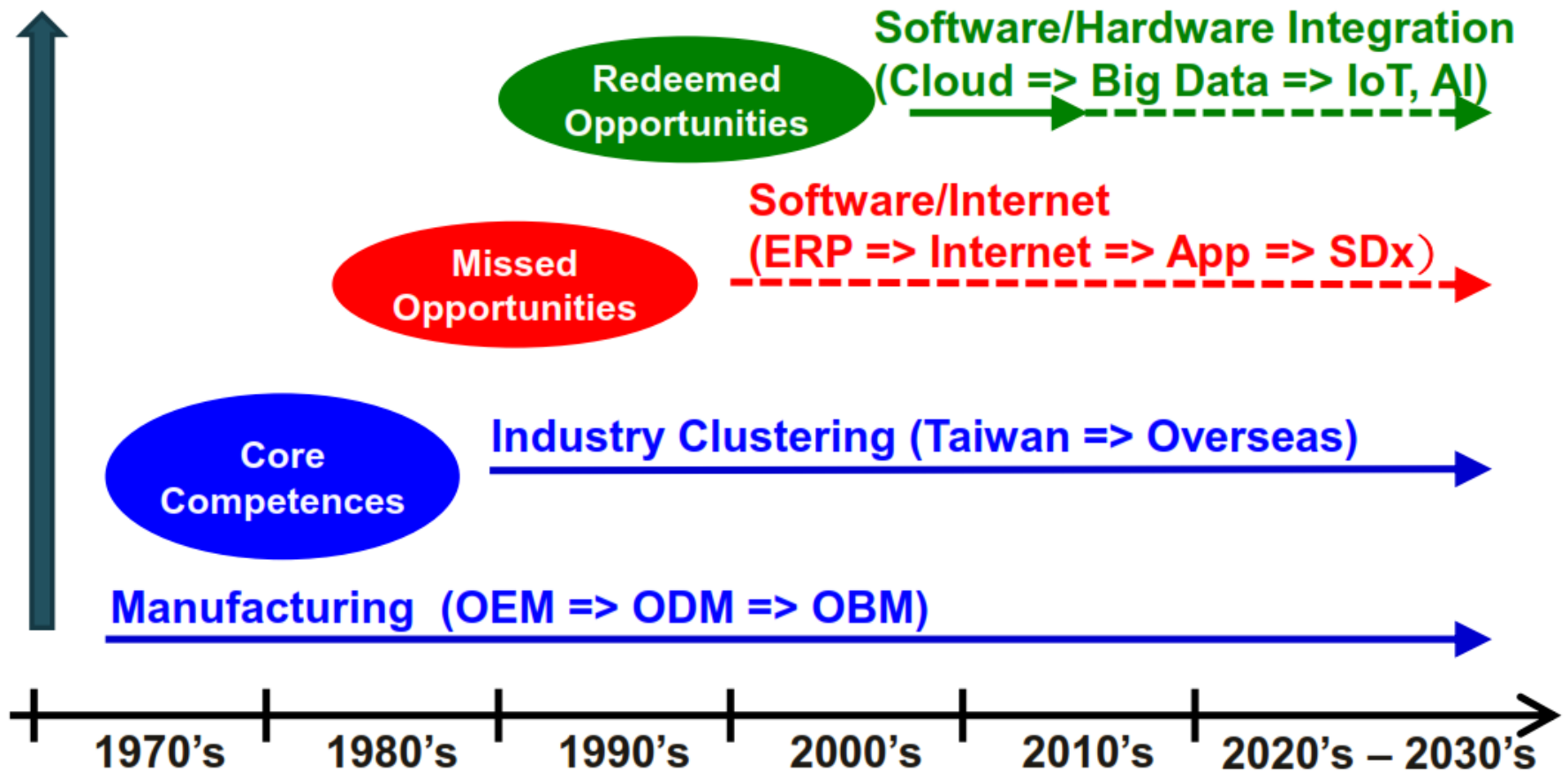
- IC Design (17.67%)
- Server (18.3%)
- Large size (>10")TFT LCD (22.6%)
- Medium & Small size (<10")TFT LCD (30.97%)
- IC Substrate (26.4%)
- Tablet (44.8%)

*rank by value

IoT Gives Taiwan Industries New Opportunity in Software and Hardware Integration

- Leverage past core competences in hardware, but need to make up software competences

Value Creation



Challenges

Most of the Taiwan companies **remain at the lower rungs of the value-added chain**, where profit margins are low and innovation is minimal.

Producers face **shrinking profit margins** from the “contract-manufacturing” model .

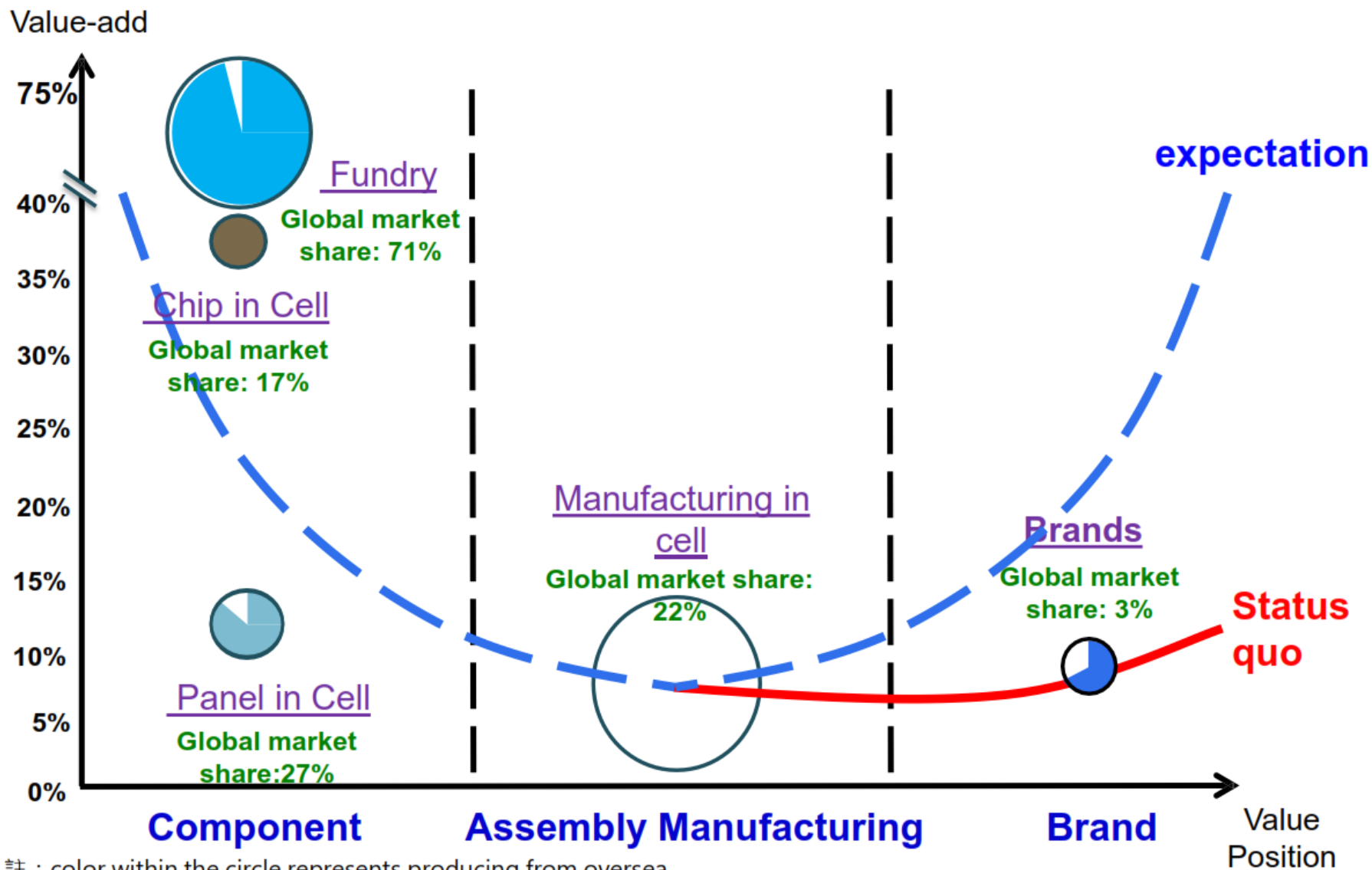
China has long been the model for **low-cost, poor-quality** goods, but if China can **gain on Taiwan’s quality**, it would present a **significant threat**.

Strategies



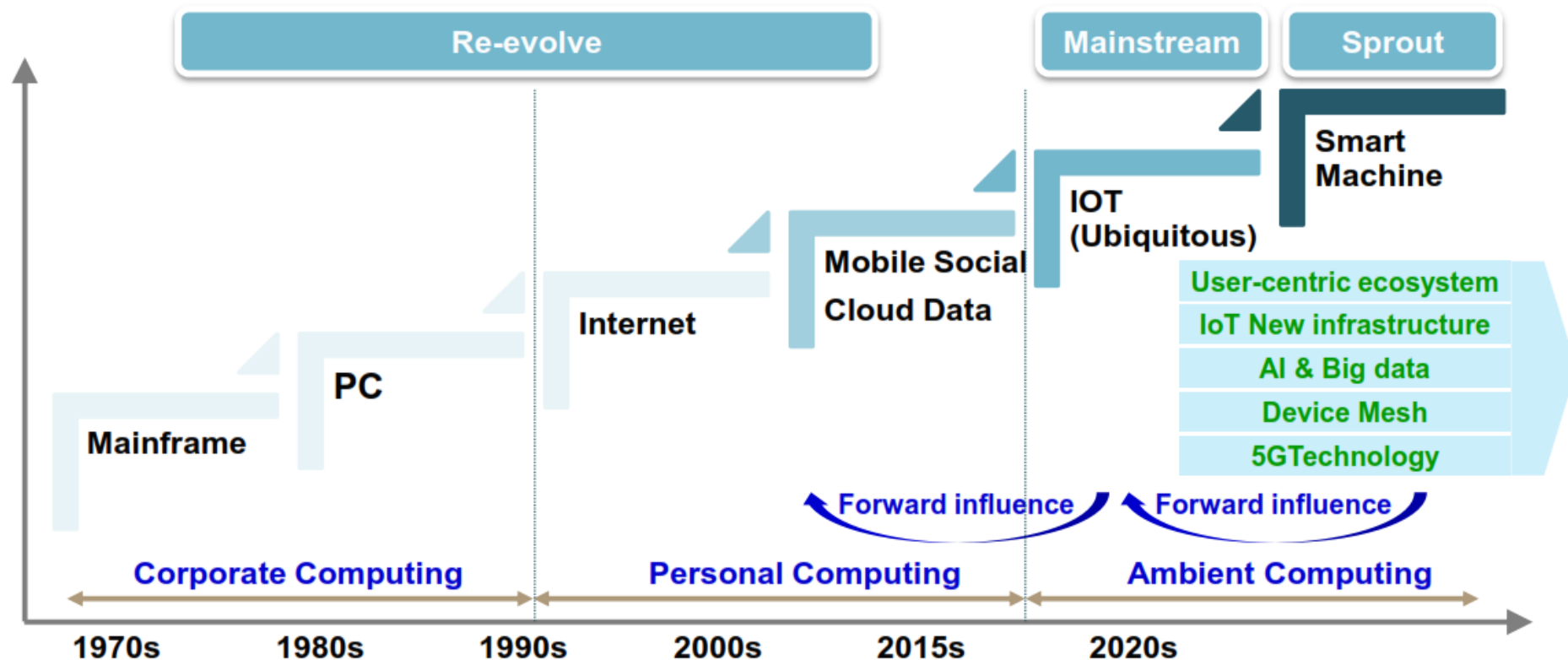
1. Seek **to make sweeping change** in selected industries, like smart machine tools, innovative textiles, logistics, and telecommunication.
2. Seek **to identify and support high-potential companies** across spectrum of domestic industries.

Short of The High Value-add Part



Taiwan's Manufacturing Strives Towards Upgrade in Value-added vs. Leading Countries

- The smart phones in the world begin to **slow down in growth**.
- The applications are influenced by the digital intelligence to change the related industries and technical innovations.
- The values created by user-centric ecosystem, **IoT new infrastructure**, digital intelligence by **AI & big data**, device mesh and 5G connected will influence the future product and the network pattern.



IoT Provides New Opportunity for Industry

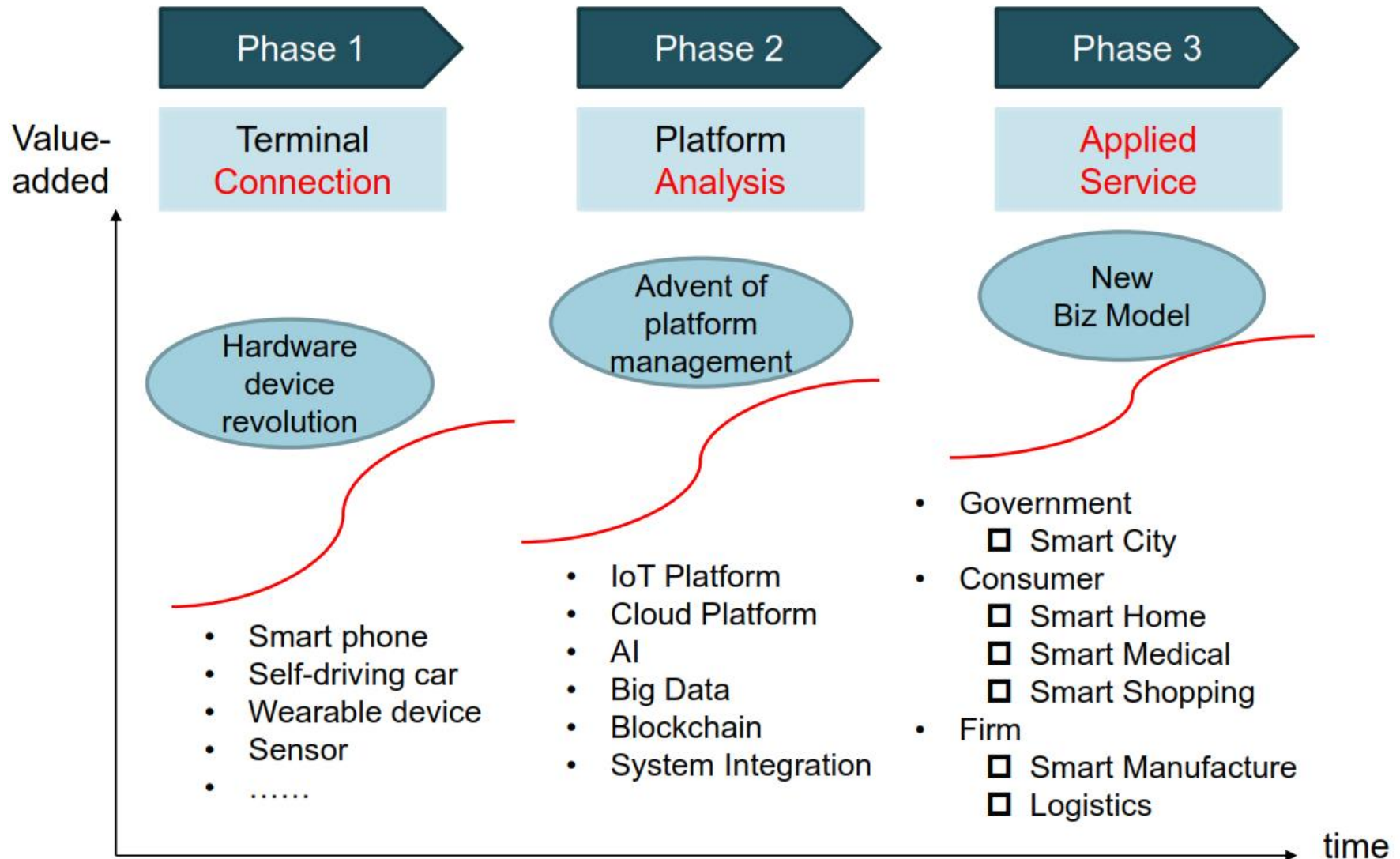
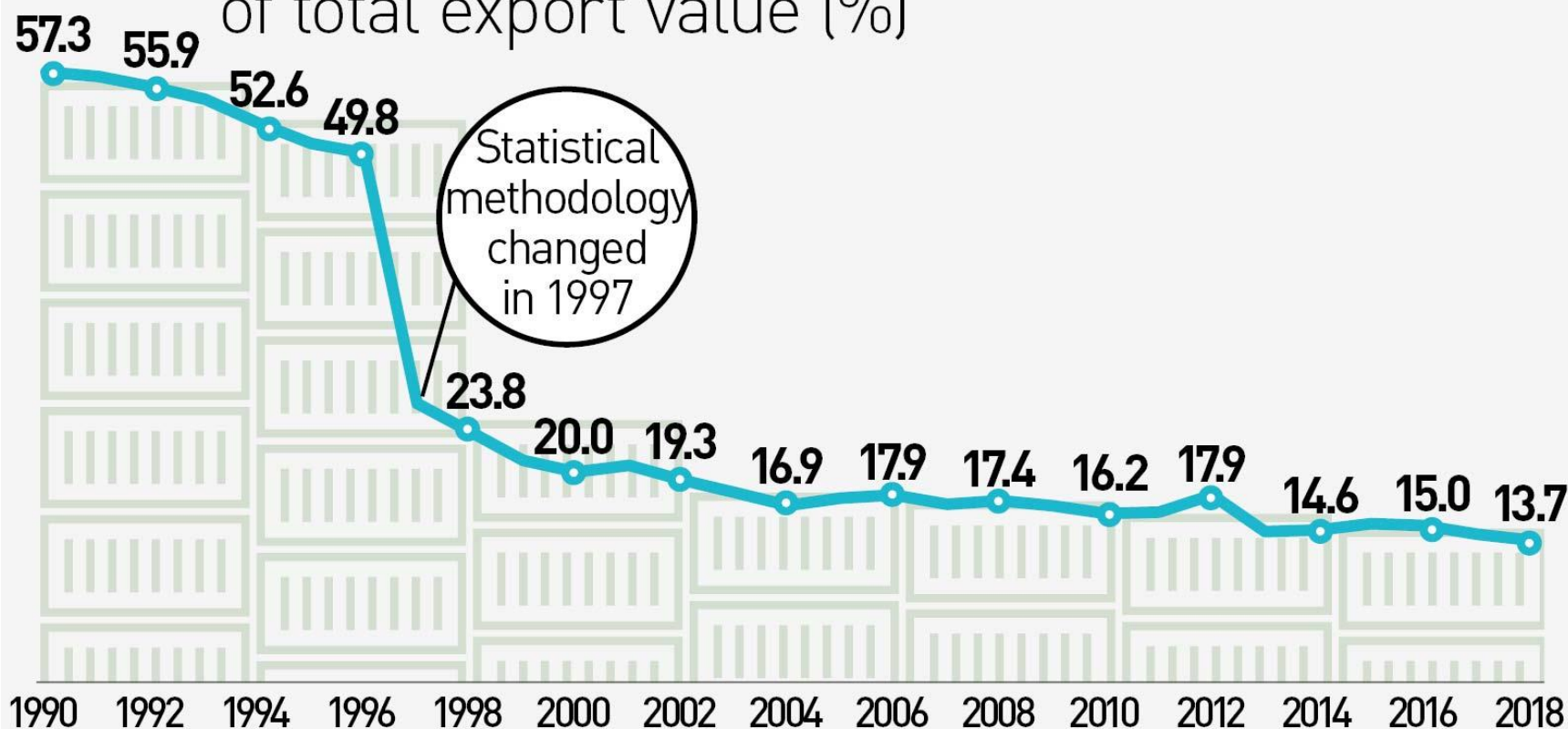


Table 1

SME Glory Days Long Gone; Share of Exports Down to 14%

Small and medium-sized enterprises share of total export value (%)

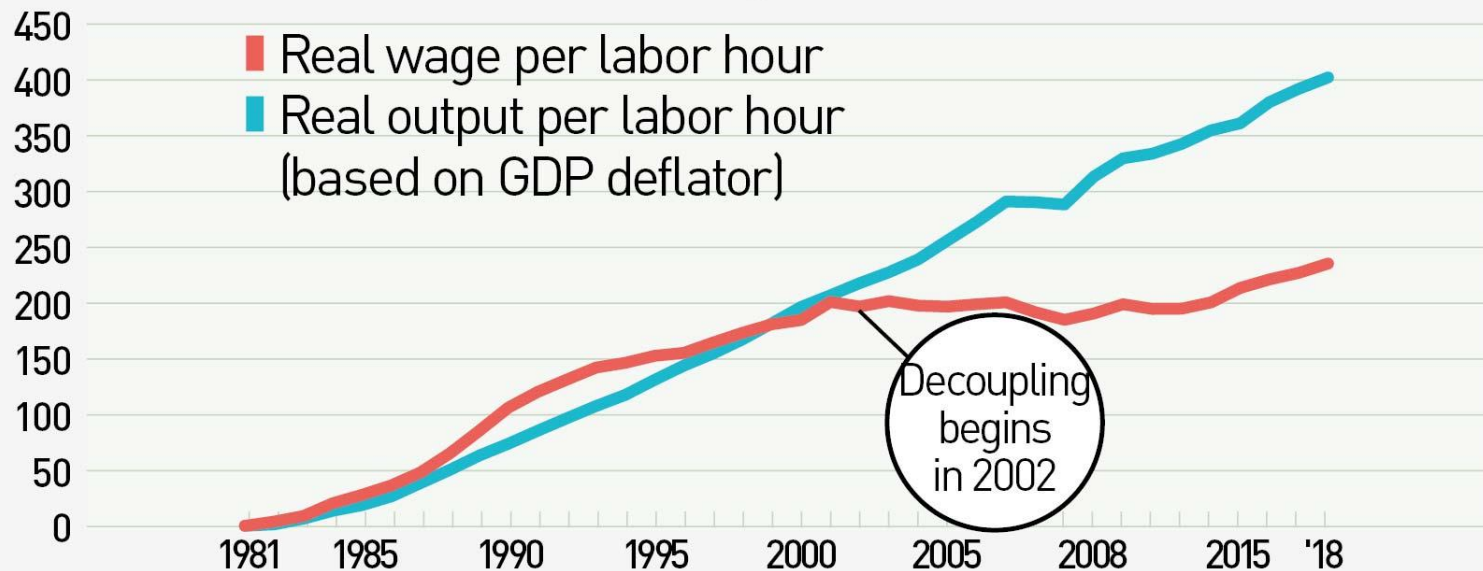


Source: Small and Medium Enterprise Administration, Ministry of Economic Affairs

Table 2

Wages Stagnant for 16 Years; Earnings Fail to Keep Pace with Spending

Cumulative growth rates of real GDP per hour worked and real wages (%)



Note: Cumulative real wage growth rate: $(\text{current value} / \text{1981 value}) - 1$; real output per labor hour is $(\text{nominal GDP} / \text{total annual work hours of employees} \times \text{GDP deflator})$; real wage per labor value is $(\text{nominal wage} / \text{total annual work hours of employees} \times \text{consumer price index})$.

Source: DGBAS

The Forces behind Taiwan's Stagnant Wages

- Taiwan's economy was long carried on **the back of its small and medium-sized enterprises** (SMEs).
- Small business owners traveled the world, a briefcase in hand, to snag orders and were **major contributors** to the **international trade** and **economic development** that became **Taiwan's lifeline**.
- **Electrical equipment and parts** became an **important export category** at the end of the 1990s, and accounted for more than 30 percent of all of Taiwan's exports by 2003 and **43 percent** of **total exports** in 2018.
- The **first generation** of the **information and communications industry**, which relied on manufacturing and exporting, also helped companies get bigger.

The Forces behind Taiwan's Stagnant Wages (cont'd)

- Enterprises relied on leveraging the fertile soil for these **“intermediate goods”** to inject additional vitality into **Taiwan's economic expansion**.
- *“Without these **so-called intermediate goods** you cannot connect to **raw materials upstream or markets downstream**,”* says CTBC Financial Management College professor Shih Kuang-hsun.
- The commercial model enabling **contract manufacturers** to make money on these **intermediate goods** helped them grow in size, but it also **imposed serious constraints** on **the value-added** of the products Taiwanese companies pumped out.

The Forces behind Taiwan's Stagnant Wages (cont'd)

- In effect, China moved into Taiwan's bailiwick, the contract manufacturing field, and created a **“red ocean” of low-price competition, pushing down the prices of Taiwanese exports** over the long term.
- Yet **productivity has risen** since then, indicating that its benefits have been diverted toward **producing increasingly cheaper products rather than boosting wages**.
- That reflects the **bottleneck Taiwan industries** have faced in **re-engineering themselves** over the past 20 years of stagnant w



Chang-Tai Hsieh

Phyllis and Irwin Winkelried Professor of Economics and PCL Faculty Scholar

[Biography](#)

[Research Interests](#)

[Academic Areas](#)

[Course Schedule](#)

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Professor Chang-Tai Hsieh

- A prominent academic figure in the U.S., Europe and China, Hsieh has published papers in the **top five periodicals** in the **economics field**.
- His work on economic development has earned him a position on the **Nobel Economic Sciences Prize Committee**, making him the **youngest member** and the **only Asian** among the **panel of five**.
- He has been an advisor to the Interamerican Development Bank, and also consulted for the **World Bank** and the **government of Singapore**.

| Chang-Tai Hsieh:

Taiwan Mired in 1980s Mentality



Source: shutterstock

Professor Chang-Tai Hsieh, an expert on economic growth and development, discusses how Taiwan can break free from its current economic predicament.

Chang-Tai Hsieh: Taiwan Mired in 1980s Mentality (cont'd)

- Hsieh says the establishment of the **Industrial Technology Research Institute (ITRI)** in 1973 was a **brilliant act** of **institutional innovation** and a **world first**.
- ITRI **attracted people** with the most **outstanding entrepreneurial spirit**, giving them the **biggest incentives** to set out on their own, start new companies, and potentially make a fortune if they succeeded.
- As a result, **world-class corporations** like **Taiwan Semiconductor (TSMC)** were formed.

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- However, **30 years down the road**, ITRI has gotten bogged down by **bureaucracy**.
- “It has become the bureaucracy of the people. They're good people here, but it's **not the same talented people** that used to be there in the early days,” he says.
- “**The model** we get from **the 80s is not going to work** because that was about industrial technology. **So with services**, it's not about industrial technologies. We need a **different institutional innovation**,” he says.