Government's R&D Subsidy Response to SCM Agreement: Evidence from Korea

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Three Ingredients

- Background of WTO subsidy rules
- Some empirical facts: R&D subsidy response to SCM in Korea
- Theoretical model (R&D subsidy and fundamentality)

The Agreement on Subsidies and Countervailing Measures (SCM Agreement)

- SCM agreement is multilateral subsidy rules of WTO and originates from the Uruguay Round negotiations (1986-94).
- SCM agreement establishes the definition of "subsidy":
  - A subsidy exists if

    (i) a "financial contribution" by a government or any public body within the territory of a member (or any form of income or price support in the sense of Article XVI of GATT); and

    (ii) a "benefit" is thereby conferred.
  - A "specific" subsidy is subject to SCM discipline (specifically offered to enterprise or industry or groups of enterprises and industries).

Two Categories of Subsidies in SCM

- **Prohibited:** Export subsidies and local-content subsidies (used for domestic over imported goods) are prohibited outright (except as otherwise provided in the Agreement on Agriculture).

- **Actionable:** Subsidies are actionable (i.e., subject to challenge through dispute settlement or countervailing action) if they are "specific" and cause "adverse effects" to trading partners. Production subsidies are under actionable category.

"Adverse Effects"

- There are 3 types of "adverse effects" under the actionable category:
  - "Injury" to a domestic industry caused by subsidized imports in the territory of the complaining member. This is the basis for imposing a countervailing measure.
  - "Nullification or impairment" of the benefits expected by tariff reduction: A nullification-or-impairment case may occur when subsidization undercuts the market access reasonably expected from tariff reduction.
  - "Serious prejudice": It may occur when a subsidy by a government causes a loss of exports by another member in the subsidizing country or in a third country.
- First two adverse effects are broadly contained in GATT as countervailing duty (CVD) and a non-violation (NV) complaint.
- Serious prejudice is a new discipline.

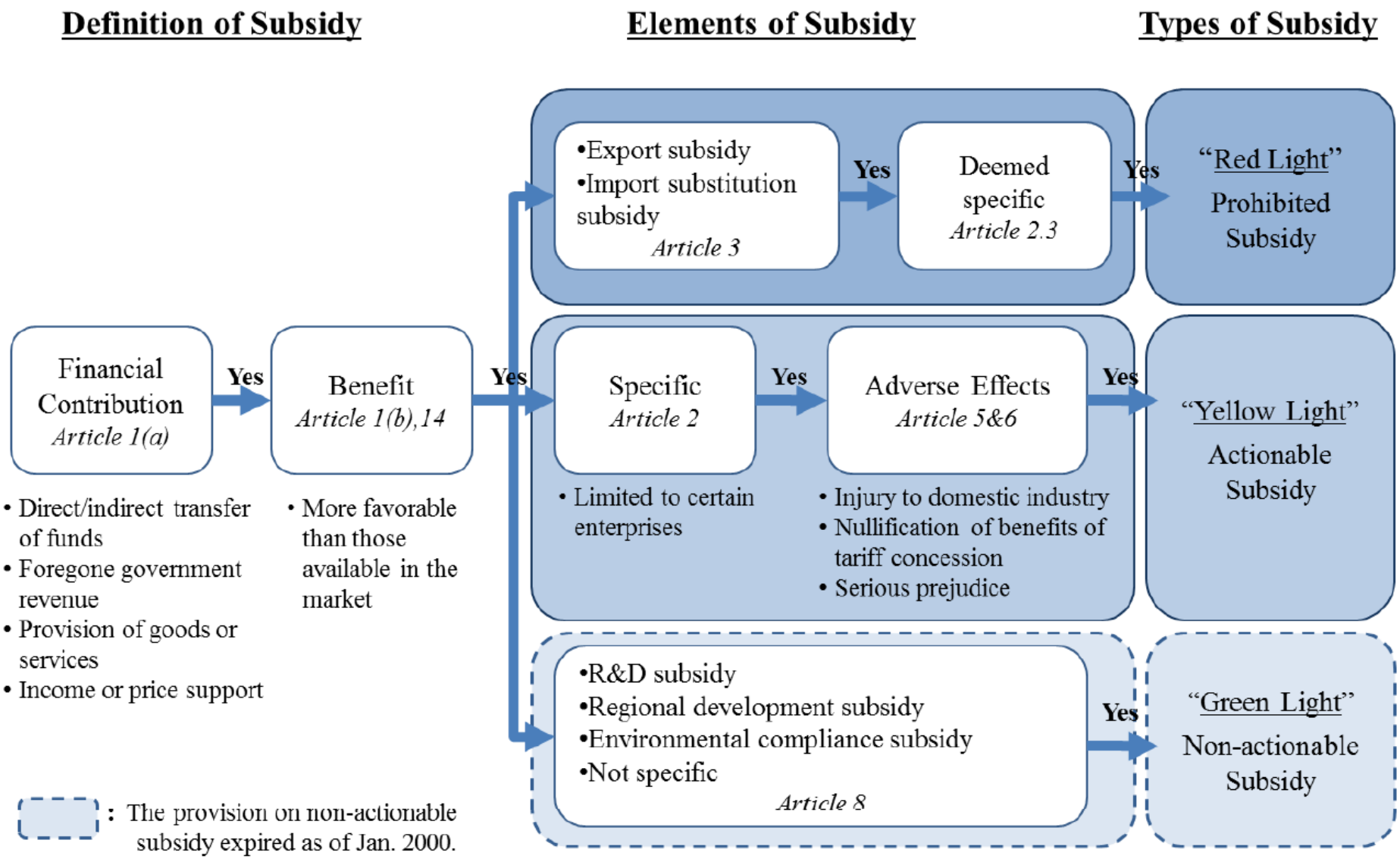
"Green Light Subsidies"

- For the first five years of WTO (1995–99), SCM contained a safe harbor available to all members for 3 particular forms of subsidies:
  - R&D subsidies: Assistance for research activities conducted by firms or by higher education or research establishments on a contract basis with firms.
  - Regional support: Assistance to disadvantaged regions within the territory of a WTO member.
  - Environmental subsidies: Assistance to promote adaptation of existing facilities to new environmental requirements imposed by law and/or regulations, which result in greater constraints and financial burden on firms.
- These subsidies were classified into the category of "non-actionable subsidies." In colloquial terms, they were called "green light subsidies."

Green Turned Yellow

- Green light subsidies were time-limited: On January 1st 2000, Article 8 of SCM expired, and the category of non-actionable subsidies disappeared.
- Under the current discipline, R&D subsidies of developed countries are in principle under "yellow light" (actionable) category (i.e., subject to dispute settlement or countervailing action).
- Providing R&D support to technology-intensive industries would be specific (selective intervention).

To Summarize



Source: Shin and Lee, 2013

Looks Like Nothing Is Going On

- Article 8.3 of SCM required that any subsidy program that a WTO member believed was non-actionable should be notified in advance of its implementation to the SCM Committee. The WTO Secretariat was then to review the notification, and the SCM Committee determined whether the notified program qualified for green light status.

- However, during the five years in which the category of green light subsidies was in effect, none of WTO members notified the SCM Committee of a non-actionable subsidy pursuant to Article 8.3 of SCM. The SCM Committee did attempt to address issues of Article 8 such as notification and arbitration procedures, but there was no notification during the five-year period.

Does SCM Really Matter?

- Recent preferential trade agreements (PTAs) go beyond eliminating tariffs on a preferential basis and include commitments of behind-the-border measures.
- Theoretical foundation for "deep integration":
  - Private information: Bajona and Ederington (2012), Lee (2016).
  - Commitment: Brou and Ruta (2013).
  - Off-shoring: Antràs and Staiger (2012).
  - Self-enforcement with intertemporal persistence: Sauré (2014).
  - Contractual costs: Horn, Maggi and Staiger (2010).
- Our question: Are R&D policies really responsive to WTO subsidy rules? The green light provision was seemingly ineffective, but the answer is yes.

Empirical Challenges

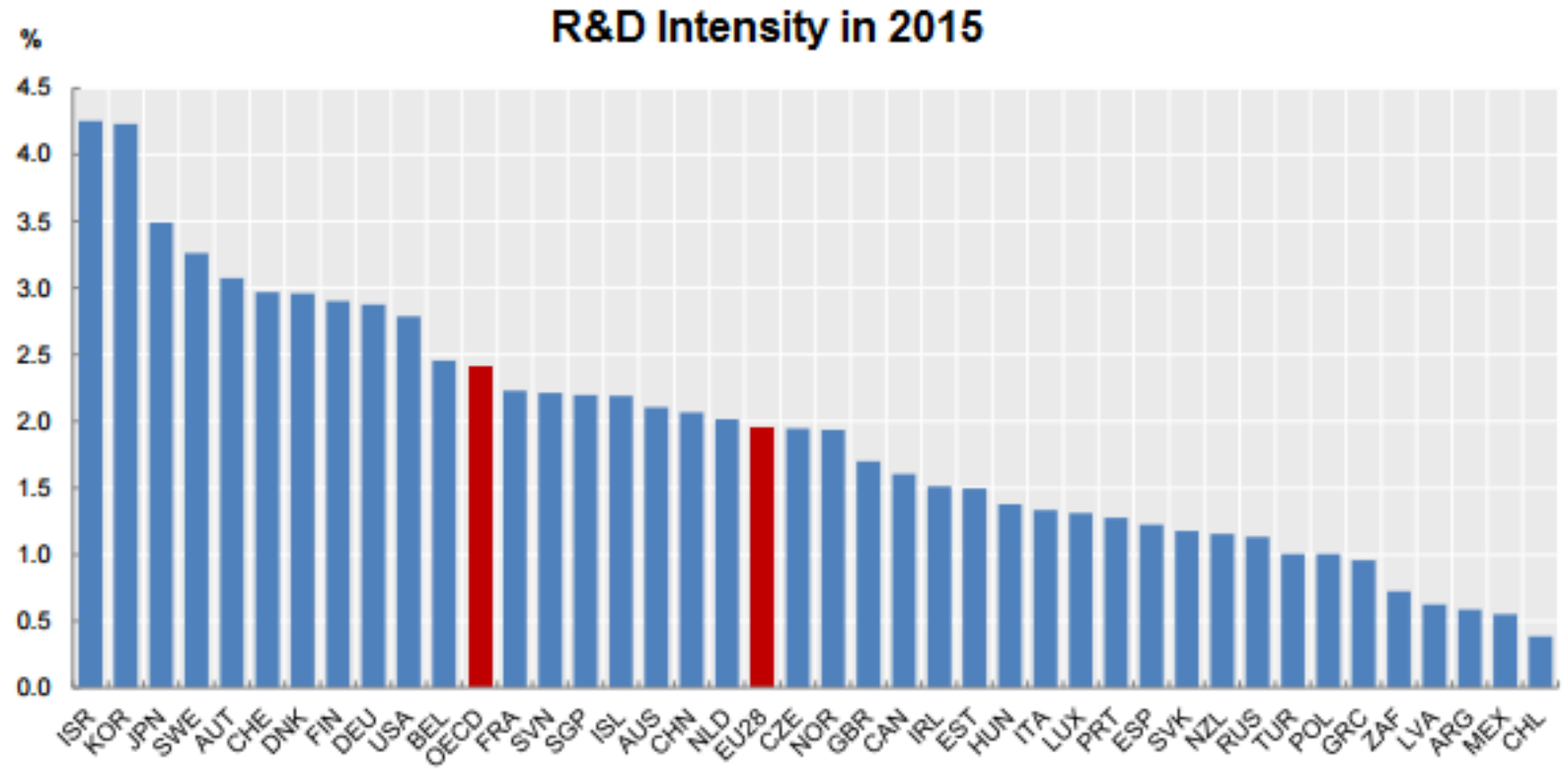
- Subsidies are extremely difficult to track not only for complainants, but also for researchers.
  - Governments have no incentives to report information on their subsidies.
  - Financial contributions are often made in various ways which are hard to detect.
- Individual disputes only allow us to infer limited information.
  - Governments' overall interventions and activities are difficult to infer from individual cases.

Empirical Analysis of R&D Subsidy

- Resources devoted to R&D activities are particularly of interest for several reasons.
  - Relatively more information is available on R&D spendings (e.g. OECD Statistics).
  - When innovations are realized from R&D activities, there can be long lasting benefits with large spillover effects in the market.
  - R&D spendings by nature have specific goals aimed to improve competitive edge in the market.
  - Given the importance of R&D, many countries devote a large amount of resources to R&D activities.

Case of Korea

- In this empirical analysis, we focus on Korea which is a typical example of a small and open economy.
- In 2015, Korea had the second highest R&D intensity (expenditure on R&D as a percentage of GDP) followed by Israel (4.23% compared to 4.25%).



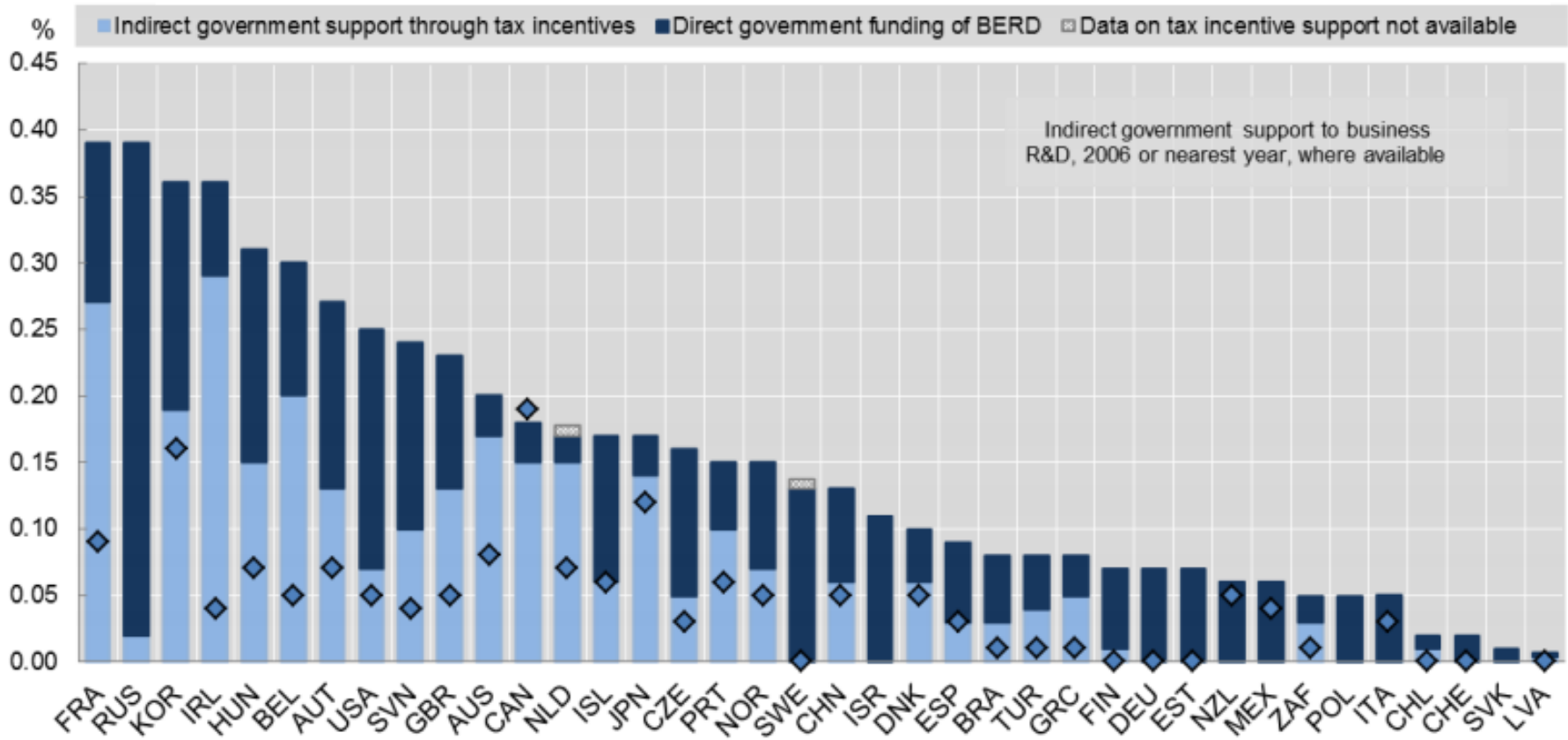
Source: OECD Main Science and Technology Indicators Database, February 2017. http://oe.cd/msti

Case of Korea

- Korea was ranked third for providing the most combined support for business R&D as a percentage of GDP in 2014.

Direct government funding of business R&D and tax incentives for R&D, 2014

As a percentage of GDP



Source: OECD, R&D Tax Incentive Indicators, http://oe.cd/rdtax and Main Science and Technology Indicators, http://oe.cd/msti, February 2017.

Data

- Survey of Research and Development in Korea
  - Published annually since 1963 by the National Science & Technology Commission and the Korea Institute of Science & Technology Evaluation and Planning.
  - Organizations covered: research institutions, general hospitals, firms, and universities
  - Survey Items
    - Organization characteristics: general expenditure (or sales), size of capital, number of employees, employees engaged in R&D, etc.
    - R&D expenditure: by source, research type, type of costs, research field, etc.

Data

- We focus on R&D activities by firms from 1991 to 2007.
  - Firms covered in the survey are:
    - Firms with 300 or more employees
    - Firms with research institute or R&D division
    - Venture businesses involved in R&D projects funded by government
  - The average number of firms that were asked to participate in the survey during these years is around 7,694.
  - The retrieval rate of survey from these firms is around 81.8%, or 6,186 firms.
  - Among them, an average of 4,670 firms have engaged in R&D activities.

Data

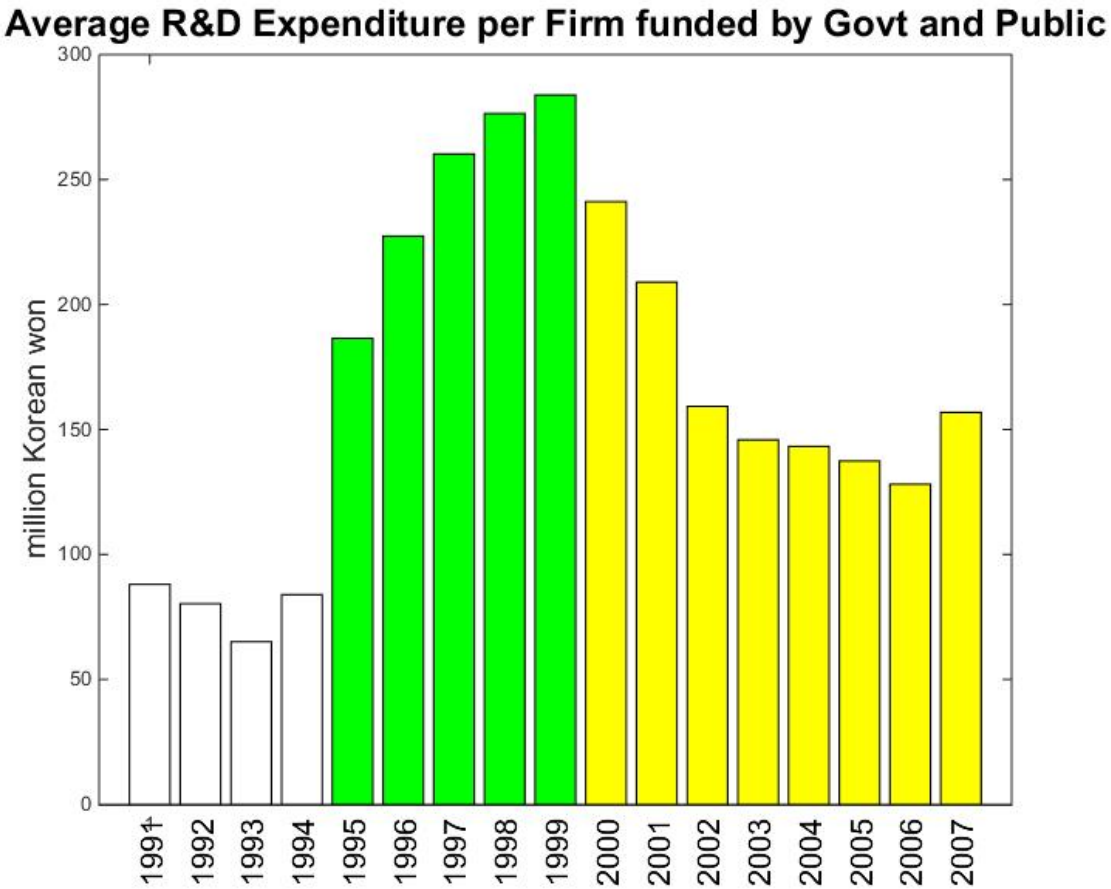
- We also append macroeconomic information on Korea to the survey data from the following sources:
- OECD Structural Analysis (STAN) Database
  - Bilateral Trade by Industry
- Economic Statistics System from Bank of Korea
  - Various macroeconomic indicators

Empirical Evidence

- We analyze the data to see if there is any impact of SCM agreement on R&D expenditures from the government and public sector across firms.
- In particular, we analyze effects in these three aspects:
  - Aggregate R&D expenditure trend
  - Characteristics of firms and sectors
  - Type of research work

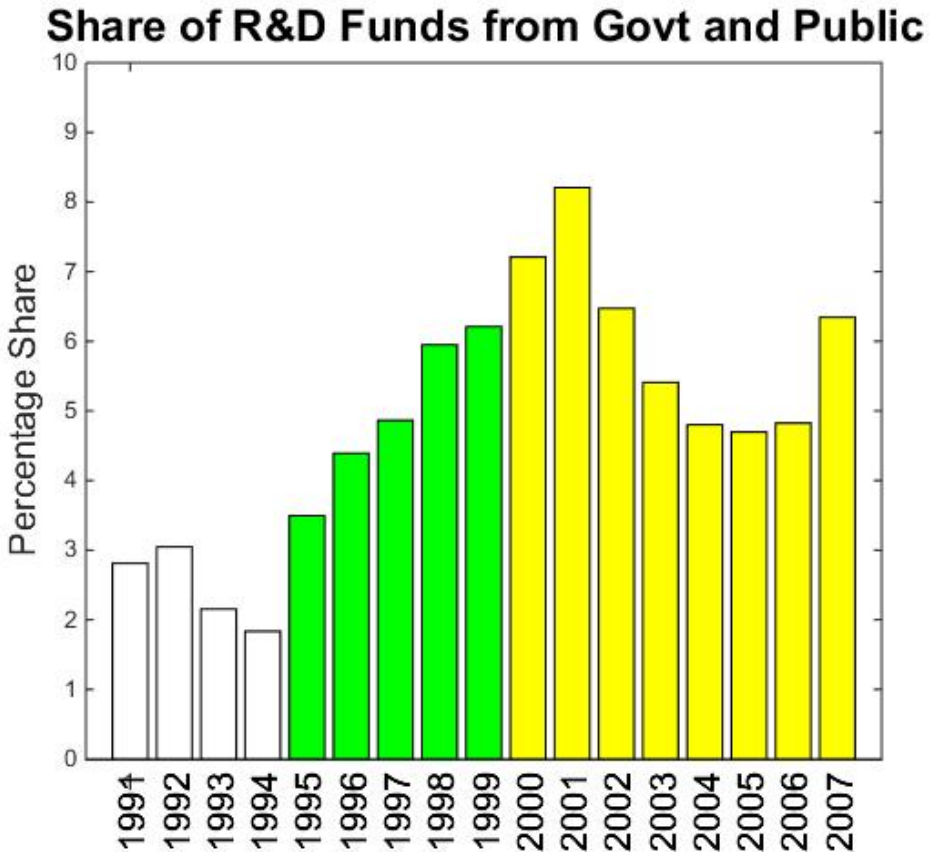
Aggregate R&D Expenditure Trend

- The average R&D expenditure by the government and public sector grew rapidly during the green light period between 1995 and 1999.
- After year 2000, the average R&D expenditure diminished gradually.



Aggregate R&D Expenditure Trend

- The share of R&D expenditure by the government and public sector out of all sources (i.e. private + gov public + foreign) also grew during the green light period.
- The share continued to grow until 2001 and diminished afterwards until 2007.



Aggregate R&D Expenditure Trend

- The government's average R&D expenditure is responsive to the adoption of SCM agreement, especially the green light period.

Dependent variable: log(average govt public R&D expenditure in t)	(1)	(2)	(3)	(4)
log(lagged average govt public R&D expenditure)	0.4641***	0.4630***	0.4634***	0.4621***
	(0.0630)	(0.0628)	(0.0629)	(0.0627)
log(lagged average private R&D expenditure)	0.1871	0.1919	0.1877	0.1922
	(0.1125)	(0.1130)	(0.1132)	(0.1140)
time trend t	0.0235		0.1172	
	(0.0296)		(0.233)	
log(lagged real GDP)		0.5717		0.2687
		(0.6346)		(0.4709)
I(green light period: '95 to '99)	0.5533**	0.4951*		
	(0.2375)	(0.2800)		
I(yellow light period: '00 onwards)	0.4403	0.3510		
	(0.3782)	(0.4389)		
I(after SCM: '95 onwards)			0.5764**	0.5456**
			(0.2202)	(0.2457)
Sector FE	Yes	Yes	Yes	Yes
R-squared	0.8256	0.8259	0.8254	0.8255
Observations	365	365	365	365

Aggregate R&D Expenditure Trend

- The hypothesis testing suggests that
  - We can reject the hypothesis that the effects before the SCM adoption in 1995 and during the green light period from 1995 to 1999 are statistically different at 5%.
  - However, we cannot reject the hypothesis that the effects during the green light period from 1995 to 1999 and the yellow light period from 2000 are statistically different at standard levels.

Characteristics of Firms and Sectors

- The government's average R&D expenditure across firms differs greatly, depending on firm size measured by number of employees.
  - The average expenditure is much greater for larger firms.
  - For smaller firms, a larger share of R&D funds is financed by the government.

Number of employees	Average amount funded by the gov and public (Unit: million won)	Share of R&D expenditure financed by the gov and public (Unit: %)
Less than 99	71.28	14.68
100 to 299	97.44	8.25
300 to 999	167.60	4.74
More than 1,000	1695.40	3.42

Characteristics of Firms and Sectors

- The government's average R&D expenditure responds differently to the SCM, depending on firm size.

Dep variable: log(average govt public R&D expenditure in t)	(1)	(2)
log(lagged average govt public R&D expenditure)	0.4955***	0.5013***
	(0.0245)	(0.0248)
log(lagged real GDP)	0.3707	1.1401***
	(0.2515)	(0.2914)
I(firm size in group 2)	0.1228	-0.0419
	(0.2716)	(0.1167)
I(firm size in group 3)	0.3456	0.0403
	(0.2716)	(0.1174)
I(firm size in group 4)	0.8005***	0.7130***
	(0.2787)	(0.1266)
I(firm size in group 1) $\times$ $I(t \geqslant 1995)$	0.6635***	
	(0.2499)	
I(firm size in group 2) $\times$ $I(t \geqslant 1995)$	0.4640*	
	(0.2409)	
I(firm size in group 3) $\times$ $I(t \geqslant 1995)$	0.2861	
	(0.2397)	
I(firm size in group 4) $\times$ $I(t \geqslant 1995)$	0.5693**	
	(0.2458)	
Sector FE	Yes	Yes
Year FE	No	Yes
R-squared	0.6038	0.6129
Observations	1,269	1,269

Characteristics of Firms and Sectors

- The hypothesis testing suggests that
  - The hypothesis that the adoption of SCM has the same effect on average R&D spending financed by government for firms of different sizes can be rejected at 5%.

Characteristics of Firms and Sectors

- Sectors with a higher export to import ratio have larger shares of R&D spendings financed by the government and public sector.

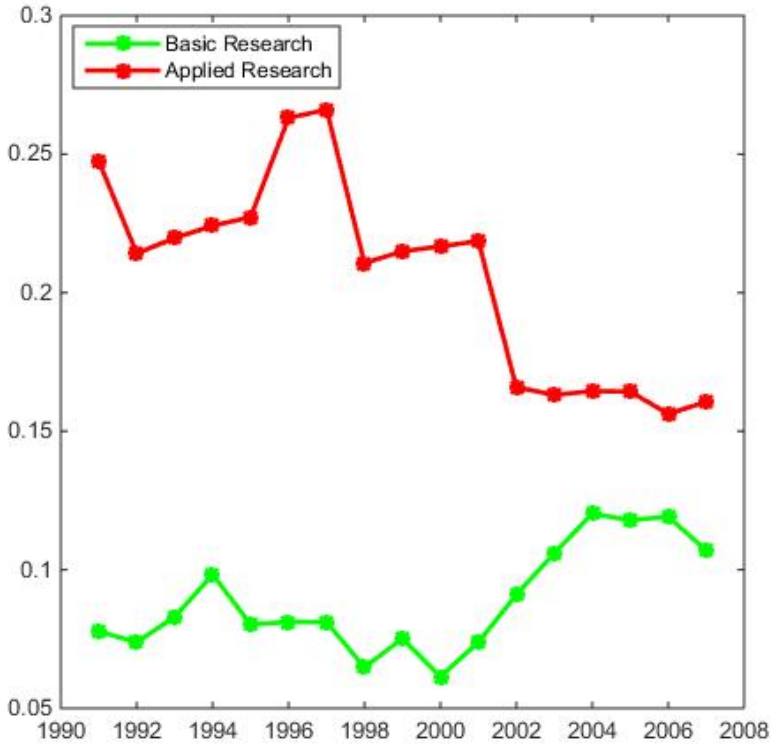
	(1) log(govt public R&D)	(2) log(govt public R&D)	(3) share of govt public R&D
log(lagged govt public R&D expenditure)	0.4259** (0.1472)	0.4278** (0.1464)	0.3512*** (0.1180)
log(lagged real export)	0.0275 (0.1425)		
log(lagged real import)	-0.1198 (0.1946)		
lagged export to import ratio		0.0354 (0.0212)	0.0115*** (0.0017)
Sector FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R-squared	0.8988	0.8967	0.6644
Observations	190	190	190

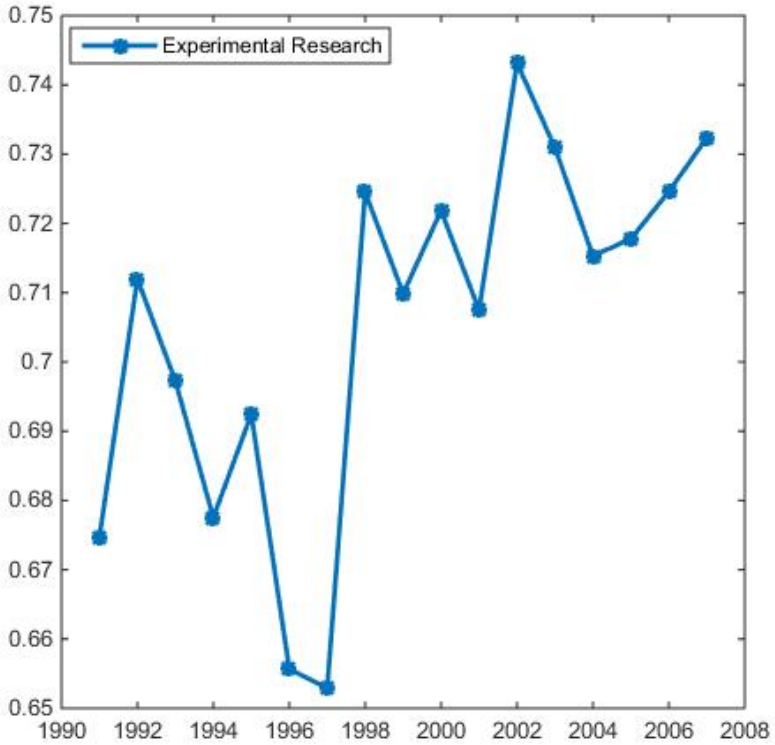
Type of Research Work

- The R&D covers basic research, applied research, and experimental research. Frascati Manual (2002) defines them as the following:
  - Basic Research: "experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view"
  - Applied Research: "original investigation undertaken in order to acquire new knowledge... directed primarily towards a specific practical aim or objective"
  - Experimental Research: "systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed"

Type of Research Work

- The data identifies R&D expenditure by research type, but for funds aggregated across private, public, and foreign sources.
- Between 1990 and 2008, around 8.89%, 20.57%, and 70.53% of aggregate R&D funds were spent on basic, applied, and experimental research respectively.





Type of Research Work

- We first look at the correlations between share of R&D spending financed by the government and the share of R&D spent for each research purpose for 24 sectors from 1991 to 2007.
- On average, the relationship is very weak and the correlation is only slightly positive for experimental research.

	share of basic research	share of applied research	share of experimental research
share of govt public expenditure	-0.0804	-0.0643	0.0932

Type of Research Work

- The government's average R&D expenditure responds differently to the SCM. The effect is larger for sectors with a bigger share of spending on basic research.

Dep variable: log(average govt public R&D expenditure in t)	(1)	(2)	(3)
log(lagged average govt public R&D expenditure)	0.5049***	0.4995***	0.4781***
	(0.0653)	(0.0673)	(0.0667)
log(lagged average private R&D expenditure)	0.1617	0.1731	0.1505
	(0.1183)	(0.1227)	(0.1102)
lagged basic share	-4.2137**		
	(1.7411)		
lagged basic share $\times$ $I(t \geqslant 1995)$	6.4087***		
	(1.5721)		
lagged applied share		-2.0982***	
		(0.7412)	
lagged applied share $\times$ $I(t \geqslant 1995)$		2.5519***	
		(0.5567)	
lagged experimental share			-0.8647
			(0.6404)
lagged experimental share $\times$ $I(t \geqslant 1995)$			0.8708***
			(0.2339)
Sector FE	Yes	Yes	Yes
R-squared	0.8195	0.8176	0.8209
Observations	364	364	364

Conclusion

- SCM agreement established multilateral rules on subsidies. R&D subsidies were classified as non-actionable for the first five years and then became actionable afterwards.
- There was no notification during the green light period and nothing much seems to have changed at a glance.
- However, an empirical analysis of Korean government's R&D spending shows a sharp response to the SCM adoption.
  - scale, type of firms, type of research

Conclusion

- Without additional data and further empirical work, we do not know yet whether such a response is specific to Korea or is commonly found in other countries.

- However, case of Korea suggests that rules on R&D subsidies can shape a government's R&D spendings, which can potentially have implications on innovations, growth, and trade patterns in the long run.