Social Security Benefits and Economic Growth in Japan: Empirical Evidence from the Nonlinear ARDL Approach

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Abstract

This study examines the asymmetric relationship between social security benefits and GDP growth using time series annual data on Japan during the period 1970–2019. For this purpose, we apply the nonlinear Autoregressive Distributed Lag (ARDL) approach proposed by Shin, Yu, and Greenwood-Nimmo (2014). The empirical results show that the increase and decrease changes in per capita GDP exert asymmetric effects on per capita social security benefits in the short- and long-run. Particularly, in the long-run, the decrease as well as the increase in GDP raises social security benefits. Hence, social security benefits increase irrespective of any GDP trend. Furthermore, the direction of causality between per capita social security benefits and per capita GDP is examined using the Toda and Yamamoto (1995) non-causality test. The results show a unidirectional causality from GDP (positive and negative changes) to

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social security benefits.

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JEL Classification Code: H53, C32, I38

1. Introduction

The relationship between growth and the Welfare State for developed countries has been of interest to many researchers. Atkinson (1995) reconsidered the effects of the Welfare State variable on economic growth and presented that mixed results are obtained among many empirical studies. For example, McCallum and Blais (1987) find that the Welfare State variable has a positive effect on annual growth rates although Landau (1985) and Hansson and Henrekson (1994) find no significant effect. In contrast, Persson and Tabellini (1994) find that transfers are negatively associated with annual growth rates. As Atkinson (1995) pointed out, since these studies use pooled time series and cross section data, the empirical results have sensitivity in some cases due to the country covered, notably the inclusion or exclusion of Japan.

On the other hand, a demand-based theory states that it is the evolution of incomes that drives the behavior of social security expenditure. In this case, whether the income elasticity of social security expenditure is larger or lower than one; in other words, whether social security expenditure is a luxury good or a necessity good has important implications for welfare policy. Auteri and Costantini (2004) and Clemente, Marcuello and Montanes (2012) estimate GDP elasticity of social expenditure using panel data from OECD countries. The aforementioned empirical studies are common in that they accept that a change in GDP has symmetric effects on social security expenditure. However, in reality, an increase or decrease in GDP may asymmetrically affect social security expenditure. Furthermore, in order to understand the relationship between growth and the Welfare State, we need to understand statistical causal relationship. Herce, Sosvilla-Rivero and de Lucio (2001) have conducted tests for causality between GDP growth and social protection expenditure for twelve countries in the EU and have obtained very interesting results.

In Japan's social security system, universal health insurance and universal pension coverage was established in the fiscal year 1961. After that, when we see the trend of social security benefits which are based on the ILO (International Labor Organization) as social security expenditure, it has been increasing consistently. During the period 1970–2019, the annual increase rate of social security benefits largely exceeded GDP growth rate. Therefore, the sustainability of the social security finance is a serious problem. Moreover, the population was aging rapidly surpassing that of other developed countries. As a result, the percentage of social security benefits in GDP is growing. Considering this situation, it is interesting to examine what effect the positive and negative changes in GDP have on social security benefits in Japan.

The purpose of this study is to examine the asymmetric relationship between social security benefits and GDP growth using time series annual data on Japan during the period 1970–2019. First, we investigate the asymmetric impact of per capita GDP on per capita social security benefits. For this purpose, we apply the nonlinear Autoregressive Distributed Lag (ARDL) approach proposed by Shin, Yu, and Greenwood-Nimmo (2014). The empirical results support long- and short-run asymmetry. Specifically, we show that per capita social security benefits increase when per capita GDP increases and decreases in the long-run. Second, we examine the direction of causality between social security benefits and GDP growth using the Toda and Yamamoto (1995) non-causality test. The results show a unidirectional causality from GDP (positive and negative changes) to social security benefits. We cannot find empirical evidence that social security benefits cause economic growth.

The remainder of this paper is organized as follows. In Section 2, we discuss the empirical methodology and data. Section 3 presents the empirical results and discussion. Finally, Section 4 concludes the study with policy recommendations.

2. Empirical methodology and data

2-1. Empirical methodology

The long-run association between social security benefits and GDP can be modelled as:

$$\ln SSB_t = \beta_0 + \beta_1 \ln GDP_t + u_t \quad (1)$$

where SSB_t is per capita real social security benefits, GDP_t is per capita real GDP, and u_t is the error term. All variables used for the estimation are measured in logarithmic forms. However, Equation (1) does not consider the asymmetric effect of GDP. For this reason, we apply the nonlinear ARDL cointegration methodology proposed by Shin, Yu, and Greenwood-Nimmo (2014), which developed the linear ARDL bounds testing approach of Pesaran, Shin, and Smith (2001).

Equation (1) is modified as:

$$\ln SSB_t = \beta_0 + \beta_1^+ \ln GDP_t^+ + \beta_1^- \ln GDP_t^- + u_t \quad (2)$$

In Equation (2), $\ln GDP_t$ is decomposed as follows.

$$\ln GDP_t = \ln GDP_0 + \ln GDP_t^+ + \ln GDP_t^- \quad (3)$$

The terms $\ln GDP_t^+$ and $\ln GDP_t^-$ are the partial sum processes of the positive and negative changes in $\ln GDP_t$. Therefore,

$$\ln GDP_t^+ = \sum_{i=1}^{t} \Delta \ln GDP_i^+ = \sum_{i=1}^{t} \max(\Delta \ln GDP_i, 0) \quad (4)$$

$$\ln GDP_t^- = \sum_{i=1}^{t} \Delta \ln GDP_i^- = \sum_{i=1}^{t} \min(\Delta \ln GDP_i, 0) \quad (5)$$

where Δ denotes the first difference operator of the respective variables.

To conduct the bounds test for cointegration, we estimate the following model.

$$\Delta \ln SSB_t = \alpha + \rho \ln SSB_{t-1} + \theta^+ \ln GDP^+_{t-1} + \theta^- \ln GDP^-_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta \ln SSB_{t-i} + \sum_{i=0}^{q} \pi_i^+ \Delta \ln GDP^+_{t-i} + \sum_{i=0}^{q} \pi_i^- \Delta \ln GDP^-_{t-i} + e_t \quad (6)$$

where $\theta^+ = -\rho\beta_1^+$, $\theta^- = -\rho\beta_1^-$, and e_t is the error term.

We test the presence of a cointegration relationship among the variables. First, based on the F-test and employing the bounds test proposed by Pesaran, Shin, and Smith (2001), we test the null hypothesis; $\rho = \theta^+ = \theta^- = 0$ against the alternative hypothesis; $\rho \neq \theta^+ \neq \theta^- \neq 0$. If the calculated F-test statistic exceeds the upper bound critical value, the null hypothesis of no cointegration is rejected. We can then confirm that the variables are cointegrated. If the calculated F-test statistic is below the lower bound critical value, it implies no cointegration. However, if the calculated F-test statistic falls into two critical values, the result is inconclusive.(1)

If the presence of a cointegration relationship among the variables of the model is revealed, we proceed to test for the presence of asymmetric effects of the change in per capita GDP on social security benefits, both in the long- and short-run using the Wald test. For Equation (6), the null hypothesis for the presence of long-run symmetry is that $-\theta^+/\rho = -\theta^-/\rho$. On the other hand, the null hypothesis for the presence of short-run symmetry is that $\sum_{i=0}^{q} \pi_i^+ = \sum_{i=0}^{q} \pi_i^-$. We examine whether the positive and negative changes in per capita GDP have asym-

(1) In bounds test for the presence of cointegration, F-test is conducted depending on the non-stationarity properties of the data, the number of independent variables, and the sample size. Pesaran, Shin, and Smith (2001) reported two sets of critical values; lower and upper bound critical values. Lower bound critical value assumes that all variables are $I(0)$ and upper bound critical value assumes that all variables are $I(1)$. However, those values reported by Pesaran, Shin, and Smith (2001) are calculated on a large sample size (sample size of 1000 observations). In contrast, Narayan (2005) reported critical values for the bounds test when the sample size ranges from 30 to 80 observations. Since our sample size is relatively small, we apply the critical values shown in Narayan (2005), which is the case in this study.

metric effects on per capita social security benefits in both the long- and short-run. In this step, the adjustment process from short-run disequilibrium to its long-run equilibrium is explained by the asymmetric cumulative dynamic multipliers as follows:

$$m_h^+=\sum_{j=0}^{h}\frac{\partial \ln SSB_{t+j}}{\partial \ln GDP_t^+},\quad m_h^-=\sum_{j=0}^{h}\frac{\partial \ln SSB_{t+j}}{\partial \ln GDP_t^-},\quad h=0,\ 1,\ 2,\ \cdots \tag{7}$$

where coefficient m_h^+ and m_h^- are multiplier effects of a one percent change in independent variables. As $h \to \infty$, m_h^+ and m_h^- tend to be equal with the long-run coefficients, β_1^+ and β_1^- respectively.

Finally, to examine the causal relationship between social security benefits and changes in GDP (both positive and negative), following Kisswani (2017, 2019) and Kisswani, Harraf and Kisswani (2019), we apply the Toda and Yamamoto (1995) non-causality test. The Toda and Yamamoto (1995) procedure uses a modified Wald (MWALD) test based on the estimation of an augmented vector autoregressive (VAR) model in levels, and is applicable irrespective of the integration and cointegration properties of the data. The basic idea of this procedure is to artificially augment the correct VAR order, k, by the maximum order of integration, d_{max}. Once this is done, a VAR in levels with a total of $(k+d_{max})$ lags is estimated and the coefficients of the last lagged d_{max} vectors are ignored in conducting the Wald test (Wolde-Rufael, 2005).[2]

To conduct the Toda and Yamamoto (1995) non-causality test between two variables (y_t and x_t), we estimate the following VAR model:

$$y_t=\alpha_0+\sum_{i=1}^{k}\alpha_{1i}x_{t-i}+\sum_{i=k+1}^{d_{max}}\alpha_{2i}x_{t-i}+\sum_{i=1}^{k}\gamma_{1i}y_{t-i}+\sum_{i=k+1}^{d_{max}}\gamma_{2i}y_{t-i}+u_{1t} \tag{8}$$

$$x_t=\beta_0+\sum_{i=1}^{k}\beta_{1i}x_{t-i}+\sum_{i=k+1}^{d_{max}}\beta_{2i}x_{t-i}+\sum_{i=1}^{k}\delta_{1i}y_{t-i}+\sum_{i=k+1}^{d_{max}}\delta_{2i}y_{t-i}+u_{2t} \tag{9}$$

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(2) Toda and Yamamoto (1995) point out that, for $d=1$, the lag selection procedure is always valid, at least asymptotically, since $k\geq 1=d$. If $d=2$, then the procedure is valid, unless $k=1$.

where the null hypothesis of non-causality from x_t to y_t in Equation (8) is that $\alpha_{11}=\alpha_{12}=\cdots=\alpha_{1k}=0$, and the null of non-causality from y_t to x_t in Equation (9) is that $\delta_{11}=\delta_{12}=\cdots=\delta_{1k}=0$.

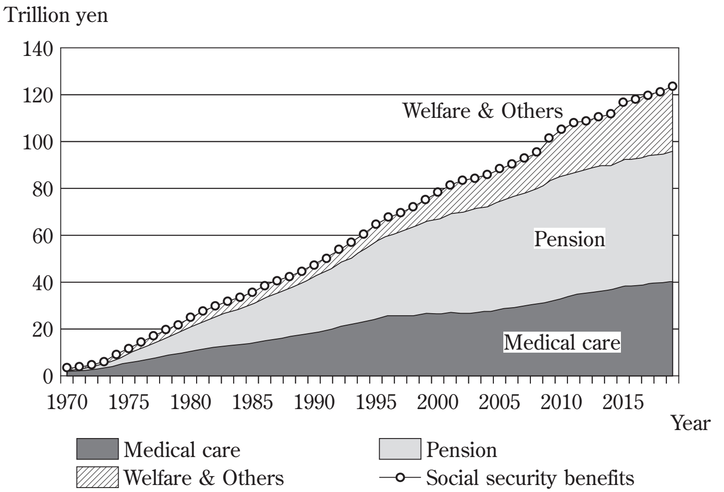
2-2. Data

In this study, to investigate the asymmetric relationship between social security benefits and GDP growth in Japan, we use time series annual data both on social security benefits and Gross Domestic Product (GDP) in per capita terms for the fiscal years 1970-2019. Real GDP is obtained from the "System of National Accounts (SNA)" by the Cabinet Office. The data on social security benefits is acquired from the Financial Statistics of Social Security in Japan by the National Institute of Population and Social Security Research. We deflate this variable using a GDP deflator, which is also obtained from the SNA by the Cabinet Office. Thus, we consider real data. To create per capita variables, we sort data based on population from the "Population estimation" by the Statistics Bureau of Japan.

The scope of social security benefits is based on the ILO (International Labor Organization) standards for international comparison. Social security benefits are divided into medical care, pensions, welfare and others. Figure 1 presents the trends of social security benefits by category. In Japan, the social security system was enhanced in 1973, and after this, social security benefits rapidly increased. On the other hand, social security revenues are composed of four sources (social insurance premiums, public burden, income from capital, and others). Figure 2 presents the trends of social security benefits and two main revenues, that is, social insurance premiums and public burden. As the increase in public spending is not necessarily financed solely by the rise in tax burden, public burden depends on deficit-covering government bonds as well as tax revenue.

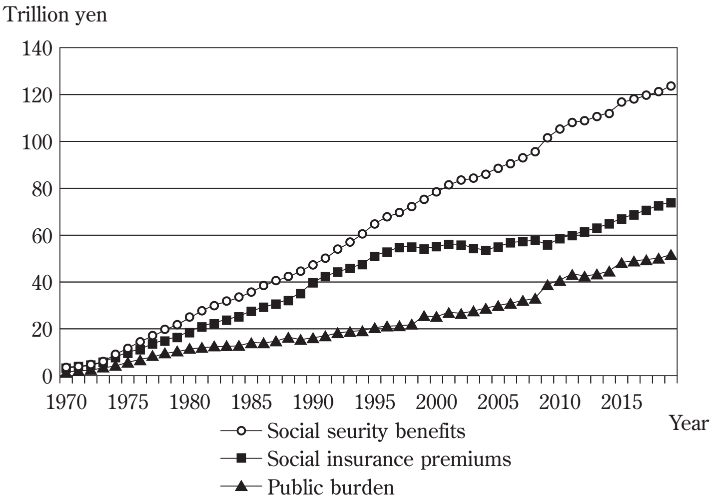
Figure 3 presents the annual rate of increase in social security benefits and

Figure 1. Social security benefits by category



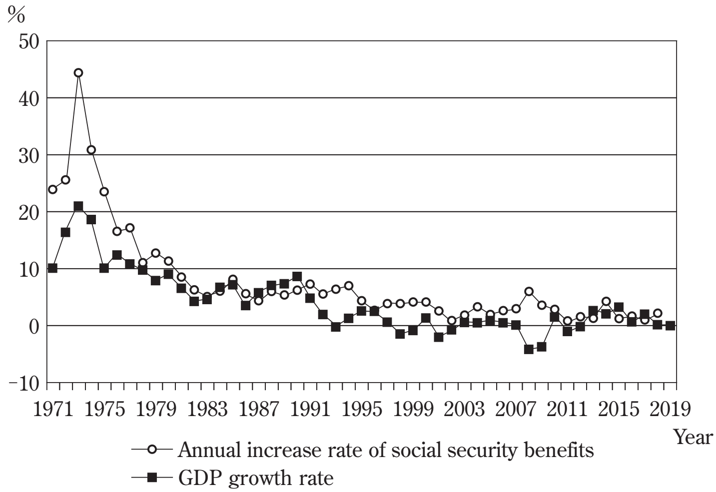
Source: The Financial Statistics of Social Security in Japan by the National Institute of Population and Social Security Research.

Figure 2. Social security benefits and social security revenues by source



Source: The Financial Statistics of Social Security in Japan by the National Institute of Population and Social Security Research.

Figure 3. Annual rate of increase of social security benefits and GDP growth rate



Source: Authors' own computation from the Financial Statistics of Social Security in Japan by the National Institute of Population and Social Security Research; the SNA by the Cabinet Office.

GDP growth rate. It can be seen that the annual increase rate of social security benefits largely exceeds GDP growth rate. Therefore, it is doubtful whether social security finance is sustainable in the future.

3. Empirical results

3-1. Unit root tests

We apply the nonlinear ARDL cointegration methodology of Shin, Yu, and Greenwood-Nimmo (2014). The ARDL bounds testing approach is primarily applied to models in which the order of integration of variables is equal to or less than one. That is, unless the order is larger than one, the test does not necessarily require the order of integration to be the same for all variables. Prior to conducting the cointegration test, we examine the order of the variables using the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979, 1981) and the

Table 1. Unit root tests

A. With a constant, no time trend

	ADF test		PP test	
Variables	Level	First difference	Level	First difference
$\ln SSB_t$	−2.9628**	−2.6685*	−4.7744***	−2.5891
$\ln GDP_t^+$	−4.1072***	−5.1532***	−3.7555***	−5.2457***
$\ln GDP_t^-$	0.4411	−6.0940***	0.6266	−6.0492***

B. With a constant, time trend

	ADF test		PP test	
Variables	Level	First difference	Level	First difference
$\ln SSB_t$	−6.6110***	−3.6581**	−3.1586	−3.6546**
$\ln GDP_t^+$	−1.6563	−5.8526***	−1.6620	−5.8955***
$\ln GDP_t^-$	−1.3866	−6.1613***	−1.4023	−6.1669***

Notes: $\ln SSB_t$ is per capita real social security benefits, $\ln GDP_t^+$ is partial sums of positive change in per capita real GDP, and $\ln GDP_t^-$ is partial sums of negative change in per capita real GDP. We conducted the unit root tests for two models: the model with a constant term but no time trend and that with a constant term and a time trend respectively. The number of lags for the ADF tests was chosen based on Akaike Information Criterion (AIC). The bandwidth for the PP tests was based on the Newey-West estimator using the Bartlett kernel. ***, ** and * show statistical significance at the 1%, 5% and 10% levels, respectively.

Phillips-Perron (PP) test (Phillips and Perron, 1988). Table 1 reports the results of these unit root tests for the model containing a constant term but not a time trend and the model containing a constant term and a time trend. Two variables are $I(0)$ or $I(1)$, except for the partial sum of negative change in real GDP, which is $I(1)$. This confirms that none of the variables are $I(2)$, as required for the implementation of the nonlinear ARDL methodology.

3-2. Nonlinear ARDL bounds test

We conducted the nonlinear ARDL cointegration test based on the estimation of Equation (6). The selection of the model (lags) is based on Akaike Information Criterion (AIC). Table 2 reports the ordinary least squares (OLS) estimation results for Equation (6). First, we conducted a test to examine the null hypothesis of no cointegration. The result of the F-test supports the existence of a

Table 2. Estimation results for nonlinear ARDL model

Dependent variable: $\Delta \ln SSB_t$			
Variables	Coefficients	Standard error	t-statistics
Constant	−0.1310*	0.0725	−1.8070
$\ln SSB_{t-1}$	−0.1018***	0.0331	−3.0785
$\ln GDP^{+}_{t-1}$	0.1044	0.0685	1.5242
$\ln GDP^{-}_{t-1}$	−0.4234**	0.1888	−2.2431
$\Delta \ln SSB_{t-1}$	0.3452***	0.1122	3.0769
$\Delta \ln GDP^{+}_{t}$	0.0337	0.2459	0.1372
$\Delta \ln GDP^{+}_{t-1}$	−0.4911**	0.2286	−2.1480
$\Delta \ln GDP^{-}_{t}$	−0.8150	0.4942	−1.6490
$\Delta \ln GDP^{-}_{t-1}$	−1.1172**	0.5159	−2.1656
Long-run coefficient estimates			
β^{+}_{1}	1.0258**	0.3961	−2.5895
β^{-}_{1}	−4.1604***	1.4470	−2.8752

F_{PSS}	6.8723		
W_{LR}	17.442 [0.0002]		
W_{SR}	3.0584 [0.0803]		
R^2	0.7661	$\bar{R}^2$	0.7290
JB	1.0766 [0.5873]	RESET	3.5912 [0.0659]
BP	3.5919 [0.0034]	BG	1.8630 [0.1699]

Notes: Nonlinear ARDL model was estimated using Equation (6). $\ln SSB_t$ is per capita real social security benefits, $\ln GDP^{+}_{t}$ is partial sums of positive change in per capita real GDP, and $\ln GDP^{-}_{t}$ is partial sums of negative change in per capita real GDP. F_{PSS} corresponds to the F-statistic concerning the null hypothesis, $\rho = \theta^{+} = \theta^{-} = 0$. The lower and upper bound critical values are 4.695 and 5.578 respectively at the 1% significance level (Narayan, 2005). β^{+}_{1} and β^{-}_{1} are the long-run coefficients respectively based on $\beta^{+}_{1} = -\theta^{+}/\rho$ and $\beta^{-}_{1} = -\theta^{-}/\rho$. W_{LR} is the Wald statistic concerning the null hypothesis of long-run symmetry; $-\theta^{+}/\rho = -\theta^{-}/\rho$. W_{SR} is the Wald statistic concerning the null hypothesis of short-run symmetry; $\sum_{i=0}^{q} \pi^{+}_{i} = \sum_{i=0}^{q} \pi^{-}_{i}$. R^2 is the coefficient of determination and $\bar{R}^2$ is the adjusted coefficient of determination. JB is the Jarque-Bera statistic, which is related to the null hypothesis of normality of the distribution of error terms. RESET is a statistic concerning the Ramsey's RESET test, and BP is a statistic for the Breusch-Pagan test. BG is a statistic in the Breusch-Godfrey LM test for the null hypothesis that there is no second-order autocorrelation. The values in parentheses are p-values. ***, ** and * show statistical significance at the 1%, 5% and 10% levels, respectively.

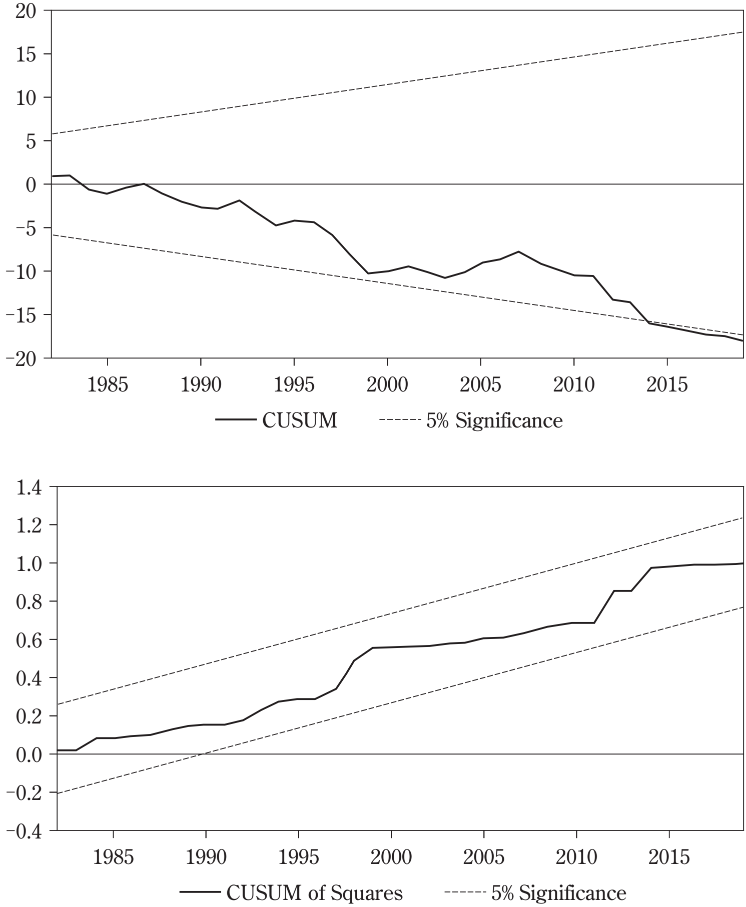
cointegration relationship. The F-test statistic (F_{PSS}) computation based on the estimated results of Equation (6) was 6.872, exceeding the upper bound critical value 5.578 at the 1% significance level. By rejecting the null hypothesis, we confirm that there is a cointegration relationship between per capita social security benefits and the positive and negative changes in per capita GDP.

In Table 2, we also report the diagnostic test results of the selected nonlinear ARDL model (6). The diagnostic tests include the Jarque-Bera (JB) normality test, Ramsey RESET specification test, Breusch-Pagan heteroscedasticity test, and Breusch-Godfrey serial correlation LM test. The estimated model (6) passes two of the four diagnostic tests for normality, specification, heteroscedasticity, and autocorrelation. The Jarque-Bera (JB) statistic indicates that error terms are normally distributed. The Breusch-Godfrey LM statistic shows no autocorrelation. Figure 4 depicts the results of the CUSUM and CUSUMSQ tests. At the very least, either of the CUSUM and CUSUMSQ test results support the stability of all three variables, indicating the nonlinear ARDL is also stable.

As we have confirmed the existence of a cointegration relationship, we further proceed to test for symmetry, and apply the Wald test to check the null hypothesis of both long- and short-run symmetry. Table 2 reports the results of the Wald test. Regarding the long-run, the Wald statistic (W_{LR}) was 17.442 and the null hypothesis of long-run symmetry between the positive and negative changes of per capita GDP was rejected at the 1% significance level. For the short-run, the null hypothesis of short-run symmetry was rejected at the 10% significance level as the Wald statistic (W_{SR}) was reported as 3.058. Thus, we obtained results which support long- and short-run asymmetry.

Having established long-run asymmetry in the estimated model (6), we proceed to the analysis of the long-run dynamics based on the results presented in Table 2. The estimated long-run coefficient (β_1^+) of $\ln GDP_t^+$ is positive and statistically significant at the 5% significance level. The estimated long-run coefficient (β_1^-) of $\ln GDP_t^-$ is negative and statistically significant at the 1% significance level. From these results, a 1% increase in per capita GDP leads to an increase of 1.026% in social security benefits. On the other hand, we also find that a 1% decrease in per capita GDP leads to an increase of 4.160% in social security benefits. This re-

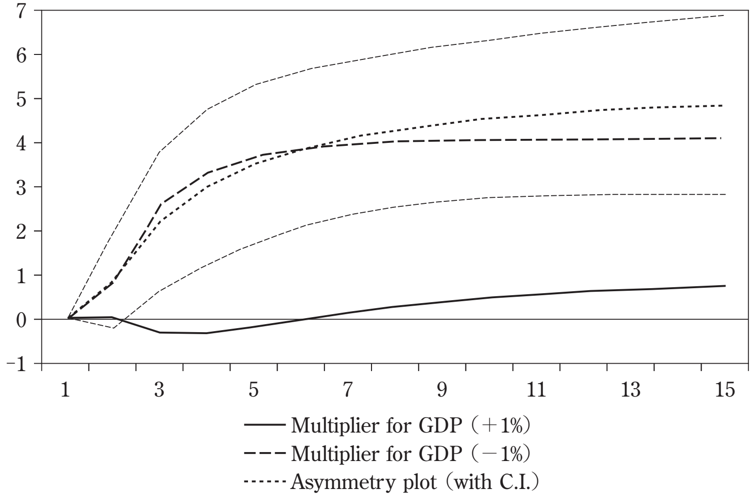
Figure 4. CUSUM and CUSUMSQ tests



sult shows that a decrease in GDP raises social security benefits more than an increase in GDP does. Moreover, according to our results, social security benefits increase irrespective of any GDP level.

To investigate the pattern of dynamic asymmetric adjustment of social security benefits from the initial long-run equilibrium to the new long-run equilibrium after a positive or negative percentage shock, we use the dynamic multipliers by

Figure 5. Asymmetric cumulative dynamic multiplier effects



(7). Figure 5 presents the multiplier effects of the positive and negative changes in GDP on social security benefits. The positive (solid line) and negative (dashed line) change curves provide the information about the asymmetric adjustment to positive and negative shocks at a given forecasting horizon, respectively. The asymmetric curve depicts the linear combination of multipliers corresponding to positive and negative shocks. Lower band and upper band for asymmetry indicate the 95% confidence interval. From Figure 5, the positive and negative changes in per capita GDP have the asymmetric effect on per capita social security benefits, which tend to increase in the long-run.

3-3. Causality tests

Finally, we conduct a test of the direction of causality between per capita social security benefits and the positive as well as the negative changes in per capita GDP. Table 3 reports the results of the Toda and Yamamoto (1995) non-causality test. In Equation (8) and (9), the number of lags is set to $k=2$ which is deter-

Table 3. Toda and Yamamoto non-causality test results

	$\ln GDP_t \nRightarrow \ln SSB_t$			$\ln SSB_t \nRightarrow \ln GDP_t$		
	MWALD	p-value	Lags	MWALD	p-value	Lags
$\ln GDP_t^+$	5.7543*	0.0563	2	0.4374	0.8036	2
$\ln GDP_t^-$	18.083***	0.0001	2	0.1783	0.9147	2

Notes: $\ln SSB_t$ is per capita real social security benefits, $\ln GDP_t^+$ is partial sums of positive change in per capita real GDP, and $\ln GDP_t^-$ is partial sums of negative change in per capita real GDP. $\ln GDP_t \nRightarrow \ln SSB_t$ is the null hypothesis that $\ln GDP_t$ does not Granger cause $\ln SSB_t$. $\ln SSB_t \nRightarrow \ln GDP_t$ is the null hypothesis that $\ln SSB_t$ does not Granger cause $\ln GDP_t$. NWALD is the modified Wald test statistic. The Wald statistic will be asymptotically distributed as a chi-square (χ^2), with degree of freedom equal to $k=2$. The number of lags is determined by AIC. *** and * show statistical significance at the 1% and 10% levels, respectively.

mined by AIC, and the maximum order of integration is set to $d_{max}=1$. The null hypothesis that the positive change in GDP does not Granger cause social security benefits is rejected at the 10% significance level. Furthermore, the null hypothesis that the negative change in GDP does not Granger cause social security benefits is rejected at the 1% significance level. On the other hand, the null hypothesis that social security benefits do not Granger cause GDP (positive and negative changes) is not rejected at even the 10% significance level. Thus, Table 3 provides the evidence for a unidirectional causality from the positive and negative changes in GDP to social security benefits.

4. Concluding remarks and policy implications

Using data from fiscal years 1970 to 2019, this study examines the relationship between social security benefits and GDP growth in Japan by applying the nonlinear ARDL approach. The results are summarized as follows.

First, we revealed that there is a cointegration relationship between per capita social security benefits and the positive and negative changes in per capita GDP. Second, the positive and negative changes in per capita GDP exert asymmetric effects on per capita social security benefits in the short- and long-run. Specifically, in the long-run, it may increase more significantly during an economic downturn than during an economic improvement. Third, the Toda and Yamamoto (1995) non-causality test results show that there is a unidirectional causality from the positive and negative changes in per capita GDP to per capita social security benefits.

These results reflect the trend in social security benefits, which has been increasing consistently at a relatively fast rate, irrespective of the economic fluctuations measured by the increase and decrease in GDP. As already mentioned, the annual rate of increase in social security benefits largely exceeds GDP growth rate. Therefore, the increase in social security benefits raises concerns on how social security finance should be sustained in the future. Based on our results, we can propose the following policy implications for Japan's social security finance.

First, policymakers should achieve stable economic growth. Social security benefits are mainly financed by social insurance premiums and public burden. Moreover, the public burden consists of taxes and bond issuance. As our results show, social security benefits tend to increase, although GDP decreases. Simultaneously, a decrease in GDP leads to decreased tax and insurance revenue. As an economic downturn raises the public burden of social security benefits, government bonds must be issued because of the lack of tax revenue. An increase in social security benefits may deteriorate the government budget. For sound management of public finance, policymakers must maintain Japan's economy on a stable growth path.

Second, policymakers should impose limits on public spending to curb social security benefits. In the long-run, social security benefits tend to increase regardless of whether GDP increases or decreases. In each system of public health care insurance, public pension, and public long-term care insurance, a certain percentage of benefit costs is determined to finance by public spending. Therefore, the increase in social security benefits leads to the increase in public spending. If the rate of increase in public spending exceeds that in tax revenue, government has no choice but to issue bonds because of the lack of tax revenue. The increase in public spending may not only deteriorate the government budget, but also make individuals less cost-conscious for social security services provided and lead to an additional demand for those services.

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