Chapter 8
Local Tax Structures and Regional Economic Growth: Times Series Analysis of the Tokyo Metropolitan Area*

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Abstract
We investigated the dynamic relationships between tax structures and economic growth in Japan by means of a vector error correction model (VECM), under the assumption of tax revenue neutrality (see Shinohara (2014b)). This paper examines the relationship between local tax structures and regional economic growth on the base of Shinohara (2014b): assuming tax revenue neutrality, we examine the effects of local tax structures on regional economic growth for the case of the Tokyo Metropolitan Area from 1960 onward.
Key words: Economic growth; Local Tax Structure; Fiscal policy; Vector Error Correction Model; Tokyo Metropolitan Area.

Introduction
We can identify the following characteristics in the researches regarding tax structures and economic growth[1]. First, many preceding studies have been international panel analyses that used cross-country panel data. In addition, although some studies have investigated developing countries as an object in their analysis, nearly all have targeted OECD countries. Second, preceding growth regression models can be broadly classified into two categories according to whether they impose government budget constraints or not. Analyses that assume governmental budget constraints can be further divided into three categories: (1) analyses that consider tax revenue neutrality, (2) analyses that consider revenue neutrality (taking into account tax revenue and public bond revenue), and (3) analyses that consider revenues and expenditures simultaneously. Third, analyses have started to develop in the direction of distinguishing between the short-term and long-term effects of fiscal policy on economic growth. Accompanying this trend, estimation methods are starting to shift from pooling regression and fixed effects estimation towards pooled mean group (PMG) estimation, a panel data error correction model.

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1) See Shinohara (2014a).

These preceding analyses using cross-country panel data simply amount to depictions of global averages. It is essential to examine whether analyses of specific countries can obtain similar results[2]. To address this gap in the literature, we investigated the dynamic relationships between tax structures and economic growth in Japan by means of a vector error correction model (VECM), under the assumption of tax revenue neutrality[3].

This paper is based on a similar theoretical model to Shinohara (2014b): assuming tax revenue neutrality, we examine the effects of local tax structure on regional economic growth for the case of the Tokyo Metropolitan Area from 1960 onward. Miller and Russek (1997) performed a representative study that analyzed the effects of local taxes on regional economic growth. That study set its dependent (explained) variable as the real economic growth rate per capita of state residents, and included not only local taxes but also subsidies and local expenditures as its independent (explanatory) variables. However, they did not analyze the effects of tax structure on regional economic growth under tax-revenue-neutral conditions.

The paper is organized as follows. First, we review trends in the tax structure and in economic growth for the Tokyo Metropolitan Area from 1960 onward. Next, we describe our analytic method in terms of our theoretical model and data used. We go on to summarize the estimation results, and then compare them with the results of preceding studies.

I. Changes in the tax structure and in economic growth in the Tokyo Metropolitan Area

1. Tax burden ratio

The tax burden ratio in the Tokyo Metropolitan Area in 2010 was 13.5%. Tax burden ratio changes from 1960 onward appear in Figure 1.

2. Tax system

(1) Classification of tax revenues by source

① Classification method

We first sort the component taxes of the tax structure: income taxes, consumption taxes (specific consumption taxes, general consumption taxes), and property taxes (asset holding taxes, asset transfer taxes). Table 1 shows the classification of the tax system in the Tokyo Metropolitan Area according to the categories of Shinohara (2014b). The table supposes that individuals and corporations split the tax burden of the interest levy on prefectural inhabitant tax equally.

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2) See Arnold (2008), p.19 and Myles (2009), p.52.

3) See Shinohara (2014b).

② Trends in the tax system

Figure 2 depicts the changes in the tax system of the Tokyo Metropolitan Area from 1960 onward. In 1960, income taxes accounted for 59.4% of total tax, consumption taxes for 18.8%, property taxes for 21.8%, and other taxes for 0.0%. The contribution of income taxes gradually increased thereafter, reaching 75.3% in 1990. However, it exhibits a decreasing trend from the 1990s onward: with the institution of the local consumption tax in 1997, it dropped to 44.0% in 1999. In the first half of the 2000s, it rised due to moderate economic recovery, but again followed a decreasing trend in the second half of the 2000s due to the impact of the 2008 global financial crisis.

The contribution of consumption taxes exhibited a decreasing trend from 1960 onward, but rised from 1997 with the introduction of the local consumption tax. It decreased in the first half of the 2000s, but the trend fliped to increase in the second half. The contribution of property taxes has been stable through the 1980s, but the smaller contributions of income taxes and consumption taxes caused it to rise in the 1990s. The first half of the 2000s showed a decreasing trend, while the second half exhibited an increasing trend.

(2) Direct-Indirect Taxes Ratio

Past trends in the ratio between indirect and direct taxes are seen in Figure 3. As a result of the radical tax reforms of 1988, direct-indirect taxes ratio rises due to the abolishment of a fraction of specific consumption taxes (local entertainment tax, food and drink consumption tax, etc.). It dropped in 1997 due to the introduction of the local consumption tax, and then is stable from 1998 onward.

3. Economic Growth Rate

Figure 4 shows the real economic growth rate per capita of labor force population of the metropolitan area from 1960 onward.

II. Analysis Method

1. Model

Widmalm (2001) used the regression model shown in Equation (1) to analyze panel data from 23 OECD countries. Y is the real economic growth rate per capita of population, while NTV stands for non-tax variables and TV for tax variables. The time-series analysis that we perform here using data from Japan was fundamentally based on this model.

$$Y=\beta_0+\beta_1 NTV+\beta_2 TV+\varepsilon \quad (1)$$

We consider tax burden (i.e., tax burden ratio) and tax structure as the tax variables in Equation (1). We assume tax revenue neutrality in the tax structure: i.e., adding together the contributions of each tax to total tax revenue equals 1.

To consider what to select as non-tax variables, we suppose the production function shown in Equation (2), following Mankiw et al. (1992). Y is output, K is physical capital, L is labor, H is human capital, A is technology level, and AL is effective labor. In addition, we assume $\alpha+\beta<1$.

$$Y_t=K_t^{\alpha}H_t^{\beta}\left(A_tL_t\right)^{1-\alpha-\beta} \tag{2}$$

Substituting $y=Y/AL$, $k=K/AL$, and $h=H/AL$ yields

$$y=k^{\alpha}h^{\beta} \tag{3}$$

We can derive Equation (4) via the relation $k=K/AL$. $\dot{K}/K$ is the growth rate of physical capital, $\dot{A}/A$ is the rate of technological progress, and $\dot{L}/L$ is the labor force population growth rate.

$$\frac{\dot{k}}{k}=\frac{\dot{K}}{K}-\frac{\dot{A}}{A}-\frac{\dot{L}}{L} \tag{4}$$

Here, by assuming that the investment rate of physical capital s_k and that its depreciation rate is δ, we obtain the relation $\dot{K}=s_kY-\delta K$. By introducing this into Equation (4) and substituting $\dot{k}=0$, we can derive Equation (5), which shows k^* in a stationary state. $\dot{A}/A=g$ and $\dot{L}/L=n$ based on the relations $L(t)=L(0)e^{nt}$ and $A(t)=A(0)e^{gt}$.

$$k^*=\frac{s_k}{n+g+\delta}y^* \tag{5}$$

Furthermore, $\dot{h}/h=\dot{H}/H-\dot{A}/A-\dot{L}/L$ given $h=H/AL$. We obtain the relation $\dot{H}=s_hY-\delta H$ by assuming that the investment rate of human capital is s_h and that its depreciation rate is δ (similar to physical capital). Therefore, h^* in a stationary state can be expressed by Equation (6).

$$h^*=\frac{s_h}{n+g+\delta}y^* \tag{6}$$

Based on Equations (5) and (6):

$$\frac{k}{s_k}=\frac{h}{s_h} \tag{7}$$

Using Equation (7), we can express k^* and h^* as Equation (8).

$$k^*=\left(\frac{s_k^{1-\beta}s_h^{\beta}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta}}$$
$$h^*=\left(\frac{s_k^{\alpha}s_h^{1-\alpha}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta}} \tag{8}$$

Substituting Equation (8) into Equation (3), taking the natural logarithm of both sides, and re-arranging yields the stationary-state output y^*.

$$\ln y^*=\frac{\alpha}{1-\alpha-\beta}\ln s_k+\frac{\beta}{1-\alpha-\beta}\ln s_h-\frac{\alpha+\beta}{1-\alpha-\beta}\ln(n+g+\delta) \tag{9}$$

Here, based on the relations $y=Y/AL$ and $A(t)=A(0)e^{gt}$, Equation (10) shows the

output per capita of labor force population.

$$\ln\frac{Y}{L}=\ln A(0)+gt+\frac{\alpha}{1-\alpha-\beta}\ln s_k+\frac{\beta}{1-\alpha-\beta}\ln s_h-\frac{\alpha}{1-\alpha-\beta}\ln(n+g+\delta) \quad (10)$$

Assuming $\ln(n+g+\delta)\approx n$ and taking the difference with respect to Equation (10) yields

$$\Delta\ln\frac{Y}{L}=g+\frac{\alpha}{1-\alpha-\beta}\Delta\ln s_k+\frac{\beta}{1-\alpha-\beta}\Delta\ln s_h-\frac{\alpha}{1-\alpha-\beta}\Delta n \quad (11)$$

The logarithmic difference is almost equal to the rate of change of the original values: as a result, the real growth rate per capita of labor force population is dependent on the rate of technological progress (g), on the rate of change of physical capital investment rate (s_k), on the rate of change of human capital investment rate (s_h), and on changes in labor force population growth rate (n). Therefore, while taking into account sample size, we decided to select rate of change of physical capital investment rate, rate of change of human capital investment rate, and labor force population growth rate as non-tax variables in Equation (1). We adopted real economic growth rate per capita of labor force population as an indicator of economic growth, following the theoretical model shown in Equation (11).

A time-series analysis assumes that variables are stationary, and that they lack unit roots. Spurious regressions due to phenomena such as (1) high coefficients of determination, (2) low Durbin–Watson ratios, and (3) high t-values are known to arise in regression analyses using variables that have unit roots (i.e., whose data series is non-stationary). Accordingly, we first performed unit root tests. Furthermore, we performed cointegration tests in order to check whether or not non-stationary variables having a unit root possess long-run equilibrium relationships.

In the event that no variable has a unit root, we estimate using a stationary vector auto-regression model (VARM). However, many economic variables are considered to have unit roots. We estimate a VECM for cases where each variable has a unit root and a cointegration relationship is established, and a difference VARM for cases where each variable has a unit root and a cointegration relationship is not established. Multicollinearity relationships frequently occur in VARMs and VECMs, but it is possible to make predictions using their results: economic interpretations of the model are informed by causality testing, impulse response functions, and variance decomposition of prediction error[4].

4) See Matsuura and McKenzie (2012), pp. 229–230.

2. Data

(1) Sources of Statistics Used

Table 2 shows the sources of the data used in estimations. Tax variables were taken from *The Annual Report of Local Finances* (Ministry of Internal Affairs and Communications (Ministry of Home Affairs)). Prefectural income, which is necessary when estimating tax burden ratio, was taken from *National Economic Calculations, Confirmed Data* (Cabinet Office). Our classification of indirect taxes and direct taxes follows *Reference Data on Local Taxes* (Ministry of Internal Affairs and Communications, Local Tax Bureau).

As for non-tax variables, we assessed economic growth rate by converting prefectural gross production data from *Prefectural Economic Calculations* (Cabinet Office) to real values using the deflator provided in *National Economic Calculations, Confirmed Data* (Cabinet Office). We took physical capital from *Prefectural Economic Calculations* (Cabinet Office), and human capital (gross education expenditures, elementary/secondary education expenditures) from *The Annual Report of Local Finances* (Ministry of Internal Affairs and Communications (Ministry of Home Affairs)). Labor force population was determined by multiplying the population aged 15 years and older (*Tokyo Statistical Yearbook*, Tokyo Metropolitan Area) by labor force participation rate (*Labor Force Survey: Long-Term Time Series Data*, Ministry of Internal Affairs and Communications, Bureau of Statistics).

(2) Descriptive Statistics

Descriptive statistics of the data are as shown in Table 3.

III. Estimation Results

1 .Unit Root Tests

The Augmented Dickey–Fuller (ADF) test and the Phillips–Peron (PP) test were conducted as unit root tests.

The results are as shown in Table 4. Real economic growth rate per capita of labor force population (gr1), rate of change of physical capital investment rate (gfcf), rate of change of human capital investment rate (gross education expenditures; hc), rate of change of human capital investment rate (elementary/secondary education expenditures; hc1), and changes in labor force population growth rate (lfpgrowth) are stationary processes: i.e., I(0). Other variables are I(1).

2. Cointegration Tests

The results of cointegration tests are shown in Table 5. Twenty VARMs (Estimating Equations 1–20) form the subject of analysis. c (constant term) is an

exogenous variable. The first step of the analysis procedure is, for VARMs of lag order 1–4, to select the lag that minimizes the Akaike Information Criteria (AIC). The Johansen test is then performed assuming the lag thus selected, with a critical value of 5%. This test can classify models into five cases depending on how it treats the trend term and constant term, but the three cases below are typical:

① Data does not contain a definitive trend; cointegration equation includes a constant term.
② Data contains a linear trend; cointegration equation includes only a constant term.
③ Data contains a linear trend; cointegration equation includes a constant term and a linear trend.

We performed the trace test and the maximum eigenvalue test for the three cases above. We selected the cases that minimized the AIC among the trace test results deemed robust[5].

3. Impulse Response Functions

We estimate VARMs and VECMs assuming the lags and cointegration numbers selected above, and measure their impulse response functions from the results. The impulse response function in this case is a generalized impulse response function unaffected by the order of the variables. A prerequisite of VARMs and VECMs is that the error term must follow a normal distribution. Table 6 shows the results of Jarque–Bera tests. Estimating Equations 7, 8, 9, 11, 12, 14, 16, 19, and 20 satisfy this condition (i.e., the null hypothesis: that the error term follows a normal distribution: cannot be rejected at 5% significance). The analysis results below regard those estimating equations that satisfied this condition.

Figure 5 shows changes in the accumulated response of real economic growth rate per capita of labor force population (grl) after the error term for each independent variable is given a shock of one positive standard deviation.

We can now observe the relationships between real economic growth rate per capita of labor force population and non-tax variables, detailed below.

① Between it and rate of change of physical capital investment rate, both positive and negative relationships can be observed depending on the combination of variables (positive: Estimating Equations 7, 8, 9, 11, 12, and 20; negative: Estimating Equations 14, 16, and 19). However, the negative effects for Estimating Equation 14 are extremely small, and

5) Based on the results of Monte Carlo experiments, the trace test is considered more robust than the maximum eigenvalue test. See Minotani (2007), p. 710.

the effects in the initial period are even positive for Estimating Equations 16 and 19.

② Between it and rate of change of human capital investment rate, negative relationships can be seen for gross educational expenditures(hc) (Estimating Equations 7, 9, 11, and 19) as well as for elementary/secondary educational expenditures (Estimating Equations 8, 12, 14, 16, and 20). A few findings have been identified regarding the relationship between government education expenditures and growth rate: (1) the statistical significance of the effects of total government education expenditures on economic growth vary among studies; and (2) elementary/secondary education expenditures have a positive effect on economic growth, but expenditures on tertiary education have a negative effect[6]. However, we failed to observe positive effects of elementary/secondary education expenditures on economic growth in the Tokyo Metropolitan Area.

③ Between it and change in labor force population growth rate, there is always a negative relationship.

Furthermore, the following relationships can be seen between real economic growth rate per capita of labor force population and tax variables under tax revenue neutral conditions:

① Real economic growth rate has a negative relationship with tax burden ratio in all estimating equations analyzed except for Estimating Equation 7.

② Raising individual income taxes promotes economic growth (Estimating Equations 7 and 8).

③ Raising corporate income taxes promotes economic growth (Estimating Equations 7 and 8).

④ Raising consumption taxes has a negative effect on economic growth (Estimating Equations 9, 11, and 12).

⑤ Raising property taxes has a positive effect on economic growth (Estimating Equation 14).

⑥ Raising recurrent real estate taxes has a positive effect on economic growth (Estimating Equation 16).

⑦ Lowering income taxes while raising consumption taxes and property taxes has a negative effect on economic growth (Estimating Equations 19 and 20).

6) See Sototani (1998).

Conclusion

The findings below have been raised in theoretical research on the relationships between tax structures and economic growth[7]:

① Consumption taxes and property taxes impede economic growth less than income taxes do.
② Corporate income taxes restrict economic growth the most because they restrict business activities.
③ Recurrent real estate taxes have the smallest economic growth-restricting effects.

Arnold (2008) supported the results of theoretical works above. If we compare the results of our analysis here with those of Arnold (2008), we can broadly identify the following matters.

First, we raise the following points of commonality: (1) raising property taxes has a positive effect on economic growth; and (2) raising recurrent real estate taxes has a positive effect on economic growth. These results are consistent with the results of theoretical analysis. However, the first finding differs from Shinohara (2014b) . We believe this to be attributable to the 60% increase in property taxes in the Tokyo Metropolitan Area (51-year mean value) mostly taking the form of recurrent real estate taxes on land and buildings.

We can identify the following as points of discrepancy: (1) raising individual income taxes promotes economic growth; (2) raising corporate income taxes promotes economic growth; (3) raising consumption taxes has a negative effect on economic growth; and (4) lowering income taxes while raising consumption taxes and property taxes has a negative effect on economic growth.

Regarding the point that increasing individual income taxes promote economic growth, Shinohara (2014b) obtained similar results. Recent research on income distribution and economic growth has demonstrated that correcting income disparities by means of taxes and social security expenditures leads to promotion of economic growth[8].

Regarding corporate income taxes, we may have failed to accurately estimate corporate income taxes due to data-related limitations. First, corporate inhabitant tax (in both prefectural inhabitant tax and municipality inhabitant tax forms) consists of a per-capita levy and an income levy calculated based on national corporation tax: the former is determined according to the amount of stated capital, and so strictly speaking it should be excluded from calculations of corporate income tax. However, data on the share of corporate per-capita

7) For examples, see OECD (2010) and Arnold et al. (2011), pp. 70-71.
8) For an example, see Cingano (2014).

levies within prefectural inhabitant tax have only been published since 1969 in The Annual Report of Local Finances (Ministry of Home Affairs & Ministry of Internal Affairs and Communications). Therefore, we were unable to exclude the per-capita levy from the corporate income tax data[9]. Second, regarding corporate enterprise taxes, pro-forma standard taxation (consisting of added-value component and capital component) in addition to an income levy has been implemented since 2004. However, we were unable to separate the tax amount of the income levy from the tax amount of the pro-forma standard tax.

Consumption taxes are invariant with regard to whether we choose current consumption or future consumption, and do not inhibit savings like income taxes. However, rises in the prices of consumer goods lower the real remuneration of labor, and inhibit the supply of labor. The results in the present paper indicate that the growth-inhibiting effects of consumption taxes exceeded their growth-promoting effects.

We investigated the effects of local tax structures on regional economic growth for the Tokyo Metropolitan Area using VECMs. Future studies should perform panel analyses at the prefectural level, without restricting analysis to the Tokyo Metropolitan Area.

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9) Relatedly, we did not exclude the individual per capita levy from individual income tax data.

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Table 1. Classification of Income Taxes, Consumption Taxes, and Property Taxes

	Income Taxes		Consumption Taxes		Property Taxes		Other
	Individual Income Taxes	Corporate Income Taxes	Specific Consumption Taxes	General Consumption Taxes	Asset Holding Taxes	Asset Transfer Taxes	
Prefectural Taxes	prefectural inhabitant tax, enterprise tax	prefectural inhabitant tax, enterprise tax, mineral products tax	prefectural tobacco tax, local entertainment tax, food and drink consumption tax, entertainment, food, and beverage tax, golf course use tax, special local consumption tax, light-oil delivery tax, accommodation tax	local consumption tax	vehicle tax, mining area tax, prefectural fixed asset tax	real estate acquisition tax, automobile acquisition tax, hunting license tax, hunting tax	taxes for non-statutory purposes, taxes due to former laws
Municipal Taxes	municipal inhabitant tax	municipal inhabitant tax	municipal tobacco tax, electric and gas tax, timber transaction tax, bath tax	–	fixed asset tax, city planning tax, special landholding tax, light vehicle tax, business office tax	–	taxes for non-statutory purposes, taxes due to former laws

Table 2. Sources of Statistics Used

Tax Variables	
Tax Burden Ratio Classification of Tax Revenues by Sources (Income Taxes, Consumption Taxes, Property Taxes) Direct- Indirect Taxes Ratio	Ministry of Internal Affairs and Communications (Ministry of Home Affairs), *Annual Report of Local Finances*. Ministry of Internal Affairs and Communications, *Local Tax Bureau, Reference Data on Local Taxes*. Cabinet Office, *Prefectural Economic Calculations.* (http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/files_kenmin.html)
Non-tax Variables	
Economic Growth Rate	Cabinet Office, *Prefectural Economic Calculations*. (http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/files_kenmin.html) Cabinet Office, *National Economic Calculations, Confirmed Data*. (http://www.esri.cao.go.jp/jp/sna/data/data_list/kakuhou/files/files_kakuhou.html)
Physical Capital Human Capital Population	Ministry of Internal Affairs and Communications (Ministry of Home Affairs), *Annual Report of Local Finances*. Ministry of Internal Affairs and Communications, Bureau of Statistics, *Labor Force Survey: Long-Term Time Series Data*. (http://www.stat.go.jp/data/roudou/longtime/03roudou.htm) Tokyo Metropolitan Area, *Tokyo Statistical Yearbook*. (http://www.toukei.metro.tokyo.jp/tnenkan/tn-index.htm) Cabinet Office, *Prefectural Economic Calculations*. (http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/files_kenmin.html)

Table 3. Descriptive Statistics

	Sample Size	Mean	Median	Maximum	Minimum	Standard Deviation
Real Economic Growth Rate Per Capita of Labor Force Population (gr1)	51	3.72	3.48	14.17	-5.85	4.57
Rate of Change of Physical Capital Investment Rate (gfcf)	51	-0.52	-0.26	13.16	-13.55	5.15
Rate of Change of Human Capital Investment Rate (Gross Education Expenditures; hc)	51	0.11	-0.71	29.94	-10.12	5.90
Rate of Change of Human Capital Investment Rate (Elementary/Secondary Education Expenditures; hc1)	51	-0.92	-2.52	24.35	-12.59	6.80
Growth Rate of Labor Force Population (lfpgrowth)	51	-0.06	-0.08	1.39	-1.85	0.69
Tax Burden Ratio (taxburden)	51	9.73	9.39	14.09	6.57	2.34
Direct-Indirect Taxes Ratio (dtoitaxratio)	51	9.15	7.63	27.32	2.49	7.13
Income Taxes (itaxes)	51	61.55	64.03	75.28	43.99	8.30
Individual Income Taxes (iitaxes)	51	23.32	23.92	28.19	15.23	3.16
Corporate Income Taxes (citaxes)	51	38.22	40.50	53.19	20.10	7.83
Consumption Taxes (ctaxes)	51	11.31	11.57	28.57	3.50	7.89
Specific Consumption Taxes (sctaxes)	51	11.31	11.11	18.75	3.50	4.27
General Consumption Taxes (gctaxes)	51	3.02	0.00	12.95	0.00	5.11
Property Taxes (ptaxes)	51	24.05	23.51	34.60	18.70	3.76
Recurrent Real Estate Taxes (ptaxes1)	51	15.26	14.89	22.87	10.76	3.20
Asset Holding Taxes (ahtaxes)	51	21.38	20.82	30.17	16.97	3.46
Asset Transfer Taxes (attaxes)	51	2.66	2.66	4.59	1.38	0.75
Consumption Taxes & Property Taxes (cptaxes)	51	38.36	35.87	56.00	23.96	8.35

Table 4. Unit Root Tests

Variable	Constant Term		Constant Term + Trend Term	
	ADF Test	PP Test	ADF Test	PP Test
Real Economic Growth Rate Per Capita of Labor Force Population (gr1)	-3.784(0)***	-3.736(3)***	-5.111(0)***	-5.165(1)***
Rate of Change of Physical Capital Investment Rate (gfcf)	-5.320(0)***	-5.320(0)***	-5.255(0)***	-5.255(0)***
Rate of Change of Human Capital Investment Rate (Gross Education Expenditures; hc)	-3.145(1)**	-5.122(3)***	-5.002(0)***	-5.034(2)***
Rate of Change of Human Capital Investment Rate (Elementary/Secondary Education Expenditures; hc1)	-5.380(0)***	-5.490(4)***	-5.321(0)***	-5.436(4)***
Growth Rate of Labor Force Population (lfpgrowth)	-6.696(1)***	-7.906(4)***	-6.879(1)***	-8.432(7)***
Tax Burden Ratio (taxburden)	-0.589(0) -7.842(0)***	-0.314(6) -8.045(5)***	-3.299(0)* -7.773(0)***	-3.325(1)* -7.972(5)***
Direct･Indirect Taxes Ratio (dtoitaxratio)	-1.522(0) -6.217(0)***	-1.743(3) -6.217(1)***	-1.447(0) -6.242(0)***	-1.569(2) -6.242(0)***
Income Taxes (itaxes)	-1.759(1) -4.917(1)***	-1.014(1) -3.875(7)***	-2.540(1) -4.929(0)***	-1.701(0) -3.820(7)**
Individual Income Taxes (iitaxes)	-3.789(0)***	-3.172(2)** -6.415(1)***	-3.744(2)** -3.591(1)**	-3.096(2) -6.400(0)***
Corporate Income Taxes (citaxes)	-0.700(0)* -5.316(0)***	-0.970(1) -5.149(5)***	-2.324(1) -5.287(0)***	-1.862(1) -5.060(6)***
Consumption Taxes (ctaxes)	-0.612(1) -5.612(0)***	-1.180(1) -4.751(5)***	-2.048(1) -4.957(0)***	-1.479(0) -4.746(6)***
Specific Consumption Taxes (sctaxes)	-2.155(1) -6.233(0)***	-1.710(1) -6.235(1)***	-1.875(1) -5.756(0)***	-1.676(1) -5.657(5)***
General Consumption Taxes (gctaxes)	-0.977(1) -4.608(0)***	-0.196(0) -4.394(6)***	-2.266(1) -4.623(0)***	-1.531(0) -4.294(4)***
Property Taxes (ptaxes)	-3.251(2)** -4.937(0)***	-2.025(3) -4.893(1)***	-3.530(2)** -4.888(0)***	-2.440(3) -4.811(1)***
Recurrent Real Estate Taxes (ptaxes1)	-2.852(2)** -4.584(0)***	-1.752(3) -4.503(1)***	-3.963(2)** -4.156(0)***	-2.615(3) -4.439(1)***
Asset Holding Taxes (ahtaxes)	-3.199(2)** -4.940(0)***	-1.548(3) -4.878(1)***	-3.895(2)** -4.877(0)***	-2.583(4) -6.074(3)***
Asset Transfer Taxes (attaxes)	-2.350(1) -6.505(0)***	-2.146(5) -7.166(19)***	-2.567(1) -6.578(0)***	-2.079(9) -13.735(48)***
Consumption Taxes & Property Taxes (cptaxes)	-0.121(1) -6.481(0)***	-0.168(2) -6.468(2)***	-1.556(0) -6.735(1)***	-1.573(0) -6.735(0)***

Note: ・* indicates significance level. ***: 1%; **: 5%; *: 10%.
・Lag order is enclosed in parentheses.
・In each cell, the first line shows the case of no difference; the second line shows the case of a difference in the first step.

Table 5. Cointegration Tests

Estimating Equation	Variable	Lag Order of VARM	Cointegration Number (5% Significance)
1	gr1, gfcf, hc, lfpgrowth, c	1	–
2	gr1, gfcf, hc1, lfpgrowth, c	1	–
3	gr1, gfcf, hc, lfpgrowth, d(taxburden), d(dtoitaxratio), c	4	3
4	gr1, gfcf, hc1, lfpgrowth, d(taxburden) , d(dtoitaxratio), c	4	2
5	gr1, gfcf, hc, lfpgrowth, d(taxburden), d(itaxes), c	4	2
6	gr1, gfcf, hc1, lfpgrowth, d(taxburden) , d(itaxes), c	1	4
7	gr1, gfcf, hc, lfpgrowth, d(taxburden), d(iitaxes), d(citaxes), c	4	4
8	gr1, gfcf, hc1, lfpgrowth, d(taxburden), d(iitaxes), d(citaxes), c	4	3
9	gr1, gfcf, hc, lfpgrowth, d(taxburden) , d(ctaxes), c	4	3
10	gr1, gfcf, hc1, lfpgrowth, d(taxburden) , d(ctaxes), c	4	2
11	gr1, gfcf, hc, lfpgrowth, d(taxburden) , d(sctaxes), d(gctaxes), c	4	4
12	gr1, gfcf, hc1, lfpgrowth, d(taxburden) , d(sctaxes), d(gctaxes), c	4	4
13	gr1, gfcf, hc, lfpgrowth, d(taxburden), d(ptaxes), c	4	3
14	gr1, gfcf, hc1, lfpgrowth, d(taxburden) , d(ptaxes), c	4	2
15	gr1, gfcf, hc, lfpgrowth, d(taxburden), d(ptaxes1), c	4	2
16	gr1, gfcf, hc1, lfpgrowth, d(taxburden) , d(ptaxes1), c	4	2
17	gr1, gfcf, hc, lfpgrowth, d(taxburden), d(ahtaxes), d(attaxes), c	4	4
18	gr1, gfcf, hc1, lfpgrowth, d(taxburden), d(ahtaxes), d(attaxes), c	4	4
19	gr1, gfcf, hc, lfpgrowth, d(taxburden), d(cptaxes), c	4	3
20	gr1, gfcf, hc1, lfpgrowth, d(taxburden), d(cptaxes), c	4	3

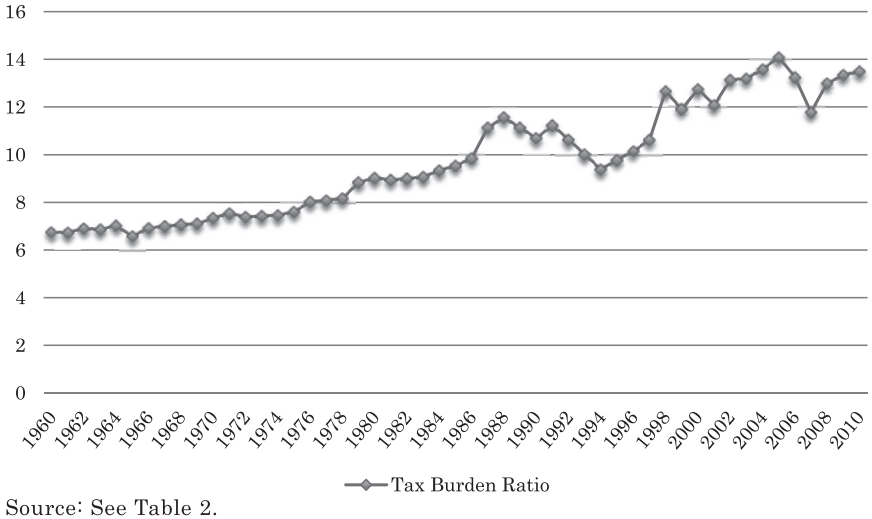
Note: Cointegration number is based on the Akaike Information Criteria (AIC).

Table 6. Jarque–Bera Tests

Estimating Equation	Test Statistic	p-value
1	182.34	0.00
2	29.56	0.00
3	25.48	0.01
4	31.30	0.00
5	42.00	0.00
6	33.85	0.00
7	9.60	0.79*
8	14.28	0.42*
9	9.27	0.67*
10	43.17	0.00
11	15.31	0.35*
12	11.75	0.62*
13	24.52	0.00
14	8.90	0.71*
15	23.86	0.02
16	13.85	0.31*
17	100.11	0.00
18	37.65	0.00
19	10.52	0.57*
20	20.24	0.06*

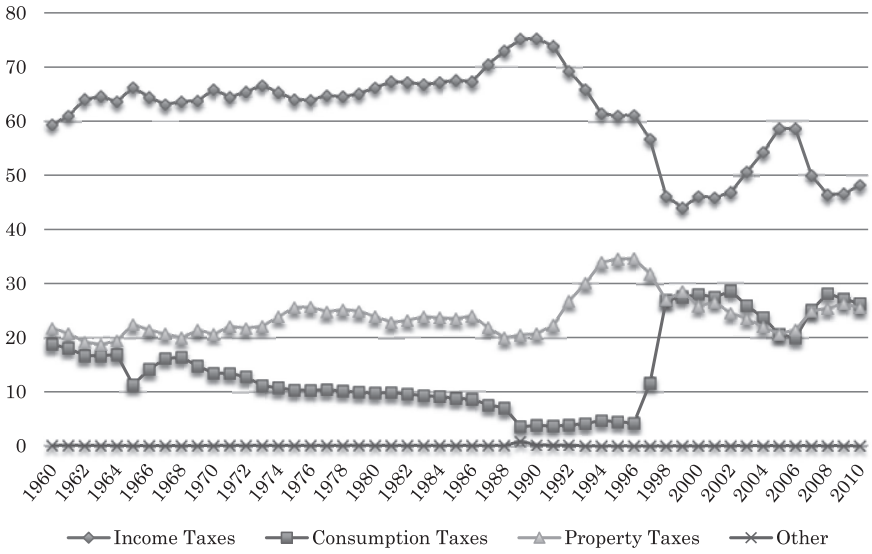
Note: * denotes cases whose error terms follow a normal distribution.

Figure 1. Tax Burden Ratio（%）



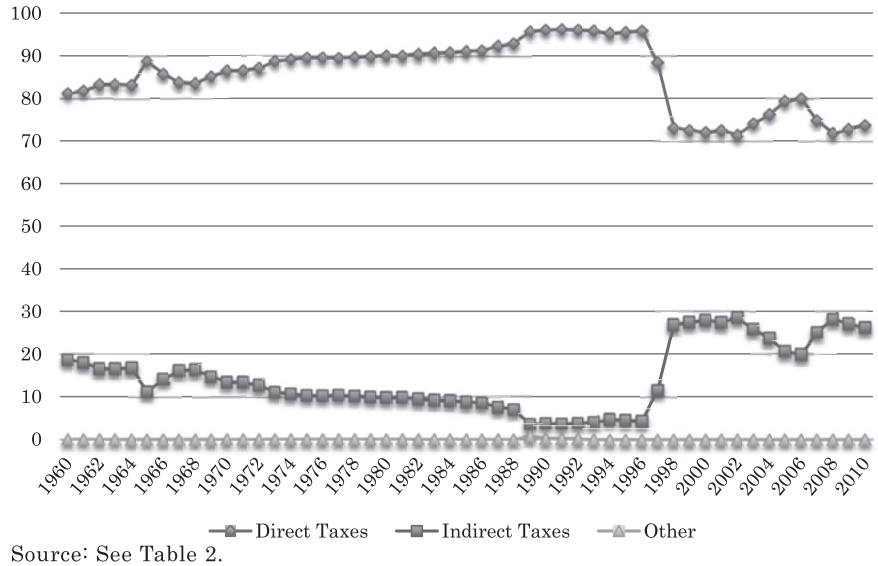
Source: See Table 2.

Figure 2. Trends in Income Taxes, Consumption Taxes, and Property Taxes (%)



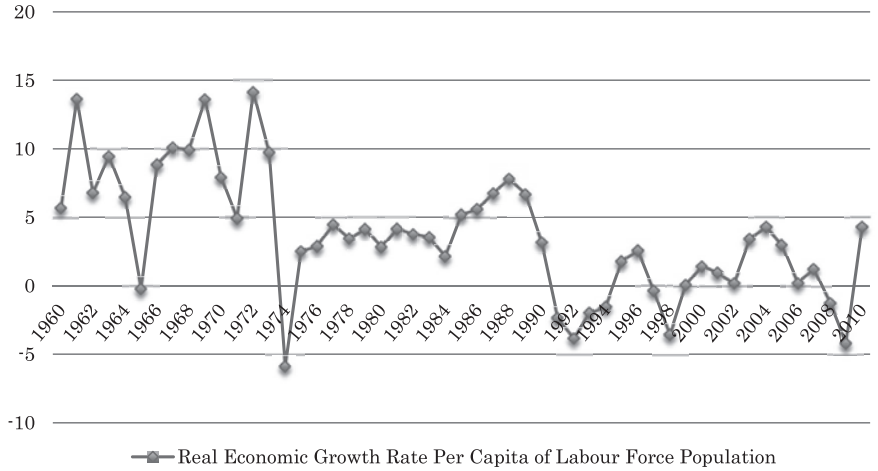
Source: See Table 2.

Figure 3. Trends in the relative shares of Direct and Indirect Taxes (%)



Source: See Table 2.

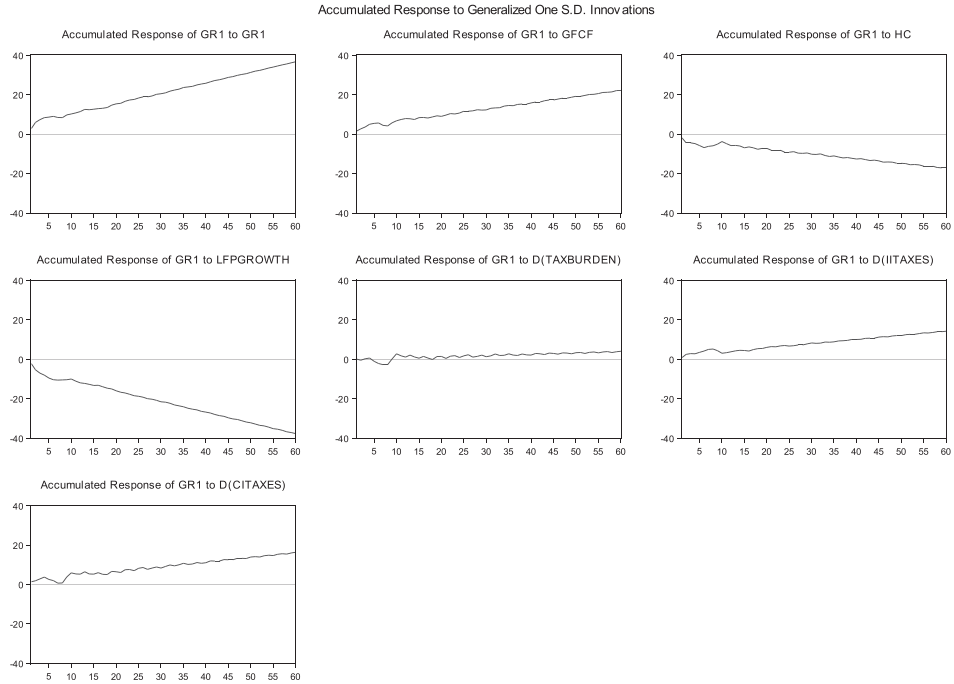
Figure 4. Real Economic Growth Rate Per Capita of Labor Force Population (%)



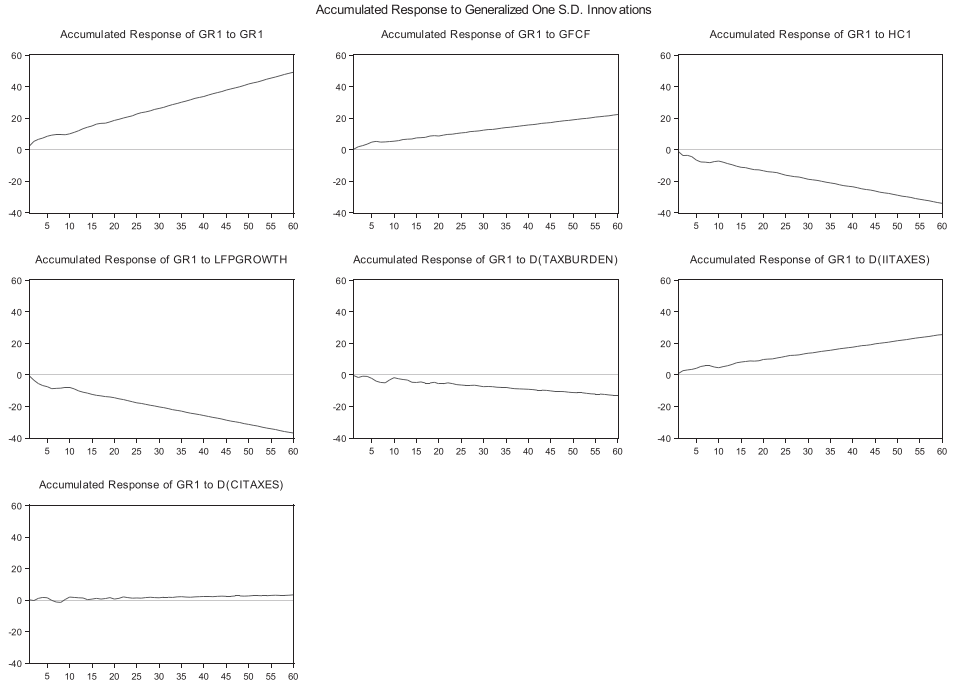
Source: See Table 2.

Figure 5. Impulse Response Functions

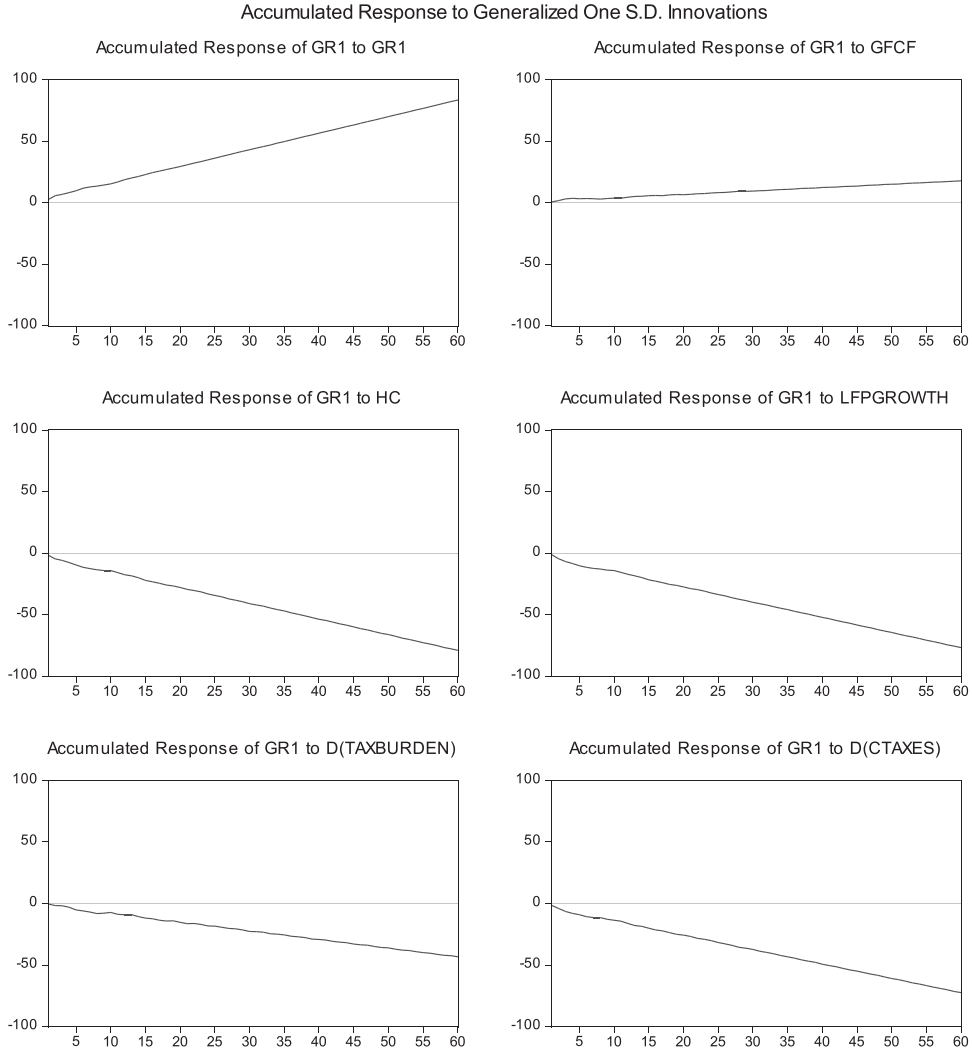
(1) Estimating Equation 7



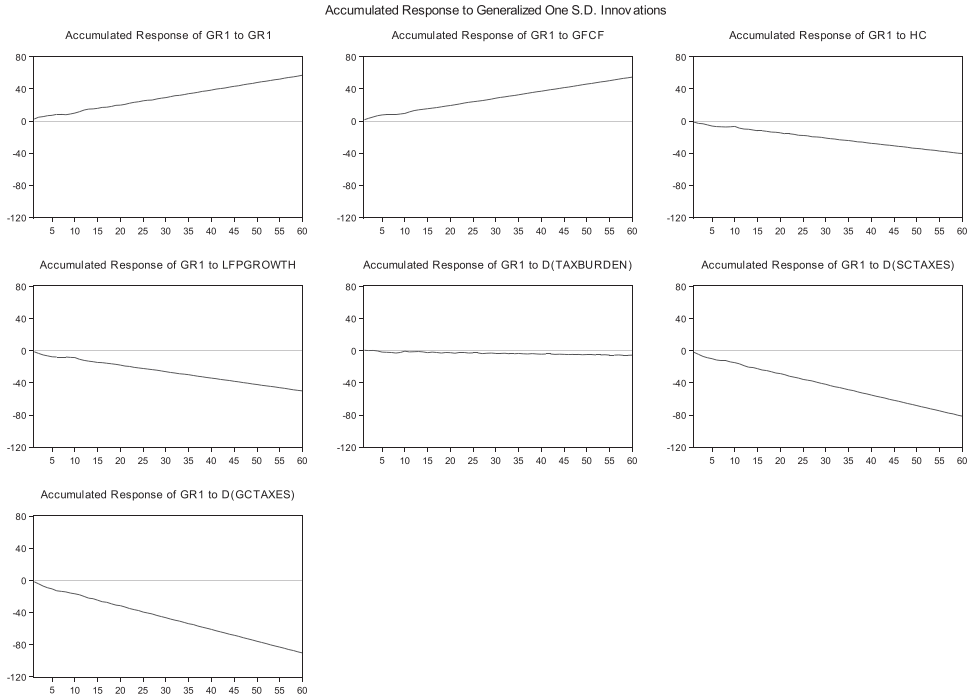
(2) Estimating Equation 8



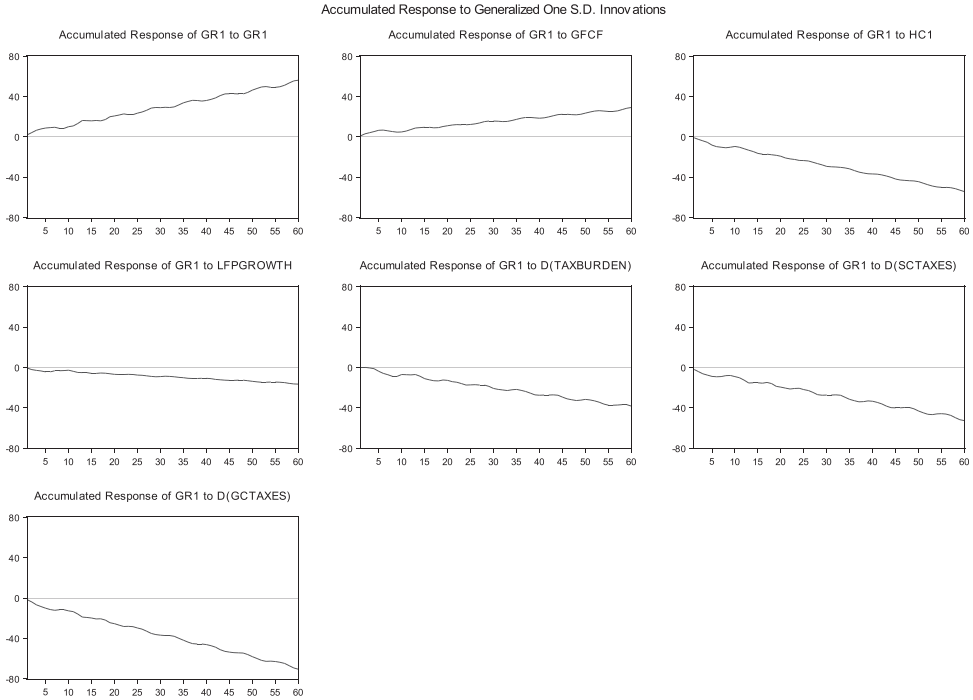
(3) Estimating Equation 9



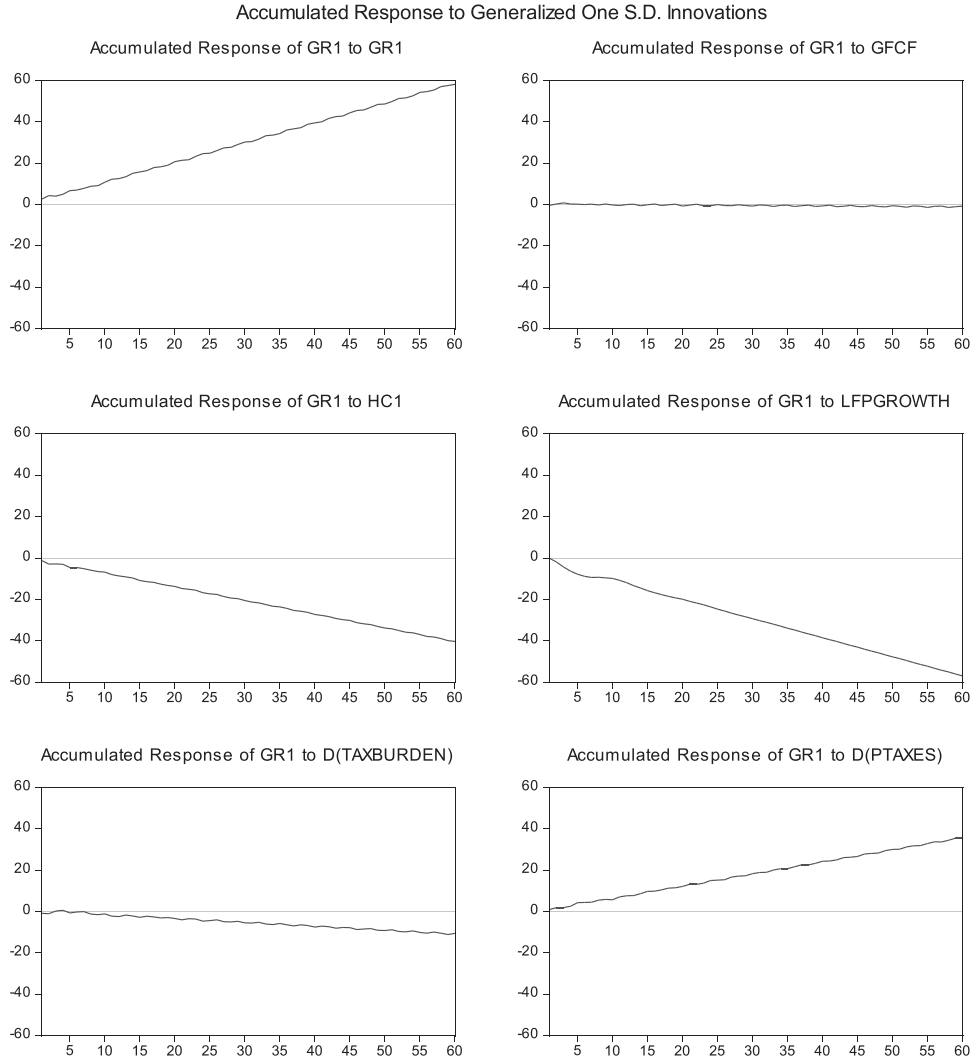
(4) Estimating Equation 11



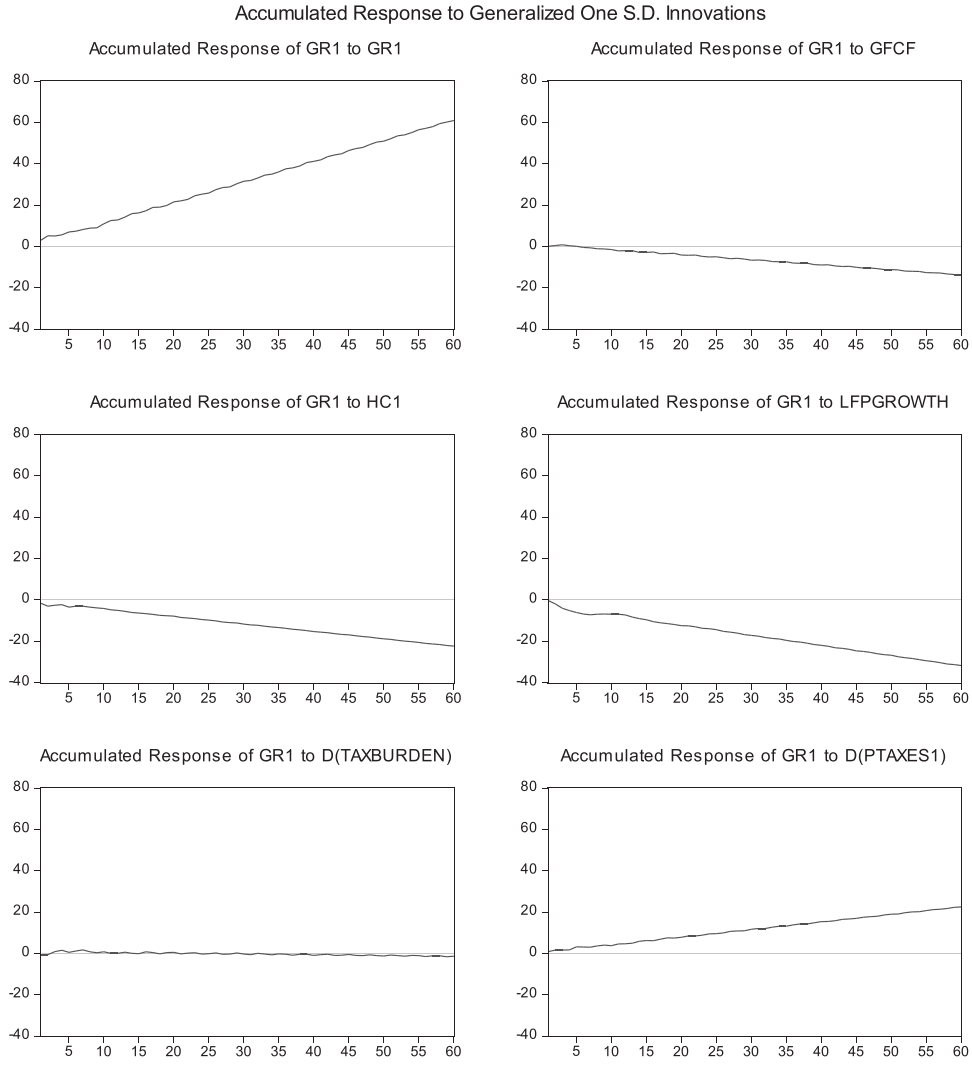
(5) Estimating Equation 12



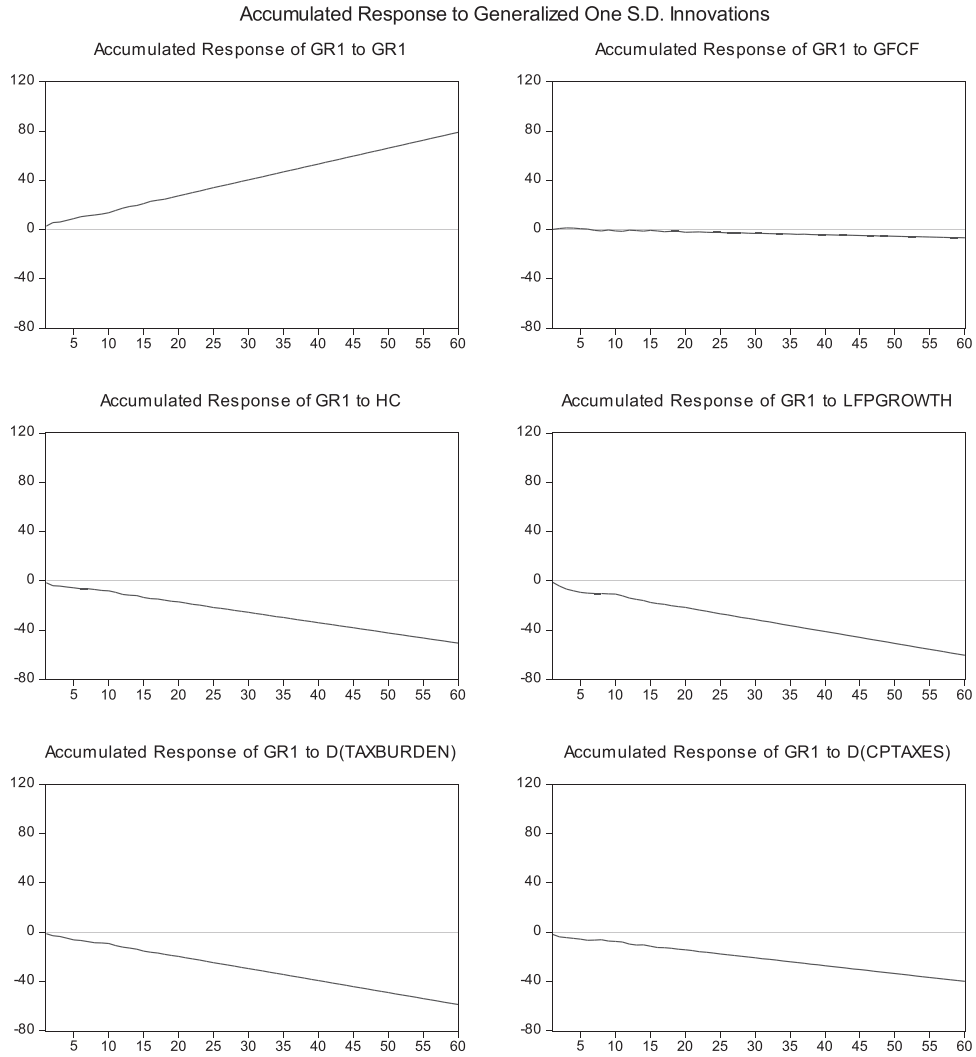
(6) Estimating Equation 14



(7) Estimating Equation 16



(8) Estimating Equation 19



(9) Estimating Equation 20