홍콩 공무국외출장

결과보고서

2016. 4.

국회예산정책처
National Assembly Budget Office

목 차

I. 출장 개요

1. 방문 목적

❑ 2016년 국제공공관리연구학회 (International Research Society for Public Management; IRSPM) 컨퍼런스[1] 참석

○ 20번째로 열리는 IRSPM 컨퍼런스는 홍콩의 홍콩폴리텍대학(The Polytechnic University of Hong Kong)에서 진행되었으며, 최근 공공관리 분야의 학문적, 정책적, 실무적 이슈와 관련된 여러 가지 토론과 의견을 교환하는 장이 되었음

○ 공무원(Public Servants: Motivation & Leadership), 세계적 및 지역적 거버넌스(Global & Local Governance), 분야간 및 정부간 동학(Inter-sectoral & Inter-governmental Dynamics) 등 공공관리의 주제들에 관해 발표가 이루어졌으며, 국회예산정책처 출장자들은 재원, 회계, 기술 및 재정관리(Resources, Accountability, Technology and Financial Management) 부문 중 공공예산과 재정관리에 관한 정책 이슈 부문(G102-Policy Issues in Public Budgeting and Financial(Fiscal) Management)에서 발표함

○ 공공관리의 최근 이슈에 대한 합리적이며 연구분석적인 능력을 제고하고 관련 자료를 수집함

○ 컨퍼런스 일정: 2016년 4월 13일~15일

1) http://www.cityu.edu.hk/lamp/irspm

2. 방문자

○ 박홍엽 (사업평가국 공공기관평가과 과장)

○ 이강구 (경제분석실 재정정책분석과 경제분석관)

3. 방문 기간 및 방문 국가

❑ 기간 : 2016. 4. 12(화) ~ 4. 17(일) (5박 6일)

❑ IRSPM 2016 참석 및 발표 (홍콩)

4. 출장일정

일 자	일 정	세 부 일 정	비 고
4. 12(화)	인천→홍콩	○ 홍콩 이동 ○ Welcome Session	Hotel ICON
13(수)~ 15(금)	홍콩	○ IRSPM 2016 참석 및 발표	G102 Sec. (13일 13:30 ~15:30)
16(토)	홍콩	○ 현지시찰	
17(일)	홍콩→인천	○ Section Chair 회의 ○ 한국 도착	

II. 주요 출장 내용

1. 2016년 국제공공관리연구학회 컨퍼런스 발표 (박홍엽)

가. 발표 개요

- ○ 제목 : 고속도로 건설투자의 사업평가
- ○ 발표 섹션: IRSPM G102 Section Policy Issues in Public Budgeting & Financial(Fiscal) Management
- ○ 일시 : 2016년 4월 13일(수) 13:30~15:30
- ○ 장소 : PolyU in Hong Kong, R507호

나. 발표 논문 및 내용 : [첨부 3], [첨부 4] 참고

2. 2016년 국제공공관리연구학회 컨퍼런스 발표 (이강구)

가. 발표 개요

- ○ 제목 : 한국의 장기 재정전망과 지속가능성 검정
- ○ 발표 섹션: IRSPM G102 Section Policy Issues in Public Budgeting & Financial(Fiscal) Management
- ○ 일시 : 2016년 4월 13일(수) 13:30~15:30
- ○ 장소 : PolyU in Hong Kong, R507호

나. 발표 논문 및 내용 : [첨부 4], [첨부 5] 참고

3. Section Chair와의 회의

가. 면담 개요

- ○ 면담 내용 : 향후 공동연구 논의
- ○ 면담 대상 : Prof. Cheol Liu (City University of Hong Kong, G102 Section Chair)
- ○ 일시 : 2016년 4월 17일
- ○ 장소 : Hotel ICON

4. 기대효과

❑ 2016년 국제공공관리연구학회 컨퍼런스의 발표참여를 통해 국회예산정책처의 평가 및 분석결과를 이론적으로 검증받는 한편 국회예산정책처의 위상을 국제적으로 제고시킴

○ 공공예산과 재정관리 정책 이슈 부문에 참석한 세계 각지의 학자들에게 고속도로 건설투자의 사업평가 및 장기재정전망과 재정의 지속가능성 검정 등에 대해 이론적으로 논의하고 개선방향을 제언 받음

○ 국제학회에 논문을 제출하고 발표하여 다양한 의견교류를 통해 학계와의 협력관계를 강화하고 글로벌 금융위기 이후의 경제·재정 상황에서 우리나라 독립적 재정기구의 역할에 대한 논의의 장을 제공함으로써 국회예산정책처의 위상을 제고

❑ 컨퍼런스 내 다양한 발표내용을 청취하고 논의함으로써 사업평가 및 경제분석 역량을 제고하고 협력관계를 구축

○ 공공예산 및 재정정책 부문의 새로운 연구 조류 및 분석방법에 대해 함께 고민하고 논의함으로써 연구 및 분석능력이 제고

○ 다양한 연구자들 중 공동의 관심분야를 가진 연구자들과 연구방향을 긴밀히 논의하는 등 향후 공동관심사에 대해 협의를 할 수 있는 협력관계를 맺음

[첨부 1] IRSPM Conference 2016 자료집

Conference Overview

	Tuesday 12 April 2016	Wednesday 13 April 2016	Thursday 14 April 2016	Friday 15 April 2016
AM		**Opening Ceremony** 09:00-10:00 Hotel ICON	**Panel Section (S3)** 09:00-10:30 Hotel ICON & PolyU	**Panel Section (S7)** 09:00-10:30 Hotel ICON & PolyU
		Coffee break 10:00-10:30 Hotel ICON	Coffee break 10:30-11:00 Hotel ICON & PolyU	
		Round Table: Governance Challenges for HK 10:30-12:00 Hotel ICON	**Panel Section (S4)** 11:00-12:30 Hotel ICON & PolyU	**Panel Section (S8)** 11:00-12:30 Hotel ICON & PolyU
		Lunchtime 12:00-13:30 Hotel ICON	Lunchtime 12:30-13:30 Hotel ICON & PolyU	Lunchtime 12:30-13:30 Hotel ICON
PM		**Panel Section (S1)** 13:30-15:30 Hotel ICON & PolyU	**Panel Section (S5)** 13:30-15:30 PolyU	**Provocation Panels** 13:30-14:30 Hotel ICON
				IRSPM's AGM 14:30-15:30 Hotel ICON
		Coffee break 15:30-16:00 Hotel ICON & PolyU	Coffee break 15:30-16:00 Hotel ICON & PolyU	Coffee break 15:30-16:00 Hotel ICON
		Panel Section (S2) 16:00-17:30 Hotel ICON & PolyU	**Panel Section (S6)** 16:00-17:30 PolyU	**Editors' Forum & Closing Ceremony** 16:00-17:30 Hotel ICON
Evening	**Welcome Drinks** 17:30-19:30 Hotel ICON	**Civic Reception** 18:30-20:00 PolyU Innovation Think Tank	**Gala Dinner** 19:00-21:30 Hotel ICON	**Farewell Reception** *18:45-21:45 Harbour Cruise

* Coaches will be arranged for pick up from Hotel ICON to Hung Hom Pier at 18:00.

WEDNESDAY (13 April 2016)

WEDNESDAY	13:30 - 15:30	Panel Section (S1)

G101 - 1 **G101 - Accounting & Accountability SIG Panel (1/6)**
Chair Iris Saliterer, James Guthrie & Ileana Steccolini
Venue PolyU_QR512

Studying performance measurement: The intersection of political science, sociology and psychology
» *Jenny Lewis (University of Melbourne - Social and Political Sciences)*

Measuring Performance in Finnish Universities: Struggling with Institutional Complexity
» *Kirsi-Mari Kallio (University of Turku, School of Economics),*
Tomi Kallio (Univeristy of Turku, School of Economics),
Giuseppe Grossi (Kristianstad University)

PERFORMANCE BUDGETING IN CHINA: An Institutional Theory Perspective
» *Meili Niu (Sun Yat-sen University),*
Alfred Ho (University of Kansas)

Making value visible: A systemic literature review of the instruments measuring and assessing the creation of value
» *Scott Douglas (Utrecht University School of Governance)*

G102 - 1 **G102 - Policy Issues in Public Budgeting & Financial (Fiscal) Management (1/3)**
Chair Cheol Liu, XiaoHu Wang, Wilson Wong & Brian Fong
Venue PolyU_R507

The Adoption and Diffusion of Participatory Budgeting: Preliminary Findings from a National Survey of Local Governments in Korea
» *Jooho Lee (University of Nebraska at Omaha),*
Soonhee Kim (KDI School of Public Policy and Management),
Junesoo Lee (KDI School of Public Policy and Management)

Does Inter-Local Collaboration Drive Cost-Savings? Evidence from Public Health Finance
» *Justin Marlowe (University of Washington)*

Performance Evaluation of the Expressway Construction Investment
» *Hong-Yeop Park (National Assembly Budget Office),*
You Sung Na (National Assembly Budget Office)

Long-term Fiscal Outlook and Assessing the Fiscal Sustainability in Korea
» *Kang Lee (National Assembly Budget Office)*

[첨부 2] IRSPM Conference 2016 참석 명단

Participants List

IRSPM CONFERENCE 2016

Surname	First Name	Organization
Abreu	Welles	University of Brasilia
Alford	John	ANZSOG and Melbourne Business School
Almqvist	Roland	Stockholm University
Amoako-Asiedu	Emelia	University of Ghana
Antonucci	Gianluca	G. d'Annunzio University of Chieti-Pescara
Arklay	Tracey	Griffith University
Aroni	Anna	University of Cagliari
Asquith	Andy	Massey University
Austen	Agata	University of Economics in Katowice, Poland
Badache	Fanny	University of Lausanne
Baertschi	Muriel	University of Bern
Ballart	Xavier	Autonomous University Barcelona
Barton	Harry	Nottingham Trent University
Bawole	Justice	University of Ghana
Baxter	Les	Tasmanian Alkaloids Pty Ltd
Bekkers	Victor	Erasmus University Rotterdam
Berman	Evan	Victoria University of Wellington
Blackman	Deborah	UNSW Canberra
Blåka	Sara	University of Agder
Bode	Ingo	University of Kassel, Germany
Bouwman	Robin	Radboud University Nijmegen
Brand	Tim	Zurich University of Applied Sciences
Brandsen	Taco	Radboud University Nijmegen
Breaugh	Jessica	Hertie School of Governance
Brewer	Gene A.	The University of Georgia
Britton	Garth	University of Queensland
Brown	Kerry	Curtin University
Brüesch	Caroline	Zurich University of Applied Sciences
Bruna	Maria Luisa	Pharmanet for the development of pharmacy in North East of Italy
Brunetto	Yvonne	Southern Cross University
Bruni	Valentina	University of Udine
Bruno	Sandro	AMBITO SA TARCENTO (UD)
Bruns	Hans-Jürgen	Leibniz Universität Hannover
Bryer	Thomas	University of Central Florida
Burau	Viola	University of Aarhus
Caforio	Antonio	University of Salento
Cannas	Francesco	Bocconi University
Cao	Hongxing	Beijing Foreign Studies University
Carayannopoulos	George	University of Sydney
Carey	Gemma	Australian National University

Surname	First Name	Organization
Kirkpatrick	Ian	University of Leeds
Kjeldsen	Anne Mette	Aarhus University
Klaassen	Henk	Erasmus University Rotterdam
Klausen	Kurt	University of Southern Denmark
Klijn	Erik Hans	Erasmus University Rotterdam
Klinger	Christopher	University of Ottawa
Knudsen	Sine Grønborg	Roskilde University
Koliba	Christopher	University of Vermont
Kominis	Georgios	University of Glasgow
Koppenjan	Joop	Erasmus University Rotterdam
Korac	Sanja	Alpen-Adria University Klagenfurt
Kristiansen	Mads Bøge	University of Copenhagen/Department of Political Science
Kudo	Hiroko	Chuo University
Kuoppakangas	Päivikki	University of Turku
Laddomada	Andrea	University of Cagliari
Laffin	Martin	Queen Mary University of London
Lai	Hing-ling Peter	The University of Hong Kong
Lai	Nin Alan	The University of Hong Kong
Laihonen	Harri	University of Tampere
Lam	Lianne	The Hong Kong Polytechnic University
Lam	Wai Fung	The University of Hong Kong
Lam	Yongling	Routledge
Lapsley	Irvine	University of Edinburgh
Lavender	Michaela	CIPFA (Chartered Institute of Public Finance and Accountancy)
Lawrie	Alex	University of Technology Sydney
Lee	Ivan Po-Chiu	City University of Hong Kong
Lee	Joonwoo	Yonsei University
Lee	Junesoo	KDI School of Public Policy and Management
LEE	Kang Koo	National Assembly Budget Office of South Korea
Lee	Myoung Jin	City University of Hong Kong
Lee	Ngok	Hong Kong UNESCO Association
Lee	Stephanie Wing	The Hong Kong Polytechnic University
Lega	Federico	Bocconi University
Lember	Veiko	Tallinn University of Technology
Lenart-Gansiniec	Regina	Jagiellonian University
Lewandowski	Mateusz	Jagiellonian University
Lewis	Jenny	University of Melbourne
Li	Che-lan Linda	City University of Hong Kong
Li	Huiping	Shanghai University of Finance and Economics
Lindquist	Evert	University of Victoria
Lips	Miriam	Victoria University of Wellington
Liu	Bangcheng	Shanghai Jiao Tong University
Liu	Cheol	City University of Hong Kong
Liu	Helen	The University of Hong Kong
Liu	Li-Chuan	National Taitung University
Liu	Ning Nicole	The Hong Kong Polytechnic University
Lo	Wing-hung Carlos	The Hong Kong Polytechnic University
Lodge	Martin	London School of Economics
Löfgren	Karl	Victoria University of Wellington
Löfström	Mikael	University of Borås
Loh	Kung-wai Christine	The HKSAR Government
Loo	Jessica Li Ping	Lee Kuan Yew School of Public Policy

Surname	First Name	Organization
Overmans	Tom	Utrecht University
Pacileo	Guglielmo	SDA Bocconi School of Management
Papenfuß	Ulf	University of Leipzig
Park	Hong-Yeop	National Assembly Budget Office, Republic of Korea
Park	Hyun Hee	Kookmin University
Park	Sung Min	Sungkyunkwan University
Park	Tae In	Yonsei University
Parment	Anders	Stockholm University
Pedersen	Dorthe	Copenhagen Business school
Perez Lopez Portillo	Hector	University of Guanajuato
Perry	James	Indiana University & The University of Hong Kong
Phillips	Susan	Carleton University
Pihl-Thingvad	Signe	University of Southern Denmark
Pimenta	Roberto	Getulio Vargas Foundation
Polzer	Tobias	Queen's University Belfast
Prenestini	Anna	CERGAS - Bocconi University
Prysmakova	Palina	Florida Atlantic University
Puaschunder	Julia	The New School Department of Economics
Pugalis	Lee	University of Technology Sydney
Qian	Lei	Sun Yat-sen University
Raab	Joerg	Tilburg University
Radnor	Zoe	Loughborough University
Rajala	Tomi	University of Tampere
Rangone	Nicoletta	Lumsa University of Rome
Reeve	Stephen	University of Brighton
Reichard	Christoph	University of Potsdam
Rennie	Caroline	Victoria University Wellington
Rhodes	Mary Lee	Trinity College Dublin
Ricci	Alberto	CERGAS - Bocconi University
Ripoll Pascual	Guillem	Universitat Autònoma de Barcelona
Ritz	Adrian	University of Bern Switzerland
Rodriguez-Acosta	Cristina	Florida International University
Roeber	Manfred	Leipzig University
Roessl	Dietmar	WU - Vienna Univ. of Econ. and Business
Rohitarachoon	Piyawadee	University of Phayao
Rossi	Gina	University of Udine
Ruan	Wangshu	Sun Yat-Sen University
Ruggiero	Pasquale	University of Siena (IT) and Brighton Business School (UK)
Ryan	Roberta	University of Technology Sydney
Saliterer	Iris	Albert-Ludwigs University Freiburg
Salkeld	Kim	The HKSAR Government
Sanabria	Pablo	PONTIFICIA UNIVERSIDAD JAVERIANA CALI
Sarker	Abu Elias	University of Sharjah
Scherpenisse	Jorren	Netherlands School of Public Administration
Schmidthuber	Lisa	Johannes Kepler University Linz
Schoburgh	Eris	University of the West Indies, Mona Campus
Schuler	Christoph	Zurich University of Applied Sciences
Schwarz	Gary	SOAS, University of London
Senfelde	Maija	Riga Technical University
Shacklock	Kate	Griffith University
Sharma	Prashant	United Nations Research Institute for Social Development (UNRISD)
Shin	Gahui	Yonsei University

IRSPM Presentation

Performance Evaluation of the Expressway Construction Investments

Hong-Yeop Park

2016.4.13

Contents

I Introduction

Some of the expressways in ROK show that the actual traffic volumes are significantly lower than the predicted traffic volumes which were estimated at the feasibility study.

If the actual traffic volume is lower than the predicted one, operating loss will inevitably take place and delay of investment retrieval will have negative impact on financial soundness of relevant public agency.

Governments are likely to put their money in building transport facilities in accordance with transport demand estimated in the pre-feasibility study. If the predicted transport demand does not reflect the actual demand, the efficiency of government investment is bound to fall.

National Assembly Budget Office

I Introduction

The government also tries to enhance the expressway investment efficiency by enforcing the feasibility study strictly. But the large gap between the actual and predicted traffic raises the doubt of efficacy of feasibility study.

This study intends to analyze the effectiveness of expressway investment projects.

For the fulfillment of such purpose this study focuses on traffic demand side centering on factors that cause errors in the forecast of traffic demand.

Ⅱ Analysis of traffic demand forecast error in the expressway construction projects

(1) Significance and method of expressway demand forecasts

Feasibility analysis for the expressway construction projects can be analyzed through a comparison of the benefits arising therefrom and the cost to build the facility.

Predicted traffic demand is one of the important factors which affect costs and benefits estimation in the pre-feasibility or feasibility study.

Therefore, traffic forecast outcome is an important criterion for assessing the validity of the government program, and choosing the optimal investment project among various alternatives.

National Assembly Budget Office

Ⅱ Analysis of traffic demand forecast error in the expressway construction projects

(2) Analysis of expressway traffic demand forecast error

A traffic demand forecast error may be taking place in the way of predicting the expressway traffic demand. It can be defined as a gap between estimated and actual traffic volume.

This study analyzes the traffic demand forecast errors using 44 post-construction assessment data which have been executed by the Korea Highway Corporation since 2004. The average utilization rate of 44 expressway routes is 72.5%.

Utilization rate of expressways (2004~2014)

(Unit: number of routes, %)

Less than 50%	50~70%	70~100%	More than 100%	No. of total routes	Average utilization rate
10	13	15	6	44	72.5

Ⅱ Analysis of traffic demand forecast error in the expressway construction projects

(3) Case analysis on causes of traffic demand forecasting errors

It is really hard to tell which factor contributes to forecast error in what extent. Despite such difficulties to find exact causes of errors, it is necessary to categorize forecast errors in order to clarify the characteristics of them.

First, errors may come from the uncertainty of basic data. Some errors may be caused by mistakes which are taking place in the way of collecting various socio-economic indicators.

Second, errors may take place in the process of making a traffic demand model. In making a demand forecast model researchers or analysts should make some assumptions on future population and number of car registration in the target year. Their subjective points view cannot be avoided in making some assumptions in each stage.

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Ⅱ Analysis of traffic demand forecast error in the expressway construction projects

Third, errors may result from optimistic prospects of government officials on future traffic demand. Traffic demand may be overestimated when relevant government officials have optimistic view on expressway project.

□ Cause analysis of expressway traffic demand forecast errors

Korean government has assessed expressways which are over 5 years after construction completion by law. This is called the post-assessment.
Such assessment also includes some analyses about why demand forecast errors occurred.

The table below shows causes of error occurring in forecasting the traffic demand centering on the expressways whose utilization rate was below 70% compared with one in the pre-feasibility study.

Ⅱ Analysis of traffic demand forecast error in the expressway construction projects

Causes of error occurring in the forecast of traffic demand

Category	Main causes	Number of relevant routes
Uncertainty of basic data	Occurring of forecast deviation of the socio-economic indicators	17
	Inaccurate reflection of future development plan	12
	Inaccurate reflection of future networks	2
	Drastic socio-economic change	7
Limits of demand forecasting model	Insufficient traffic demand forecast infrastructure	11
	Limits of application theories and models	3
	Difference of basic data in the traffic analysis	Lack of connected transport means

National Assembly Budget Office

Ⅱ Analysis of traffic demand forecast error in the expressway construction projects

Comparison between estimated number and actual number in Gochang-Damyang route

(Unit: one thousand persons, one thousand cars)

	2009 estimated number(A)	2009 actual number (B)	Difference (A-B)
National population	49,112	50,644	-1,532
Population of neighboring region, Jeollabuk-do Province	2,007	1,874	133
Population of neighboring region, Jeollanam-do Province	2,324	1,934	390
Population of neighboring region, Gwangju	1,512	1,446	66
Number of vehicle registration nationally	23,565	17,325	6,240
Number of vehicle registration in Jeollabuk-do Province	1,022	683	339
Number of vehicle registration in Jeollanam-do Province	954	686	268
Number of vehicle registration in Gwangju	707	494	213

Ⅱ Analysis of traffic demand forecast error in the expressway construction projects

□ Case analysis of traffic demand forecasting error of expressways

First, uncertainty of the basic data is the main cause of error occurring.

The prediction of national population was approximately precise, but population predictions of neighboring regions were overestimated in the Gochang-Damyang route without exception.

The number of vehicle registrations was also overestimated by more than 6 million cars nationally, and more than 200,000 cars regionally.

Second, the limit of demand forecast model is another cause of error occurring. Most of future demand forecast had been done before the build-up of national transport database. Therefore, each researcher in charge of future prediction of future demand used different O/D(Origin/Destination) data. Different O/D data were used under researcher' s jurisdiction.

Ⅲ Evaluation of the economic feasibility of expressways investment

(1) Assess the economic feasibility of expressways after completing the construction

The newly completed expressways are subjects to be reassessed of its economic feasibility by the post-construction assessment by law since 2010.

Post-construction assessment plays a role of the important indicator for looking into the adequacy of the project because its economic feasibility is reassessed at the time of operation.

More accurate economic feasibility analysis is possible through the post-reassessment because actual construction cost is taken into account and future traffic volume is re-estimated using the newly updated traffic circumstances.

Ⅲ Evaluation of the economic feasibility of expressways investment

Below are the comparison of two B/C(Benefit/Cost)' s. The former was estimated at the pre-feasibility study before the construction, and the latter was the estimated one at the post-reassessment after the construction.

Korean government has performed the 21 economic feasibility reassessments since 2010. B/C' s of 8 sections fell below 1 even though all of their B/C' s were higher than 1 before the construction. 8 routes were shaded on the table.

National Assembly Budget Office

Ⅲ Evaluation of the economic feasibility of expressways investment

Comparison of B/C' s at the routes taking the economic feasibility reassessment since 2010

(Unit: %, B/C)

Year of opening	Year of reassessment	Routes	Section	Base year of traffic volume	Utilization rate	B/C reassessment outcome		
						pre-study	post-reassessment	Difference
2006	2011	GochangDamyang	Jangsung~Damyang	2010	35	1.15	0.93	0.22
2006	2011		Gochang~Jangsung					
2007	2012	JoongbuNaeryoog	Hyunpoong~Gimcheon	2011	53	3.86	0.53	3.33
2007	2012	IksanPohang	Iksan~Jangsu	2011	27	2.22	0.85	1.37
2007	2012	DangjinYeongdeok route	Cheongwon~Sangju	2011	47	2.89	0.92	1.97
2008	2013	DangjinYeongdeok route	Dangjin~Daejon	2012	55	1.86	0.72	1.14
2009	2013	SeocheonGongju route	Seocheon~Gongju	2012	54	1.80	0.97	0.83
2009	2013	PyeongtaekJecheon route	Ansung~Eumsung	2012	58	1.67	0.82	0.85
2009	2014	Donghae route	Hyunnam~Hajodae	2013	25	1.06	0.47	0.59

Ⅲ Evaluation of the economic feasibility of expressways investment

This table shows another interesting point that all new B/C' s which were reproduced at the economic feasibility reassessment were lower than those of pre-feasibility study. This implies that some optimistic prospects about the future traffic volume contributed to the overestimation of traffic demand and made B/C higher.

(2) Deficit routes

However, several expressway routes face the deficit in the operation. It means that they do not make revenues enough to cover basic maintenance costs. 7 routes among total 27 expressway routes record operating loss every year since their opening. These routes do not contribute to retrieving the investment cost, but they increase the magnitude of debt of KHC. The deficit routes are shaded.

National Assembly Budget Office

Ⅲ Evaluation of the economic feasibility of expressways investment

Deficit routes whose retrieval rate was below '0'
(As of 2014.12.31)

(Unit: a billion KRW, %)

Routes	Total construction Cost	Amount retrieved	Amount not retrieved	Retrieval rate
MuanGwangju, 88	3.167.7	-301.6	3.469.3	-9.5
Ik-Pohang	3,506.9	-20.5	3,527.4	-0.6
Sooncheon-Wanju	2,357.2	-54.1	2,411.3	-2.3
Seoul-Yangyang	2,050.5	-2.8	2,053.3	-0.1
Donghae	4,375.0	-148.5	4,523.5	-3.4
Seocheon-Gongju	1,015.5	-18.0	1,033.5	-1.8
Gochange-Damyang	895.6	-46.1	941.7	-5.1

III Evaluation of the economic feasibility of expressways investment

Most of deficit-recording expressway routes showed satisfactory B/C at the pre-feasibility study before the construction, but the actual feasibility of such deficit routes turned out to be lower than the criteria after construction.

Failure of predicting the accurate future traffic demand results in large increase of debt of the Korea Highway Corporation. Therefore, it is required to execute more accurate feasibility study in order to avoid deficit expressway routes.

Government needs to find out why overestimation of future traffic demand takes place repeatedly at the pre-feasibility study, and present some policy improvements that lead to amendment of the relevant laws and enforcement ordinances

National Assembly Budget Office

IV Policy suggestions to improve the assessment system of transport investment projects

(1) Need to enhance the credibility of national traffic DB

Korean government updates annually the DB including the change of socio-economic indicators and change of development plans. But the credibility of DB is still the question to be resolved because of the frequent changes of development plans and insufficient accuracy of data. It is needed for the KTDB to be constantly reflected the actual traffic conditions.

(2) Need to collect and manage program information systematically

In order to evaluate the effects of transport SOC investments it is necessary to check whether actual traffic demand coincides with estimated demand derived at the feasibility study, and whether expected revenue is collected during the operation period. Therefore, government needs to accumulate and manage all the relevant data on projects systematically.

Ⅳ Policy suggestions to improve the assessment system of transport investment projects

(3) Need to check the accuracy of predicted future traffic demand

To reduce the errors of traffic demand forecast it is needed to update the basic data regularly on the one hand, and to make the low-utilized expressways take post-reassessment to find out why less traffic than expected one occurs on the other hand.

Thank you.

Performance Evaluation of the Expressway Construction Investments

1. Introduction

Some of the expressways constructed and operated by the Republic of Korea(ROK) government and Korea Highway Corporation(KHC)[1] show that the actual traffic volumes are significantly lower than the predicted traffic volumes which were estimated at the feasibility study. If the actual traffic volume is lower than the predicted one, operating loss will inevitably take place and delay of investment retrieval will have negative impact on financial soundness of relevant public agency. Most of national governments are likely to put their money in building transport facilities in accordance with transport demand estimated in the pre-feasibility study. If the predicted transport demand does not reflect the actual demand, the efficiency of government investment is bound to fall.

The government has built and provided the National Transportation DB since the early 2000s in order to increase the reliability of traffic demand forecast. The government thinks that the reliability of the traffic demand forecast will be gradually improved if the accuracy and usability of the National Transportation DB information is to be enhanced. However, the credibility of the traffic demand forecast is still low due to inherent limitations of DB, changes of regional

[1] Korea Highway Corporation is the state-owned enterprise which is in charge of constructing and managing the expressways in the Republic of Korea.

development plan, frequent civil complaints, budget constraints, and frequent expressway design changes.

The government also tries to enhance the expressway investment efficiency by enforcing the feasibility study strictly. But the large gap between the actual and predicted traffic raises the doubt of efficacy of feasibility study.

In order to enhance the validity and effectiveness of transport facility programs it is needed to scrutinize why the big difference occurs between the predicted traffic demand measured at the stage of feasibility study and actual traffic demand measured during the operation. It is also needed to derive the institutional improvements that may reduce the error of demand forecast.

This study intends to analyze the effectiveness of expressway investment projects among ROK transportation-related SOC investments. For the fulfillment of such purpose this study focuses on traffic demand side centering on factors that cause errors in the forecast of traffic demand. Finally some policy recommendations that will help improve the efficiency of transportation-related SOC investments are suggested.

2. Current expressway construction investments in the Republic of Korea

ROK ranked 5th place in the aspect of expressway extension among 34 OECD countries in 2011. ROK government and Korea Highway Corporation have invested 13.6 trillion KRW for the past 5 years. Their investment size was increasing after 2012 for the purpose of vitalizing the depressed domestic economy as well as expanding the social overhead capital (SOC).

[Table 1] Investments for the expressway construction for the past 5 years

(Unit: one billion KRW)

	2010	2011	2012	2013	2014	합계
Total investment	3,000.4	2,220.8	2,541.5	2,841.6	2,990.8	13,595.1
Government Financing	1,071.7	896.5	1,372.4	1,535.5	1,409.4	6,285.5
Korea Highway Corporation Financing	1,928.7	1,324.3	1,169.1	1,306.1	1,581.4	7,309.6

Source : Korea Highway Corporation.

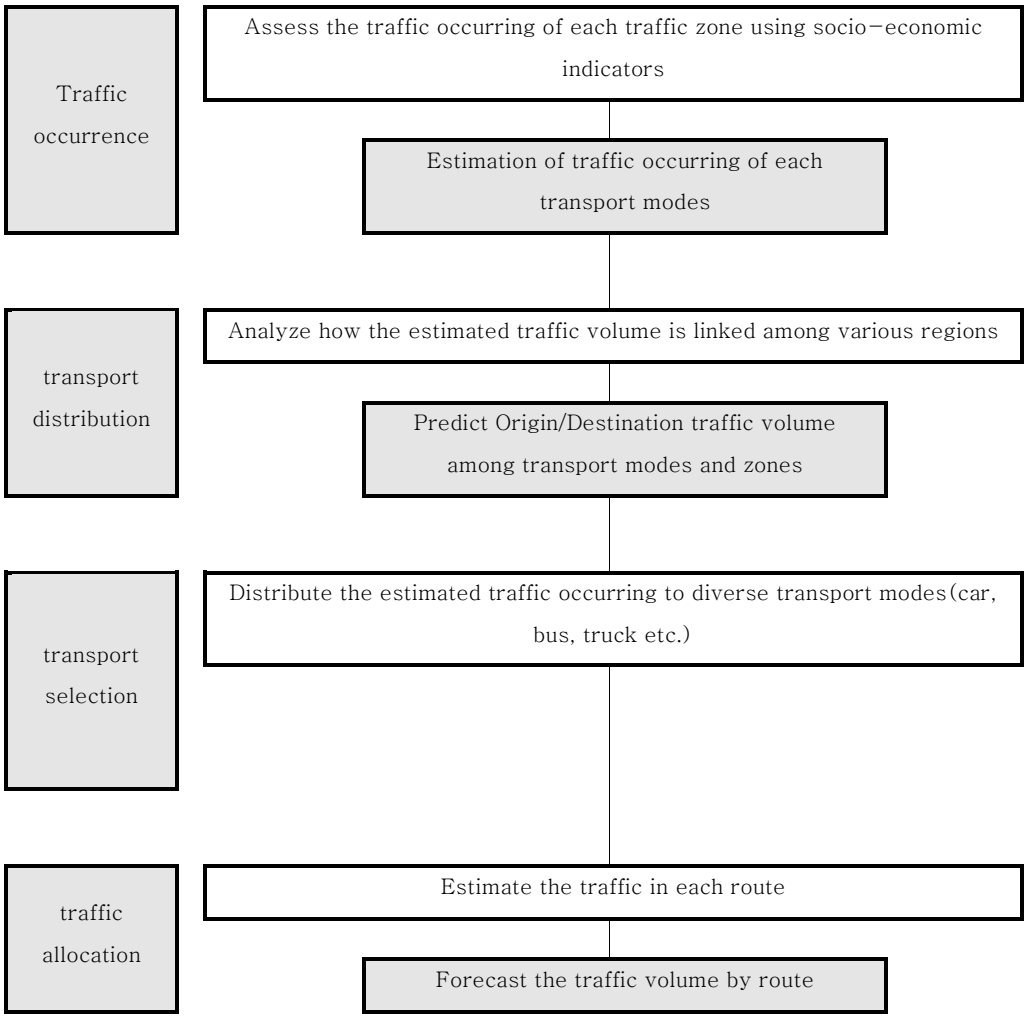
3. Analysis of traffic demand forecast error in the expressway construction projects

(1) Significance and method of expressway demand forecasts

Feasibility analysis for the expressway construction projects can be analyzed through a comparison of the benefits arising therefrom and the cost to build the facility. Predicted traffic demand is one of the important factors which affect costs and benefits estimation in the pre-feasibility or feasibility study. When a pre-feasibility study or feasibility study is normally performed, the benefits of the traffic infrastructure construction are estimated by the vehicle operation cost savings, travel time savings, accident reduction benefits, environmental cost savings. Demand forecast outcome for the future traffic occurring is essentially included in the computation of such benefits.

Therefore, traffic forecast outcome is an important criteria for assessing the validity of the government program, and choosing the optimal investment project among various alternatives. If the government puts an demand-overestimated ineffective project into execution, the financial burden of the government will increase, and finally ordinary people will pay for such ineffective investment.

[Figure 1] Traffic demand forecasting process



Source: Korea Highway Corporation.

The typical process of traffic demand forecast is as follow. First, draw up traffic network system and traffic zone after determining the influenced range of each expressway. Next, establish a transport demand forecast model after reviewing present traffic situation, socio-economic condition and transportation system in the traffic influence zone. Thirdly, predict a possible change of transport system and future socio-economic state in the target year after taking related development plans into consideration. Lastly, forecast a future traffic volume using

the transport demand forecast model in which 4 steps are usually taken; traffic occurring, transport distribution, transport mode selection, and traffic allocation.

(2) Analysis of expressway traffic demand forecast error

A traffic demand forecast error may be taking place in the way of predicting the expressway traffic demand. It can be defined as a gap between estimated and actual traffic volume. If actual traffic volume is same as estimated one, the utilization rate will be 100%, and the actual traffic volume is half the estimated traffic demand, the utilization rate will be 50%. This study analyzes the traffic demand forecast errors using 44 post-construction assessment data which have been executed by the Korea Highway Corporation since 2004.

[Table 2] Utilization rate of expressways (2004~2014)

(Unit: number of routes, %)

Less than 50%	50~70%	70~100%	More than 100%	No. of total routes	Average utilization rate
10	13	15	6	44	72.5

Source: Pos-assessment reports, Korea Highway Corporation.

The average utilization rate of 44 expressway routes is 72.5%. The number of overutilization expressway routes whose utilization rate is more than 100% is 6. The number of underutilization expressway routes whose utilization rate is less than 70% is 23. The number of expressway routes whose utilization rate is less than 50% is 10.

(3) Case analysis on causes of traffic demand forecasting errors

(A) Categories and causes of traffic demand forecast errors

Traffic demand forecast errors taking place in the way of doing the feasibility study are caused by the uncertainty of basic data, limitations of transport demand models, errors in the modeling process, and biases resulting from institutional culture. It is really hard to tell which factor contributes to forecast error in what extent (Kim Joo-young, 2014). Despite such difficulties to find exact causes of errors it is necessary to categorize forecast errors in order to clarify the characteristics of them.

First, errors may come from the uncertainty of basic data. Correct socio-economic indicators are essential basic data that are needed to carry out traffic demand forecasts. Some errors may be caused by mistakes which are taking place in the way of collecting various socio-economic indicators. In addition, future development plans like housing site, industrial complex, etc. in relevant regions must be reflected in forecasting the traffic demand. However, since most of development plans are subject to change frequently before they are finally determined, such uncertainty is likely to contribute to forecast errors in some extent.

Second, errors may take place in the process of making a traffic demand model. Traffic demand forecast is usually implemented by making use of 4-stage model; Traffic occurrence, transport distribution, transport mode selection, and traffic allocation. In making a demand forecast model researchers or analysts should make some assumptions on future population and number of car registration in the target year. Their subjective points view cannot be avoided in making some assumptions in each stage. It is almost impossible for the actual traffic to be realized in the model. Therefore, some errors inevitably take place because of various assumptions involved in the model.

Third, errors may result from government official's optimistic prospect on future traffic demand. Relevant ministry or public agencies taking the responsibility of expressway construction tend to see the bright aspect of the construction project for the purpose of expanding the own budget and power. Traffic demand may be overestimated when relevant government officials have optimistic view on expressway project. Errors may also take place if researchers in charge of assessing the validity of expressway project have the disposition of meeting the expectation of government officials taking charge of expressway construction.

(B) Cause analysis of expressway traffic demand forecast errors

As mentioned above, it is not easy to identify specific causes of traffic demand forecast errors because of diverse sources of error occurring. But Korean government has assessed expressways which are over 5 years after construction completion by law. This is called the post-assessment.

Such assessment also includes some analyses about why demand forecast errors occurred. This study looks into causes presented in the post assessment reports, and categorizes them to derive some policy improvements. The table below shows causes of error occurring in forecasting the traffic demand centering on the expressways whose utilization rate was below 70% compared with one in the pre-feasibility study.

[Table 3] Causes of error occurring in the forecast of traffic demand

Category	Main causes	Number of relevant routes
Uncertainty of basic data	Occurring of forecast deviation of the socio-economic indicators	17
	Inaccurate reflection of future development plan	12

Category	Main causes	Number of relevant routes
	Inaccurate reflection of future networks	2
	Drastic socio-economic change	7
Limits of demand forecasting model	Insufficient traffic demand forecast infrastructure	11
	Limits of application theories and models	3
	Difference of basic data in the traffic analysis	Lack of connected transport means

Source: Post-assessment reports, Korea Highway Corporation.

These findings are similar to those of overseas cases. Flyvberg et al(2007) compared actual traffic volume with estimated traffic volume of the 201 transportation projects in the 14 countries. They argued that overestimation of traffic demand was not confined to specific period, countries and programs. It showed up randomly and was not improved. Forecast errors increased in the long run. The cause of increased error rate was not in the incomplete forecast method, but in the uncertainty of land development plan and basic data.

Kim(2007) also analyzed forecast errors in the state roads and expressways, and presented the result that estimated volume of traffic demand was 22% higher than actual traffic volume. He analyzed that overestimation of traffic demand was caused by the propensity of government officials to push ahead the construction projects as well as characteristics of models and data that gave rise to uncertainty.

(C) Case analysis of traffic demand forecasting error of expressways

Main causes of demand forecast errors in the low-utilized expressways are uncertainty of basic data(occurring of forecast deviation in the socio-economic indicators, inaccurate reflection of future development plans, drastic socio-economic change, etc.), limits of demand forecast model(insufficient traffic demand

forecast infrastructure, limits of application theories and models, difference of basic data in the traffic analysis, etc.), and lack of connected transport means. Below are the case analyses in terms of error causes in the low-utilized expressways.

First, uncertainty of the basic data is the main cause of error occurring. The number of population, the number of vehicles, socio-economic indicators, land development plans including industrial complex, and other competing transport routes development plans are kinds of basic data. For example, the prediction of national population was approximately precise, but population predictions of neighboring regions were overestimated in the Gochang-Damyang route without exception. The number of vehicle registrations was also overestimated by more than 6 million cars nationally, and more than 200,000 cars regionally.

[Table 4] Comparison between estimated number and actual number in Gochang-Damyang route

(Unit: one thousand persons, one thousand cars)

	2009 estimated number(A)	2009 actual number (B)	Difference (A-B)
National population	49,112	50,644	-1,532
Population of neighboring region, Jeollabuk-do Province	2,007	1,874	133
Population of neighboring region, Jeollanam-do Province	2,324	1,934	390
Population of neighboring region, Gwangju	1,512	1,446	66
Number of vehicle registration nationally	23,565	17,325	6,240
Number of vehicle registration in Jeollabuk-do Province	1,022	683	339

	2009 estimated number(A)	2009 actual number (B)	Difference (A−B)
Number of vehicle registration in Jeollanam−do Province	954	686	268
Number of vehicle registration in Gwangju	707	494	213

Source: Post−assessment reports, Korea Highway Corporation.

The number of vehicle registration was also overestimated in Cheongwon−Sangju route. When compared with the actual number of car registration, the estimated number of car registration was more than 5 million cars than actual one nationally.

[Table 5] Comparison between estimated number and actual number of the vehicle registration in regions around Cheongwon−Sangju route

(Unit: one thousand cars)

2010 estimated registration (A)	2010 actual registration (B)	Difference (A-B)
22,701	17,689	5,012

Source: Post−assessment reports, Korea Highway Corporation.

Second, the limit of demand forecast model is another cause of error occurring. The limit of demand forecast model can be pointed out in two aspects. One is the lack of traffic demand forecast infrastructure; the other is the limit of demand forecast model itself. Most of future demand forecast had been done before the build−up of national transport database. Therefore, each researcher in charge of future prediction of future demand used different O/D(Origin/Destination) data. Different O/D data were used under researcher's jurisdiction. The quantitative economic model also had its own limit in its accuracy of future economic forecast. The 4−stage model(traffic occurrence, transport distribution, transport mode

selection, and traffic allocation) made various assumptions in each stage in terms of human behavior, thinking, psychology, cognition etc. When such assumptions were not able to reflect the real situation, errors might be inevitable in the demand forecast.

Third, the incomplete condition of presumed traffic construction in other routes also affects the actual traffic volume. For example, the actual traffic volume might be lower than the estimated one if intersections which had been planned to construct in two spots were finished in only one spot at the point of measuring traffic volume. Hyunnam-Hajodae route in the northeastern area was the case of this type of less traffic volume.

4. Evaluation of the economic feasibility of expressways investment

(1) Assess the economic feasibility of expressways after completing the construction

The newly completed expressways are subjects to be reassessed of its economic feasibility by the post-construction assessment by law since 2010. Post-construction assessment plays a role of the important indicator for looking into the adequacy of the project because its economic feasibility is reassessed at the time of operation. More accurate economic feasibility analysis is possible through the post-reassessment because actual construction cost is taken into account and future traffic volume is re-estimated using the newly updated traffic circumstances. Below are the comparison of two B/C(Benefit/Cost)'s. The former was estimated at the pre-feasibility study before the construction, and the latter was the estimated one at the post-reassessment after the construction.

Korean government has performed the 21 economic feasibility reassessments since 2010. B/C's of 8 sections fell below 1 even though all of their B/C's were higher than 1 before the construction. 8 routes were shaded on the table.

[Table 6] Comparison of B/C' s at the routes taking the economic feasibility reassessment since 2010

(Unit: %, B/C)

Year of opening	Year of reassessment	Routes	Section	Base year of traffic volume	Utili-zation rate	B/C reassessment outcome		
						pre-study	post-reassessment	Differ-ence
2004	2010	JoongbuNaeryoog	Yeoju~Chungju	2008	82	1.51	1.13	0.38
			Chungju~Sangju					
			Sangju~Gumi					
2004	2010	IksanPohang	Daego~Pohang	2006	54	2.47	1.12	1.35
2004	2010	Donghae	Gangneung~Donghae	2006	69	3.56	1.03	2.54
2005	2010	TongyeongDaejon	Tongyeong~Jinju	2008	60	1.78	1.43	0.35
2006	2011	GochangDamyang	Jangsung~Damyang	2010	35	1.15	0.93	0.22
2006	2011		Gochang~Jangsung					
2007	2011	MuanGwangju	Muan~Naju	2010	57	2.32	1.47	0.85
2008	2011		Naju~Gwangju					
2006	2011	Gyungbu	Dongdaegu~Yeongcheon	2010	48	1.23	1.04	0.19
2006	2011	Gyungbu	Yeongdong~Gimcheon	2010	60			

Year of opening	Year of reassessment	Routes	Section	Base year of traffic volume	Utili-zation rate	B/C reassessment outcome		
						pre-study	post-reassessment	Differ-ence
2006	2011		Gimcheon~Gumi					
2007	2012	JoongbuNaeryoog	Hyunpoong~Gimcheon	2011	53	3.86	0.53	3.33
2007	2012	IksanPohang	Iksan~Jangsu	2011	27	2.22	0.85	1.37
2007	2012	DangjinYeongdeok route	Cheongwon~Sangju	2011	47	2.89	0.92	1.97
2008	2013	DangjinYeongdeok route	Dangjin~Daejon	2012	55	1.86	0.72	1.14
2009	2013	SeocheonGongju route	Seocheon~Gongju	2012	54	1.80	0.97	0.83
2009	2013	PyeongtaekJecheon route	Ansung~Eumsung	2012	58	1.67	0.82	0.85
2009	2014	Donghae route	Hyunnam~Hajodae	2013	25	1.06	0.47	0.59
2009	2014	Incheondaegyo	Connection road to Incheondaegyo	2013	127	2.7	1.04	1.66

Source: Post-reassessment reports, ROK.

This table shows another interesting point that all new B/C's which were reproduced at the economic feasibility reassessment were lower than that of pre-feasibility study. This implies that some optimistic prospects about the future traffic volume contributed to the overestimation of traffic demand and made B/C higher.

(2) Retrieval of investment cost after completion of expressways

Debt of Korea Highway Corporation (KHC) has increased a lot these days. Its debt increased by 2,733.6 billion KRW from 2010 to 2014. Such debt increase was caused by the construction investments of expressways. The main source of revenue of KHC is the expressway toll. KHC has not paid principal and interest with toll revenue since 2007. If revenue by toll is enough to pay the principal and interest of debt, debt of KHC may not increase by a large scale. There may be various causes that affect the debt increase of KHC, but undoubtedly the less actual traffic volume than expected one at the pre-feasibility study is one of main causes of debt increase.

Retrieval rate of expressway investment cost was 29.0% by the end of 2014. Because the investment cost of expressways is scheduled to be retrieved over more than 30 years with the form of tolls, it is hard to argue that 29.0% of retrieval rate is low. However, several expressway routes face the deficit in the operation. It means that they do not make revenues enough to cover basic maintenance costs. 7 routes among total 27 expressway routes record operating loss every year since their opening. These routes do not contribute to retrieving the investment cost, but they increase the magnitude of debt of KHC. The deficit routes are shaded.

[Table 7] Retrieval rate of expressway investment cost by route

(As of 2014.12.31)

(Unit: a billion KRW, %)

Routes	Total construction Cost	Amount retrieved	Amount not retrieved	Retrieval rate
Gyeongbu	6,687.3	9.394.1	-2,706.8	140.5
Namhae	5,144.7	1,486.7	3,658.0	28.9
MuanGwangju, 88	3.167.7	-301.6	3.469.3	-9.5

Routes	Total construction Cost	Amount retrieved	Amount not retrieved	Retrieval rate
Seohaean	4,912.2	1,296.5	3,615.7	26.4
Ulsan	709	155.6	−847	219.6
Ik−Pohang	3,506.9	−20.5	3,527.4	−0.6
CheonganNonsan, Honam	1,773.3	1,056.3	717.0	59.6
Sooncheon−Wanju	2,357.2	−54.1	2,411.3	−2.3
Dangjin−Yeongdeok	4,819.9	180.7	4,639.2	3.8
DaejonTongyeong, Joongbu	4,450.9	1,460.1	2,990.8	32.8
Je2joongbu	753.2	127.2	626.0	16.9
Pyeongtaek−Jecheon	2,963.9	92.2	2,871.7	3.1
JoongbuNaeroog	5,218.7	703.6	4,515.1	13.5
Yeongdong	5,120.0	2,516.8	2,603.2	49.2
Joongang	5,516.2	290.1	5,226.1	5.3
Seoul−Yangyang	2,050.5	−2.8	2,053.3	−0.1
Donghae	4,375.0	−148.5	4,523.5	−3.4
Seouloegwak	4,007.9	1,847.9	2,160.0	46.1
NamhaeJe1jiseon	821.4	35.8	785.6	4.4
NamhaeJe2jiseon	789.4	232.8	556.6	29.5
Je2gyeongin	830.3	139.1	691.2	16.8
Gyeongin	272.9	615.0	−342.1	225.3
Seocheon−Gongju	1,015.5	−18.0	1,033.5	−1.8
HonamJiseon	335.9	284.2	51.7	84.6
Gochange−Damyang	895.6	−46.1	941.7	−5.1
DaejonNambuSoonhwan	340.2	27.5	312.7	8.1
JoongbuNaeroogJiseon	682.0	106.9	575.1	15.7
Other routes under construction	1,100.3	−	1,100.3	−
Total	73,979.9	21,457.5	52,522.4	29.0

Source: Korea Highway Corporation.

Expressways may be constructed for the purpose of achieving nationally balanced growth of remote regions even though economic feasibility is not so high as to meet the criteria of construction. However, most of deficit-recording expressway routes showed satisfactory B/C at the pre-feasibility study before the construction, but the actual feasibility of such deficit routes turned out to be lower than the criteria after construction. Failure of predicting the accurate future traffic demand results in large increase of debt of the Korea Highway Corporation.

Therefore, it is required to execute more accurate feasibility study in order to avoid deficit expressway routes. In particular, it is needed to set the priority in accordance with investment efficiency before carrying out financially large-scaled projects. Government needs to find out why overestimation of future traffic demand takes place repeatedly at the pre-feasibility study, and present some policy improvements that lead to amendment of the relevant laws and enforcement ordinances

5. Policy suggestions to improve the assessment system of transport investment projects

(1) Need to enhance the credibility of national traffic DB

Korean government has built and provided Korea Transport Data Base(KTDB) to raise the accuracy of transport demand forecast since 1999. Korean government also made it a legal rule to use such KTDB in forecasting the transport demand in the year of 2009. Korean government had carried out O/D(Origin/Destination) surveys nationally, and updates annually the DB including the change of socio-economic indicators and change of development plans.

It is expected to lower the uncertainty of basic data when KTDB is renewed regularly, but the credibility of DB is still the question to be resolved because of the frequent changes of development plans and insufficient accuracy of data. Therefore, it is needed for the KTDB to be constantly reflected the actual traffic conditions.

(2) Need to collect and manage program information systematically

In order to evaluate the effects of transport SOC investments it is necessary to check whether actual traffic demand coincides with estimated demand derived at the feasibility study, and whether expected revenue is collected during the operation period. It is also necessary to manage program information systematically from the initiation of the project to the operation of it after completion to assess the efficiency of projects.

However, it is really difficult to evaluate whether demand forecast is correctly implemented or not because those fundamental data on future development plans around neighboring regions and predicted socio-economic indicators are not managed systematically. Such loose management of fundamental data affects the demand forecast negatively, and inaccurate demand forecast will undoubtedly affect the outcome of economic feasibility. Therefore, government needs to accumulate and manage all the relevant data on projects systematically.

(3) Need to check the accuracy of predicted future traffic demand

Large-scaled project takes long before the construction begins. It usually takes 2~3 years in taking the pre-feasibility study and making plans, and 2~4 years in making the design. Another 3~10 years is also needed to gain budget and finish the construction. Sometimes a lot of projects are delayed due to the lack of

finances. Such delay of SOC infrastructure may retard the development of surrounding areas, and the volume of expected traffic may be influenced negatively by this deferred development. In order to enhance the efficiency of investment it is necessary to minimize errors of traffic demand forecast.

To reduce the errors of traffic demand forecast it is needed to update the basic data regularly on the one hand, and to make the low-utilized expressways take post-reassessment to find out why less traffic than expected one occurs on the other hand.

Bibliography

Flyvberg *et al.* How *(In)ACCURATE Are Demand Forecasts in Public Works Projects?* : The Case of Transportation」, Journal of American Planning Association, 2007.11

Kim, Gang-soo, *Rationalization policies of SOC investment decision-making - centering on the estimation risk of traffic volume*, Korea Development Institute, 2007.

Kim, Joo-young *et al. Improvement policies of SOC investment program progress interim check*, The Korea Transport Institute, 2014.

Ministry of Strategy and Finance, Republic of Korea, *2014~2018 National fiscal management plan*, 2014.9.

Rho, Jung-hyun, *Transportation planning - traffic demand theories and models*, Nanam, 2012.

The Korea Transport Institute, *2014 National transportation survey and DB building program – national transportation DB reassessment*, 2014.12.

20th IRSPM Conference 2016 Hong Kong

Long-term Fiscal Outlook and Assessing the Fiscal Sustainability in Korea

2016. 4. 13

KANG KOO LEE

국회예산정책처
National Assembly Budget Office

Order

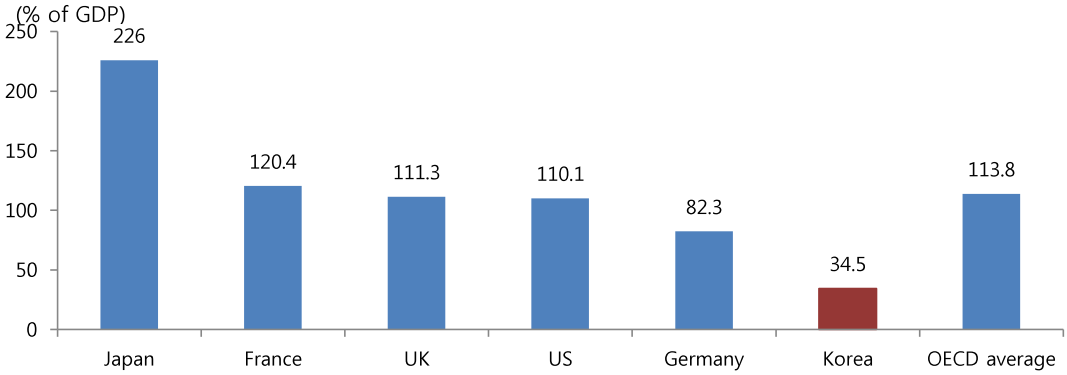
I. Introduction

Fiscal Soundness

◆ **Government Debt (per GDP)**

A common index of fiscal soundness

Korea is lower government debt ratio compare to advanced countries



However, according to IMF (2003), 55% of default countries under 60% of government debt ratio.

35% of default countries below 40% of government debt ratio.

I. Introduction

Fiscal Sustainability

◆ **The fiscal sustainability**

One of concepts widely used to evaluate the fiscal soundness

◆ **Meaning of the fiscal sustainability**

current fiscal policies and systems can maintain itself with no requirement of current policies which will have to change

◆ **The reason for testing the fiscal sustainability**

to assist in finding non-sustainable fiscal policies and systems

And improving them in the long-run

▷ The fiscal authority could correct them based on test results which found existing or possible being a fiscal risk

⇒ he/she can minimize the fiscal risks in the future.

I. Introduction

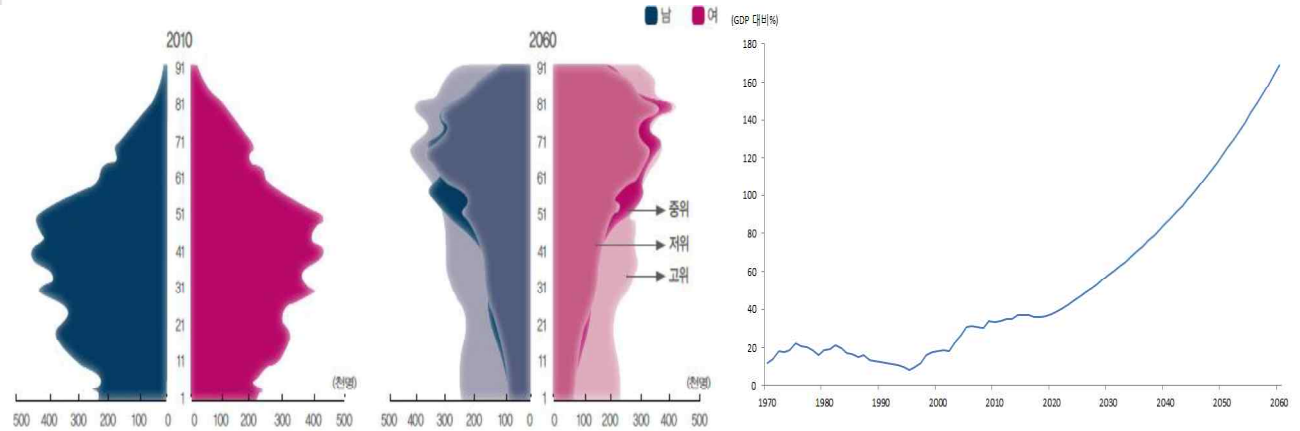
Long-term population and fiscal Projection of Korea

◆ **National Assembly Budget Office (2014)**

the long-term fiscal outlook in accordance with demographic change of Korea

Based on the projection results for FY 2060,

I actually estimate when Korean fiscal policy is to be sustained.



II. Previous Literature

Approach	Strengths	Weaknesses	Key references
Summary indicators	- simple to use - good first approximation - can be used with different modelling frameworks - easy to communicate - results between studies easy to compare	- require inputs from other models - do not explicitly account for uncertainty - do not explicitly account for interactions between variables	Buiter et al. (1985) Blanchard et al. (1990)
Econometric tests	- derived directly from theory - useful in study of past policies	- mostly retrospective; hard to conduct prospective analysis	Hamilton and Flavin (1986) Bohn (1998, 2005)
Value-at-Risk approach	- explicitly accounts for interactions and uncertainty - public sector balance sheet is analyzed as a whole - can be used with different modelling frameworks	- a lot of data needed (public sector balance sheet etc.) - large effort to build the model needed - long-run analysis hard	Barnhill and Kopits (2003)
Fiscal limits and fiscal space	- different perspective - explicitly accounts for interactions and uncertainty - easy to communicate	- very model-dependent (fiscal limits) - a broad sample of data needed (fiscal space)	Bi (2012) Cochrane (2011) Leeper and Walker (2011) Ostry et al. (2010)
General equilibrium models	- explicitly accounts for interactions - structurally detailed and accurate description of the economy - country-specific features can be modelled	- very large effort to build a model - a lot of parameter values need to be calibrated - predictive accuracy of the model not guaranteed	van Ewijk et al. (2006) Andersen and Pedersen (2006)
Generational accounting	- different perspective - inter-generational equity also considered	- do not explicitly account for interactions or uncertainty - hard to allocate benefits of expenditures accurately to age groups	Auerbach et al. (1991) Gokhale and Smetters (2003)

II. Theoretical Discussions

Government Budget Constraint

◆ **Maintaining the fiscal sustainability**

if government can repay current debt by the primary fiscal surpluses arising in the future

$$D_{t-1} \leq PB_t + \frac{PB_{t+1}}{(1+r)} + \frac{PB_{t+2}}{(1+r)^2} + \cdots + \frac{PB_{t+\infty}}{(1+r)^{\infty}}$$

Current government debt = the previous government debt
+ the interest of the previous government debt + current fiscal deficits

$$d_t = d_{t-1} + (i_t - y_t)d_{t-1} + g_t - t_t$$

where g is government spending excluding interest payment, t is tax revenue, i is the real interest rate, and y is real GDP growth rate

A change of the current government debt = fiscal deficit + the interest

$$\Delta d_t = -pb_t + (i_t - y_t)d_{t-1}$$

$\Delta d_t = 0$, it should be $(i_t - y_t)d_{t-1} = pb_t$

$i \leq y$, Ponzi Scheme

$i > y$, needs primary fiscal surplus unless the government debt increase

III. Bohn's Test

◆ **Bohn (1998)**

basically primary fiscal balance is the reaction function of government debt

$$pb_t = f(d_t) + \mu_t = \rho d_t + \alpha_0 + \alpha_G GVAR_t + \alpha_Y YVAR_t + \varepsilon_t$$

where pb is the primary fiscal balance per GDP, d is government debt per GDP, $GVAR\left(=\frac{g-g^*}{y}\right)$ is the temporary government spending, $YVAR\left(=\left[1-\frac{y}{y^*}\right]\frac{g^*}{y}\right)$ is the business cycle indicator, y is the real GDP, g is the real government spending, $*$ is trends (calculated by HP filtering), μ, ε refer to the error terms.

◆ **Government debt ratios' coefficient (ρ)**

When ρ is positive (+), Government fiscal condition is considered sustainable
← the fiscal balance is improved as increasing the government debt

When the sign of ρ is the negative (-), not sustainable
← there are considered not to reduce the net debt by improving the fiscal balance

III. Result of Bohn's Test

Bohn's test results in Korea

	Constant	GVAR	YVAR	Debt	R^2	S.E.	D.W.
2014	-0.021 (0.005)	-0.732 (0.002)	-0.593 (0.179)	0.115 (0.002)	0.360	0.018	0.342
2020	-0.023 (0.001)	-0.741 (0.001)	-0.572 (0.162)	0.121 (0.000)	0.429	0.017	0.350
2030	-0.004 (0.495)	-0.721 (0.003)	-0.369 (0.414)	0.023 (0.219)	0.182	0.019	0.233
2031	-0.002 (0.729)	-0.718 (0.003)	-0.352 (0.440)	0.014 (0.424)	0.166	0.019	0.224
2032	-0.000 (0.984)	-0.715 (0.003)	-0.336 (0.465)	0.006 (0.714)	0.155	0.019	0.216
2033	0.001 (0.815)	-0.716 (0.003)	-0.323 (0.483)	0.000 (0.983)	0.152	0.019	0.212
2034	0.003 (0.576)	-0.713 (0.004)	-0.310 (0.505)	-0.007 (0.660)	0.149	0.019	0.206
2035	0.004 (0.387)	-0.711 (0.004)	-0.297 (0.524)	-0.013 (0.373)	0.152	0.019	0.200
2040	0.010 (0.029)	-0.704 (0.004)	-0.249 (0.596)	-0.037 (0.002)	0.231	0.020	0.182
2050	0.016 (0.000)	-0.703 (0.003)	-0.199 (0.661)	-0.057 (0.000)	0.504	0.019	0.170
2060	0.016 (0.000)	-0.704 (0.002)	-0.187 (0.662)	-0.059 (0.000)	0.699	0.018	0.171

IV. Calculated amount of fiscal balance needed to ensure sustainability

EU's Sustainability Gap Indicator

calculate the amount of the fiscal adjustment needed to achieve the specific goals of the government debt

◆ S_1 indicator

the difference between current primary fiscal balance and the primary fiscal balance which need to reach a debt ratio of 60% of GDP in the target period (eg 2060)

(1) IBP; the required adjustment given the initial budgetary position
(2) DR; the adjustment necessary to reach the debt target
(3) LTC; the required adjustment given the long-term change

◆ S_2 indicator

a change of the current level of primary fiscal balance to present value of primary balance in the future needed to make the same level of debt for an indefinite time period.

⇒ Eventually estimate the amount of 'necessary fiscal adjustments' in the EU member countries to reach a fiscal sustainable position

IV. Calculated amount of fiscal balance needed to ensure sustainability

EU's Sustainability Gap Indicator

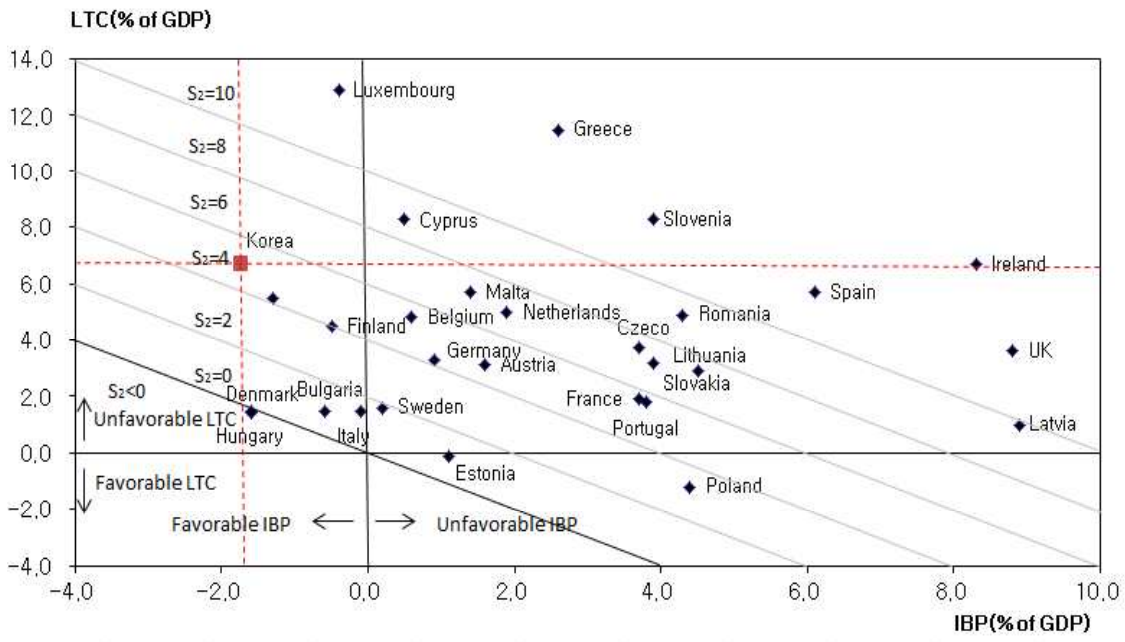
◆ **the calculated S_1 and S_2 in Korea**

Based on the government debt projection of NABO (2014)
The target time point : 2060
The target debt ratio : 60%
for comparing EU countries

	Total	IBP	DR	LTC
S1	**2.62**	-2.00	-0.48	5.10
S2	**4.95**	-1.74	0	6.69

IV. Calculated amount of fiscal balance needed to ensure sustainability

EU's Sustainability Gap Indicator(S2) Comparison



IV. Calculated amount of fiscal balance needed to ensure sustainability

Calculated amount of PB needed to improve

◆ **A kind of government debt rules**

▷ maintain the government debt ratio of 65.2% in 2033
the last year of fiscal sustainable to perform its role properly

▷ derive the primary fiscal balance that must be improved in order to achieve a debt ratio of 65.2% since 2034 annually

Next [Table] speaks calculation results

→ improving 107 trillion KW, 2.7%p of primary fiscal balance per GDP in 2034
by revenue increase or expenditure decrease

Since 2034 the improving primary fiscal balance is gradually expanding

⇒ improving primary balance which is 5.1%p of GDP, 445 trillion KW in 2060.

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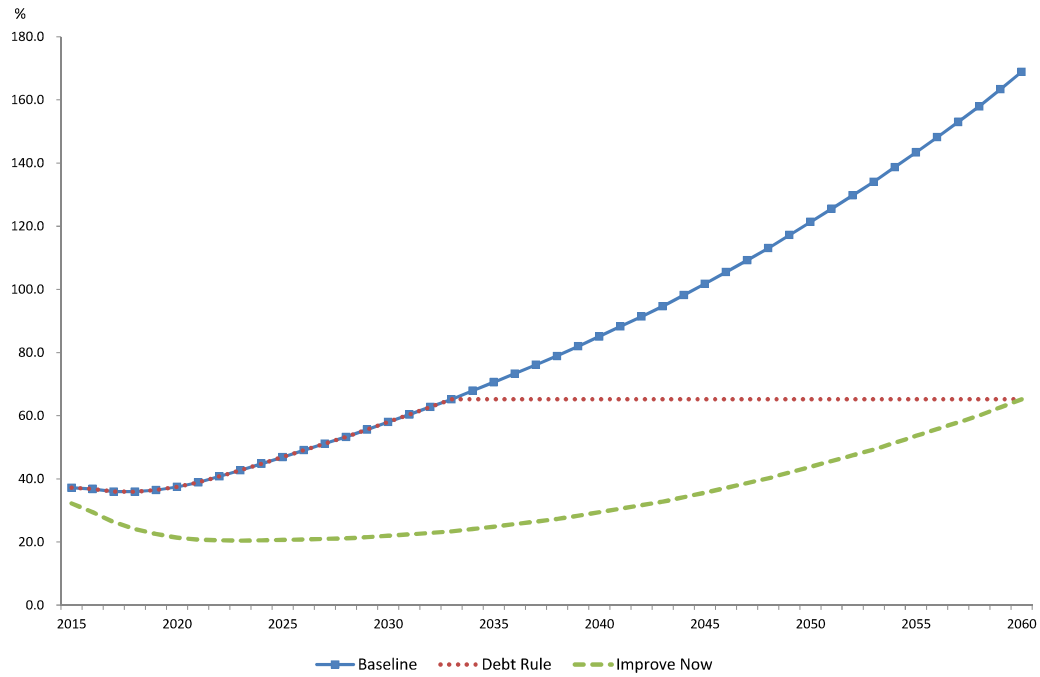
IV. Calculated amount of fiscal balance needed to ensure sustainability

The projection of Government Debt



IV. Calculated amount of fiscal balance needed to ensure sustainability

Calculated amount of PB needed to improve

	Nominal GDP (Billion KW)	Primary fiscal balance (%)	Gov't debt (%)	To maintain the debt ratio in 2034			Target debt ratio: 65.2% in 2060		
				Needed (%p)	Amount (100 MKW)	Debt (%)	Needed (%p)	Amount (100 MKW)	Debt (%)
2014	1,390,392	1.88	37.0			37.0	2.53	351,436	34.5
2020	2,012,094	1.24	37.4			37.4	2.53	508,577	21.4
2025	2,640,296	-0.66	46.9			46.9	2.53	667,361	20.7
2030	3,361,554	-1.72	58.0			58.0	2.53	849,667	22.0
2031	3,515,189	-1.93	60.4			60.4	2.53	888,499	22.4
2032	3,672,734	-2.15	62.8			62.8	2.53	928,320	22.9
2033	3,834,144	-1.82	65.2			65.2	2.53	969,118	23.4
2034	3,998,071	-2.69	67.9	2.69	1,074,277	65.2	2.53	1,010,553	24.1
2035	4,165,038	-2.87	70.6	2.76	1,149,287	65.2	2.53	1,052,755	24.9
2040	5,036,217	-3.97	85.1	3.29	1,659,085	65.2	2.53	1,272,954	29.4
2050	6,878,849	-6.24	121.3	4.35	2,989,502	65.2	2.53	1,738,698	43.8
2060	8,653,701	-7.95	168.9	5.14	4,449,909	65.2	2.53	2,187,310	65.2

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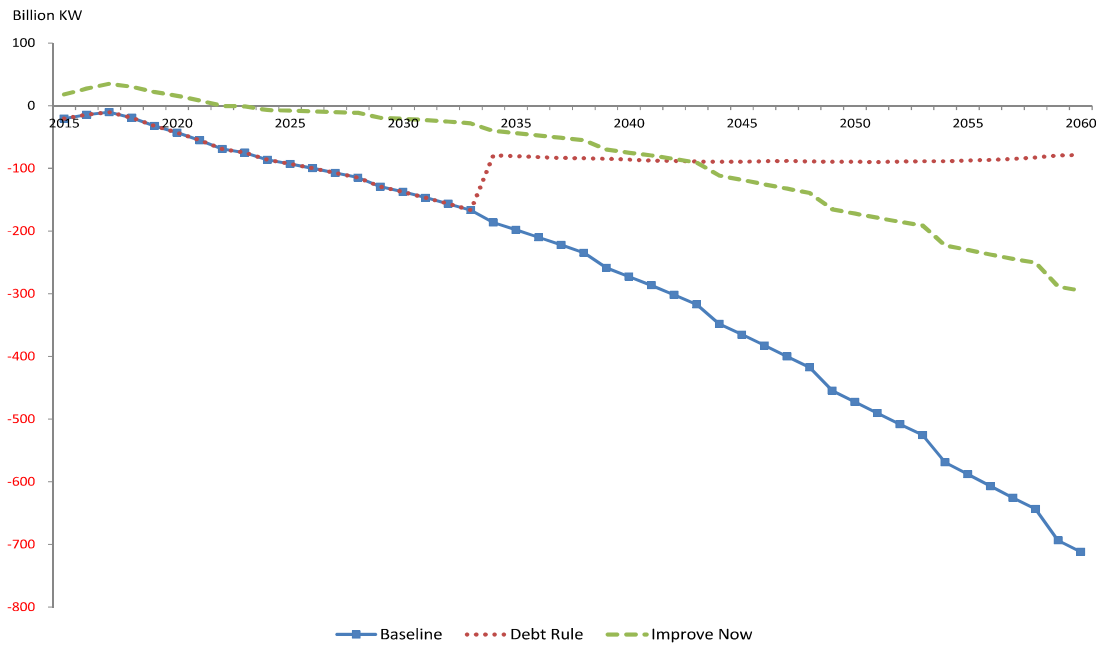
IV. Calculated amount of fiscal balance needed to ensure sustainability

The projection of managed fiscal balance



IV. Calculated amount of fiscal balance needed to ensure sustainability

Calculated amount of PB needed to improve

This improvement of primary fiscal balance calculated : a unrealistic huge adjustment

→ need excess revenues expand or reduce excessive government spending

⇒ a burden on economic growth
⇒ give up Korean fiscal authority serve as last resort in the national economy

◆ **Need to improve the primary fiscal balance preemptively**
the required primary fiscal balance from now for government debt ratio 65.2%to achieve in 2060 is 2.5%p of primary fiscal balance each year

I cannot insist that the government debt ratio in 2060 should be achieved just 65.2% of debt ratio or must be improved 35 trillion KW of primary fiscal balance in 2014

⇒ However, fiscal improvement projects from now are much feasible and much less fiscal burden than improvement after waiting time to lose the fiscal sustainability

V. Conclusion

Summary

◆ Using Bohn's sustainability test method, the present fiscal policy and system could be sustainable until 2033

◆ Korea has better current fiscal status and much-needed improvements for long-term fiscal balance compared to the major European countries from EU's sustainability gap.

◆ From government debt rules(65.2%) the improvement of primary fiscal balance calculated may be described as a large-scale adjustment referred to as impractical and it might be a burden on economic growth

▷ There would face less fiscal burden to restore the fiscal soundness reforming fiscal system and policy from now, instead of waiting until the point of losing the sustainability.

V. Conclusion

Future work

◆ **"What is a sustainable level of government debt ratio?"**

▷ In calculating the sustainability gap indicators of the EU: 60% of government debt ratio according to the EU's stability and growth pact.

▷ For the sort of debt rule : 65.2% debt ratio in 2033.

⇒ need the study of the optimal debt level
the sustainable debt level for the long-term fiscal goals in Korea

Thank you!

Long-term Fiscal Outlook and Assessing the Fiscal Sustainability in Korea

KANG KOO LEE

Abstract

In this paper, based on *2014-2060 long-term fiscal outlook*, the result from the National Assembly Budget Office according to the demographic changes, I found that the present fiscal policy and system could be sustainable until 2033 using Bohn's sustainability test method. In order to maintain fiscal sustainability (government debt ratio to 60% of GDP) until 2060, there must be required 2.62%p of GDP increasing revenue or decreasing expenditure according to the Sustainability gap indicators (S_1) used in the EU. Also I found that S_2 is 4.95%p.

I suppose an alternative which sustainable debt ratio in 2033 to 65.2% maintains until 2060. The calculation results of the required primary fiscal balance improvement are from 2.69%p of GDP in 2034 to 5.14%p in 2060. This will be a huge adjustment to be called unrealistic that should serve as an undue burden on the national economy. Therefore, if I could improve the fiscal balance from now, I have to improve the primary fiscal balance of 2.5%p annually. Instead of waiting until the point of losing the sustainability, there would face less fiscal burden to restore the fiscal soundness reforming fiscal system and policy from now.

Keywords: Long-term fiscal outlook, Fiscal sustainability, Primary balance

This paper was written by modifying based on the National Assembly Budget Office (2014), "2014 ~ 2060 Long-term Fiscal Projection" and Kang Koo Lee (2015), "Long-term Fiscal Outlook and Assessing the Fiscal Sustainability", Journal of Budget and Policy, for presentation of IRSPM 2016.

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Ⅰ. Introduction

IMF (2003) compares to the debt ratio of the countries which experienced sovereign default over the past 30 years. The result is appeared to be not in the clear correlation on the default and debt ratio. The 55% of countries suffering the default was the government debt ratio lower than 60% of GDP. The 35% of these countries happened to the sovereign default crisis even in the debt ratio below 40% of GDP. In the case of Spain in 2010, there was mentioned the fiscal crisis possibility immediately after reached 62.9% of GDP. In contrast, Japan has not been raised the possibility over the twice of GDP, because Japanese people held the most government bonds. Thus, it is not easy to judge the fiscal sustainability by the government debt as a percentage. Therefore, it is very important to determine the possibility of fiscal crisis whether a fiscal sustainability of the government debt could be maintained than the rate itself.

Fiscal sustainability is one of the concepts that are widely used to evaluate the fiscal soundness, but it is difficult to define exactly what it means[1]. Generally speaking, the fiscal sustainability means that current fiscal policies and systems can maintain itself without requirement of changing. The reason for testing the fiscal sustainability is to find non-sustainable fiscal policies and financial systems and to improve them in the long-run. The fiscal authority could correct them based on test results which found existing or possible being a fiscal risk, and then he/she will be able to minimize the fiscal risks in the future.

National Assembly Budget Office (2014) was done the long-term fiscal outlook in accordance with demographic change. Based on the projection results for FY 2060, I actually estimate whether Korean fiscal policy and systems is to be sustained. The sustainability test method is used Bohn's test among a number of test methods because of it is utilized widely and often. Also, I derive the sustainability gap indicators of the European Union by setting sustainable government debt level as the debt rule (a kind of fiscal rules) in order to check a sustainable fiscal status. Alternatively, I tried to calculate the primary fiscal balance which needs improvement.

For the development of this discussion I will introduce the theoretical discussions and previous research of sustainability in chapter Ⅱ, and explain the test method of Bohn and derive the actual test results on the basis of long-term fiscal projection in chapter Ⅲ. In the chapter Ⅳ I try to derive the sustainability gap used by the EU countries for improving primary fiscal balance required to ensure fiscal sustainability. I will summarize the main arguments in chapter Ⅴ.

Ⅱ. Theoretical Discussions and Previous Literature about the Sustainability

1. Government Budget Constraint

Definitions of the fiscal sustainability are based on the Government Inter-temporal Budget Constraint. The equation can be seen to ensure whether it meets the budget constraints that mean the solvency of the government.

[1]National Assembly Budget Office (2007) says that variety of sustainability definitions and conditions are each used by which the theory has been proposed. Burnside (2005) shows the definitions of 'sustainable' from Webster's dictionary, and many economists' saying expressed their thoughts.

Basically, if government can repay current debt by the primary fiscal surpluses arising in the future, I can determine that the fiscal sustainability is maintained. These can be expressed by a formula as equation (1).

$$D_{t-1} \leq PB_t + \frac{PB_{t+1}}{(1+r)} + \frac{PB_{t+2}}{(1+r)^2} + \cdots + \frac{PB_{t+\infty}}{(1+r)^{\infty}} \tag{1}$$

where D is he accumulated debt (stock), PB is the primary fiscal balance, $(1+r)$ is the discount rate. Rearranging equation (1) to GDP ratio as follows:

$$d_{t_0} - \sum_{t=t_0+1}^{\infty} \frac{pb_t}{(1+r)^{t-t_0}} = 0 \tag{2}$$

where t_0 is the base year, d is the government debt per GDP, pb is the primary fiscal balance per GDP, $1+r = \frac{(1+R)}{(1+Y)}$ is the discount rate. R is the nominal interest rate and Y is a nominal GDP growth rate.

Current government debt can be composed of the previous government debt, the interest of the previous government debt, and current fiscal deficits. These can be displayed by realized debt ratio in the following process:

$$d_t = d_{t-1} + (i_t - y_t)d_{t-1} + g_t - t_t \tag{3}$$

where g is government spending excluding interest payment, t is tax revenue, i is the real interest rate, and y is real GDP growth rate.

The above equation represents a change of the current government debt can be configured the fiscal deficit and the interest of previous government debt. In addition, the amount of the current debt may determine that the cumulative fiscal deficit. Equation (3) can be expressed by based on the primary balance by the following equation:

$$\Delta\, d_t = -pb_t + (i_t - y_t)d_{t-1} \tag{4}$$

where $\Delta\, d_t$ is the change in debt per GDP. If there is not an increasing government debt, that is $\Delta\, d_t = 0$, it should be $(i_t - y_t)d_{t-1} = pb_t$. In other words, if the interest of previous government debt would be paid by the improvement of primary fiscal balance, there is no increase of the government debt. If $i \leq y$, there is no increase of government debt when fiscal balance is even or there is some fiscal deficit. In other words, it would be possible to repay existing debt with new debt (Ponzi Scheme). If $i > y$, there needs primary fiscal surplus unless the government debt increase.

2. Previous Literature

The test methods of the fiscal sustainability vary widely. Hong (2013) classify the method of fiscal sustainability test analysis into 6 types; which are simple summary indicators, the econometric method, Value at Risk indicators (explicit model by macroeconomic uncertainty), the fiscal limit and fiscal space method, the general equilibrium model, and the generational accounting.

A summary indicator has an advantage of simple-to-understand and easy-to-use. In addition, one of the biggest advantages is that it can be possible to compare between the countries and between the time, and between the studies' result. However, there is a disadvantage which is not clearly described the interaction and uncertainties of the main economic parameters affecting the debt level. The summary indicators can be the simple fiscal indicators, such as the government debt and fiscal balance. And there could be analyzed the sustainability by using the S_1 and S_2 indicators used in the EU, or the fiscal gap indicators used in the United States' CBO or Canada's PBO.

Method using a VaR (Value at Risk) index is a way to evaluate sustainability in the net worth distribution of the public sector by modeling the macroeconomic uncertainties. The VaR is followed methodologies analyzed using risk variables in the financial research. There is an advantage to clarify the interactions and uncertainties because variables that determine the fiscal balance can represent as a function of various macroeconomic variables. And the net worth of the public sector can represent as a function of several risk variables. However, there are weaknesses that need for large-scale data such as public financial statements, require a lot of efforts in building models, and difficult to analyze long-term time period.

The Fiscal Limit and the Fiscal Space are methods to measure the government debt limit and evaluate the present fiscal capacity compared with debt limit levels. That means the fiscal limit is determined on the interaction of the fiscal reaction functions and interest payment level. Thus we could be obtained the fiscal space between the fiscal limit and current debt levels. They are easy to understand, however, it is necessary to be aware of needing a large-scale data and depending on a model.

General equilibrium model determines a number of variables endogenously in the model that variables affect the changes of the government debt. Therefore it is available the detailed and clear explanation on economic structure and the interaction between variables. However, it requires a lot of effort on building models and a lot of parameter values which may need to calculate, and it is difficult to ensure the accuracy of the prediction model.

Generational accounting method is to evaluate the sustainability for comparing between the current generation and future generations by comparing net tax burden. It has the advantage that analyzes not only evaluation of the sustainability but also information about generational equality. However, there are disadvantages which are difficult to clearly explain the interaction and uncertainties and to distribute fiscal benefits by age group.

The econometric methods for evaluating sustainability are classified into the three categories. The first methods are using the transversality condition like Hamilton and Flavin (1986) and Wilcox (1989). The second methods are using a co-integration relationship between revenues and expenditures like Trehan and Walsh (1988) and Ahmed and Rogers (1995). The third methods are using the government reaction function of the relationship between fiscal balance and government debt, such as Bohn (1988).

Hamilton and Flavin (1986) analyzed a fiscal sustainability test using the NPG (no Ponzi game) conditions. It satisfied that the discounted government debt converges to a constant when the real interest rate is constant and the primary fiscal balance and government debt is stable. Wilcox (1989) showed that the NPG condition is satisfied when the discounted government debt is stable and its convergence goes to zero under the changing real interest rates from time to time.

Trehan and Walsh (1988) and Ahmed and Rogers (1995) showed that the first difference of government debt should be stable for satisfying the NPG condition when expenditure and tax revenues follow the unstable I(1) process. This means that there is cointegrating relationship between the government debt and primary fiscal balance.

Bohn (1998) proposed a test method based on the fact that the primary fiscal balance would be improved when the government debt increased. Bohn's test has been used a lot in the advantage of being able to test the fiscal sustainability in relation to fiscal balance and government debt without discretionary changes and short-term economic fluctuations.

Therefore this paper will be analyzed the sustainability using Bohn's Test which is utilized widely and often.

[Table 1] The strengths and weaknesses of the sustainability tests

Approach	Strengths	Weaknesses	Key references
Summary indicators	- simple to use - good first approximation - can be used with different modelling frameworks - easy to communicate - results between studies easy to compare	- require inputs from other models - do not explicitly account for uncertainty - do not explicitly account for interactions between variables	Buiter et al. (1985) Blanchard et al. (1990)
Econometric tests	- derived directly from theory - useful in study of past policies	- mostly retrospective; hard to conduct prospective analysis	Hamilton and Flavin (1986) Bohn (1998, 2005)
Value-at-Risk approach	- explicitly accounts for interactions and uncertainty - public sector balance sheet is analyzed as a whole - can be used with different modelling frameworks	- a lot of data needed (public sector balance sheet etc.) - large effort to build the model needed - long-run analysis hard	Barnhill and Kopits (2003)
Fiscal limits and fiscal space	- different perspective - explicitly accounts for interactions and uncertainty - easy to communicate	- very model-dependent (fiscal limits) - a broad sample of data needed (fiscal space)	Bi (2012) Cochrane (2011) Leeper and Walker (2011) Ostry et al. (2010)
General equilibrium models	- explicitly accounts for interactions - structurally detailed and accurate description of the economy - country-specific features can be modelled	- very large effort to build a model - a lot of parameter values need to be calibrated - predictive accuracy of the model not guaranteed	van Ewijk et al. (2006) Andersen and Pedersen (2006)
Generational accounting	- different perspective - inter-generational equity also considered	- do not explicitly account for interactions or uncertainty - hard to allocate benefits of	Auerbach et al. (1991) Gokhale and Smetters (2003)

	expenditures accurately to age groups

Source: Sarvi (2011)

Ⅲ. Bohn's Test and Result

1. Bohn's Test

Bohn (1998) is explained that primary fiscal balance basically consists of the reaction function of government debt like equation (4). Here are controlled temporary changes affected by economic fluctuations and temporary fiscal spending. It can also be represented by formulas as follows.

$$pb_t = f(d_t) + \mu_t = \rho d_t + \alpha_0 + \alpha_G GVAR_t + \alpha_Y YVAR_t + \varepsilon_t \quad (5)$$

where pb is the primary fiscal balance per GDP, d is government debt per GDP, $GVAR\left(=\frac{g-g^*}{y}\right)$ is the temporary government spending, $YVAR\left(=\left[1-\frac{y}{y^*}\right]\frac{g^*}{y}\right)$ is the business cycle indicator, y is the real GDP, g is the real government spending, $*$ is trends (calculated by HP filtering), μ, ε refer to the error terms.

Government fiscal condition is considered sustainable that the fiscal balance is improved as increasing the government debt when government debt ratios' coefficient (ρ) are shown as positive (+). In contrast, when the sign of ρ is the negative (-), there are considered not to reduce the net debt by improving the fiscal balance. That is, if there is increased the government debt, it could not be converted to a primary fiscal surplus and increasing debt have been financed by new government bonds. So when increasing net debt paid by new debt issued, the creditors of the government bond recognize that it could not be maintained the value of government bonds and anyone does not want to hold government bonds anymore. That is considered not sustainable fiscally.

2. The Bohn's test results in Korea

I tried to check the fiscal sustainability using the Bohn's test method based on the results of long-term fiscal projection of NABO. [Table 2] shows the Bohn's test results that it is to perform properly the role of fiscal until 2033 during the period up to 2060.[2]That is, we could be interpreted as a sustainable fiscal policy and systems from 2014 to 2033 because of a positive correlation (+) between fiscal balances and government debt. It is important to note that the government debt ratio is only 65.2% in 2033, the last year when is expected to perform fiscal roles properly.

In contrast, it does not seem fiscal sustainable from 2034 to 2060 with the negative correlation between fiscal balances and government debt. Since 2034 increasing government debt, primary fiscal balance would not be switched from deficits to surpluses for reducing the net debt. That means Korea is not fiscal sustainable at that time. Interest payment in 2034

[2]The Bohn's test method is basically regression analysis and the analyzed period is to set from 1970 to last each year.

would be amounted to 63 trillion KW, 5.7% of total expenditure and 1.6% of GDP. It would continue to rise and reach to 10.5% of the total expenditure in 2060. We could easily imagine that fiscal policy is difficult to perform its roles because of fiscal stiffening phenomena which means there could not be spent properly in sectors needed fiscal resources.

[Table 2] Bohn's test results in Korea

	Constant	GVAR	YVAR	debt	R^2	S.E.	D.W.
2014	-0.021	-0.732	-0.593	0.115	0.360	0.018	0.342
	(0.005)	(0.002)	(0.179)	(0.002)			
2020	-0.023	-0.741	-0.572	0.121	0.429	0.017	0.350
	(0.001)	(0.001)	(0.162)	(0.000)			
2030	-0.004	-0.721	-0.369	0.023	0.182	0.019	0.233
	(0.495)	(0.003)	(0.414)	(0.219)			
2031	-0.002	-0.718	-0.352	0.014	0.166	0.019	0.224
	(0.729)	(0.003)	(0.440)	(0.424)			
2032	-0.000	-0.715	-0.336	0.006	0.155	0.019	0.216
	(0.984)	(0.003)	(0.465)	(0.714)			
2033	0.001	-0.716	-0.323	0.000	0.152	0.019	0.212
	(0.815)	(0.003)	(0.483)	(0.983)			
2034	0.003	-0.713	-0.310	-0.007	0.149	0.019	0.206
	(0.576)	(0.004)	(0.505)	(0.660)			
2035	0.004	-0.711	-0.297	-0.013	0.152	0.019	0.200
	(0.387)	(0.004)	(0.524)	(0.373)			
2040	0.010	-0.704	-0.249	-0.037	0.231	0.020	0.182
	(0.029)	(0.004)	(0.596)	(0.002)			
2050	0.016	-0.703	-0.199	-0.057	0.504	0.019	0.170
	(0.000)	(0.003)	(0.661)	(0.000)			
2060	0.016	-0.704	-0.187	-0.059	0.699	0.018	0.171
	(0.000)	(0.002)	(0.662)	(0.000)			

Note: 1) If the coefficient of debt (ρ) is positive value (+), I interpret that fiscal sustainability is maintained.
In contrast, when it is negative value (-), fiscal sustainability is not maintained.
2) The numbers in parentheses are p-value.
Source: NABO (2014)

Ⅳ. Calculated amount of fiscal balance needed to ensure sustainability

1. EU's Sustainability Gap indicator

Through the Sustainability gap indicator developed by the EU we could calculate the amount of the fiscal adjustment needed to achieve the specific goals of the government debt. The EU has proposed that each of the two indicators reflect the 'finite and infinite' duration. S_1 indicator shows the difference between current primary fiscal balance and the primary fiscal balance which need to reach a debt ratio of 60% of GDP in the target period (eg 2060). S_2 indicator explains a change of the current level of primary fiscal balance to present value of primary balance in the future needed to make the same level of debt for an indefinite time period. Eventually these indicators are estimated the amount of 'necessary fiscal adjustments' in the EU member countries to reach a fiscal sustainable position.

Based on the Sustainability gap indicators, the EU Commission and the Council of Economy and Finance in EU Member Countries regularly evaluate the long-term fiscal sustainability in the context of the Stability and Growth Pact. In the EU, these assessments are being utilized as a basis for monitoring the budget policy of the country.

Usually fiscal outlook is sensitive to the basic assumptions because it is an estimation based on the partial equilibrium analysis. In particular, the debt projection might be shown a significant difference depending on the assumption of the initial period. And alternative assumptions about the interest rate and the growth rate can cause significant differences in the sustainability rating. Eventually outlook for the debt levels are not predictive of the results. In other words, debt projection will differ from realized value from the next year immediately. Instead of good prediction, there are meanings that are possible to vigorous policy debate through the use of the Sustainability gap indicators for fiscal soundness. Because these can tell us a lot of information about the timing and amount of the budget challenges that may arise 'when there is no change in policy (baseline projections).

Specifically S_1 is a needed amount of increasing revenue (or decreasing expenditure) required to be the debt ratio, d_t in the end of T year. In here, assuming the ratio of interest/growth rate (r) is constant explained in equation (2), there may be derived the following equation.

$$S_1 = rd_{t_0} - pb_{t_0} + \frac{r\left(d_{t_0} - d_T\right)}{(1+r)^{T-t_0} - 1} - \frac{\sum_{i=t_0+1}^{T} \frac{\Delta pb_i}{(1+r)^{i-t_0}}}{\sum_{i=t_0+1}^{T} \frac{1}{(1+r)^{i-t_0}}} \tag{6}$$

where $\Delta pb = pb_t - pb_{t_0}$ is the primary fiscal balance compared to the base year.

S_2 is derived by a needed amount of increasing revenue (or decreasing expenditure) required to be the completely eliminating the government debt within an infinite time period.

$$S_2 = rd_{t_0} - pb_{t_0} - r\sum_{i=t_0+1}^{\infty} \frac{\Delta pb_i}{(1+r)^{i-t_0}} \tag{7}$$

Assuming that the ratio of the interest rate/growth rate (r) is constant, [Table 3] shows the S_1 and S_2 for the comparison. The S_1 could be divided into three components: (1) IBP; the required adjustment given the initial budgetary position, (2) DR; the adjustment necessary to reach the debt target, (3) LTC; the required adjustment given the long-term change. In details, 'IBP' means the difference between the current structural budget balance and long-term fiscal balance that stabilizes the debt. 'DR' is derived the necessary adjustment in order to achieve the fiscal capacity of the target debt GDP ratio of 60% until 2060. Finally, LTC means the required primary fiscal balance that is the necessary adjustment amount to achieve the target debt ratio in the long-term fiscal structure.

[Table 3] S_1 and S_2 when the ratio of interest/growth is constant

	IBP		DR		LTC
$\boldsymbol{S_1}$ $=$	$rd_{t_0} - pb_{t_0}$	+	$\frac{r(d_{t_0} - d_T)}{(1+r)^{T-t_0} - 1}$	+	$-\frac{\sum_{i=t_0+1}^{T} \frac{\Delta pb_i}{(1+r)^{i-t_0}}}{\sum_{i=t_0+1}^{T} \frac{1}{(1+r)^{i-t_0}}}$
$\boldsymbol{S_2}$ $=$	$rd_{t_0} - pb_{t_0}$	+	0	+	$-r\sum_{i=t_0+1}^{T} \frac{\Delta pb_i}{(1+r)^{i-t_0}}$

Assuming that the ratio of the interest rate/growth rate (r) is not constant, there should be introduced α in order to derive S_1.

$$\alpha_{i,j} = \begin{cases} (1+r_i)(1+r_{i+1})\cdots(1+r_j) & \text{if } i \le j \\ 1 & \text{otherwise} \end{cases} \tag{8}$$

Therefore, the equation of the government debt is as following.

$$d_t = d_{t_0}\alpha_{t_0+1,t} - \sum_{i=t_0+1}^{\infty} pb_i\alpha_{i+1,t} \tag{9}$$

Equation (2), the government intertemporal budget constraint, could be rearranged as equation (10).

$$d_{t_0} = \sum_{i=t_0+1}^{\infty} \frac{pb_i}{\alpha_{t_0=1,i}} \tag{10}$$

Thus, when the ratio of the interest rate/growth rate (r) is not constant, S_1 is represented as the following equation (11) putting different r in each year.

$$S_1 = \frac{d_{t_0}(\alpha_{t_0+1,T} - 1)}{\sum_{i=t_0+1}^{T} \frac{1}{\alpha_{i+1,T}}} - pb_{t_0} + \frac{d_{t_0} - d_T}{\sum_{i=t_0+1}^{T} \frac{1}{\alpha_{i,T}}} - \frac{\sum_{i=t_0+1}^{T} \Delta pb_i \alpha_{i=1,T}}{\sum_{i=t_0+1}^{T} \alpha_{i+1,T}} \quad (11)$$

[Table 4] presents comparison of S_1 with 2 assumptions about the ratio of the interest rate / growth rate.

[Table 4] Comparison of S_1 with two assumptions about the ratio of the interest rate / growth rate

	IBP		DR		LTC
$\boldsymbol{S_1} =$ (when $\boldsymbol{r}$ is constant)	$rd_{t_0} - pb_{t_0}$	+	$\frac{r(d_{t_0} - d_T)}{(1+r)^{T-t_0} - 1}$	+	$-\frac{\sum_{i=t_0+1}^{T} \frac{\Delta pb_i}{(1+r)^{i-t_0}}}{\sum_{i=t_0+1}^{T} \frac{1}{(1+r)^{i-t_0}}}$
$\boldsymbol{S_1} =$ (when $\boldsymbol{r}$ is different)	$\frac{d_{t_0}(\alpha_{t_0+1,T} - 1)}{\sum_{i=t_0+1}^{T} \frac{1}{\alpha_{i+1,T}}} - pb_{t_0}$	+	$\frac{d_{t_0} - d_T}{\sum_{i=t_0+1}^{T} \frac{1}{\alpha_{i,T}}}$	+	$-\frac{\sum_{i=t_0+1}^{T} \Delta pb_i \alpha_{i+1,T}}{\sum_{i=t_0+1}^{T} \alpha_{i+1,T}}$

S_2 is represented in the following eq. (12) putting different r in each year when the ratio of the interest rate/growth rate (r) is not constant.

$$S_2 = \frac{d_{t_0}}{\sum_{i=t_0+1}^{\infty} \frac{1}{\alpha_{t_0+1,i}}} - pb_{t_0} - \frac{\sum_{i=t_0+1}^{\infty} \frac{\Delta pb_i}{\alpha_{t_0+1,i}}}{\sum_{i=t_0+1}^{\infty} \frac{1}{\alpha_{t_0+1,i}}} \quad (12)$$

However, if r is not constant until 2060 and r is constant after 2060 to infinite time period as National Assembly Budget Office long-term fiscal outlook, it should be expressed as equation (13).

$$S_2 = \frac{d_{t_0}}{\sum_{i=t_0+1}^{T} \frac{1}{\alpha_{t_0+1,i}} + \frac{1}{r_T \alpha_{t_0+1,T}}} - pb_{t_0} - \frac{\sum_{i=t_0+1}^{T} \frac{\Delta pb_i}{\alpha_{t_0+1,i}} + \frac{\Delta pb_\infty}{r_\infty \alpha_{t_0+1,T}}}{\sum_{i=t_0+1}^{T} \frac{1}{\alpha_{t_0+1,i}} + \frac{1}{r_\infty \alpha_{t_0+1,T}}} \quad (13)$$

[Table 5] S_1 and S_2 when the ratio of interest/growth is not constant

	IBP		DR		LTC
$\boldsymbol{S_1} =$	$\frac{d_{t_0}(\alpha_{t_0+1,T}-1)}{\sum_{i=t_0+1}^{T}\frac{1}{\alpha_{i+1,T}}} - pb_{t_0}$	+	$\frac{d_{t_0}-d_T}{\sum_{i=t_0+1}^{T}\frac{1}{\alpha_{i,T}}}$	+	$-\frac{\sum_{i=t_0+1}^{T}\Delta pb_i\alpha_{i=1,T}}{\sum_{i=t_0+1}^{T}\alpha_{i+1,T}}$
$\boldsymbol{S_2} =$	$\frac{d_{t_0}}{\sum_{i=t_0+1}^{T}\frac{1}{\alpha_{t_0+1,i}}+\frac{1}{r_T\alpha_{t_0+1,T}}} - pb_{t_0}$	+	0	+	$-\frac{\sum_{i=t_0+1}^{T}\frac{\Delta pb_i}{\alpha_{t_0+1,i}}+\frac{\Delta pb_\infty}{r_\infty\alpha_{t_0+1,T}}}{\sum_{i=t_0+1}^{T}\frac{1}{\alpha_{t_0+1,i}}+\frac{1}{r_\infty\alpha_{t_0+1,T}}}$

Now, when the ratio of the interest rate/growth rate (r) is not constant, [Table 5] shows the S_1 and S_2 for the comparison.

Based on the government debt projection of NABO (2014), it could be estimated the revenue increases or expenditure reductions required to achieve a certain debt ratios at a particular time period by EU sustainability gap indicator. I set the target time point in 2060, and set a target debt ratio to 60% for comparing EU countries. I report the calculated S_1 and S_2 in Korea in [Table 6].

[Table 6] The result of calculated the sustainability gap indicator in Korea (setting T:2060, target debt: 60%)

	Total	IBP	DR	LTC
S_1	2.62	-2.00	-0.48	5.10
S_2	4.95	-1.74	0	6.69

IBP of Korea has 2%p of estimated fiscal space because Korea fiscal is stable now. The estimated DR in Korea is 0.48%p of fiscal space because the current debt ratio is lower than the 60%. Finally, Korea's LTC is estimated 5.1%p until 2060. Therefore, according to these results Korean government has to do 2.62%p of revenue increase or expenditure reduction per year from now to achieve the government debt ratio of 60% from 169% in 2060

S_2 is configured only (1) 'IBP' and (3) 'LTC,' but (2) 'DR' of S_1 does not need. The result is shown Korean government has to repay the government debt by 4.95%p of fiscal surplus for an infinite time period.

In fact, among European countries Spain is similar population and economic scale with Korea. S_1 and S_2 of Spain are each 9.5%p, 11.8%p. Thus Spain would be a massive increase in fiscal surplus. To be specific Spain's IBPs which are 5.9%p(S_1) and 6.1%p(S_2) are worse than Korea's IBPs which are -2.0%p(S_1) and -1.7%p(S_2). However, Spain's LTCs which are 3.6%p(S_1) and 5.7%p(S_2) are better than Korea's LTCs which are 5.1%p(S_1) and 6.7%p(S_2).

[Table 7] demonstrates that Germany and Finland look similar to the aggregate value of S_1 and S_2 of Korea. Germany is 3.1%p(S_1), 4.2%p(S_2), and Finland is 2.6%p(S_1), 4.0%p(S_2). Korea

is 2.6%p(S_1) and 4.9%p(S_2). However, Germany and Finland's IBPs are worse than Korea's IBPs and their LTCs are better than Korea's LTCs.

[Figure 1] can be easily compared the S_2 of Korea and European countries. Countries which are similar with Korea's S_2 are Finland, Belgium, Germany, Austria, France and Portugal. When S_2 divided IBP and LTC, Countries similar with Korea's sound IBP are Hungary and Denmark (-1.6%p). But countries which seem to be more difficult than Korea's LTC are only Luxembourg, Greece, Cyprus, Slovenia, and Ireland which are above the horizontal dotted line.

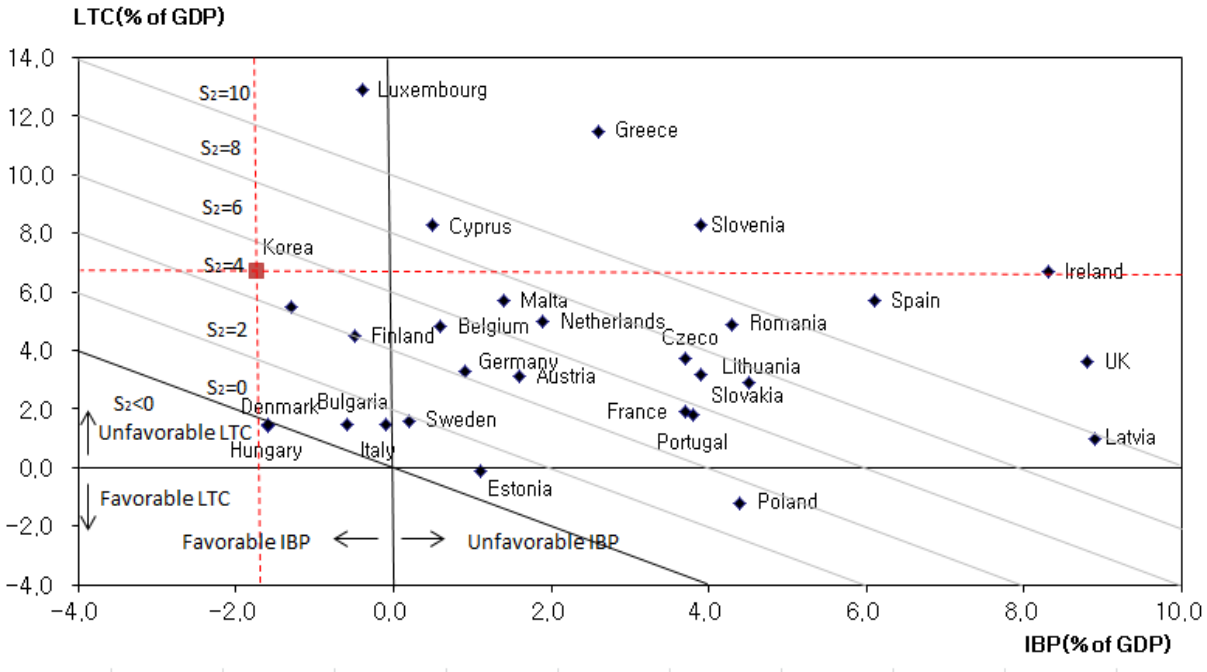
[Table 7] Comparison of S_1 and S_2 in Korea and EU countries

	S_1				**S_2**		
	S_1	IBP	DR	LTC	S_2	IBP	LTC
Korea	**2.6**	**-2.0**	**-0.5**	**5.1**	**4.9**	**-1.7**	**6.7**
Belgium	4.5	0.5	0.6	3.5	5.3	0.6	4.8
Bulgaria	-0.6	-0.7	-0.5	0.6	0.9	-0.6	1.5
The Czeco Repulic	5.3	3.6	-0.3	1.9	7.4	3.7	3.7
Denmark	-0.6	-1.9	-0.5	1.8	-0.2	-1.6	1.4
Germany	3.1	0.8	0.2	2.1	4.2	0.9	3.3
Estonia	0.3	1.0	-0.6	-0.2	1.0	1.1	-0.1
Ireland	12.1	8.2	0.2	3.7	15.0	8.3	6.7
Greece	10.8	2.4	0.7	7.7	14.7	2.6	11.5
Spain	9.5	5.9	-0.1	3.6	11.8	6.1	5.7
France	5.5	3.8	0.4	1.4	5.6	3.8	1.8
Italy	1.9	-0.2	0.7	1.4	1.4	-0.1	1.5
Cyprus	4.6	0.2	-0.3	4.7	8.8	0.5	8.3
Latvia	9.4	8.8	-0.2	0.9	9.9	8.9	1.0
Lithuania	5.4	3.7	-0.3	2.0	7.1	3.9	3.2
Luxembourg	6.2	-0.6	-0.8	7.5	12.5	-0.4	12.9
Hungary	-1.1	-1.9	0.4	0.4	-0.1	-1.6	1.5
Malta	4.7	1.1	0.2	3.4	7.0	1.4	5.7

The Netherlands	5.2	1.6	0.0	3.7	6.9	1.9	5.0
Austria	3.8	1.5	0.2	2.2	4.7	1.6	3.1
Poland	2.9	4.2	0.0	-1.2	3.2	4.4	-1.2
Portugal	4.7	3.4	0.3	1.0	5.5	3.7	1.9
Romania	6.9	4.1	-0.4	3.2	9.1	4.3	4.9
Slovenia	9.2	3.8	-0.3	5.7	12.2	3.9	8.3
Slovakia	5.7	4.3	-0.3	1.6	7.4	4.5	2.9
Finland	2.6	-0.8	-0.3	3.7	4.0	-0.5	4.5
Sweden	0.5	-0.1	-0.3	0.8	1.8	0.2	1.6
United Kingdom	10.8	8.6	0.2	2.0	12.4	8.8	3.6

Source: European Commission (2009), Korea is calculated by the author.

[Figure 1] Comparison of S_2 in Korea and EU countries



2. Calculated amount of primary fiscal balance needed to improve

To consider alternative to be fiscal sustainable, I consider a suggestion applied some sort of government debt rules which maintain the government debt ratio of 65.2% in 2033, the last year of fiscal sustainable to perform its role properly.

I can derive the primary fiscal balance that must be improved in order to achieve a debt ratio of 65.2% since 2034 annually by inversion. [Table 8] speaks calculation results that are improving 107 trillion KW, 2.7%p of primary fiscal balance per GDP in 2034 by revenue increase

or expenditure decrease. Since 2034 the improving primary fiscal balance is gradually expanding, there appears to be improving primary balance which is 5.1%p of GDP, 445 trillion KW in 2060.

This improvement of primary fiscal balance calculated may be described as a huge adjustment referred to unrealistic. In other words, there need excess revenues expand or reduce excessive government spending. It might be served a burden on economic growth and this would give up Korean fiscal authority serve as last rest in the national economy.

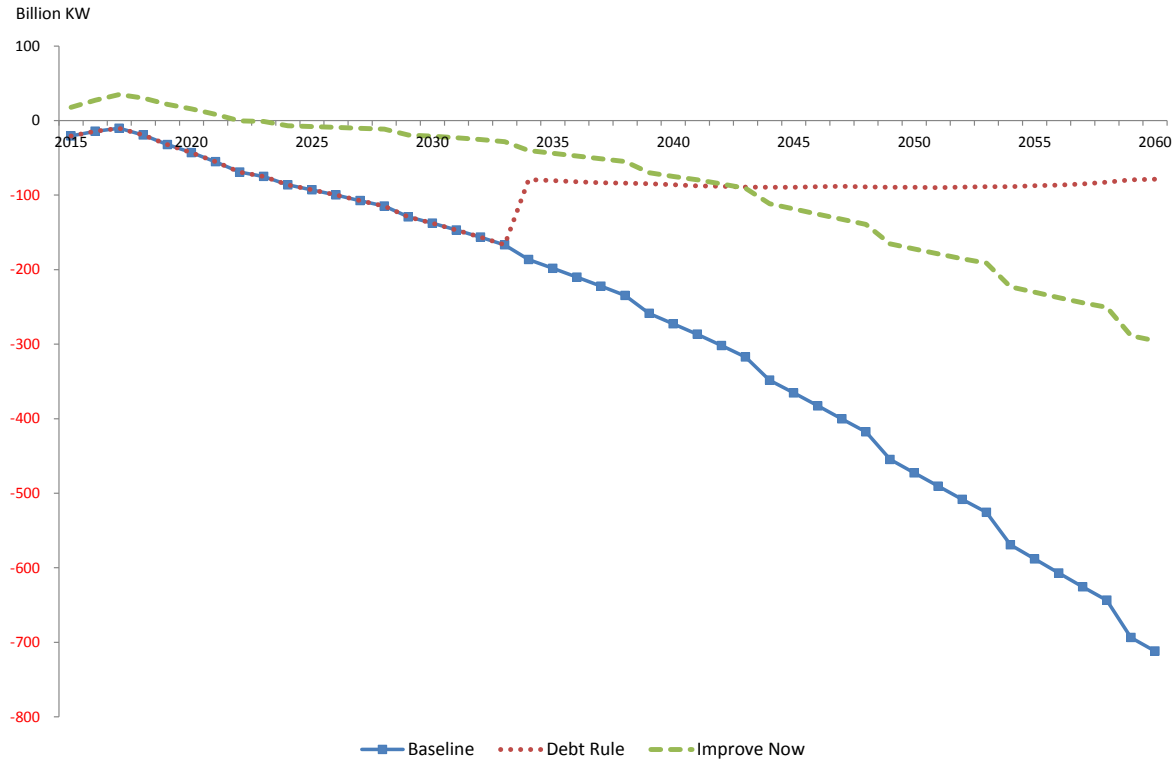
Therefore, there need to improve the primary fiscal balance preemptively with the possible revenue raising and expenditure-cutting efforts from now to be maintained fiscal sustainability. For this aim I estimate the required primary fiscal balance from now for government debt ratio 65.2%to achieve in 2060. The result showed that it is necessary to improve 2.5%p of primary fiscal balance each year. Of course, we cannot insist that claims the government debt ratio in 2060 should be achieved just 65.2% of debt ratio for fiscal sustainable or must be improved 35 trillion KW of primary fiscal balance in 2014. However, it will be considered that fiscal improvement projects from now are much feasible and much less fiscal burden than improvement after waiting time to lose the fiscal sustainability.

[Table 8] Calculated amount of primary fiscal balance needed to improve

	Nominal GDP (Billion KW)	**Primary fiscal balance (%)**	**Gov't debt (%)**	**To maintain the debt ratio in 2034**			**Target debt ratio: 65.2% in 2060**		
				Needed (%p)	Amount (100 MKW)	Debt (%)	Needed (%p)	Amount (100 MKW)	Debt (%)
2014	1,390,392	1.88	37.0			37.0	2.53	351,436	34.5
2020	2,012,094	1.24	37.4			37.4	2.53	508,577	21.4
2025	2,640,296	-0.66	46.9			46.9	2.53	667,361	20.7
2030	3,361,554	-1.72	58.0			58.0	2.53	849,667	22.0
2031	3,515,189	-1.93	60.4			60.4	2.53	888,499	22.4
2032	3,672,734	-2.15	62.8			62.8	2.53	928,320	22.9
2033	3,834,144	-1.82	65.2			65.2	2.53	969,118	23.4
2034	3,998,071	-2.69	67.9	2.69	1,074,277	65.2	2.53	1,010,553	24.1
2035	4,165,038	-2.87	70.6	2.76	1,149,287	65.2	2.53	1,052,755	24.9
2040	5,036,217	-3.97	85.1	3.29	1,659,085	65.2	2.53	1,272,954	29.4
2050	6,878,849	-6.24	121.3	4.35	2,989,502	65.2	2.53	1,738,698	43.8
2060	8,653,701	-7.95	168.9	5.14	4,449,909	65.2	2.53	2,187,310	65.2

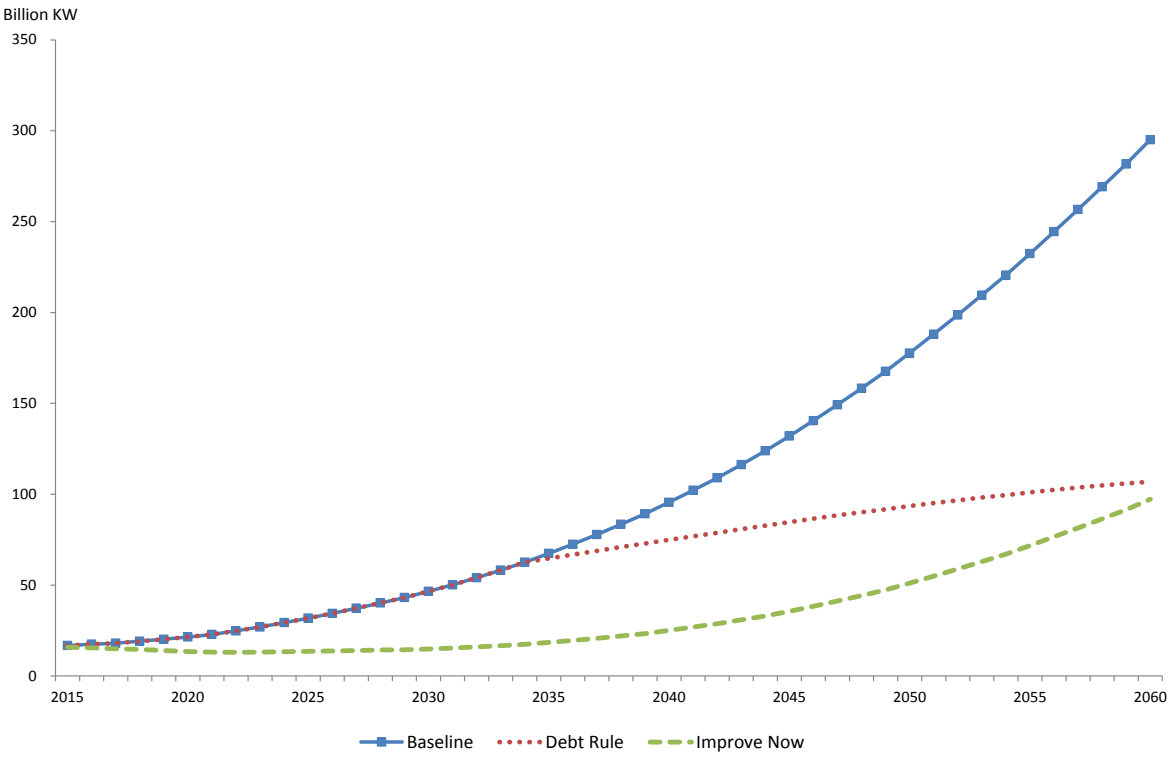
Source: NABO(2014)

[Figure 2] The projection of managed fiscal balance



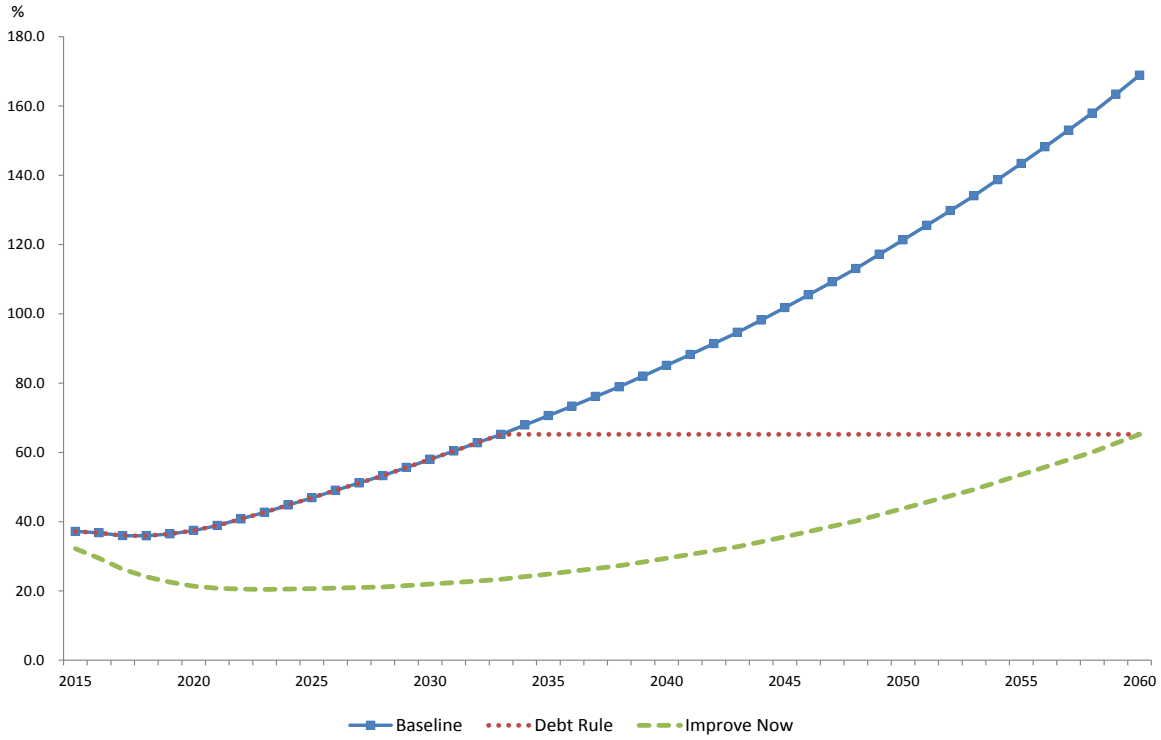
Source: NABO(2014)

[Figure 3] The projection of interest payment



Source: NABO(2014)

[Figure 4] The projection of government debt



Source: NABO(2014)

V. Conclusion

Generally speaking, the fiscal sustainability means that current fiscal policies and systems can maintain itself without changing. The reason for testing the fiscal sustainability is to assist in finding non-sustainable fiscal policies and financial systems and to improve them in the long-run. The fiscal authority could correct them based on test results which found existing or possible being a fiscal risk, and then he/she will be able to minimize the fiscal risks in the future.

Therefore, I actually estimate whether Korean fiscal is to be sustained based on the projection results of National Assembly Budget Office (2014) which was done the long-term fiscal outlook in accordance with demographic change. Using the Bohn's test method among various sustainability analyses the result shows that it is to perform properly the role of fiscal policy and systems until 2033 during the period up to 2060

In order to maintain the fiscal sustainability during the projection period, what will we do? The EU has estimated 'necessary amounts of budget adjustments' of EU member countries to reach a fiscal sustainable by the sustainability gap indicator. Based on the government debt projection of NABO (2014), Korean government should do 2.62%p of revenue increases or expenditure reductions required to achieve 60% debt ratios in 2060 by EU sustainability gap indicator. Also Korean government could repay all of the government debt by 4.95%p of fiscal surplus for an infinite time period. Germany and Finland look similar to the gross value of S_1 and S_2 of Korea. Looking in detail, however Korean government has better current fiscal status and much-needed improvements for long-term fiscal balance compared to the major European countries.

I applied some sort of government debt rules which maintain the government debt ratio of

65.2% in 2033. Thus I get the result that the primary fiscal balance must be improved from 2.7%p in 2034 to 5.14%p in 2060. This improvement of primary fiscal balance calculated may be described as a large-scale adjustment referred to as impractical and it might be a burden on economic growth since 2034. So I estimate the required primary fiscal balance from now for government debt ratio 65.2% to achieve in 2060, then it is necessary to improve 2.5%p of primary fiscal balance each year. I can recheck that there would face less fiscal burden to restore the fiscal soundness reforming fiscal system and policy from now, instead of waiting until the point of losing the sustainability.

While I research about the fiscal sustainability, another question is "what is a sustainable level of government debt ratios?" In calculating the sustainability gap indicators of the EU I set at 60% of government debt ratio according to the EU's stability and growth pact. Also for the sort of debt rule, I set to a 65.2% debt ratio in 2033. Thus, it seems appropriate research about setting the sustainable debt level for the long-term fiscal goals in Korea by the study of the optimal debt level, and leaving it to my future work.

Reference

Ahmed, S. and Rogers, J.H., "Government budget deficits and trade deficits: Are present value constraints satisfied in long-term data?" *Journal of Monetary Economics 36,* 1995.

Andersen, T.M. and Pedersen, L.H., "Assessing fiscal sustainability and the consequences of reforms," Presented at the budgetary implications of structural reforms, European Commission, 2006.

Auerbach, A.J., Gokhale, J. and Kotlikoff, L.J., "Generational Accounts: A Meaningful Alternative to Deficit Accounting," *Tax Policy and the Economy*, Vol. 5, 1991.

Barnhill., T.M. and Kopits, G., "Assessing Fiscal Sustainability Under Uncertainty," *IMF Working Paper,* WP/03/79, 2003.

Bi, H., "Sovereign default risk premia, fiscal limits, and fiscal policy," *European Economic Review*56, 2012.

Blanchard, O., Chouraqui, J.-C., Hagemann, R.P. and Sartor, N., "The Sustainability of Fiscal Policy: New Answers to An Old Question," *OECD Economic Studies* No.15, 1990.

Bohn, H., "The behavior of US public debt and deficits," *The Quarterly Journal of Economics*

Vol.113 No.3, 1998.

Bohn, H., "The Sustainability of Fiscal Policy in the United States," *CESifo Working Paper Series* No.1446, 2005.

Buiter, W.H., Persson, T. and Minford, P., "A Guide to Public Sector Debt and Deficits," *Economic policy* Vol. No.1, 1985.

Burnside, C. ed., *Fiscal Sustainability in Theory and Practice: A Handbook*, The World Bank, 2005.

Cochrane, J.H., "Understanding policy in the great recession: Some unpleasant fiscal arithmetic", *European Economic Review*55, 2011.

European Commission Directorate-General for Economic and Financial Affairs, *Sustainability Report 2009,* European Commission, 2009.

Gokhale, J. and Smetters, K., "Fiscal and Generational Imbalances: New Budget Measures for New Budget Priorities," *Federal Reserve Bank of Cleveland Policy Discussion Papers,*2003

Hamilton, J.D. and Flavin, M.A., "On the Limitations of Government Borrowing: A Framework for Empirical Testing," *The American Economic Review,*Vol.76 No.4, 1986.

Hong, S.H., "Assessing the fiscal Sustainability and the relative document of major countries", Taxation and Fiscal BRIEF, Korea Institute of Public Finance, 2013.

IMF, "Chapter III. Public debt in emerging markets: is it too high?" *World Economic Outlook: Public Debt in Emerging Markets,* International Monetary Fund, 2003.

Lee, Kang Koo, "Long-term Fiscal Outlook and Assessing the Fiscal Sustainability (in Korean)," *Journal of Budget and Policy*, Vol.4 No.1, 2015.

Leeper, E.M. and Walker, T.B., "Fiscal Limits in Advanced Economies", *NBER Working Paper* No. 16819, National Bureau of Economic Research, 2011.

National Assembly Budget Office, *A Study on the Government Debt Management* (in Korean), National Assembly Budget Office, 2007

National Assembly Budget Office, *2014-2060 Long-term Fiscal Projection*, National Assembly Budget Office, 2014

Ostry, J.D., Ghosh, A.R., Kim, J.I. and Qureshi, M.S., "Fiscal Space," *IMF Staff Position Note* SPN/10/11, International Monetary Fund, 2010.

Park, H.S., et al., *Government Debt Management in Korea* (in Korean), Korea Institute of Public Finance, 2008.

Sarvi, T., "Some Approaches for Assessing the Sustainability of Public Finances," Aalto University School of Economics, 2011.

Trehan, B. and Walsh, C.E., "Common Trends, the Government Budget Constraint, and Revenue Smoothing," *Journal of Economic Dynamics and Control,* Vol.12 No.2-3, 1988.

van Ewijk, C., Draper, N., ter Rele, H. and Westerhout, E., *Ageing and Sustainability of Dutch Public*

Finances, CPB Netherlands Bureau for Economic Policy Analysis, 2006.

Wilcox, D.W., "The Sustainability of Government Deficits: Implications of the Present-Value Borrowing Constraint," *Journal of Money, Credit, and Banking,* Vol. 21 No.3, 1989.