

TRADE, FIRMS, AND ECONOMIC DEVELOPMENT

Sînâ T. Ateş

Federal Reserve Board

Younghun Shim

International Monetary Fund

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[†]The views expressed here are those of the authors and should not be attributed to the IMF, its Executive Board, its management, and the Board of Governors or the Federal Reserve System.

Outline

1. International linkages and economic growth: channels of transmission
2. Foreign technological competition, technology upgrading, and appropriate policies
3. South Korean development and industrial policies

Key Channels in the Literature

1. Access to better inputs

Amiti and Konings (2007), Lileeva and Trefler (2010), Goldberg et al. (2010), Iacovone (2012), Boler et al. (2015), Bloom et al. (2016), Kee and Tang (2016), Fieler and Harrison (2018), Juhász and Steinwender (2018), Shu and Steinwender (2019), ...

2. Market size

Lopez (2009), Lileeva and Trefler (2010), Aw et al. (2011), Mayer et al. (2014), Coelli et al. (2022), Melitz and Redding (2022), Aghion et al. (2022), ...

3. Knowledge spillovers and technology transfer

Grossman and Helpman (1991), Coe and Helpman (1995), Keller (2002, 2004), Acemoglu et al. (2006), Sampson (2016) Alvarez et al. (2017), Buera and Oberfield (2020), Perla et al. (2021), Lind and Ramondo (2022), Santacreu (2023), Hsieh et al. (2023), ...

4. Foreign direct investment

Javorcik (2004), Alfaro et al. (2004), Branstetter (2006), Haskel et al. (2007), Keller and Yeaple (2009), Fons-Rosen et al. (2017, 2023), Ates, Akcigit, Kalemli-Ozcan, Villegas-Sanchez (2023), ...

Cross-border Investment and Technology Adoption

- ▶ Akcigit et al. (2023): foreign firms' investments in U.S. startups
 - ▶ Increased patenting and citation to U.S. startups by investing firms, and by others in the same class
 - ▶ Larger effect in more basic technologies

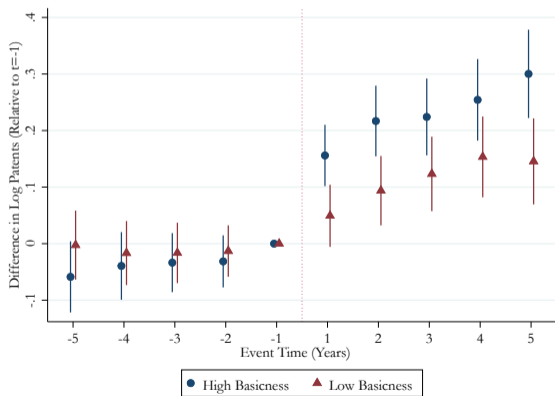
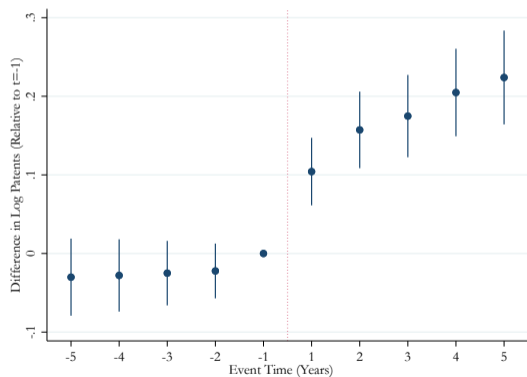


FIGURE: Akcigit, Ates, Lerner, Townsend, Zhestkova (2023)

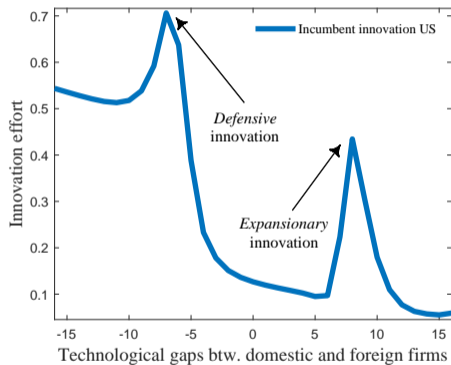
Foreign Technological Competition, Innovation and Growth

- ▶ Akcigit, Ates, Impullitti (2022): How to manage intensified foreign competition?
- ▶ Tariffs vs. R&D subsidies
- ▶ Optimal policies in short and long run
- ▶ Technology gaps, competition, and dynamic incentives
 - ▶ Close competition (narrow gaps) incentivizes firms to improve
 - ▶ Wider gaps discourage firms from improving
- ▶ Speaking to extensive empirical work

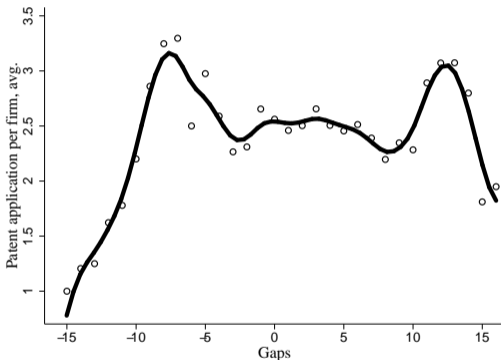
Pavcnik (2002), Muendler (2004), Aghion et al. (2005), Gorodnichenko et al. (2010), Bustos (2011), Iacovone et al. (2011), Amiti and Khandelwal (2013), Bloom et al. (2016), Hombert and Matray (2018), Autor et al. (2020), ...

Foreign Technological Competition, Innovation and Growth

FIGURE: Incumbent innovation effort and leadership (Akcigit et al., 2022)



A) Model



B) Data

International competition can spur innovation.

Policy Results from the Model

1. Static effects:

- ▶ Protectionism could “potentially” benefit the domestic economy via *profit shifting*.

2. Dynamic effects:

- ▶ Openness leads more innovation through competition:
 - Domestic market: **defensive innovation**
 - Foreign market: **expansionary innovation**

3. Protectionism: welfare-reducing at all horizons

- ▶ Hurts (i) innovation incentives and (ii) competitiveness

4. R&D subsidies: Dominant policy for **non-myopic policy makers**

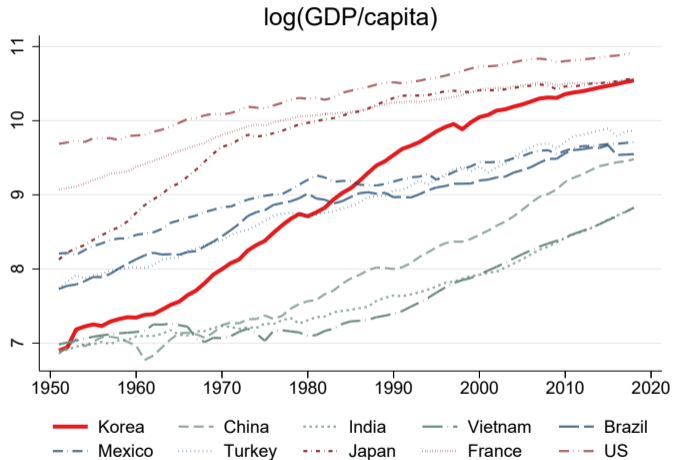
5. Policy complementarity: Globalization → less need for policy intervention

- ▶ Markets themselves take care of incentives

Takeaways for Developing Countries

1. Outright opening may be subject to other considerations
2. Findings' emphasis is more about the direction / end goal
3. Protectionism distorts forward-looking incentives, is welfare-reducing beyond a few years
4. Goal needs to be building up capacity to compete, adopt / upgrade technology, innovate
5. Korea lowering import tariffs while actively investing in technology policies

GDP per Capita in South Korea over Year



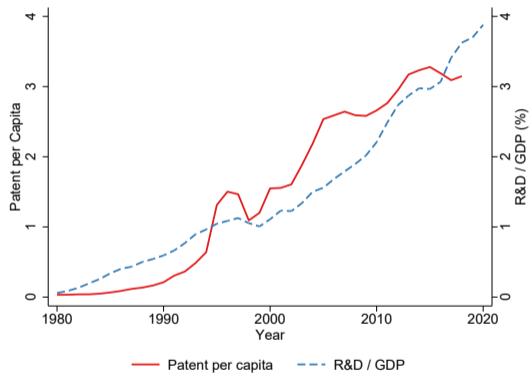
Industrial Policies in South Korea

- ▶ Sector specific policy: subsidizing heavy manufacturing sector
Lane (2023), Choi and Levchenko (2023), Kim, Lee, Shin (2022), Choi and Shim (2023a)
- ▶ Trade policy: reducing import tariff during development
Connolly and Yi (2015)
- ▶ Picking winners: subsidizing large firms
Choi, Levchenko, Ruzic, Shim (2023)
- ▶ Technology policy: subsidizing technology adoption → innovation
Choi and Shim (2023b)

Industrial Policies in South Korea

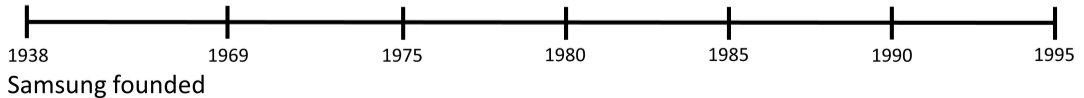
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- ▶ **Technology policy: subsidizing technology adoption → innovation**
Choi and Shim (2023b)

Technological Growth of Korea



of Patent per 1,000 people, R&D / GDP

From Adoption to Innovation: Case of Samsung



From Adoption to Innovation: Case of Samsung

SANYO ●

Adoption

SAMSUNG



Samsung Electronics founded

From Adoption to Innovation: Case of Samsung

NEC 

SANYO 

SONY 

Adoption

Adoption

SAMSUNG



1938

1969

1975

1980

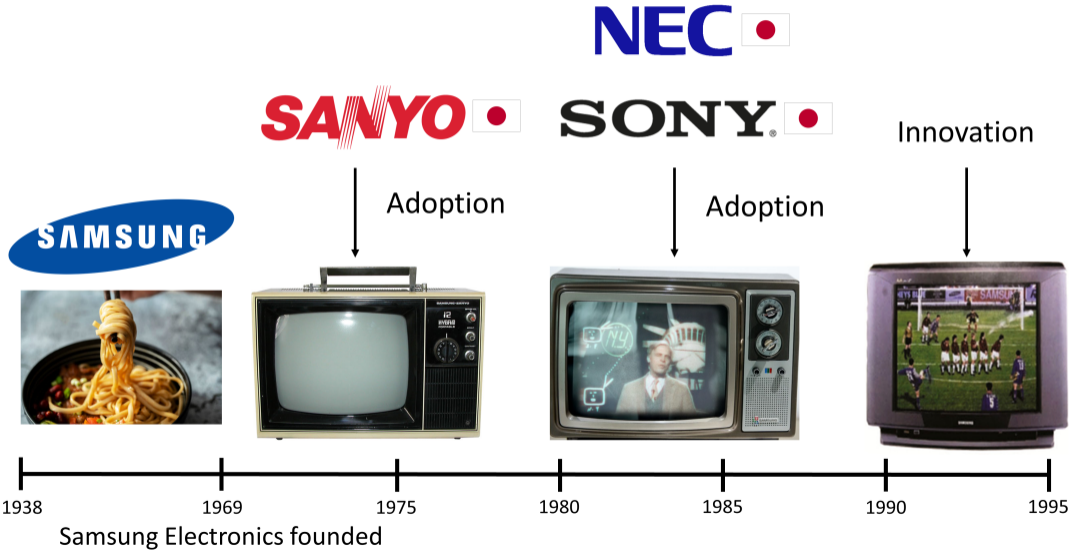
1985

1990

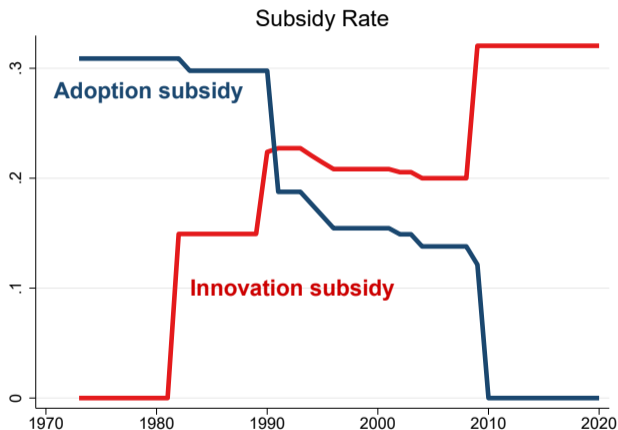
1995

Samsung Electronics founded

From Adoption to Innovation: Case of Samsung

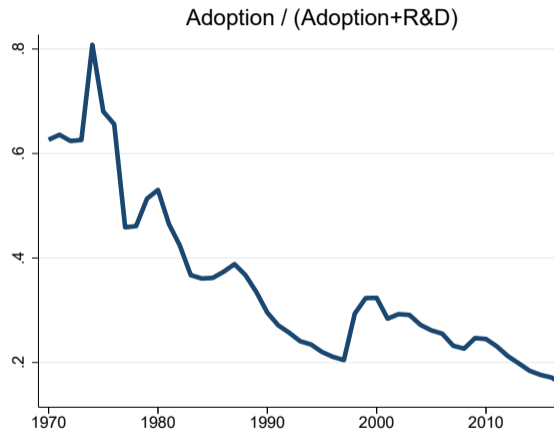
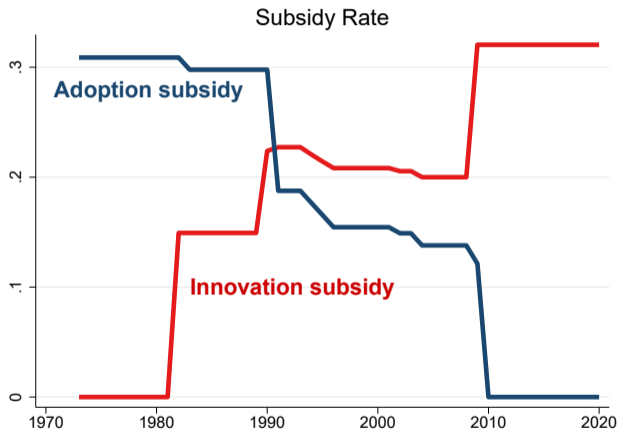


From Adoption Subsidy to Innovation Subsidy



Adoption and innovation subsidy is tax credit for adoption fee and R&D expenditure.

From Adoption Subsidy to Innovation Subsidy



Adoption expenditure is (gross) payment to foreign firm for blueprints, industrial process, and licensing for patents and trademarks. GDP is in PPP.

Data

- ▶ Technology transfer contracts between Korean and foreign firms, '62-'93

Data

► Technology transfer contracts between Korean and foreign firms, '62-'93

TECHNICAL COLLABORATION AGREEMENT

BY AND BETWEEN

NIPPON ELECTROIC CO., LTD.

AND

SAMSUNG ELECTRON DEVICES CO., LTD.

AUGUST 1977

(a) During the term of this Agreement NEC will upon reasonable request furnish SED with one transparent copy of each drawing, specification and other technical document as well as programs and related documentation within the scope specified in Section 1 (d) hereof.

During the term of this Agreement NEC will upon reasonable written request permit an agreed number of qualified SED employees to visit NEC factories in Japan for the purpose of enabling them to acquaint themselves with Manufacturing Information, Software Information and System Information.

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- ▶ Capture the universe of contracts, 8,000+ contracts with 2,800+ unique firms
- ▶ Name of **buyer and seller, fixed fee, royalty rate, year**
- ▶ **> 50% from Japan, ~25% from US, 95% in manufacturing**
- ▶ 95% involves know-how transfer

Data

- ▶ Technology transfer contracts between Korean and foreign firms, '62-'93

- ▶ Firm balance sheet data 1970 –
 - ▶ Korean firms: digitize firm survey data ('70-'83) + KIS value data ('83-)
 - ▶ Foreign firms : Global Compustat
 - ▶ Sales, employment, fixed asset, sector

Data

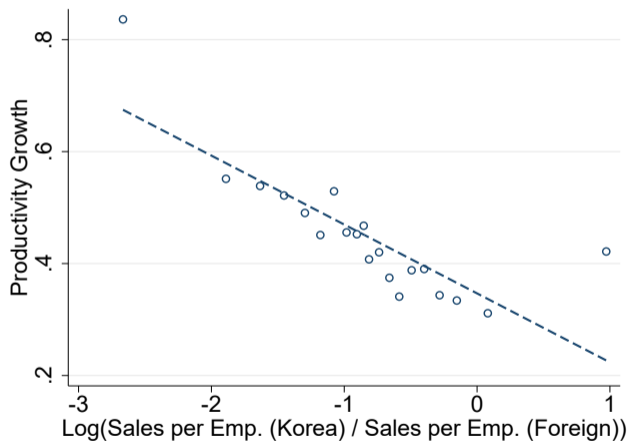
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- ▶ Patent data
 - ▶ Korean Patent office data : 1945 -
 - ▶ US Patent office data : 1975 -

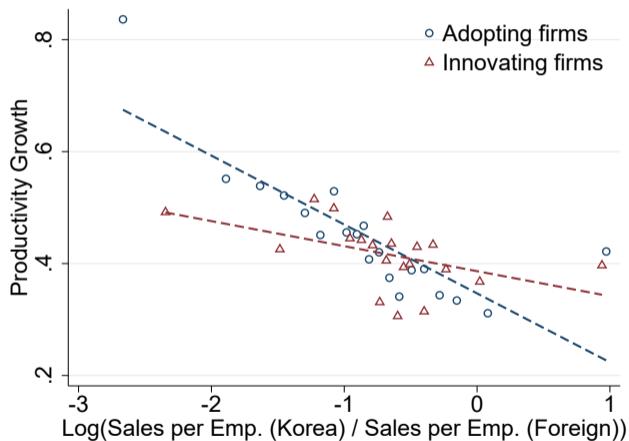
1. When the Initial Gap is Larger, Productivity Growth after Adoption is Larger

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Binscatter plot. Productivity growth = $\Delta \log(\text{sales} / \text{emp})_{i,t+5}$

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Binscatter plot. Productivity growth = $\Delta \log(\text{sales} / \text{emp})_{i,t+5}$

2. When Productivity Gap is Smaller, Adoption Fee is Higher

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$$\mathcal{F}_{ift} = \beta \log \frac{z_{it}}{z_{ft}} + \delta + \epsilon_{ift}$$

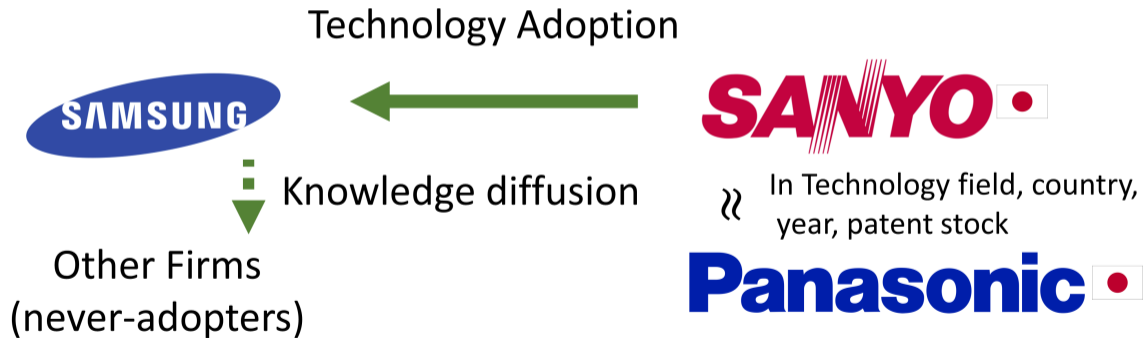
	(1)	(2)	(3)	(4)	(5)
<u>Panel A. Dep. Log Fixed Fee</u>					
Log Productivity Gap	0.183*** (0.052)	0.133** (0.060)	0.093 (0.068)	0.280*** (0.078)	0.292*** (0.088)
N	1,790	1,644	1,619	1,630	1,516
<u>Panel B. Dep. Royalty Rate</u>					
Log Productivity Gap	0.108* (0.059)	0.160** (0.079)	0.392* (0.203)	0.202* (0.118)	0.190* (0.114)
N	1,159	1,075	996	1,055	973
Year FE	✓	✓	✓		
Sector FE		✓			
Domestic Firm FE			✓		
Sector x Year FE				✓	✓
Foreign Country x Year FE					✓

3. Other Firms Get Knowledge Diffusion from the Adopted Technology

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3. Other Firms Get Knowledge Diffusion from the Adopted Technology

Patent Citation



≈ In Technology field, country,
year, patent stock



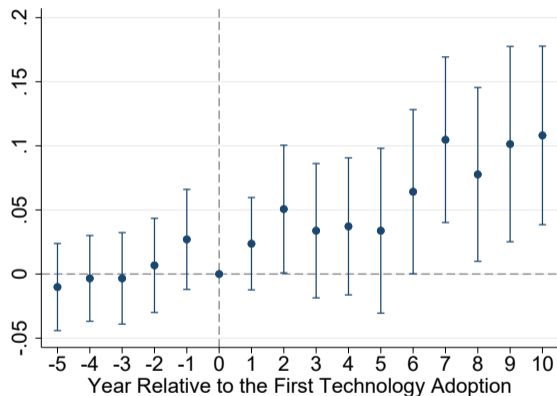
Patent A **cites** patent B \Rightarrow patent A **builds on** patent B

Match **technology seller** and **placebo firm** in same country, field, and similar patent

Plot **difference of citations between seller and placebo firm** around first adoption

Non-adopters Increase Patent Citations to the Adopted Technology

$$Y_{fmt} = \sum_{\tau=-5}^{10} \beta_{fi} (D_{mt}^{\tau} \times 1[\text{Seller}_{fmt}]) + \delta_{fm} + \delta_{mt} + \epsilon_{fmt}$$

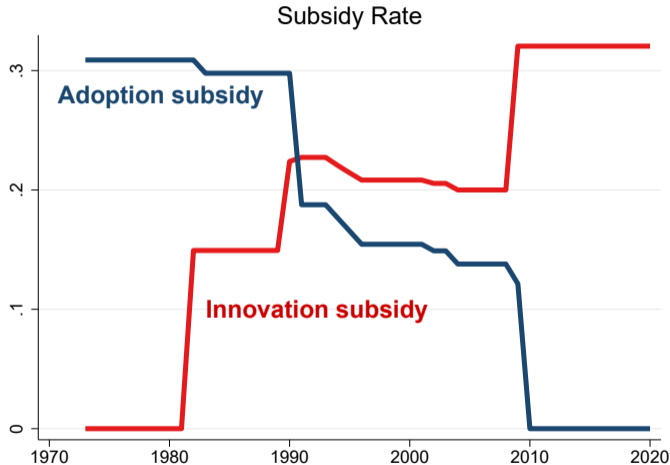


Y_{it} is citation dummy from non-adopters to foreign firm i . Vertical line is 95% confidence interval. Standard error clustered at foreign firm and match levels.

Takeaways

- ▶ Technology adoption brings larger productivity gain with lower cost at the early stages of development
- ▶ Adoption also brings knowledge diffusion, which causes underinvestment problem
- ▶ Subsidizing adoption can be effective at the early stages
- ▶ But, gain from adoption diminishes as country catches up
- ▶ We quantify the policy implications using two-country growth model with endogenous adoption and innovation

Adoption and Innovation Subsidies

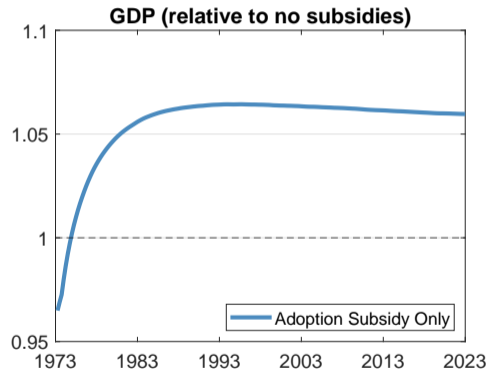
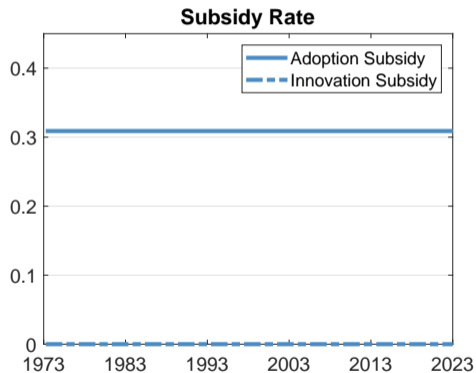


Compare the actual policy with ..

1. With no subsidies
2. Adoption subsidy only
3. Innovation subsidy only

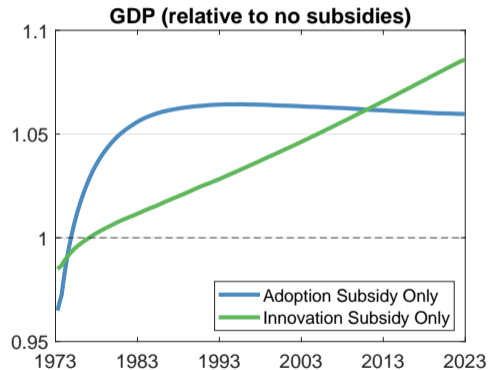
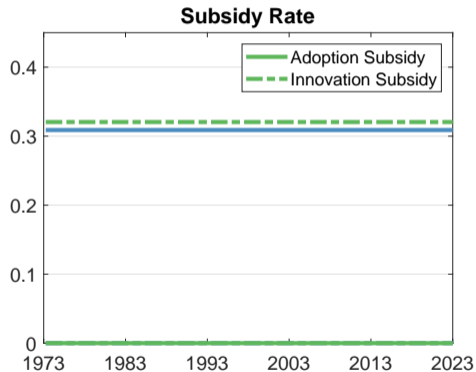
Adoption and innovation subsidy is in a form of tax credit for adoption fee payment and R&D expenditure, respectively.

When Subsidizing Only Adoption



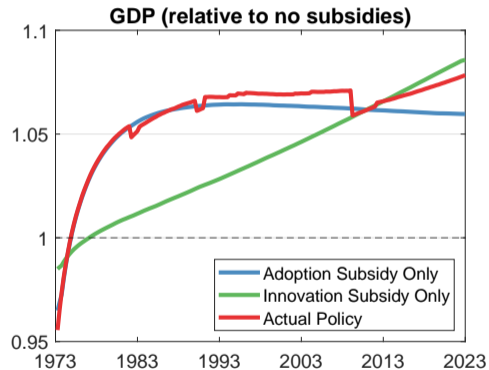
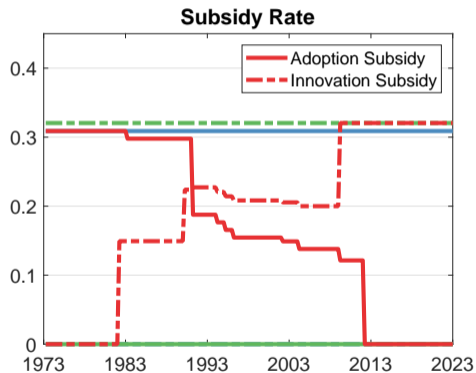
Government spending is financed by lump-sum tax

When Subsidizing Only Innovation



Government spending is financed by lump-sum tax

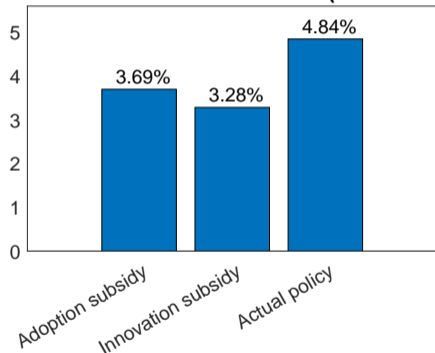
Actual Policy: Adoption Subsidy → Innovation Subsidy



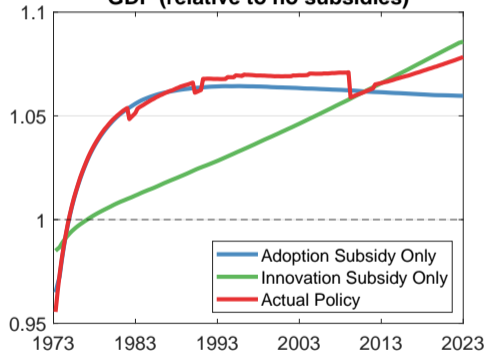
Government spending is financed by lump-sum tax

Welfare Gains Compared to Case with No Subsidies

Welfare increase from no subsidies (in consumption)



GDP (relative to no subsidies)



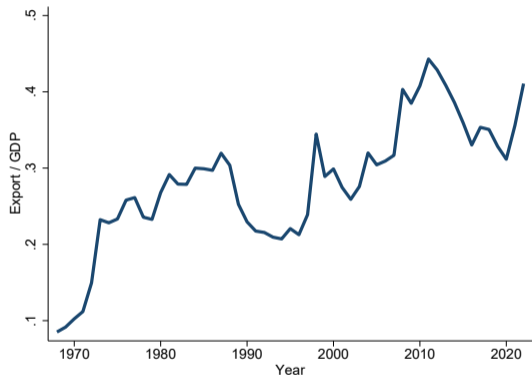
$$\text{Welfare} = \int_{t=0}^{\infty} e^{-\rho t} U(C_t) dt$$

Conclusion

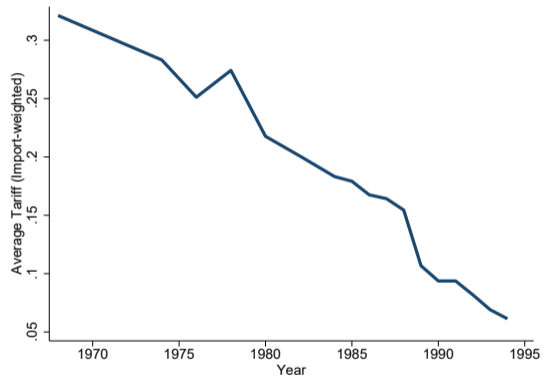
- ▶ Policies that are effective for developed countries **may not work** for **developing countries**
- ▶ State-dependent policy that starts with **adoption** subsidy and **shifts towards innovation** subsidy was indeed effective in South Korea

Appendix

Export Share in Korea has Increased over Time



Export / GDP



Average Import Tariff