

[ECOMOD2014]

The Effect of R&D Subsidy for Small and Medium Enterprises

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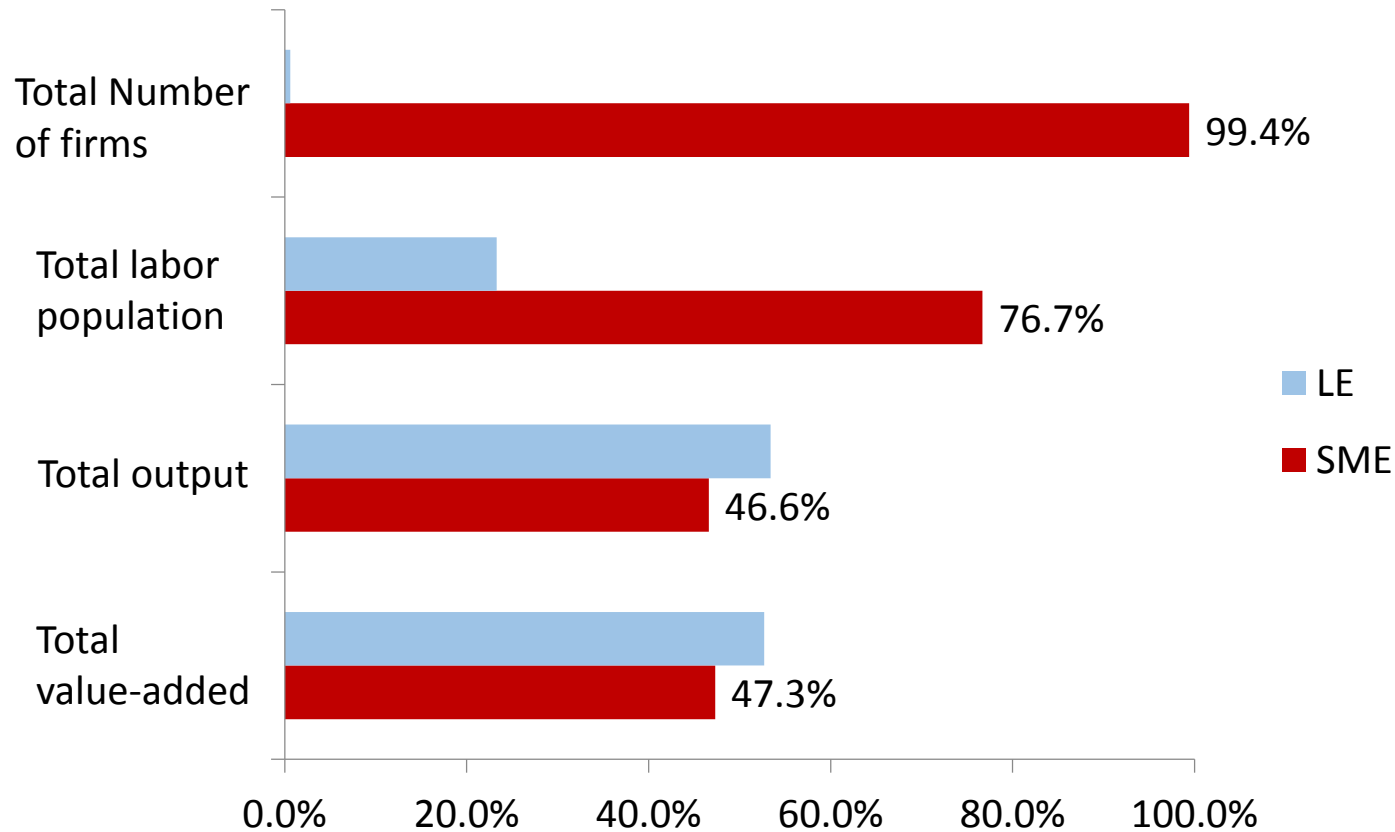
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Chanyoung Hong

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1. Introduction & motivation

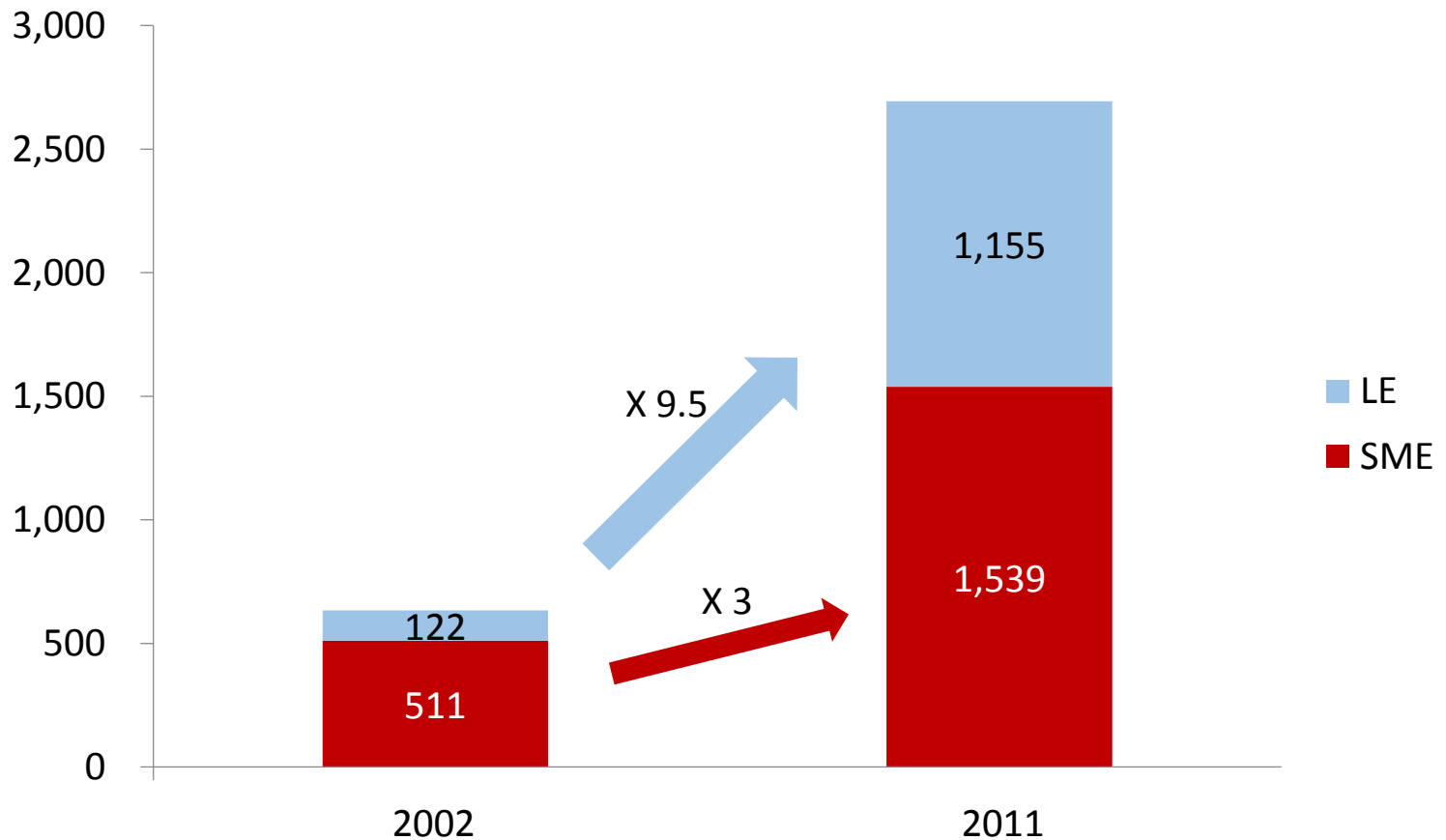
- **Status: Small and Medium Enterprise (SME) in Korea**



1. Introduction & motivation

- **Governmental investment on R&D projects with enterprises**

Unit : million dollar



▪ R&D promotion for SME and its national effect

- Last Korean government (till 2012) was said to be an advocate of LE-oriented policy.
- Despite of broad policies, rate of economic growth has decreased. (under 3% on average)
- New Korean government (from 2013) promised to overcome the situation by new policies fostering SMEs.

▪ R&D promotion for SME and its national effect

- In governmental R&D promotion,
which one is more helpful for economic growth? : Subsidy for LE vs. Subsidy for SME

▪ Firm size and R&D

- The relationship between firm size and R&D is a traditional issue since Schumpeter.
- Despite some exceptions, researchers agreed that there is no advantage of scale in R&D.
- Most studies deal with this issue in firm-level or industry-level, not nation-level.

▪ Firm size and I-O analysis

- SME with I-O table data is tried by very few scholars.
(Madsen and Jensen-Butler, 2003; Romero and Santos, 2007)
- Recently, however, the practical needs for national economic analysis with respect to firm size have arisen.
(Japan, U.S., Korea, Thailand)

3. Model setup

- **R&D based Social Accounting Matrix (SAM) by firm size**

- First, calculate the economic indices of SMEs in each industry by using official statistics from the Bank of Korea and the Korea Customs and Trade Development Institute.

Table 1. The Share of SMEs by industry and by economic indices (Unit: %)

ID	Industry	Total sales (A)	Labor cost (B)	Operating surplus (C)	Depreciation (D)	Corporate tax (E)	Development cost (F)	Intermediate goods (G=A-B-C-D-E-F)
S01	Agriculture, fisheries, mining	-	-	-	-	-	-	-
S02	Food, textile, wood	64.9	64.9	51.5	55.4	47.7	71.2	66.1
S03	Petroleum, chemicals	31.0	50.9	28.8	31.3	29.0	40.3	29.5
S04	Metal, machinery	56.4	67.8	50.9	44.1	49.5	57.8	55.9
S05	Electrical, electronics	32.5	48.7	29.0	12.7	31.9	20.9	33.2
S06	Precision instr., transport	31.5	34.3	19.4	31.4	15.4	28.4	32.1
S07	Service	-	-	-	-	-	-	-

* Industry S01 and S07 are not separated between LE and SME

Six manufacturing industries (S02 to S06) are separated between LE and SME.

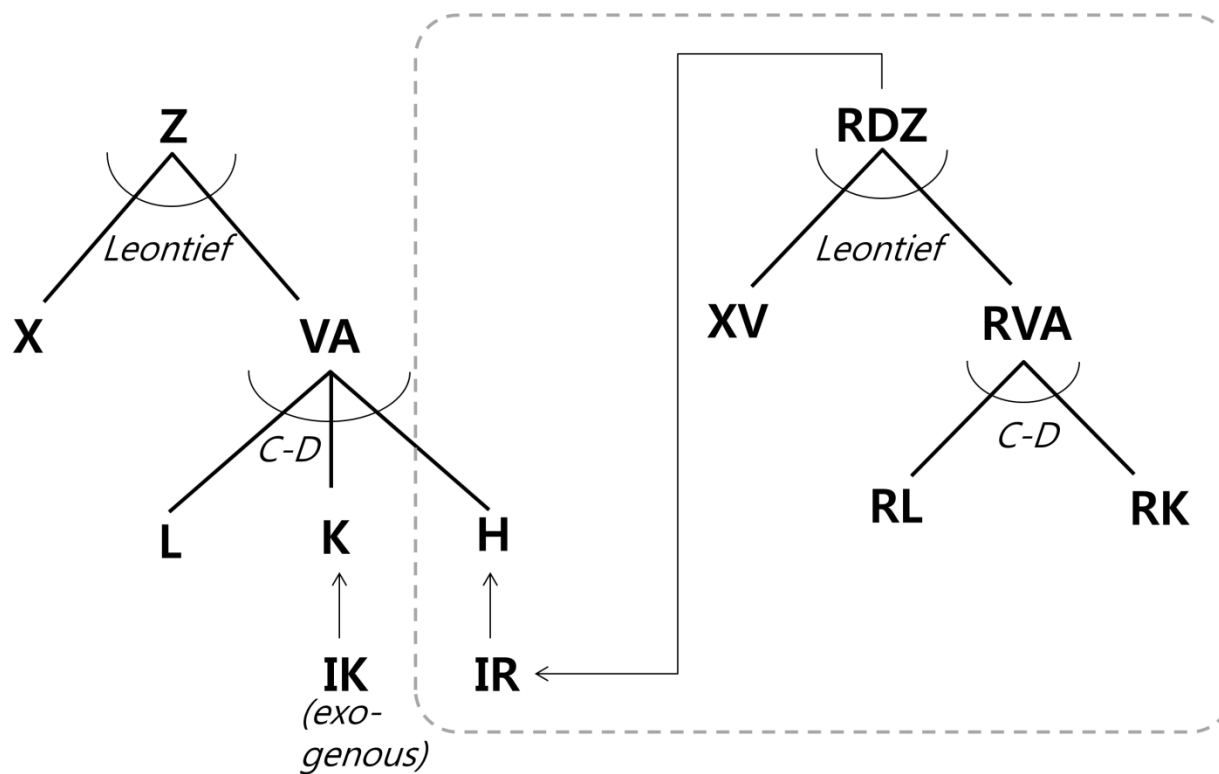
3. Model setup

- Second, divide the target industries of 2009 Korean I-O table on the basis of SME shares.
 - “Use industry” (column direction) is divided by the proportion of intermediate input
 - “Source industry” (row direction) is divided by the proportion of gross output

			Prod.		Factor	Inst.	Invest.	T.	ROW
			LE	SME					
			1 ... N	1 ... N	L K R	H G	PK RH RG	T	E M
Production	LE	1 ... N	$(1-(A))(G)Z$						
	SME	1 ... N	$(A)(1-(G))Z$	$(A)(G)Z$					
Factor Input		L K R			(B)L (C)K (F)R				
Institution		H G			(D)PK				
Investment		PK RH RG			(E)T				
Tax		T							
ROW		E M							

3. Model setup

- Production structure of final and investment goods



▪ TFP growth by spillover effect

- Spillover (spl) is defined as a function of governmental knowledge stock (H_{gov}) and other industry sectors' knowledge stock (H_{other}).
- A sector's own knowledge stock is used as a primary input factor in production, so it is not added in the spillover equation.

$$spl(i, t) = a_{spl}(i) [H_{gov}(t)]^{grdes} [H_{other}(i, t)]^{rdes(i)}$$

$$\text{where } H_{other}(i, t) = \sum_{j \neq i} intindwt(j, i) H(j)$$

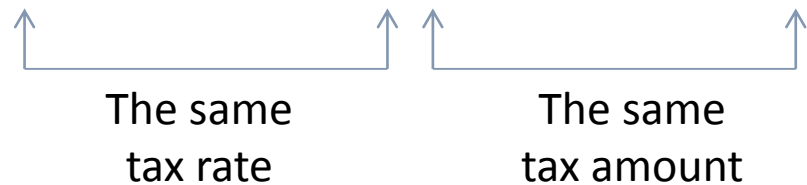
▪ Efficiency of knowledge accumulation

- The increase of knowledge stock is set to be affected by the existing stock of already accumulated.
- It reflects the empirical findings that SMEs are more efficient in R&D investment.

$$H_{i,t+1} = (1 - rdep)H_{i,t} + IR_{i,t}H_{i,t}^{-\gamma}$$

- Scenario definition

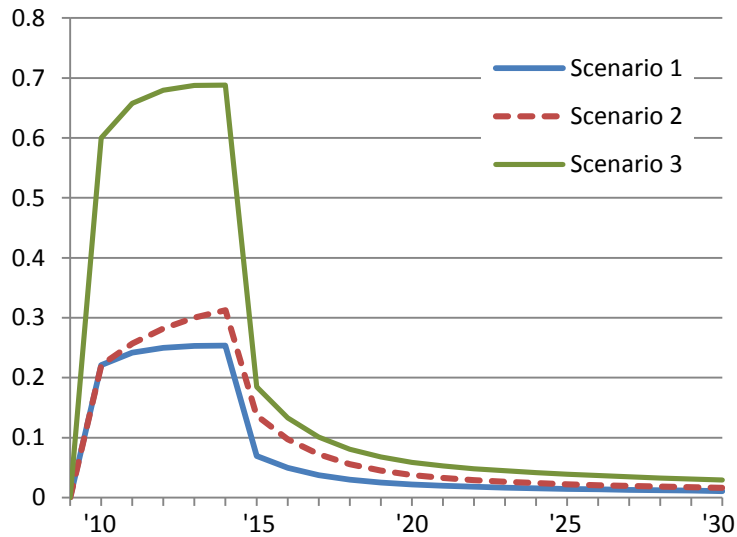
Beneficiary in manufacturing sectors	Additional reduction of tax rate for R&D expenditure		
	Scenario 1	Scenario 2	Scenario 3
Large Enterprise	-	1%p	-
Small & Medium enterprise	1%p	-	2.64%p



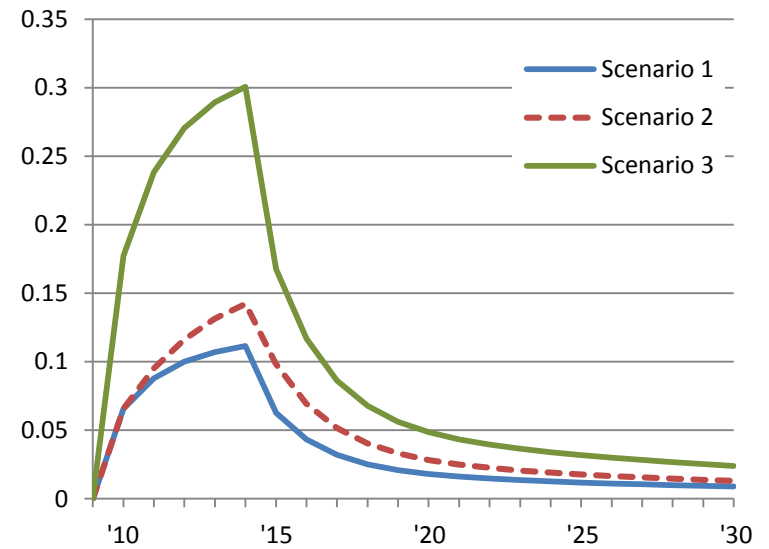
Policy shock is applied during 5 years from 2010.

Scenario results

Beneficiary in manufacturing sectors	Additional reduction of tax rate for R&D expenditure		
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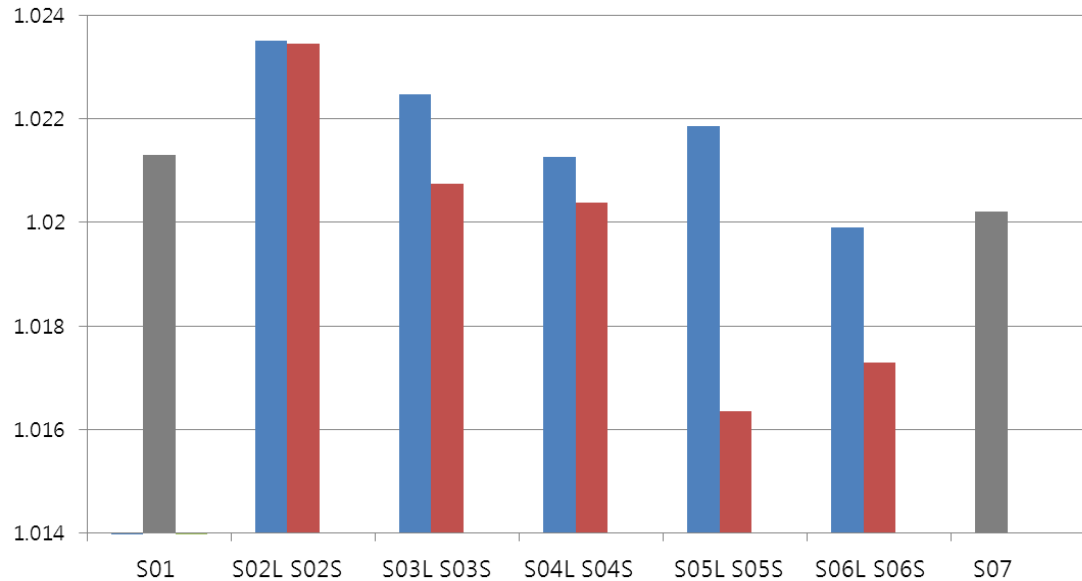


GDP



Utility

Scenario results



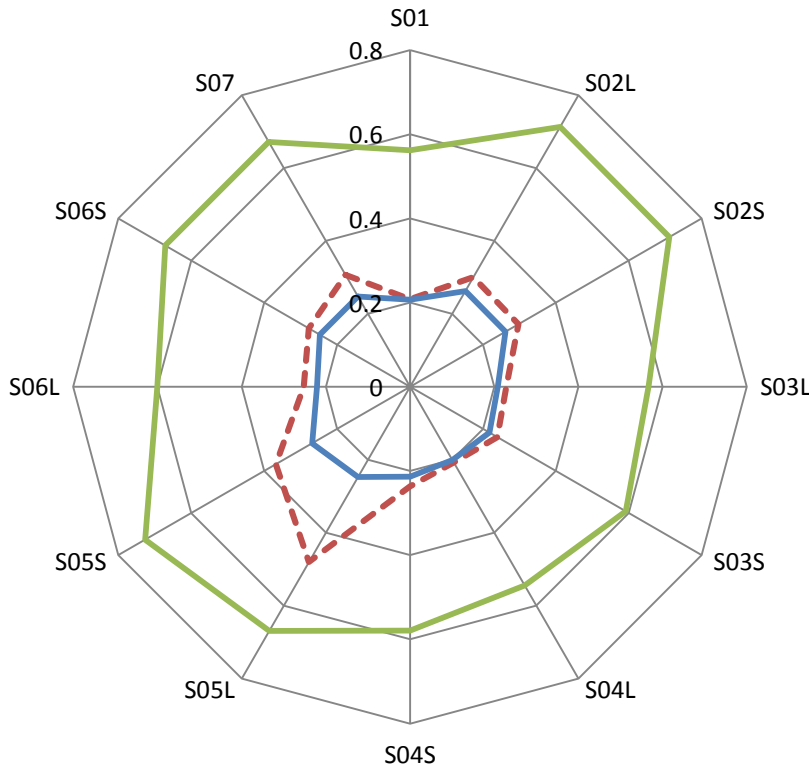
Spillover coefficient (BAU, 2010)

LEs are bigger recipients of spillover than SMEs.

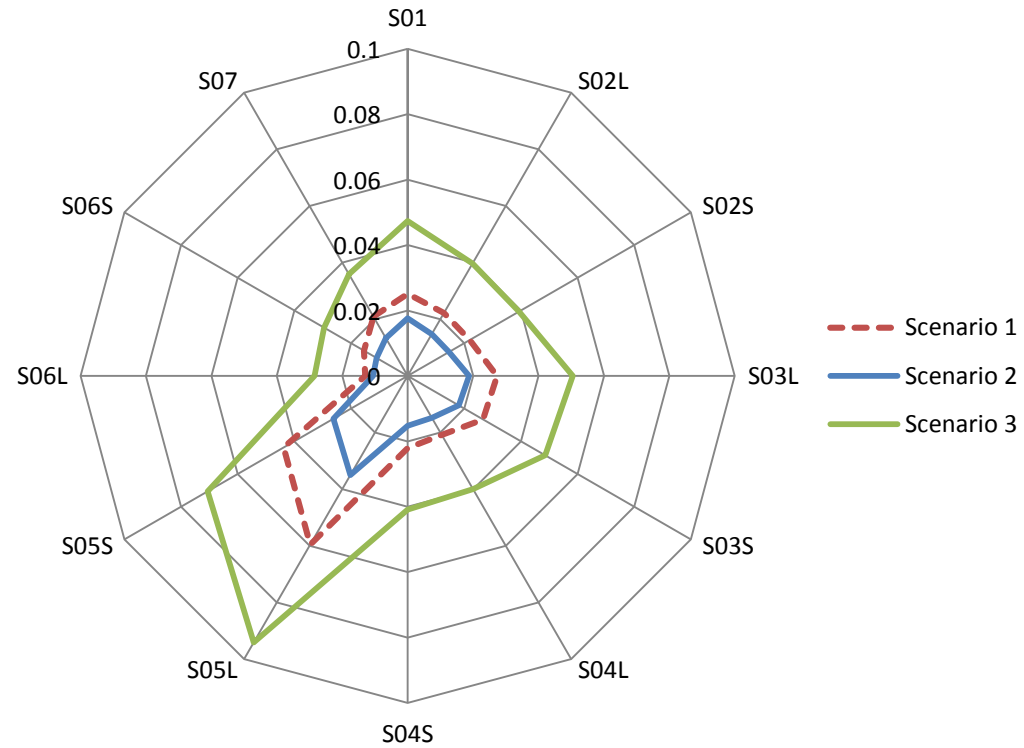
$$spl(i, t) = a_{spl}(i) [H_{gov}(t)]^{grdes} [H_{other}(i, t)]^{rdes(i)}$$

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Scenario results



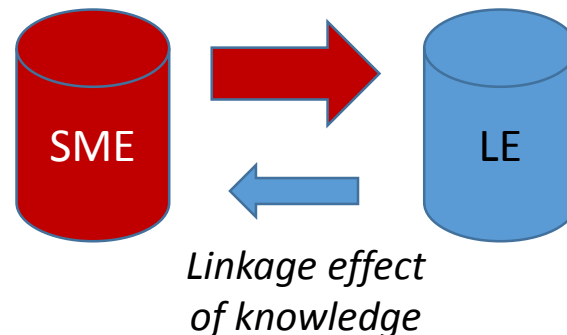
Growth of sector output in 2014
(short term)



Growth of sector output in 2024
(long term)

■ Implication

- This study is the first try to show the economic effect of R&D tax rate by firm size. Authors used R&D-based CGE model to find the nation-level impact.
- In case of offering R&D tax benefit, giving to LEs results in more growth when the additional tax rate is same, while giving to SMEs results in more growth when the total reduction of tax amount is same.
- This is because SMEs are bigger recipients of knowledge spillover than LEs. In other words, SMEs induce more linkage effect than LEs do. In reality, we can imagine that SME's technology (or knowledge) can be easily transferred to LE, while the transfer to the opposite direction is relatively less easy.



▪ **Limitation**

- The relationship between LE and SME is highly dependent on national characteristics.
- The production functions have a form of Cobb-Douglas.
- The elasticity parameter in R&D investment is set arbitrarily, so it needs to be estimated empirically.
- The model assumes full employment and does not consider the impact to unemployment.