

# SOC Infrastructure investment in the age of ageing

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# SOC Infrastructure

- SOC (Social Overhead Capital) has been continuously invested in that it is an important production factor for economic growth and national welfare.
- SOC investment has not only been a driving force for economic growth in the past, but has also been used as a policy tool for responding to the economy
- However, several studies have argued that it is difficult to expect the policy effectiveness of the past
  - Nonlinear relationship between SOC investment and economic growth.
  - Due to the increased burden on social welfare fiscal demands
  - The aging of SOC assets that have been invested in the past economic development period may hinder growth vitality.

# SOC Infrastructure

- Under this background logic, this study intends to develop the following discussions for establishing a new keynote of resource allocation for SOC investment.
- Discuss the expenditure and international comparison of SOC transportation infrastructure by applying OECD COFOG data.
- Empirically analyze the determinants of SOC expenditure, which combines transportation infrastructure and telecommunications infrastructure among economic expenditures of COFOG.
- We will evaluate mid-term SOC investment scale through adequacy evaluation of SOC investment.

## SOC Investment in Korea (2005~2010)

Year	'05	'06	'07	'08	'09	'10	Annual rate
GDP (A)	919,797	966,054	1,043,257	1,104,492	1,151,707	1,265,308	6.59%
SOC investment (B)	18,253	18,420	18,421	19,586	24,743	25,111	7.01%
B/A(%)	1.98%	1.91%	1.76%	1.77%	2.15%	1.98%	-
Transportation and Logistics	15,530	15,284	15,750	16,415	20,192	17,522	2.44%
Road	7,707	7,356	7,533	7,784	9,473	8,004	0.76%
Railways	4,898	4,589	4,747	4,940	6,335	5,351	1.78%
Shipping and port	1,855	1,940	2,062	2,037	2,129	1,862	0.08%
Airport	445	391	333	210	59	67	-31.5%
Logistic	625	1,008	1,074	1,441	2,195	2,239	29.07%
Regional Development	2,723	3,136	2,671	3,171	4,551	7,589	22.75%
Water resources	1,892	2,242	1,621	1,600	2,265	5,108	21.97%
Region and cities	484	523	632	1,037	1,404	1,592	26.89%
industrial complex	347	371	417	534	880	889	20.70%

## SOC Investment in Korea (2011~2018)

Year	'11	'12	'13	'14	'15	'16	'17	'18	Annual rate
GDP (A)	1,332,681	1,377,456	1,429,445	1,486,079	1,564,123	1,637,420	1,730,398	–	4.45%
SOC investment (B)	24,441	23,099	24,302	23,690	24,807	23,695	22,135	17,716	-1.64%
B/A(%)	1.83%	1.68%	1.70%	1.59%	1.59%	1.45%	1.28%	–	–
Transportation and Logistics	16,799	17,482	19,012	18,894	20,295	19,819	18,624	14,186	-2.39%
Road	7,449	7,761	8,645	8,470	9,085	8,341	7,409	5,442	-4.39%
Railways	5,406	6,113	6,859	6,803	7,405	7,465	7,144	4,714	-1.94%
Shipping and port	1,633	1,636	1,509	1,505	1,664	1,800	1,761	1,702	0.59%
·Airport	68	70	82	101	136	164	144	126	9.21%
Logistic	2,243	1,902	1,917	2,015	2,005	2,049	2,167	2,201	-0.27%
Regional Development	7,642	5,617	5,290	4,796	4,512	3,876	3,511	3,530	-10.45%
Water resources	5,018	2,902	2,731	2,383	2,273	2,150	1,811	1,676	-14.5%
Region and cities	1,642	1,685	1,630	1,514	1,349	1,099	1,203	1,554	-0.78%
industrial complex	981	1,031	929	899	890	628	498	300	-15.57%

## SOC Investment in midterm outlook (2018-2023)

구분	Road	Railways	Shipping and port	Airport	Logistic	Water resources	Region and cities	industrial complex	Sub total
2018	5,938	5,197	1,764	144	2,283	1,678	1,667	321	18,992
2019	5,428	4,961	1,671	143	2,348	1,714	1,944	340	18,549
2020	5,210	4,569	1,578	255	2,230	1,675	2,141	390	18,048
2021	5,143	4,421	1,466	301	2,275	1,589	2,165	365	17,723
2022	4,904	4,307	1,321	778	2,274	1,532	2,137	274	17,528
Annual rate(%)	-4.7	-4.6	-7.0	52.6	-0.1	-2.2	6.4	-3.9	-2.0

## OECD COFOG and SOC Infrastructure Investment

	1 <sup>st</sup> level	2 <sup>nd</sup> level		
Total Expend iture	General public services			
	Defence			
	Public order and safety			
	<b>Economic Affairs</b>	Econ1	General economic, commercial and labour affairs.	
		Econ2	Agriculture, forestry, fishing and hunting.	
		Econ3	Fuel and energy.	
		Econ4	Mining, manufacturing and construction.	
		<b>Econ5</b>	<b>Transport.</b>	
		Econ6	Communication.	
		Econ7	Other industries.	
		Econ8	R&D economic affairs.	
		Econ9	Economic affairs n.e.c.	
	Environmental protection			
	Housing and community amenities			
Health				
Recreation, culture and religion				
Education				
Social protection				

# OECD COFOG and SOC Infrastructure Investment

## COFOG Economic Affairs

(Econ1) GENERAL ECONOMIC, COMMERCIAL AND LABOUR AFFAIRS

(Econ2) AGRICULTURE, FORESTRY, FISHING AND HUNTING

(Econ3) FUEL AND ENERGY

(Econ4) MINING MANUFACTURING AND CONSTRUCTION

(Econ5) TRANSPORT

(Econ6) COMMUNICATION

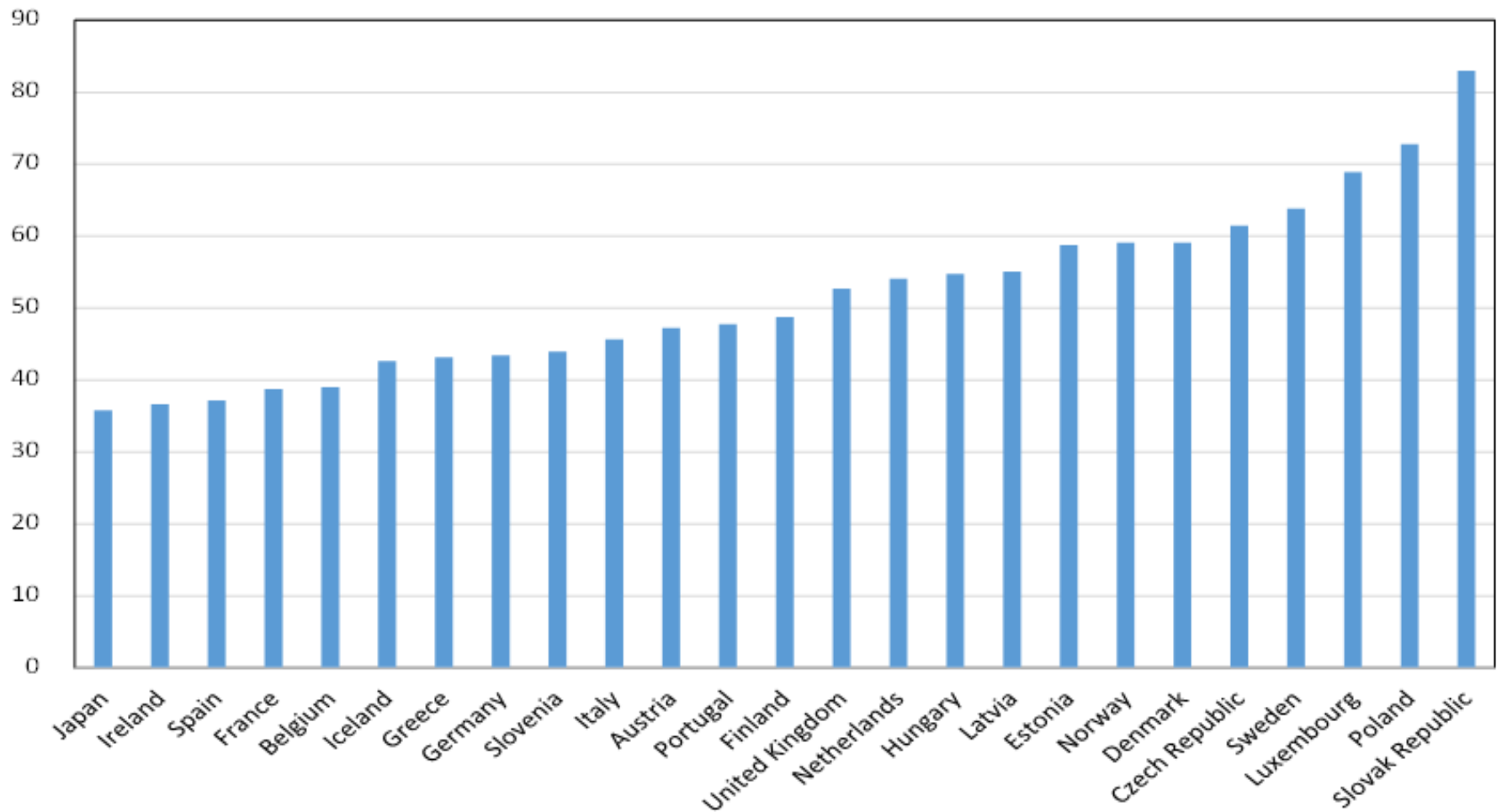
(Econ7) OTHER INDUSTRIES

(Econ8) R&D ECONOMIC AFFAIRS

(Econ9) ECONOMIC AFFAIRS e.c.c.

## OECD COFOG and SOC Infrastructure Investment

Share of transport spending (Economic 5) in Economic Affairs(%)



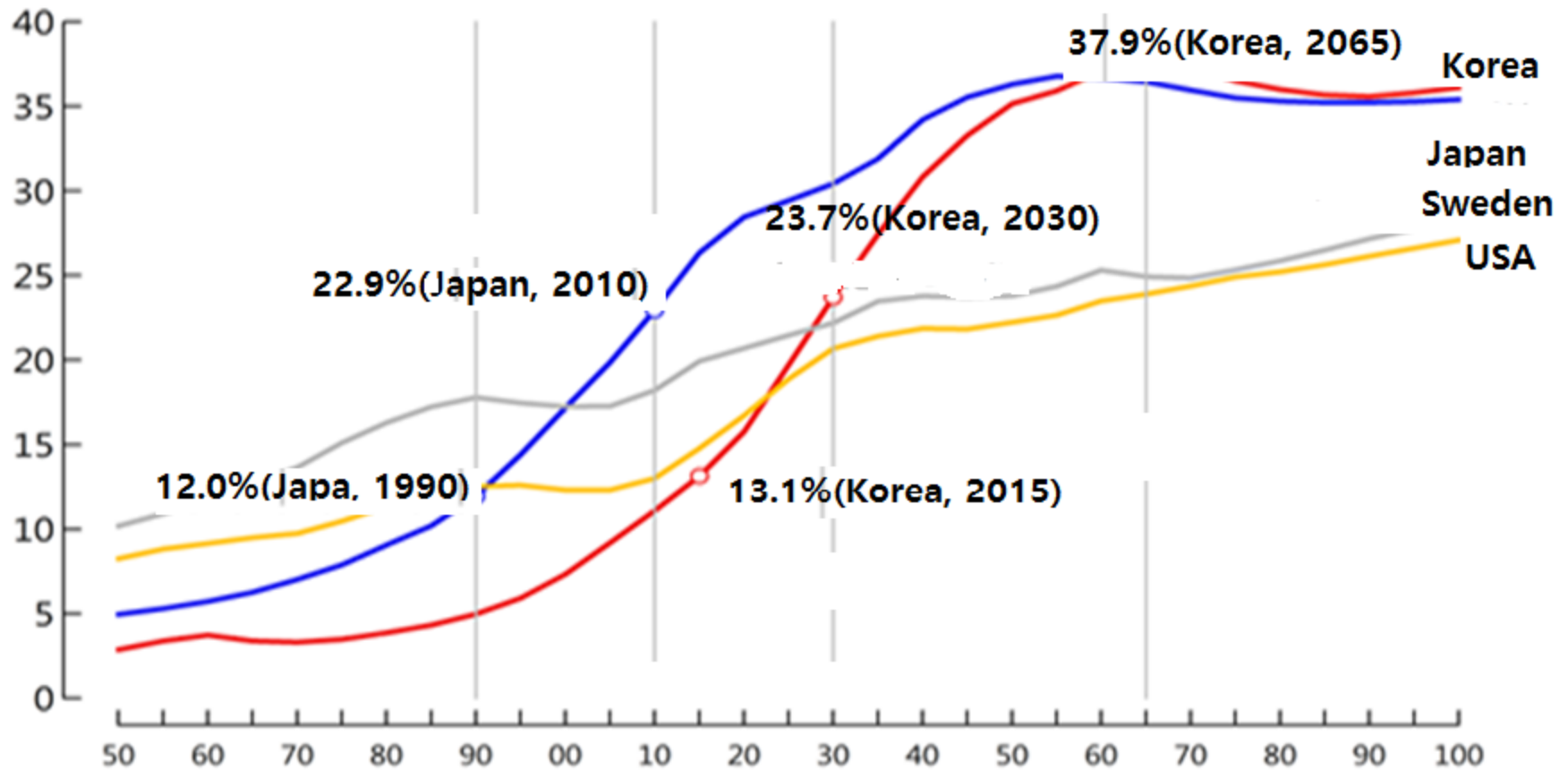
## OECD COFOG and SOC Infrastructure Investment

Country	Econ1	Econ2	Econ3	Econ4	Econ5	Econ6	Econ7	Econ8	Econ9
Austria	23.8	6.3	0.2	0.2	50.8	0.9	2.8	14.8	0.2
Belgium	53.2	1.0	1.0	0.1	37.4	1.1	1.7	4.4	0.1
Czech	6.8	7.8	17.1	0.2	58.6	-0.7	5.0	1.7	3.3
Denmark	18.5	4.5	12.4	0.0	59.3	0.0	1.6	3.3	0.3
Estonia	12.5	10.4	2.9	1.2	60.3	1.1	2.3	6.7	2.6
Finland	11.9	17.2	2.6	4.9	52.0	0.4	0.0	11.0	0.0
France	35.8	3.5	6.9	0.5	32.9	-0.3	5.4	13.9	1.5
Germany	19.2	5.9	3.9	5.9	48.3	0.2	4.9	5.9	5.8
Greece	5.5	6.7	0.1	2.6	70.1	0.3	1.0	0.0	13.8
Hungary	31.3	6.7	2.7	0.6	50.3	0.3	3.8	2.6	1.7
Iceland	22.9	16.1	2.3	0.8	43.2	1.0	1.9	7.7	4.2
Ireland	15.3	12.3	6.7	1.3	49.7	0.4	4.1	6.7	3.5
Italy	6.9	6.6	23.1	9.6	40.1	1.0	4.2	6.0	2.6
Japan	3.2	22.8	9.2	6.4	37.9	1.1	12.8	6.2	0.5
Latvia	12.9	8.4	23.8	0.9	48.6	0.6	1.5	0.0	3.4
Luxembourg	11.1	5.2	2.6	2.3	66.3	1.1	2.8	8.2	0.6
Netherlands	12.6	2.8	4.1	1.9	54.8	0.3	8.3	15.0	0.4
Norway	8.3	11.2	2.1	0.1	64.5	0.9	0.1	9.1	3.7
Poland	7.6	10.1	5.5	1.4	69.7	0.2	1.1	3.4	0.8
Portugal	14.7	7.6	1.1	6.9	53.1	0.8	8.0	7.8	..
Slovak		6.8	2.4	1.5	76.6	0.6	5.6	0.8	1.6
Slovenia	28.1	9.9	7.3	0.8	43.2	-2.6	4.3	9.1	0.0
Spain	29.4	8.5	9.5	0.9	35.5	1.8	4.5	8.9	1.0
Sweden	25.5	3.2	1.4	2.2	63.7	0.5	1.2	1.9	0.6
UK	14.9	3.9	8.5	0.5	57.7	0.6	0.3	14.0	-0.3
OECD	17.4	8.2	6.4	2.1	53.0	0.5	3.6	6.8	2.2

# Methodology

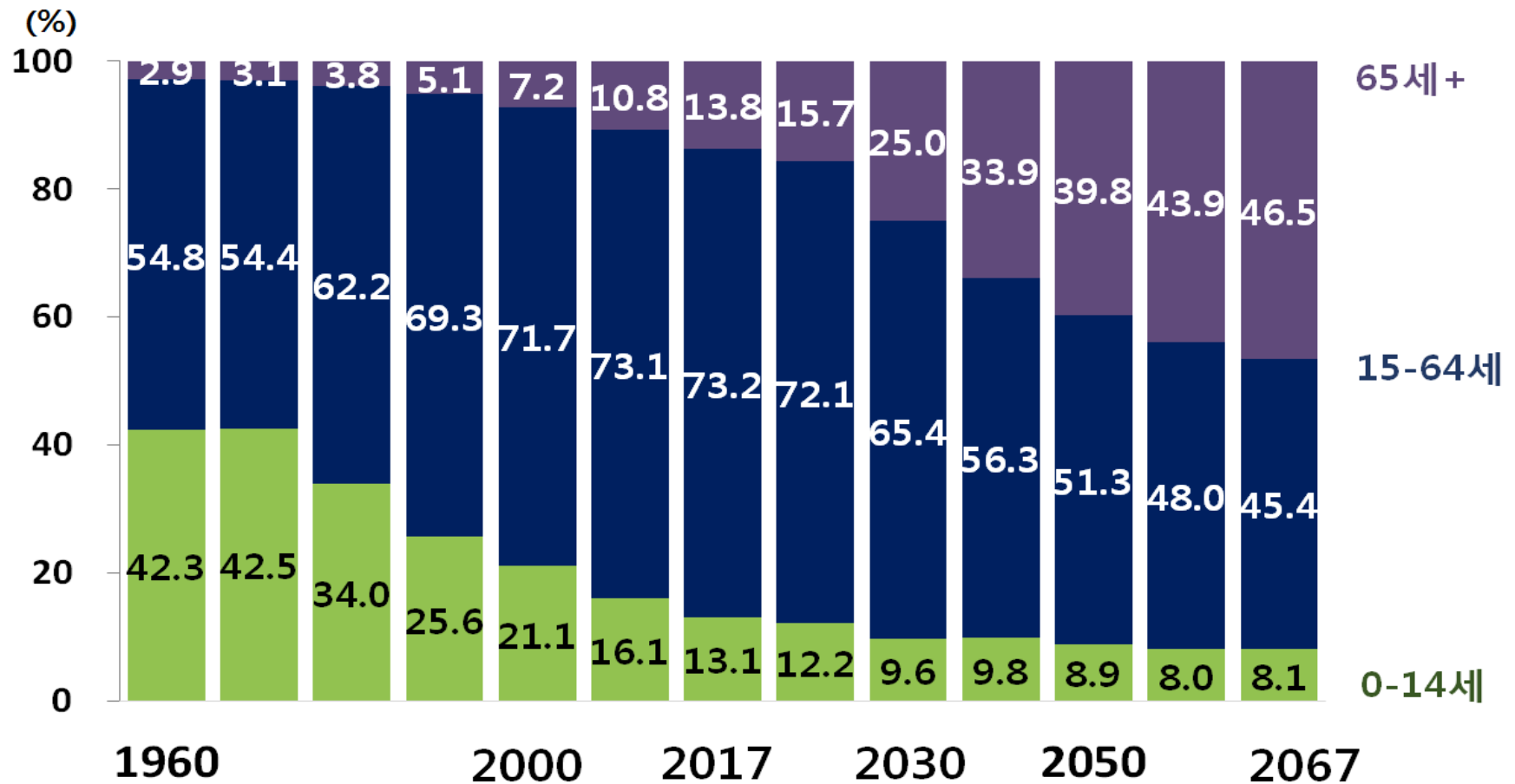
- This study conducted an empirical analysis of 24 OECD member countries during 2009-16 to analyze the determinants of expenditure structure in the transport sector
- In order to examine the determinants of the share of expenditure in SOC traffic, this study performed the panel regression analysis.
- Dependent variable: share of economic sector expenditure among the general government economic affairs on COFOG
- Explanatory variables: national income per capita (PGDP), land coefficient (CC), government bond interest rate (INTR), unemployment rate (UR), 65 and older people ratio(OLD), the share of economic expenditure to total fiscal expenditure (ECONS)

# OECD Countries' Ageing Forecast



## OECD Countries' Ageing Forecast

## Demographic change , 1960- 2067



# Methodology

- Equation 1

$$y_{it}^j = \beta_0 + \beta_1 \times \ln(PGDP)_{it} + \beta_2 \times \ln(CC)_{it} + \beta_3 \times INTR_{it} + \beta_4 \times OLD_{it} \\ + \beta_5 \times UR_{it} + \beta_6 \times ECONS_{it} + \epsilon_{it}$$

- Equation 2

$$y_{it}^j = \beta_0 + \beta_1 \times \ln(PGDP)_{it} + \beta_2 \times \ln(CC)_{it} + \beta_3 \times INTR_{it} + \beta_4 \times OLD_{it} \\ + \beta_5 \times UR_{it} + \beta_6 \times ECONS_{it} + \delta \times (D\_ECONS_{it} \times ECONS_{it}) + \epsilon_{it}$$

- Equation 3

$$y_{it}^j = \beta_0 + \beta_1 \times \ln(PGDP)_{it} + \beta_2 \times \ln(CC)_{it} + \beta_3 \times INTR_{it} + \beta_4 \times OLD_{it} \\ + \beta_5 \times UR_{it} + \beta_6 \times ECONS_{it} + \delta \times (D\_SOC_{it} \times ECONS_{it}) + \epsilon_{it}$$

# Methodology

- Income variable (PGDP): In general, when incomes are high, it can be expected that all spending on the economic sector will be positive.
- Country Coefficient (CC): This is expected to be a positive sign, considering that there is a large demand for SOC investment in a large land area and a large population.  $CC = \sqrt{POP \times land}$
- Interest rate (INTR): The expenditure on the SOC sector in economic expenditures is large and large, so it is assumed that the government will issue and issue government bonds, which is a common method of financing. Yes. Therefore, if interest rates are low, the spending demand for SOC investment is expected to be high, so a negative sign can be expected.
- Aging Rate (OLD): A measure of the proportion of people aged 65 and over in the total population, and it is not easy to predict the correlation between aging rate and SOC sector expenditure. Many countries that are aging are already advanced countries, which means that SOC infrastructure is highly matured.

# Methodology

- Economic Response Policy Variables (UR): If we want to boost the economy by increasing SOC spending when the economy is not good, this can predict a positive correlation between unemployment and SOC spending. However, when economic recession rises and unemployment rises, even if economic expenditure increases, but SOC spending may decrease because the effect of SOC spending is time consuming and the effects can be long term.
- Economic sector expenditures (ECONS): These variables are used to control the likelihood of economic sector expenditure itself becoming higher of total gross expenditures.

# Methodology

- Dummy Variable 1 (D\_ECONS): In countries with high economic spending (D\_ECONS = 1), it is possible to consider increasing SOC spending if economic spending increases. I.e., we can expect D\_ECONS  $\times$  ECONS variable positive. On the contrary, if economic spending increases, we can consider reducing SOC spending. In other words, OECD countries already have sufficient SOC infrastructure expenditures and sufficient transport infrastructure stocks that tend to increase spending in other sectors.
- Dummy Variable 2 (D\_SOC): It is to create a dummy variable through the high / low share of SOC expenditure in the economic sector and to confirm the direction of resource allocation through the estimated coefficient of the interaction term D\_SOC  $\times$  ECONS.

# Technical Statistics

Variables	mean	median	maximum	minimum	stdev	# obs.
SOC (%)	51.51	50.55	84.43	15.5	14.04	128
LGDP	11.26	11.31	12.21	10.76	0.29	128
INTR (%)	4.01	3.39	22.5	0.53	2.87	128
LCC	13.98	13.8	15.74	10.49	1.26	128
OLD(%)	17.41	17.45	25.7	11	2.82	128
UR(%)	9.67	8.2	27.2	3.4	5.01	128
ECONS	10.73	10.02	38.73	5.86	3.95	128
D_ECONS	0.4	0	1	0	0.49	128
D_SOC	0.48	0	1	0	0.5	128

## Regression Result

variables	Random effect model			Fixed effect model		
	Model (1)	Model (2)	Model (3)	Model (1)	Model (2)	Model (3)
constant	292.69*** (91.07)	296.1*** (92.8)	203.4*** (56.70)	432.92 -449.56	305.22 -422.72	552.67 -413.7
LPGDP	-12.88** (7.22)	-13.2* (7.36)	-7.83* (4.40)	26.28*** -9.42	23.18** -9.02	34.76*** -9.4
INTR	-0.81*** (0.26)	-0.77*** (0.26)	-0.49** (0.23)	-0.82*** -0.3	-0.78** -0.3	-0.60** -0.28
LCC	-2.43 (1.93)	-2.55 (1.97)	-1.11 (1.14)	-43.46 -26.87	-32.04 -27.05	-59.27** -26.3
UR	-0.65*** (0.22)	-0.67*** (0.22)	-0.44** (0.17)	-0.80** -0.34	-0.81** -0.34	-0.62** -0.31
OLD	-2.26*** (0.59)	-2.23*** (0.59)	-1.95*** (0.42)	-2.62*** -0.39	-2.52*** -0.36	-2.67*** -0.41
ECONS	-1.24*** (0.13)	-1.01*** (0.25)	-1.15*** (0.12)	-1.22*** -0.24	-1.03*** -0.24	-1.14*** -0.21
D_ECONS*ECONS	-	-0.16 (0.15)		-	-0.13* -0.07	-
D_SOC*ECONS	-	-	0.96*** (0.14)	-	-	0.77*** -0.16
adjusted R^2	0.57	0.57	0.72	0.9	0.89	0.91
# of obs.	128	128	128	128	128	128

# Regression results

- Income variable (LPGDP): The effect of LPGDP on the SOC expenditure, which is an income variable, has had a positive effect across the models (1) to (3). It can be judged that the Wagner's law is verified.
- Country Coefficient (CC): CC is a variable that reflects the population and the area of land, but it was found that the estimate was negative. Unexpected!
- Interest rate (INTR): INTR was estimated negative as expected. In other words, if the interest rate of government bonds is high, the government responded by reducing the proportion of SOC investment expenditure in consideration of financing problems.
- Ageing Rate (OLD): The ageing ratio (OLD) was negative, reflecting a higher proportion of spending more on welfare than on economic expenditures. This also reflects a lower proportion of SOC proportion than on economic expenditure.

# Regression results

- Economic Response Policy Variables (UR): The estimated coefficient of UR showed a significant negativity, which indicates that when the recession comes and the unemployment rate increases, the share of SOC in the economic sector decreases and other economic sector expenditure increases.
- Economic sector expenditures (ECONS, D\_ECCONS)
  - ✓ In model (1), the increase in economic sector expenditure itself was shown to reduce the share of SOC. In other words, the increase in spending in the economic sector was based on the proportion of SOC in the economy's expenditure (52.5% on average in OECD countries).
  - ✓ When considering the case of countries with a high share of economic expenditure (considering the D\_ECONS variable), this tendency seems to be somewhat weakened. However, considering the interaction terms, the results of model (2) and the estimated coefficients of model (1) were similar.

# Regression results

- Economic sector expenditures (ECONS, D\_SOC)
  - ✓ On the other hand, distinguishing countries with high SOC spending in the economic sector can yield different results. In other words, countries with high SOC expenditures responded by increasing SOC expenditures when economic sector spending increased.
  - ✓ The estimated coefficient of  $D\_SOC \times ECONS$  is positive, indicating that the decrease in SOC spending is smaller than models (1) and (2) when the ECONS spending increases.

# Concluding remarks and suggestions

- SOC sector fiscal expenditure has been relatively controlled compared to other financial sectors, reflecting changes in existing policy directions.
  - ✓ This has been attributed to relative overinvestment in SOC investments and increased fiscal demand in other sectors.
  - ✓ If this investment direction continues, SOC investment is expected to continue to fall.
  - ✓ In addition, the results of empirical analysis analyzed through OECD data also indicate that aging factors and economic factors further accelerate the downward investment in SOC investment.
  - ✓ If so, it is necessary to evaluate and judge whether this SOC investment direction is appropriate.

# Concluding remarks and suggestions

- Considering that SOC stocks have reached a certain level, and the welfare sector's fiscal expenditure growth has been less demanding for SOC investment than in the past, it is necessary to examine whether the reduction of SOC investment in stages is an effective SOC investment direction.
  - ✓ For example, **maintenance investment in aging infrastructure** can increase the size of the stock of production capital, bringing externality to production, and improve the quality of life for the public by keeping people safe from outdated infrastructure.
  - ✓ In addition, investment in **transportation infrastructure that facilitates the entry and exit of metropolitan areas and other metropolitan areas** can not only lower traffic congestion costs, but also meet balanced regional development.
  - ✓ The construction of **public rental housing for the young generation** can not only guarantee the housing stability of the young generation, but can also play a positive role in restoring the competitiveness of the construction industry with high employment effects.