Can Aging Population Affect Economic Growth through the Channel of Government Spending?

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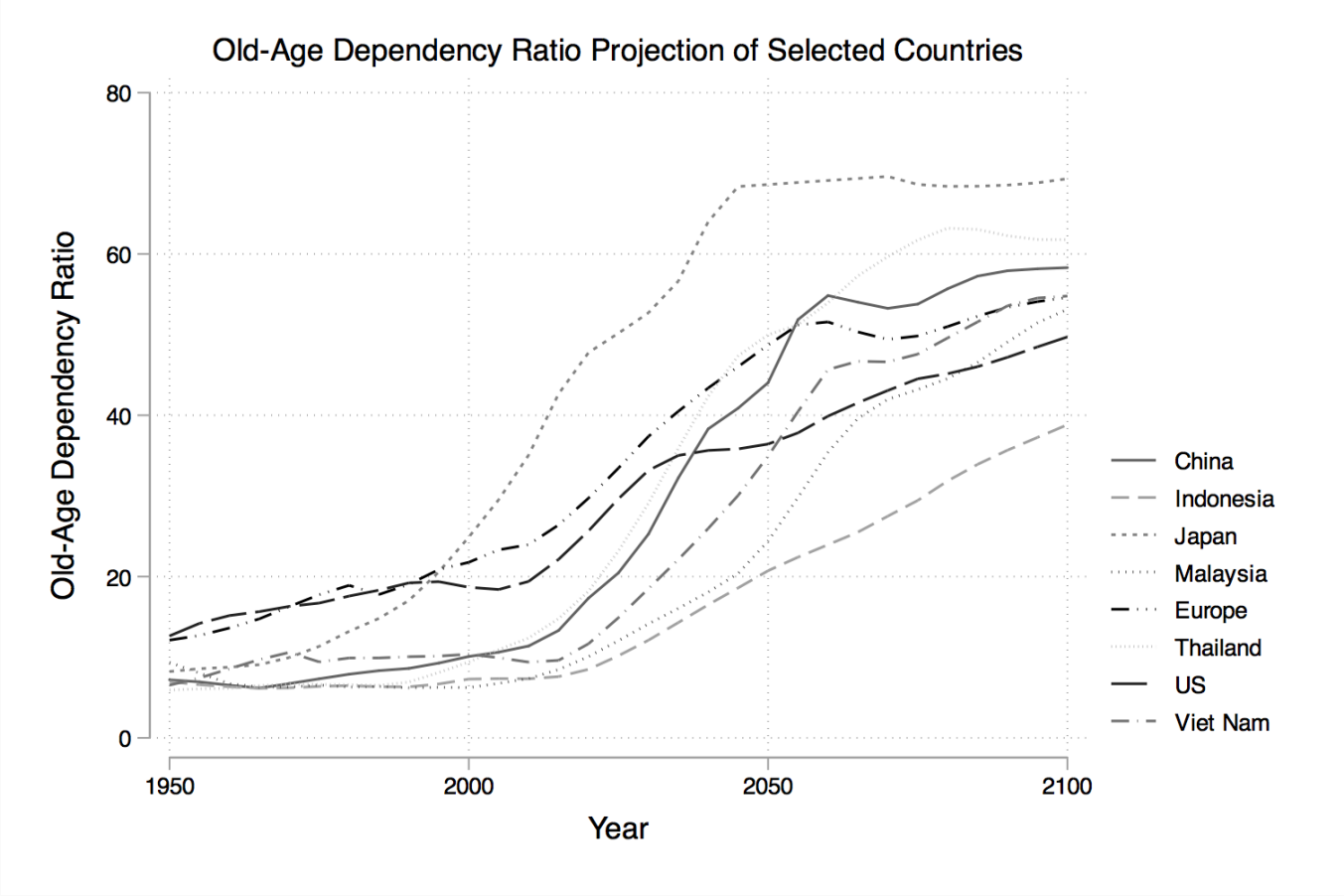
Intro

Motivation: Ageing situation around the world



Source: Author's own calculation

Fig. 1. Old-Age Dependency Ratio Projection of Selected Countries

How old is old?

Definition of the old...

- According to the United Nations (United Nations) guidelines, the definition of the elderly is people over 65 years of age.
- When age reaches the statutory retirement age. Of course, each country has different retirement age criteria.

and when the country becomes aged...

- When the percentage of the old-age population to total population above 14 % (WHO).
- The process by which older individuals become a proportionally larger share of the total population (UN report on World Population Aging: 1950-2050)
- The old-age dependency ratio (fraction of pensioners to working-age population).
- Life expectancy (at birth) is increasing.

The aging society significantly put challenges to the country's fiscal position

As the aging population has been increased, it creates demand for programs or income support for the elderly.

- Shelton (2007) finds that social protection and other welfare expenditures are raised due to aging.
- Sanz & Velázquez (2007) study the role of an aging population on economic growth in the OECD countries from 1990 to 1997. A change in demographic structure toward an aging society pushes public expenditure related to aging, e.g. social protection and health care expenditure, to be higher.
- Higher proportion of the old-age population reduce economic growth by cutting saving and, thus, capital accumulation [see Hviding & Mérette (1998), Bloom, Canning & Fink (2010), and Van Der Gaag & de Beer (2015)].

An increase in government spending directly affects long-term economic growth.

- The expenditure needs and the fiscal position are vary from country to country at different income levels (Tanzi & Schuknecht ,1997)
- Barro (1990) found that the relationship between government spending and economic growth was non-homothetic.
- Moving to Japan, Goh et al. (2020) states that government spending is exceptionally increased due to the old-age population. This negatively affects long-term economic growth (Oliver, 2015).
- Bloom, Canning & Sevilla (2001) say that good health is the main factor that will increase economic growth. This will increase work efficiency as well as improve the level of development.

Research Objectives

What are we trying to answer?:

- How does the aging population affect government spending at the aggregate level?
- What effects on each component of government spending?
- Can the aging population enhance economic growth through the channel of government spending reallocation?

Data

Description of the Dataset

- Unbalanced panel data of 87 countries from 1996 to 2017, both high- (21) and low-income (66) countries.
- Government spending at the aggregate level and in each compositional, Classification of the Functions of Government (COFOG), including public administration, defense, law and order, environment, economic affair, housing, health, culture, education, and social protection. We employed the Government Finance Statistics (GFS) dataset, International Monetary Funds (IMF).
- Others control variables such as trade to GDP, control of corruption, etc.

Description Statistic: full sample (Cont.)

Table 1
Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Old-age Dependency ratio	14.369	8.306	0.8	46.17	2369
Old-age population	9.475	5.644	0.690	27.58	2369
GDP per capita	17713.808	20784.559	187.52	111968.4	2388
Government Spending per capita	3254.587	4002.767	12.49	21977.28	2281
Control of Corruption, ln	3.815	0.828	-0.755	4.605	2078
Trade to GDP	93.518	61.121	0.17	442.62	2333
Financial Openness	0.626	0.364	0	1	2169
Total Expenditure to GDP	30.109	13.396	3.05	128.37	2019
Expenditure on Public Administrative to GDP	6.901	3.978	0.46	38.82	1885
Expenditure on Defense to GDP	1.898	1.796	0.02	17.33	1787
Expenditure on Order to GDP	1.704	1.223	0.11	20.38	1885
Expenditure on Economics to GDP	4.145	2.653	0.05	25.36	1914
Expenditure on Environment to GDP	0.474	0.577	-0.26	6.53	1494
Expenditure on Housing to GDP	0.727	0.686	-0.35	8.94	1884
Expenditure on Health to GDP	3.212	2.555	0	12.7	1919
Expenditure on Culture to GDP	0.685	0.574	0	5.03	1796
Expenditure on Education to GDP	3.857	2.069	0.04	23.55	1913
Expenditure on Social Protection to GDP	7.427	7.145	0	25.65	1853

Description Statistic (Cont.)

Table 2
Summary statistics of different income group

Income Level	High-Income		Middle-Income		Low-Income	
Variables	No.Obs	Mean	No.Obs	Mean	No.Obs	Mean
GDP per capita	935	38496.647	1208	5091.605	245	634.893
Government Spending per capita	930	6932.08	1146	838.381	205	78.506
Old-age Dependency ratio, ln	935	2.784	1189	2.347	245	1.819
Old-age population, ln	935	2.402	1189	1.897	245	1.233
Polity IV	841	6.961	1138	4.383	245	1.286
Financial Openness	824	.876	1106	.489	239	.4
Trade to GDP, ln	930	4.546	1181	4.317	222	3.82
Control of Corruption, ln	826	4.418	1043	3.576	209	2.623

Source: Author's own calculation

Methodology

Identification Strategy: Objective I

We use the Generalized Method of Moments (GMM) to overcome the endogeneity problem.– The system GMM estimator in dynamic panel data models combines moment conditions for the differenced equation with moment conditions for the model in levels.

- Analysis of government spending at the aggregate level

$$G_{i,t} = \alpha + \beta_1 Old_{i,t} + \beta_2 G_{i,t-1} + \beta_3 Y_{i,t} + \beta_4 X'_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t}$$

- Analysis of each government spending composition

$$G_{i,m,t} = \alpha + \beta_1 Old_{i,t} + \beta_2 G_{i,m,t-1} + \beta_3 Y_{i,t} + \beta_4 X'_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t}$$

Identification Strategy: Objective I (Cont.)

where

$G_{i,t}$ is government spending of entity i at time t (m denotes each component of government spending)

$Old_{i,t}$ is indicator related to aging population

$Y_{i,t}$ represents GDP per capita

$X'_{i,t}$ is the set of control variables

μ_i capture country specific effect

λ_t is a time dummy

$\epsilon_{i,t}$ is the shock for each period.

Identification Strategy: Objective II

- We modify the model from Ormaechea Morozumi (2013) to test whether the reallocation of government spending could enhance economic growth in the aging society.

$$
\begin{aligned}
Y_{i,t} - Y_{i,t-n} = {} & \delta_1 Y_{i,t-n} + \delta_2 X'_{i,t} + \delta_3 E_{i,t-n} + \delta_4 Old_{i,t-n} \\
& + \sum_{j=1}^{m} \gamma_j s_{i,j,t-n} + \sum_{j=1}^{m} \theta_j s_{i,j,t-n} * Old_{i,t-n} * Y_{i,t-n} \\
& + \mu_i + \lambda_t + \epsilon_{i,t}
\end{aligned}
$$

Identification Strategy: Objective II (Cont.)

We omitted one component of the government spending to avoid exact multicollinearity.

$$
\begin{aligned}
Y_{i,t} - Y_{i,t-n} = {} & (\delta_1 + \theta_m) Y_{i,t-n} + \delta_2 X'_{i,t} + \delta_3 E_{i,t-n} + (\delta_4 + \theta_m) Old_{i,t-n} \\
& + \sum_{j=1}^{m-1} (\gamma_j - \gamma_m) s_{i,j,t-n} + \sum_{j=1}^{m-1} (\theta_j - \theta_m) s_{i,j,t-n} * Old_{i,t-n} * Y_{i,t-n} \\
& + \mu_i + \lambda_t + \epsilon_{i,t}
\end{aligned}
$$

So that $\frac{\partial Y_{i,t} - Y_{i,t-n}}{\partial s_{i,j,t-n}} = (\gamma_j - \gamma_m) + (\theta_j - \theta_m) * Old_{i,t-n} * Y_{i,t-n}$ is the parameter of interest.

Results and Discussion

Aging induces higher government spending as expected

Table 3
Regression Results: The effect of old-age population on aggregate government spending

	(OLS)	(FE)	(1DGMM)	(2DGMM)	(1SGMM)	(2SGMM)
Old_depend, ln	0.0199***	0.0539^{+}	0.0913	-0.0154	0.0609**	0.0642***
	(0.000)	(0.069)	(0.386)	(0.731)	(0.001)	(0.000)
L.Gov Spending	0.912***	0.714***	1.021***	1.061***	0.794***	0.798***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP per capita	0.0835***	0.200***	-0.261	-0.204**	0.147*	0.137***
	(0.000)	(0.000)	(0.579)	(0.001)	(0.027)	(0.000)
N. Obs.	1705	1705	1428	1428	1705	1705
R-Squared	0.996	0.854				
Adjusted R-Squared	0.996	0.843				
AR(1) p-value			0.00396	0.00462	0.00424	0.00842
AR(2) p-value			0.262	0.261	0.319	0.329
Hansen p-value			0.0908	0.0908	0.0831	0.0831

Source: Author's own calculation.
t statistics are in parentheses and * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The regression results of control variables are omitted.

*** Results from different regression indicate endogeneity

However, not so significant in the countries with annual income per capita lower than 12000 USD

Table 4
Regression Result: The effect of old-age population on aggregate government spending by income group

	(Income <12000)	(Income >12000)
Old_depend, ln	0.00605	0.178***
	(0.126)	(0.000)
GDP per capita	0.00807	0.0938***
	(0.617)	(0.000)
N. Obs.	702	1003
AR(1) p-value	0.00578	0.0222
AR(2) p-value	0.911	0.377
Hansen p-value	0.871	0.359

Source: Author's own calculation.
t statistics are in parentheses and * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The regression results of control variables are omitted.

Social protection and environmental spending are increased when the country move towards an aging society

Table 5

Regression Result: The effect of old-age population on each government spending composition

	Public Admin	Defense	Order	Economic	Environment	Housing	Culture	Health	Education	Social Protection
Old_depend, ln	-0.916**	0.0166	-0.0246	0.342^{+}	0.0277*	-0.340***	0.0410^{+}	0.0923^{+}	-0.174**	1.626***
	(0.004)	(0.448)	(0.184)	(0.091)	(0.027)	(0.000)	(0.089)	(0.080)	(0.010)	(0.000)
GDP per capita	2.013***	-0.0699**	0.0328^{+}	-0.0512	-0.00157	0.116*	0.0976***	0.201***	0.191**	1.463***
	(0.000)	(0.001)	(0.052)	(0.755)	(0.879)	(0.020)	(0.000)	(0.000)	(0.004)	(0.000)
N. Obs.	1382	1344	1382	1407	1130	1380	1310	1409	1408	1354
AR(1) p-value	0.0205	0.0155	0.0397	0.00188	0.000456	0.0239	0.0105	0.00368	0.00000682	0.140
AR(2) p-value	0.169	0.782	0.358	0.0264	0.908	0.355	0.326	0.448	0.724	0.294
Hansen p-value	0.158	0.320	0.0791	0.0438	0.108	0.494	0.284	0.119	0.187	0.0695

Source: Author's own calculation.

t statistics are in parentheses and * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The regression results of control variables and the lagged of each government spending component are omitted.

Different story for middle- and low-income countries!?

Table 6

Regression Result: The effect of old-age population on each government spending composition in countries with income level are lower than 12000 USD

	Public Admin	Defense	Order	Economic	Environment	Housing	Culture	Health	Education	Social Protection
Old_depend, ln	-3.823***	0.350***	0.0509	-0.0856	0.0343	-0.473***	0.0118	-0.000214	-0.390***	0.199
	(0.000)	(0.000)	(0.138)	(0.764)	(0.227)	(0.000)	(0.637)	(0.997)	(0.000)	(0.291)
GDP per capita	3.872***	-0.413***	-0.0450	-0.0987	-0.00233	0.330***	0.0186	0.0749^{+}	0.154	0.873***
	(0.000)	(0.000)	(0.289)	(0.676)	(0.924)	(0.001)	(0.403)	(0.095)	(0.114)	(0.000)
N. Obs.	746	710	748	771	576	746	688	774	772	718
AR(1) p-value	0.0388	0.00557	0.0657	0.00466	0.00951	0.117	0.00384	0.0179	0.0000350	0.0425
AR(2) p-value	0.119	0.635	0.423	0.355	0.643	0.675	0.869	0.424	0.919	0.482
Hansen p-value	0.621	0.638	0.354	0.681	0.618	0.286	0.380	0.539	0.526	0.399

Source: Author's own calculation.

t statistics are in parentheses and * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The regression results of control variables and the lagged of each government spending component are omitted.

Reallocation to education expenditure would promote growth

Table 7

Regression Result: The effect of government spending reallocation on growth

Growth rate of GDP per capita (4years) / Reallocated to which component	Public Admin	Defense	Order	Economic	Environment	Housing	Culture	Health	Education	Social Protection
Financing Component										
(Public Admin)	x				-*		-***		+***	
(Defense)	+**	x					-***		+***	
(Order)			x				-***		+***	
(Economic)	+***			x			-***		+***	
(Environment)	+***				x		-***		+***	
(Housing)						x	-***		+***	
(Culture)				-*			x		+**	
(Health)	+**						-***	x	+**	
(Education)							-*		x	
(Social Protection)	+**						-***		+**	x

Source: Author's own calculation.

t statistics are in parentheses and * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

reallocation results

Key takeaways

Key takeaways

- Aging society pushes higher government spending in high- and low-income countries.
- However, governments in high-income countries tend to spend more on environmental and social protection expenditures, while governments in the middle- and low-income countries tend to focus more on defense expenditure and reduce the spending on education.
- Reallocation to education expenditure would promote growth.

THANK YOU FOR YOUR ATTENTION :D

Q&A

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Table 8
Regression Result: 1.1.2 Aggregate level_oldpercent

	(OLS)	(FE)	(1DGMM)	(2DGMM)	(1SGMM)	(2SGMM)
Percentage Old pop	0.0199***	0.0827*	0.120	0.0253	0.0612***	0.0641***
	(0.000)	(0.012)	(0.393)	(0.607)	(0.000)	(0.000)
L.Gov Spending	0.913***	0.714***	1.011***	1.051***	0.791***	0.797***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP per capita	0.0819***	0.196***	-0.256	-0.207**	0.155*	0.142***
	(0.000)	(0.000)	(0.614)	(0.002)	(0.019)	(0.000)
N. Obs.	1705	1705	1428	1428	1705	1705
R-Squared	0.996	0.854				
Adjusted R-Squared	0.996	0.843				
AR(1) p-value			0.00409	0.00453	0.00424	0.00800
AR(2) p-value			0.262	0.262	0.308	0.318
Hansen p-value			0.0526	0.0526	0.0846	0.0846

Source: Author's own calculation.
t statistics are in parentheses and * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The regression results of control variables are omitted.

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Table 9
Regression Result: Reallocation Gov Spend

	(Public Admin)	(Defense)	(Order)	(Economic)	(Environment)	(Housing)	(Culture)	(Health)	(Education)	(Social Protection)
l4ln_gdp_percapita	-2.131***	-2.724***	-2.569***	-2.536***	-2.898***	-2.694***	-2.318***	-2.600***	-2.233***	-2.480***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
l4exp_gdp	0.0278	0.0785	-0.226**	-0.0233	-0.230**	-0.145	-0.138*	0.0345	-0.179*	-0.0190
	(0.310)	(0.281)	(0.007)	(0.539)	(0.006)	(0.115)	(0.018)	(0.685)	(0.012)	(0.579)
l4ln_old_depen	0.781	-0.316	-0.517	-0.325	-1.103	-0.496	-0.0655	-0.0262	0.00619	-0.0711
	(0.205)	(0.612)	(0.296)	(0.589)	(0.102)	(0.418)	(0.910)	(0.966)	(0.991)	(0.909)
l4exp_pub_gdp		-0.328**	-0.114	-0.316**	-0.247*	-0.191	-0.0810	-0.310*	-0.0747	-0.255*
		(0.006)	(0.309)	(0.008)	(0.014)	(0.131)	(0.306)	(0.026)	(0.463)	(0.011)
l4exp_def_gdp	-0.256		0.326	0.0519	0.205	0.218	0.174	-0.0880	-0.0641	0.0200
	(0.401)		(0.321)	(0.857)	(0.431)	(0.552)	(0.319)	(0.794)	(0.829)	(0.941)
l4exp_order_gdp	0.164	0.0483		-0.00798	1.266*	0.187	0.193	0.0965	-0.234	-0.0266
	(0.725)	(0.918)		(0.986)	(0.018)	(0.686)	(0.710)	(0.841)	(0.576)	(0.954)
l4exp_econ_gdp	0.0382	-0.0264	0.343+		0.275	0.197	0.504**	0.0984	0.177	0.133
	(0.791)	(0.883)	(0.059)		(0.153)	(0.276)	(0.007)	(0.599)	(0.292)	(0.383)
l4exp_envi_gdp	3.188*	2.305+	2.003	2.070		2.455+	0.639	2.563*	1.459	2.307+
	(0.011)	(0.074)	(0.119)	(0.115)		(0.068)	(0.666)	(0.037)	(0.293)	(0.096)
l4exp_housing_gdp	-0.229	-0.120	0.189	-0.200	0.445		-0.496	-0.342	-0.228	-0.168
	(0.601)	(0.792)	(0.673)	(0.647)	(0.386)		(0.351)	(0.440)	(0.624)	(0.701)
l4exp_health_gdp	-0.180	-0.512	0.272	0.0777	0.115	0.0117	0.903		-0.197	0.429
	(0.731)	(0.380)	(0.607)	(0.891)	(0.828)	(0.982)	(0.187)		(0.717)	(0.301)
l4exp_cult_gdp	1.676***	2.537***	2.541***	2.566***	2.691***	2.878***		2.366***	2.038***	2.318***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)

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Table 10
Regression Result: Reallocation Gov Spend

	(Public Admin)	(Defense)	(Order)	(Economic)	(Environment)	(Housing)	(Culture)	(Health)	(Education)	(Social Protection)
l4exp_edu_gdp	-1.009**	-1.553***	-1.124**	-1.195**	-1.522***	-1.377***	-0.973**	-1.277**		-1.230**
	(0.004)	(0.000)	(0.002)	(0.002)	(0.000)	(0.001)	(0.004)	(0.002)		(0.001)
l4exp_socpro_gdp	0.116	0.132	0.306+	0.159	0.444**	0.317+	0.230	0.0387	0.305+	
	(0.402)	(0.434)	(0.086)	(0.410)	(0.006)	(0.096)	(0.261)	(0.818)	(0.067)	
l4ln_old_depen X l4exp_def_gdp X l4ln_gdp_percapita	0.0157		0.00429	0.00660	0.0109	0.00420	0.00705	0.0105	0.0193+	0.00804
	(0.206)		(0.734)	(0.580)	(0.333)	(0.770)	(0.418)	(0.422)	(0.089)	(0.489)
l4ln_old_depen X l4exp_order_gdp X l4ln_gdp_percapita	-0.0235	-0.0119		-0.0154	-0.0494+	-0.0168	-0.0204	-0.0204	-0.00191	-0.0131
	(0.346)	(0.637)		(0.545)	(0.091)	(0.501)	(0.451)	(0.451)	(0.936)	(0.605)
l4ln_old_depen X l4exp_econ_gdp X l4ln_gdp_percapita	-0.00130	-0.00110	-0.00351		0.00155	-0.00112	-0.0139*	-0.00418	-0.000393	-0.00354
	(0.794)	(0.834)	(0.471)		(0.795)	(0.821)	(0.016)	(0.446)	(0.938)	(0.497)
l4ln_old_depen X l4exp_envi_gdp X l4ln_gdp_percapita	-0.0991*	-0.0766+	-0.0516	-0.0562		-0.0693	0.000690	-0.0685+	-0.0304	-0.0622
	(0.019)	(0.097)	(0.235)	(0.209)		(0.130)	(0.989)	(0.093)	(0.514)	(0.187)
l4ln_old_depen X l4exp_housing_gdp X l4ln_gdp_percapita	0.00374	-0.00489	-0.00121	0.00723	-0.000111		0.0203	0.0101	0.0138	0.00576
	(0.851)	(0.811)	(0.951)	(0.722)	(0.996)		(0.364)	(0.595)	(0.537)	(0.775)
l4ln_old_depen X l4exp_health_gdp X l4ln_gdp_percapita	0.00907	0.0173	0.00146	0.00371	0.00838	0.00839	-0.0209		0.0157	-0.00844
	(0.641)	(0.409)	(0.942)	(0.860)	(0.659)	(0.674)	(0.414)		(0.449)	(0.557)
l4ln_old_depen X l4exp_cult_gdp X l4ln_gdp_percapita	-0.0665***	-0.112***	-0.0900***	-0.0964***	-0.105***	-0.106***		-0.0945***	-0.0579*	-0.0886***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.012)	(0.000)
l4ln_old_depen X l4exp_edu_gdp X l4ln_gdp_percapita	0.0389**	0.0648***	0.0524***	0.0497**	0.0705***	0.0619***	0.0410**	0.0504**		0.0506**
	(0.009)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.003)	(0.001)		(0.001)
l4ln_old_depen X l4exp_socpro_gdp X l4ln_gdp_percapita	-0.00436	-0.00740	-0.00272	-0.00509	-0.00738	-0.00577	-0.00225	-0.00179	-0.00201	
	(0.398)	(0.210)	(0.611)	(0.412)	(0.194)	(0.331)	(0.749)	(0.659)	(0.731)	
l4ln_old_depen X l4exp_pub_gdp X l4ln_gdp_percapita		0.0131**	0.0159**	0.0163**	0.0230***	0.0160**	0.0114*	0.0141**	0.0120*	0.0137**
		(0.008)	(0.002)	(0.002)	(0.000)	(0.002)	(0.037)	(0.003)	(0.013)	(0.006)
N	785	803	785	785	963	791	790	785	785	785
ar1p	0.896	0.306	0.250	0.245	0.285	0.190	0.661	0.339	0.381	0.347
ar2p	0.111	0.172	0.481	0.189	0.488	0.270	0.962	0.168	0.243	0.205

Source: Author's own calculation.

Notes: Table estimates ..... using Dynamic System Generalised Method of Moments or System Difference Generalised Method of Moments. government spending Gap is a dependent variable. L.Gov Gap represents Lagged Government Spending Gap. This table is omitted the estimator results of constant term and all estimators for time dummy. t statistics are in parentheses and * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

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