Interactions between Regional Public and Private Investment: Evidence from Japanese Prefectures

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Interactions between Regional Public and Private Investment: Evidence from Japanese Prefectures♣

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This paper examines the effects of government investment on private sector capital investment by investigating Japanese prefecture data. Empirical results show that crowding-out effect is observed in some sectors especially in rural areas where the government had invested heavily before the 1990s. This suggests that public investment is not necessarily useful to stimulate the economic activities through private capital formation there.

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1. Introduction

In the wake of the 2008 global financial crisis, governments in many developed countries included region-specific infrastructure investment in economic stimulus packages. For example, the American Recovery and Reinvestment Act of 2009 provided close to one billion dollars to upgrade drinking water to rural areas and ensure adequate water supplies in drought-affected western US communities. Furthermore, Australia's third stimulus measure included a provision for local community infrastructures.[1] These facts tell us that policy makers might earmark public investment for specific local districts as part of stimulus packages to support income distribution in a region rather than macroeconomic stabilization.

The purpose of this study is to examine the regional effects of public investment on business investment by examining data from Japanese prefectures. In the 1990s, when the government formulated numerous economic stimulus packages, public investment in Japan was more frequent in rural areas than in urban regions as argued in Section 3.1. This means that the approaches presented above were pursued in practice even before the 2008 global financial crisis in Japan, thereby implying that policy makers were expecting public investment to a positive effect on the demand side of the economy in rural areas. However, public investment has two asymmetric effects, especially in terms of private sector capital investment:

[1] For details, see OECD (2009), Stoney and Krawchenko (2011), and the website of Recovery.gov (http://www.recovery.gov/).

crowding-in and crowding-out. If crowding-out effect is observed in rural areas, public investment discourages private business investment there, which thereby contradicts the intent of the policy makers.

Although some recent studies have examined the regional interaction between public and private investment in Japan, it remains controversial. Kawasaki et al. (2013) examine the effects of public capital on private business investment using prefecture-level data and observed crowding-in effect. Moreover, Kameda (2015) examines the regional effects of public investment on the index related to the value of shipments and employment by using a panel VAR (vector autoregression) model and concluded that public investment has positive effects on these indices. However, Brückner and Tuladhar (2013) reported that public construction has a positive but insignificant effect on regional private investment. Incidentally, these earlier studies neglect the distinction of various sectors investment in response to public investment, and regional distinctions such as urban or rural. To deal with these, first, we examine the behavior of sector capital investment in response to public investment by dividing the private investment into sectors such as finance and insurance, transportation and communication, and utilities. Second, we estimate the effects of public investment by separating the prefectures into urban an area group and a rural one. By doing this, our study can be helpful in ascertaining whether or not regional public investment is useful in rejuvenating the economic activities in a specific region through capital formation in the private sectors.

This paper is organized as follows. Section 2 summarizes the explanation of the economic stimulus packages in Japan. Section 3 presents the data, the testable hypothesis, and the empirical framework underlying this research. Section 4 reports the estimation results. We show that while the investments in the transportation and communication industries are stimulated by public investment, the crowding-out effect appears in some industries such as the finance and insurance and services especially for 36 prefectures classified into rural areas. Our results imply that policy makers should pay more attention to this when planning economic stimulus involving regional public investment in rural areas where the government had invested heavily before the 1990s. Section 5 presents our conclusion.

2. Background: Economic stimulus packages in Japan and the movement of public investment

Public investment (public work) has been frequently included in economic stimulus packages in Japan over the past decades. Specifically, stimulus packages implemented in August 1992, April 1993, and September 1995 have comprised more than half of Japan's stimulus packages. Table 1 details these fiscal stimulus packages in Japan in the 1990s.

Before the 2008 global financial crisis, most developed countries mainly used monetary policy for macroeconomic stabilization. However, as shown in previous research, such as

Ihori (2006), Doi and Ihori (2009), Miyazaki (2010), Asako (2012), and Miyazaki (2015), the Japanese government had actively used fiscal policy for economic stabilization even before the crisis. Above all, the reason public investment has been used, as shown in Table 1, is that it has been expected to serve as economic stimulus, redistribution of income among regions, and infrastructure-improvement, as presented by Asako (2012).

Here, we examine whether or not the Japanese government also implemented public investment as regional income redistribution by depicting the changes in per capita public investment to prefectural GDP (hereafter PGDP). These changes are shown in Figures 1a to 1f, which cover the periods 1980-2009, for six geographic groups: Hokkaido and Tohoku, Kanto, Chubu and Koshinetsu, Kansai, Chugoku and Shikoku, and Kyushu and Okinawa.

All figures show that the per capita public investment to PGDP was large in rural areas such as Aomori, Iwate, Kochi, and Kagoshima in the 1990s, when the government often planed economic stimulus packages. However, the ratio of public investment to PGDP did not change significantly in urban areas such as Tokyo, Kanagwa, Aichi, Osaka, and Fukuoka during our sample period.

This tells us that the Japanese government has used public investment for regional income redistribution rather than macroeconomic stabilization. Therefore, as we have already claimed, the Japanese case is worthy of investigation to further examine interactions between public and private regional investment.

3. Methodology: Empirical framework

3.1. Datasets

Data on public investment (public capital formation of general government), prefectural GDP and population came from the database of the 2013 prefectural economic and fiscal model of the Cabinet Office in Japan (accessed last August 1, 2015).[2] Data on private investment came from the prefectural private capital stock provided by the Cabinet Office in Japan (accessed last on August 1, 2015).[3] There are nine comparable sectors; agriculture, forestry, and fisheries, mining, manufacturing, utilities, wholesale and retail, finance and insurance, real estate, transportation and communication, and services (for example, personal services such as entertainment, education, hospitality, and welfare and hospitals, and business services such as advertising and automobile and mechanical repairs). This follows Fujii et al. (2013). The "aggregate investment" that we examine is the sum of the investment of these nine sectors. The construction industry is also included in the categories from the Cabinet Office. However, the increase in the investment in the construction industry is difficult to identify. This increase is obscured by the expectation of the industry's productivity improvement, assumed as the crowding-in effect that we define further later, and the purchase of the materials and/or machinery accompanying the work

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2 For more detail, please see http://www5.cao.go.jp/keizai3/pref_model.html. Notably, we cannot exclude the housing investment from public capital formation in this database. Therefore, we had to conduct the empirical investigation including public sector housing investment.

3 http://www.esri.cao.go.jp/jp/sna/data/data_list/kenmin/files/contents/main_h21stock.html.

orders from the government. Therefore, we exclude the construction industry.

We use data from the general government excluding other public enterprises. Since some public enterprises in Japan have been privatized, companies categorized into such enterprises have changed during our sample periods. It could be difficult to capture the effects of such public investment properly if we include these in our estimation, and therefore, these are excluded.[4]

Our annual panel covers 47 prefectures in Japan for the periods 1980 to 2009. Since the initial year of the prefectural economic and fiscal model is 1980, we set 1980 as the first year of our sample periods. Furthermore, we set the final year of per capita public investment to per capita PGDP as 2009 because the data for sector private investment in 2010 were not available when we last accessed the website.

All data are expressed in real terms using 2000 as the deflator. Both datasets (public and private investment) are calculated on the basis of the System of Integrated Environment and Economic Accounting proposed by the United Nations in 1993 (SNA93 data).[5]

We assume that public investment is a public good in that a public capital is a

[4] Similarly, there were two major privatizations of public enterprises during this time: Nippon Telegraph and Telephone Public Corporation (currently, Nippon Telegraph and Telephone Corporation, NTT) in 1985; and, Japan National Railways (currently, Japanese National Railways, JR) in 1987. Reflecting this, the data for transportation and communications increased drastically in the mid to late 1980s because NTT and JR were included in the private sectors following their privatization. Although we limit the sample periods after 1988 to deal with this for investment in transportation and communications, the estimate results are relatively unchanged compared with those shown in Tables 2a to 5b. For details, please see Appendix 1.

[5] Another option is to use SNA68 data instead of SNA93 data, following Artis and Okubo (2011) and Brückner and Tuladhar (2013). However, it is desirable to use data based on the new method as much as possible. Therefore, we use SNA93 data.

non-excludable good, which potentially affects the economic activities of all industries, following Pereira and Andraz (2001). This means that in our estimation, aggregate public investment has either a positive or negative effect on each industry's business investment. Thus, we did not divide the public investment into either central or local government, as in the case of Kameda (2015), or into sectors such as roads, educational facilities, and sewers.[6]

3.2. Definitions of "crowding-in" and "crowding-out" and our hypothesis

Our hypothesis is to investigate whether or not crowding-in and crowding-out effects are observed in prefectures in Japan. Here, we summarize the arguments on the effects of public investment on business investment and define the "crowding-in" and "crowding-out" effects examined here.

Public capital may have a complementary relationship with private capital. For example, infrastructure, such as airports, roads, and sewage systems, creates favorable conditions for private enterprises through a reduction in transportation costs or savings of time. Thus, implementation of public investment is expected to raise the productivity of private capital, thanks to public facilities or future infrastructure, and as a result, private enterprises may

[6] The data of the Public Administrative Investment (Gyosei-toshi jisseki in Japanese) and the Annual Report on Local Public Finance (Chiho Zaisei Tokei Nenpo in Japanese) provided by the Ministry of Internal Affairs and Communications (MIAC) are also available. The data of Public Administrative Investment can be separated into categories such as roads and metropolitan parks and we can gather the data on local government investment from the Annual Report on Local Public Finance. Notably, while public and private investment data from the Cabinet Office do not include land acquisition, public investment data provided by the MIAC do include this. As it is desirable that the data excludes land purchases for business investment and for public investment so as to examine the interactions between public and private investment, we do not use the data provided by the MIAC.

increase current business investment.[7] This argument is based on some earlier research such as Aschauer (1989), Voss (2002), Atukeren (2005), and Afonso and St. Aubyn (2009). The "crowding-in" effect is defined as the increase in current business investment by accompanying the increase in the public investment from a complementarity between public and private capital.[8]

The "crowding-out" effect of public investment is usually classified twofold; direct crowding-out and indirect. Direct crowding-out argues that government investment, whether financed by taxes or government debt, competes with the private sector for the use of physical and financial resources, and as a result, it discourages the investment activities of the private sector; indirect crowding-out argues that the increase in public investment raises interest rates and then the increase in interest rates leads to a cutback in business investment.

Notably, the crowding-in effect is not changed by the interest rate. This effect is basically a direct relationship between public and private investment. To better compare the crowding-out and crowding-in effects, it is reasonable to focus solely on the "direct"

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[7] Usually, it takes some years for investment to accumulate as capital stock and affect economic activity. For example, Nose (1973) argues that it takes seven years on average for public capital to have a productivity effect. Therefore, of note is the assumption that private enterprises increase their current investments based on the "expectation" of an increase in productivity of private capital due to the new public facilities or infrastructure.

[8] Notably, the effects of public capital on business investment are assumed in both the crowding-in and out effects, as in Aschauer (1989), Annala et al. (2008), Mitsui et al. (1995), and Kawasaki et al. (2013). However, as it takes more than a few years for public investment to become public capital and affect the productivity of private capital, the specification that pubic capital directly affects private investment may not be appropriate. In fact, the effects of public capital on private capital are examined separately from the investigation of the relationship between public and private investment in recent research such as Hatano (2010) and Hunt (2012). Following these, we do not assume the effects of public capital.

crowding-out effects, leaving indirect crowding-out for another research study.

3.3. Empirical model

Many empirical studies examine the interactions between public and private investment. Most of them use econometric methods such as VAR or vector error correction models. However, Furceri and Sousa (2011) examine the impact of the changes in the share of public expenditure to GDP on the growth of real private expenditure. Of note is the fact that dependency on public sector investment may differ among prefectures, meaning some prefectures may depend more heavily on public investment or public employment than others. Similarly, this regional difference of dependency on public works may also affect the private sector activity in a region. Furceri and Sousa's (2011) framework has an advantage in capturing these effects, rather than examining a simple relationship between public and private expenditure using certain econometric methods. Furthermore, Furceri and Sousa (2011) leave the effects of interest rates as of an avenue for future research. Following their line of thinking, we judge that their specification is most suitable for our research.[9]

The basic specification is as follows:

$$\frac{\Delta I_{it}}{I_{it}} = \alpha_i + \beta_t + \gamma_1 \Delta\left(\frac{GI_{it}}{Y_{it}}\right) + \gamma_2 \Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right) + \varepsilon_{it}, \tag{1}$$

[9] Although Furceri and Sousa (2011) do not specifically identify the direct and indirect effects in their crowding-out effects argument, it is plausible to assume that they examine direct crowding-in or out effects considering their specification and their arguments on interest rates.

where i and t are prefecture and year indices, respectively; α_i is the prefecture-specific effect that captures the regional characteristics unchanged through time; β_t is a set of year dummies, which captures the aggregate (country-level) business conditions; I_{it} is private investment, GI_{it} is public investment, and Y_{it} is PGDP[10]; ε_{it} is an error term.

Here, the definition of the crowding-in effect is the interaction between "current" public and private investment. Thus, at first glance the dynamic effects should not be considered in our estimation. However, public investment implemented in the end of a fiscal year may also affect business investment at the beginning of the next fiscal year. Accordingly, the one-year lagged value of $\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$ is also assumed in equation (1).[11]

γ_i is expected to be both positive and negative. If either γ_1 or γ_2 is estimated to be positive, the contribution of public investment to PGDP increases the growth in the business investment, and we interpret that crowding-in effect is observed. Conversely, if either γ_1 or γ_2 is estimated to be negative, we interpret that crowding-out effect is observed.

Moreover, since the change in public investment differed between urban and rural areas as discussed, asymmetric effects in $\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$ may be observed. Following this, we also

[10] Furceri and Sousa (2011) express these variables in per capita terms. Since our research uses the data within one country, we do not do so.

[11] Furthermore, if we assume a longer lag, we cannot identify the effect of public investment and of public capital because some public capital may affect the private sector's activity in a few years. Thus, we avoid a longer lag in contrast to Furceri and Sousa (2011), who examine the effects of government consumption that do not accumulate as capital stock.

conduct an estimation using a coefficient dummy variable that captures a specific prefectural group. Specifically, we introduce the dummy variable $UDUM$, which takes 1 if a prefecture is categorized as "urban prefectures" and 0 otherwise. We select 11 prefectures as urban prefectures: Saitama, Chiba, Tokyo, Kanagawa, Shizuoka, Aichi, Osaka, Hyogo, Nara, Hiroshima, and Fukuoka. This follows Hayashi (2003) and Miyazaki et al. (2015).

We multiply this dummy by $\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$ and $\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$ so as to specify the effects of the public investment to PGDP in urban prefectures. In this case, the specification is as follows:

$$\begin{aligned}\frac{\Delta I_{it}}{I_{it}} &= \alpha_i + \beta_t + \gamma_1 \Delta\left(\frac{GI_{it}}{Y_{it}}\right) + \gamma_2 \Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right) \\ &\quad + \gamma_3 * UDUM * \Delta\left(\frac{GI_{it}}{Y_{it}}\right) + \gamma_4 * UDUM * \Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right) + \varepsilon_{it}.\end{aligned} \tag{2}$$

Here, whereas both γ_3 and γ_4 capture the effects in urban prefectures, γ_1 and γ_2 identify the effects in 36 prefectures other than urban ones, in other words, the rural prefectures.

4. Empirical results

4.1. Basic results

We estimate equation (1) by the least squares method with both time and country fixed effects (LSDV). Tables 2a and 2b report the estimation results for equations (1) and (2), respectively.

Table 2a reports that while current share public investment to PGDP ($\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$) has positive and significant effects on investment in agriculture, forestry, and fisheries and transportation and communication, it has negative and significant effects on investment in wholesale and retail industries and services. Table 2a also shows that $\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$ has positive and significant effects on investment in transportation and communication and the mining industry. According to Table 2b, business investments in the urban prefectures decrease in industries such as agriculture, forestry, and fisheries, mining, wholesale and retail, and transportation and communication. For rural prefectures, $\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$ has positive and significant effects on the business investment in transportation and communication, and $\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$ has positive and significant effects on the mining industry. However, negative and significant crowding-out effects are observed in finance and insurance, real estate, and services.

4.2. Alternative frameworks

We re-estimate equations (1) and (2) using another estimation method and under alternative specifications.

First, we add some explanatory variables. Here, we added a jobs-to-applicants ratio (JOB_{it}) and the growth rate of "lending outstanding" ($\frac{\Delta L_{it}}{L_{it}}$).[12] The jobs-to-applicants ratio is from the Report on Employment Service estimated by the Ministry of Health, Labor and Welfare, and the data for "lending outstanding" are from the Bank of Japan's Financial and Economic Statistics of Prefectures. The jobs-to-applicants ratio controls the business conditions in each prefecture, and "lending outstanding" represents the loans from financial organizations, which also affect the investment behavior of private companies. Since we cannot obtain the 2007 end of the business year data on such lending, the estimations shown in Tables 2a and 2b become unbalanced panel data and the number of observations is reduced. Needless to say, "lending outstanding" is not added as an independent variable in the finance and insurance industry. The results are shown in Tables 3a and 3b. While most of the results of $\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$ and $\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$ are the same as in Tables 1a and 1b, respectively, the effects on investment in finance and insurance and real

[12] The average or effective tax rate of local corporate tax is also assumed as an additional regressor. However, while corporate business income of each prefecture provided by the Cabinet Office, which comprises the denominator of the average or effective tax rate as a tax base, covers only the income of private enterprises until 1993, it expands the scope to all companies including public enterprises after 1997, as shown in Fukazawa (2009). Since it is difficult to calculate the average or effective tax rate of local corporate tax, we do not use this variable.

estate are negative and significant in Table 3a. Further, the effect on investment in real estate is positive and significant in the urban prefectures, as shown in Table 3b.

Second, the public investment to PGDP decreased after 2002 owing to the cutback of public investment and intergovernmental transfers needed to finance it. To deal with this, we reestimate the model by ending the sample periods in 2001. The results are reported in Tables 4a and 4b. In this case, most results are unchanged from our benchmark case. However, in urban prefectures the coefficient of $\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$ is estimated to be positive and significant for finance and insurance, and the coefficient of $\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$ is also estimated to be significant for real estate, as shown in Table 4b. Moreover, we affirm a crowding-out effect for the wholesale and retail industry for both urban and rural prefectures.

Finally, while the public investment affects the private investment, the contribution ratio of public expenditures to PGDP may increase when business conditions get worse. This type of reverse causality may cause concern in our specification. Moreover, current business investments may be also dependent on investments in previous periods. To deal with these issues, we also estimate equation (1) using the system GMM (general methods of moment) procedure (one-step estimation) developed by Arellano and Bover (1995) and Blundell and Bond (1998). This method avoids the downward bias of the coefficient of the lagged dependent variable, even in finite N and T cases such as ours (N = 47 and sample periods = 30), compared with the method developed by Arellano and Bond (1991). It also helps avoid the problem of weak instruments. To avoid the problem of too many instruments (Okui, 2009; Roodman, 2009), we assume possible lagged values of instrumental variables at most at one period.

These results are shown in Tables 5a and 5b. Basically, we assume one-period lag for the dependent variable, but in some industries the null of the AR (2) test is rejected when we assume one or two period lags for $\frac{\Delta I_{it}}{I_{it}}$. To address this, we assume a three-year lagged value for five industries, as shown in Tables 5a and 5b. Even if we estimate the model by using another method, we obtain positive and significant results for transportation and communication, and negative and significant for services in Tables 5a and 5b. It is notable that $\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$ has positive and significant effects on the aggregate investment, as shown in Table 5a, and this occurs in rural prefectures rather than urban prefectures, as shown in Table 5b. It also has a positive and significant effect on investment in the mining industry in both urban and rural prefectures, as shown in Table 5b, unlike our basic case.

4.3. Discussion of the results

On the basis of the estimation results shown in Tables 2a to 5b, we discuss the private sector's business investment response to public investment.

First, we review the difference in policy impact by sector. While negative impacts in the service industries were observed, our results strongly confirm the crowding-in effects in the mining and transportation and communication industries. This is in contrast to the results in Fujii et al. (2013), which indicate that crowding-out effects are observed in these three industries. Public infrastructure, such as roads, airports, and railways, which share almost 40 % of all public capital in Japan, as shown in Figure 2,[13] creates a favorable condition for transportation company or tourism industry through the reduction in transportation costs or savings of time. Moreover, since the capital in the information and telecommunication (IT) industry may bear a strong complementary relationship with IT infrastructure in terms of technology production, the construction of optical cables would raise the productivity of the IT industry in the future, and as a result, induce IT companies' current investment. The mining industry relies heavily on materials transportation by trucks, and it may benefit significantly from improved infrastructure, as in the case of transportation companies or the tourism industry. In this regard, public investment may induce current investment in these industries through the path as defined previously. On the other hand, since public investment discourages investment in the service industry, we can conclude that it competes with this industry for the use of physical and financial resources.

Second, we review the effects in rural areas, where public investments implemented as part of stimulus packages have been heavily allocated. The positive effects on the transportation and communication industry's investment summarized above are

[13] For details, please see http://www5.cao.go.jp/keizai2/jmcs/docs/pdf/jmcs2012_digest.pdf.

particularly notable. However, the estimated coefficients are less than unity. Although we also confirm crowding-in effects in the mining industry for all cases, the share of this industry is very small. On the other hand, we observed crowding-out effects for the services and the finance and insurance industries in all cases. Incidentally, finance and insurance, especially financial institution, is essential to support the financial activity of the private sectors in a region as argued in some works such as Abiko and Yoshioka (2003) and Horie (2009). Furthermore, the service industry is expected to play an important role even in rejuvenating the rural areas because its productivity is one of major determinants of economic growth.[14] Since we can observe strong, crowding out effects among industries that substantially revitalize both financial and industrial activities in rural areas, heavy allocation of public stimulus investment packages in these areas does not appear to be necessarily adequate in terms of stimulating the capital formation of private sectors.

5. Conclusion

This study examines the interactions between regional public and private investment using Japanese prefecture data. We also investigate the behavior of sector capital investment by classifying the categories of private investment into specific sectors. Our

[14] For example, please see the website: http://www.rieti.go.jp/en/papers/contribution/morikawa/05.html.

empirical results show that while the investments in mining and transportation and communication are stimulated by public investment, crowding-out effects are observed in the finance and insurance industry and services in rural areas.

Our results suggest that government investment activities do not always encourage private enterprise investment in a region. This appears especially so in rural areas, thus implying that although the Japanese government implemented economic stimulus packages numerous times, including regional public investment for rural areas, such policies were not necessarily adequate in terms of stimulating the economic activities through private capital formation there. The policy implication drawn from our results is that policy makers should be aware of this when they plan economic stimulus including regional public investment.

Moreover, political factors such as pork-barrel politics have had a strong impact on public investment policy in Japan. These factors may also affect private business investment through public investment. It would be worthy of investigation to examine the extent the effect of public investment has on business investment depending on political variables. Additionally, although we use prefecture level data, it would be also necessary to investigate the model using municipal level data. Since the degree of population concentration and firm concentration is different even within one prefecture, policy effects may also be different within a prefecture. These issues remain for future research.

Appendix 1

Figure A.1 depicts the movement of investment in transportation and communications. From this figure, you can understand that this had increased drastically in the late to mid-1980s, when the investments of two major companies, JR and NTT, had been added since their establishment. To deal with this, we reestmate Equations (1) and (2). The results are shown in Table A.1 and A.2, respectively. The coefficients of $\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$ are estimated to be positive and significant for all cases in Table A.1, and we strongly confirm the crowding-in effects in rural areas, following Table A.2.

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Figure 1a. The change in the contribution of per capita public investment to per capita PGDP (Hokkaido and Tohoku)

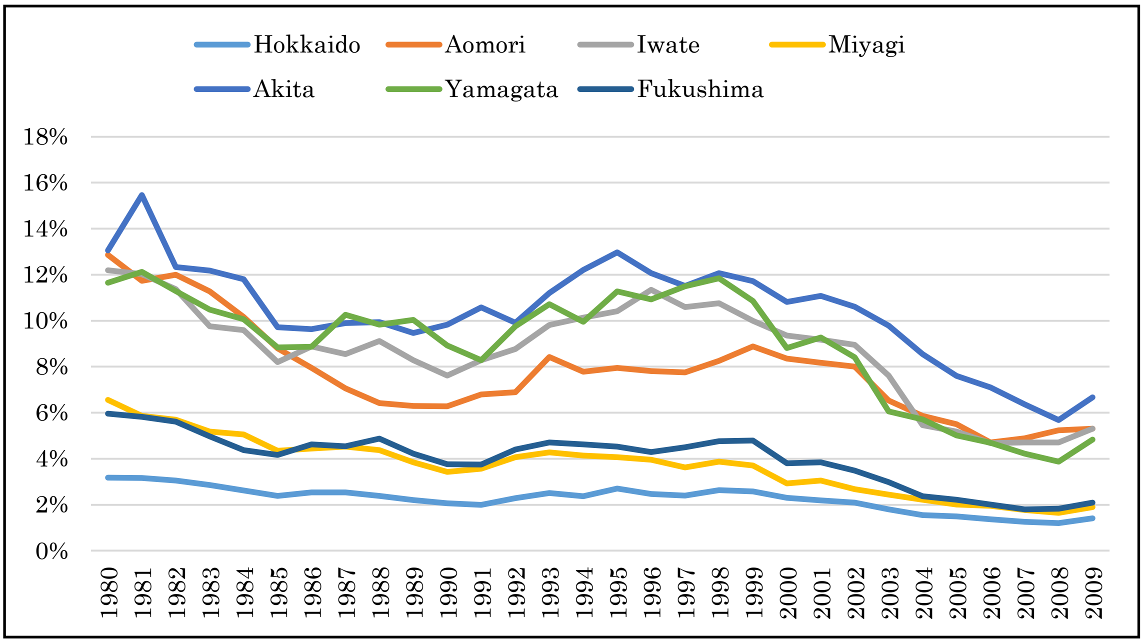


Figure 1b. The change in the contribution of per capita public investment to per capita PGDP (Kanto)

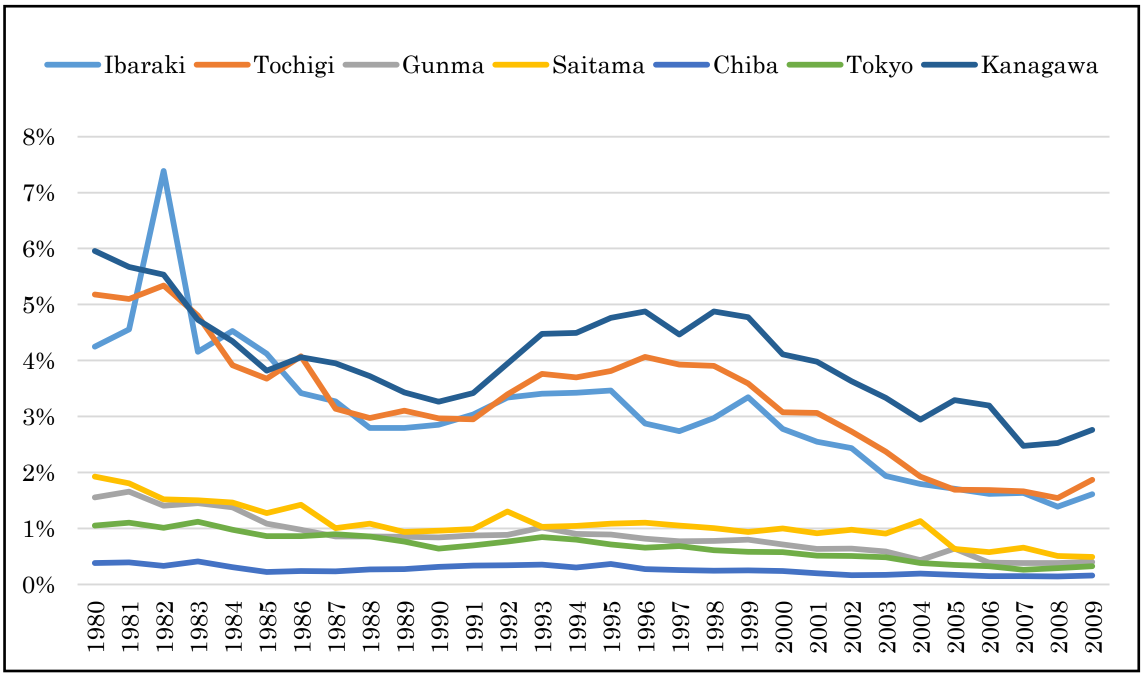


Figure 1c. The change in the contribution of per capita public investment to per capita PGDP (Chubu and Koshinetsu)

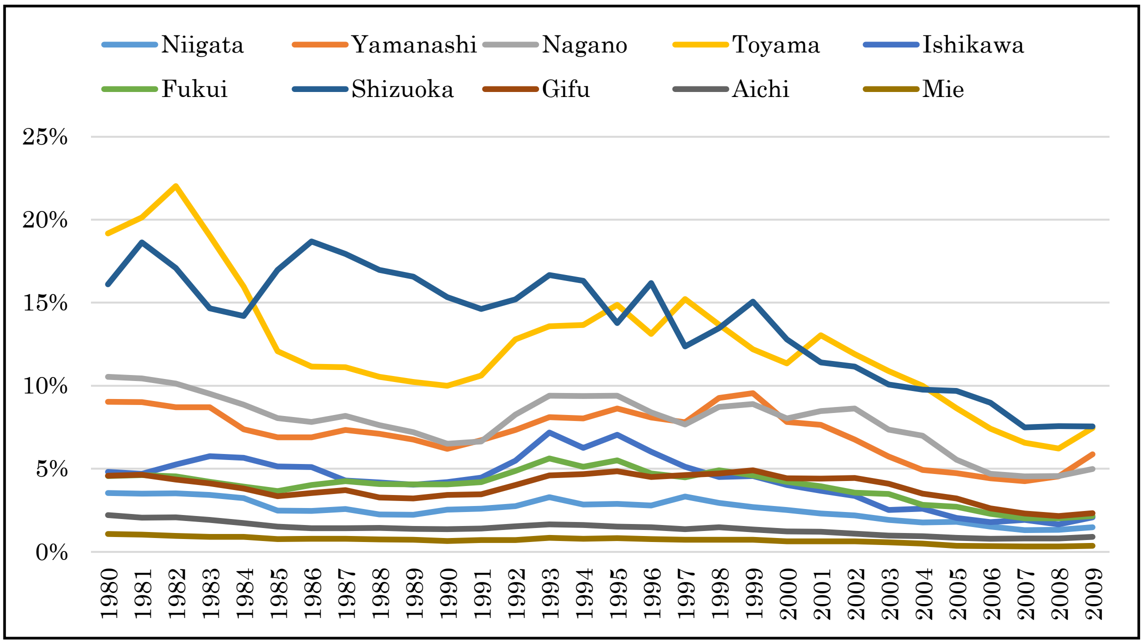


Figure 1d. The change in the contribution of per capita public investment to per capita PGDP (Kansai)

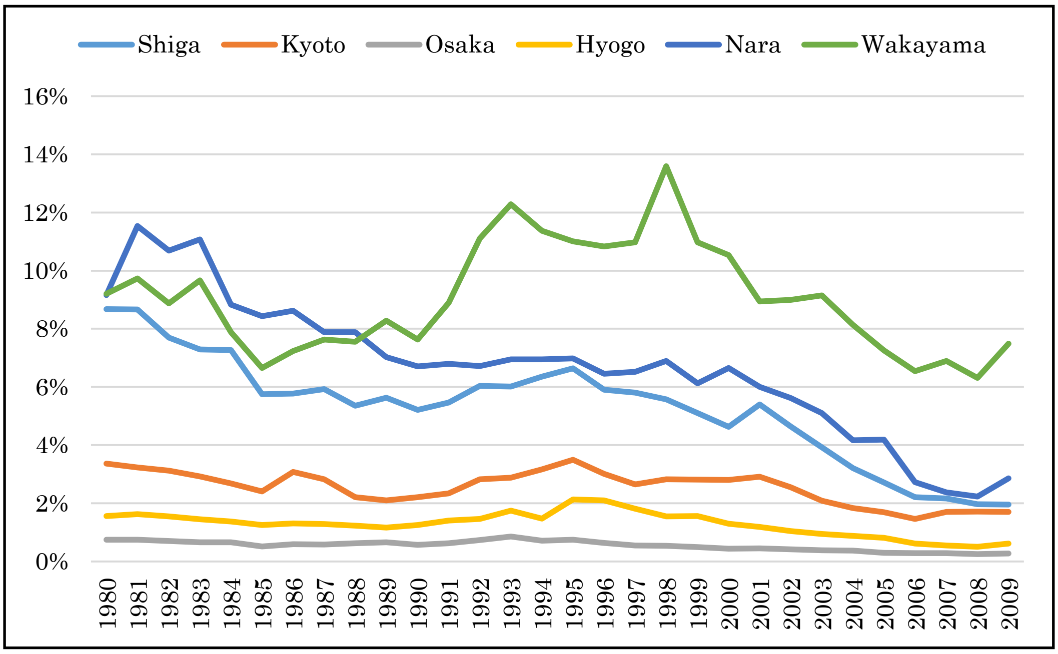


Figure 1e. The change in the contribution of per capita public investment to per capita PGDP (Chugoku and Shikoku)

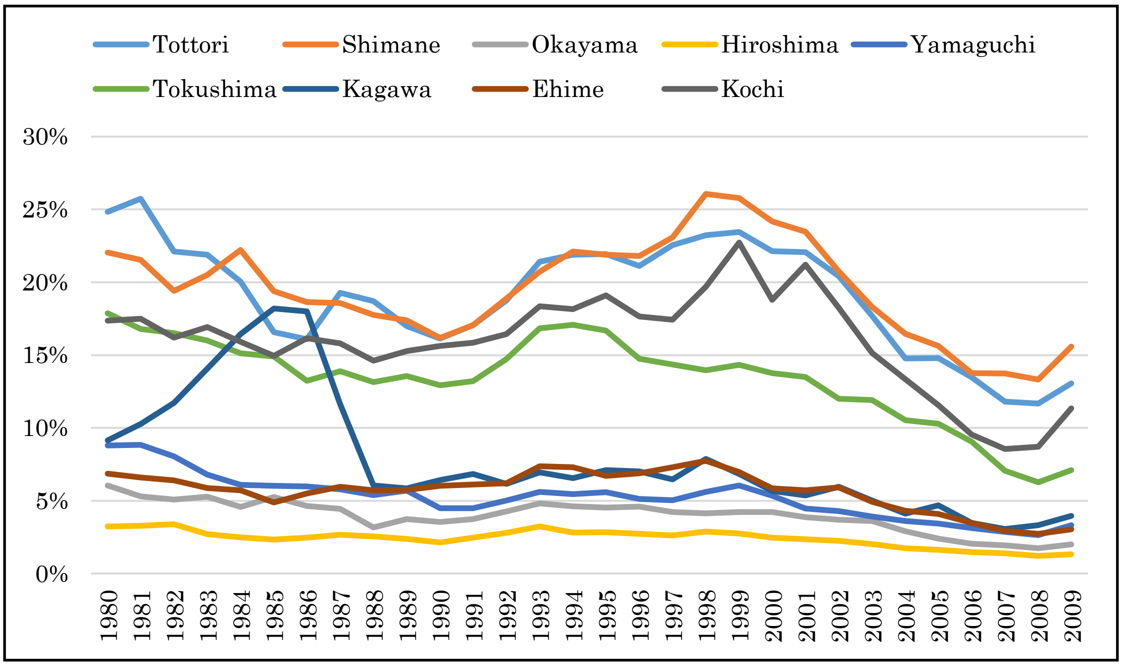


Figure 1f. The change in the contribution of per capita public investment to per capita PGDP (Kyushu and Okinawa)

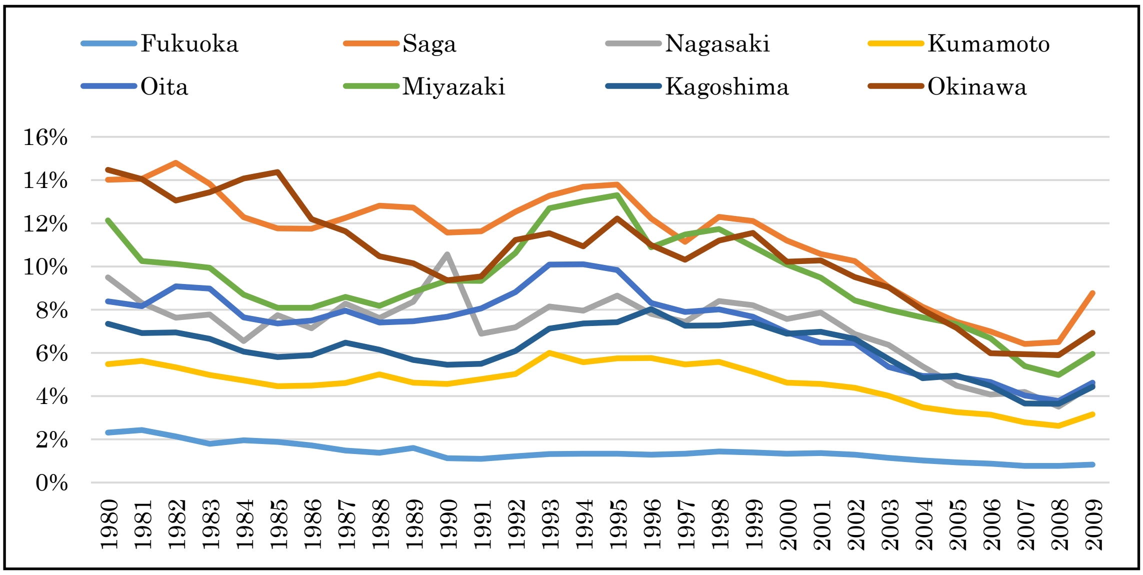
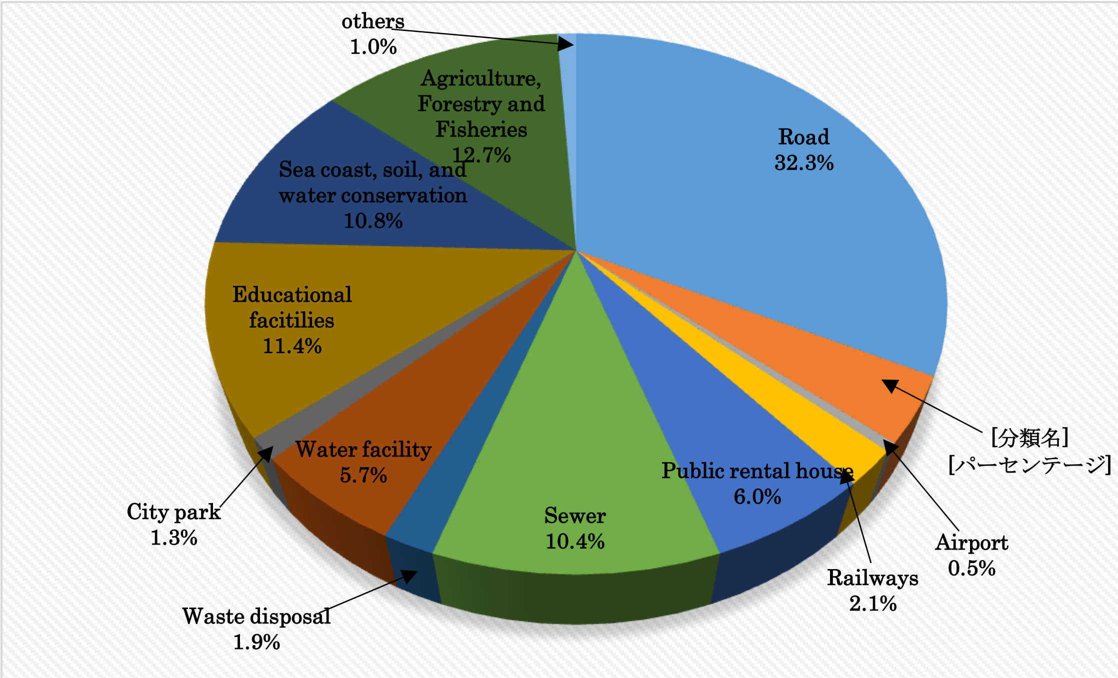


Figure 2. Breakdown of public capital (gross capital stock) in Japan (FY=2009)



Source: Public Capital in Japan, published by the Cabinet Office in Japan (http://www5. cao.go.jp/keizai2/jmcs/docs/pdf/jmcs2012.pdf).

Note: Others include the postal service, national forests, and industrial water service.

Table 1. Fiscal Stimulus Packages in the 1990s (JPY trillion)

	1992	1993		1994	1995		1998		1999
	August	April	September	February	April	September	April	November	November
Tax cut		0.2		5.9			4.6	6	
Cash transfers to households								0.7	
Total public works (Public investment)	**6.3**	**7.2**	**2**	**3.7**	**0**	**7.7**	**3.1**	**3.6**	**2.9**
Public works by central government	4.5	5.6	1.5	3.4		6.7	1.6	3.6	2.9
Public works by local governments	1.8	1.6	5	0.3		1	1.5		
Other government investment					5.4	1.4	4.6	3.6	4
Other government measures	4.5	5.8	4	5.7	1.5	5.2	4.4	9.1	11.3
Total size of economic stimulus packages	**10.8**	**13.2**	**6**	**15.3**	**6.9**	**14.3**	**16.7**	**23**	**18.2**

Note: This Table follows Brückner and Tuladhar (2013). Other government investment includes the investment in fields such as science and technology, education and social welfare, alternative energy and environment, and natural disaster relief. All government investment in the economic stimulus packages in April 1995 was for natural disaster relief because this package was planned as countermeasures for the Great Hanshin-Awaji earthquake.

Table 2a. Estimation Results of Equation (1): Estimation Method = LSDV, NOB = 1316

Dependent Variable	Aggregate Investment	Manufacturing	Agriculture, etc.	Mining	Wholesale and Retail
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	0.457	0.128	4.650 *	0.811	−0.472 *
	(0.455)	(1.283)	(2.581)	(1.102)	(0.268)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.128	−0.771	−1.499	2.004 ***	0.366
	(0.517)	(1.335)	(3.032)	(0.677)	(0.287)
Const.	0.011	0.006	0.090	−0.190 ***	0.042 ***
	(0.014)	(0.031)	(0.067)	(0.017)	(0.006)
R^2	0.471	0.293	0.061	0.480	0.855
Dependent Variable	Finance and Insurance	Real Estate	Transportation and Communication	Utilities	Services
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	−0.382	−0.095	0.656 **	−0.318	−0.235 **
	(0.256)	(0.171)	(0.247)	(0.562)	(0.103)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.119	−0.344	0.415 *	0.157	0.071
	(0.270)	(0.225)	(0.234)	(0.535)	(0.115)
Const.	−0.043 ***	0.126 ***	−0.043 ***	−0.028 ***	0.035 ***
	(0.005)	(0.004)	(0.004)	(0.010)	(0.003)
R^2	0.872	0.981	0.954	0.681	0.968

Note: Robust standard errors are in parentheses. Asterisks indicate significance levels: ＊=10%, ＊＊=5%, and ＊＊＊=1%. For brevity, dummy variables for years are not shown.

Table 2b. Estimation results of Equation (2): Estimation Method=LSDV, NOB=1316

Dependent Variable	Aggregate Investment	Manufacturing	Agriculture, etc.	Mining	Wholesale and Retail
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	0.509	0.070	2.922	1.222	−0.298
	(0.471)	(1.364)	(2.659)	(1.123)	(0.263)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.180	−0.857	0.954	1.511 **	0.227
	(0.531)	(1.352)	(2.778)	(0.596)	(0.255)
$UDUM$	−0.548	1.398	14.054	−3.851 **	−2.019 ***
$*\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	(0.583)	(1.702)	(9.063)	(1.794)	(0.729)
$UDUM$	0.411	1.450	−23.618 ***	4.411	0.934
$*\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	(1.075)	(2.361)	(6.630)	(3.561)	(0.952)
Const.	0.010	0.006	0.097	−0.191 ***	0.041 ***
	(0.014)	(0.031)	(0.065)	(0.017)	(0.006)
R^2	0.471	0.294	0.069	0.483	0.857
Dependent Variable	Finance and Insurance	Real Estate	Transportation and Communication	Utilities	Services
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	−0.457 *	−0.098	0.715 ***	−0.247	−0.222 **
	(0.264)	(0.175)	(0.250)	(0.572)	(0.103)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	0.158	−0.400 *	0.372	0.099	0.041
	(0.278)	(0.236)	(0.234)	(0.547)	(0.110)
$UDUM$	0.978	0.375	−0.713 *	−0.802	−0.046
$*\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	(0.668)	(0.305)	(0.405)	(0.751)	(0.196)
$UDUM$	−0.122	0.778	0.259	0.413	0.329
$*\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	(0.476)	(0.509)	(0.406)	(0.671)	(0.337)
Const.	−0.043 ***	0.126 ***	−0.043 ***	−0.013	0.035 ***
	(0.005)	(0.004)	(0.004)	(0.013)	(0.003)
R^2	0.872	0.981	0.954	0.681	0.968

Note: Robust standard errors are in parentheses. Asterisks indicate significance levels: ＊=10%, ＊＊=5%, and ＊＊＊=1%. For brevity, dummy variables for years are not shown.

Table 3a. Estimation Results of Equation (1) (The case adding some variables): Estimation Method = LSDV, NOB=1316 for finance and insurance, and 1222 for other sectors

Dependent Variable	Aggregate Investment	Manufacturing	Agriculture, etc.	Mining	Wholesale and Retail
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	0.141	−0.479	4.360 *	0.711	−0.608 **
	(0.470)	(1.274)	(2.551)	(1.065)	(0.280)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.300	−0.849	−1.527	1.784 **	0.345
	(0.534)	(1.379)	(3.331)	(0.799)	(0.305)
JOB_{it}	0.041 ***	0.051 ***	0.013	0.035 *	0.010 *
	(0.007)	(0.021)	(0.059)	(0.023)	(0.007)
$\frac{\Delta L_{it}}{L_{it}}$	0.007	−0.134	−0.160	0.028	0.023
	(0.051)	(0.119)	(0.293)	(0.076)	(0.037)
const	−0.016	−0.018	0.092	−0.213 ***	0.033 ***
	(0.016)	(0.037)	(0.073)	(0.022)	(0.008)
R^2	0.491	0.304	0.058	0.439	0.848
Dependent Variable	Finance and Insurance	Real Estate	Transportation and Communication	Utilities	Services
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	−0.497 *	−0.158	0.497 **	−0.378	−0.346 ***
	(0.265)	(0.172)	(0.245)	(0.557)	(0.111)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.004	−0.450 *	0.324	0.135	−0.037
	(0.279)	(0.247)	(0.266)	(0.563)	(0.126)
JOB_{it}	0.027	0.018 ***	0.020 **	−0.014	0.021 ***
	(0.009)	(0.007)	(0.011)	(0.011)	(0.004)
$\frac{\Delta L_{it}}{L_{it}}$		0.105 ***	−0.016	0.057	0.025 **
		(0.033)	(0.043)	(0.040)	(0.015)
Const.	−0.060 ***	0.107 ***	−0.055 ***	−0.009	0.020 ***
	(0.008)	(0.007)	(0.008)	(0.016)	(0.004)
R^2	0.873	0.980	0.956	0.678	0.966

Note: Robust standard errors are in parentheses. Asterisks indicate significance levels: ＊=10%, ＊＊=5%, and ＊＊＊=1%. For brevity, dummy variables for years are not shown.

Table 3b. Estimation Results of Equation (2) (The case adding some variables): Estimation method = LSDV, NOB = 1316 for finance and insurance, and 1222 for other sectors

Dependent Variable	Aggregate Investment	Manufacturing	Agriculture, etc.	Mining	Wholesale and Retail
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	0.197 (0.471)	−0.526 (1.339)	2.997 (2.604)	1.165 (1.055)	−0.431 (0.269)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.344 (0.536)	−0.940 (1.375)	0.749 (0.292)	1.404 ** (0.650)	1.197 (0.267)
$UDUM * \Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	−0.756 (0.764)	1.168 (1.638)	13.434 (10.084)	−6.034 ** (2.564)	−2.345 *** (0.649)
$UDUM * \Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	0.424 (1.149)	1.529 (2.569)	−28.112 *** (9.000)	3.792 (5.001)	1.474 (1.013)
JOB_{it}	0.041 *** (0.007)	0.053 *** (0.021)	−0.0002 (0.059)	0.035 * (0.023)	0.010 * (0.007)
$\frac{\Delta L_{it}}{L_{it}}$	0.007 (0.051)	−0.133 (0.119)	−0.161 (0.298)	0.028 (0.076)	0.023 (0.037)
const	−0.016 (0.016)	−0.019 (0.037)	0.109 (0.071)	−0.215 *** (0.022)	0.033 *** (0.008)
R^2	0.491	0.304	0.067	0.442	0.850
Dependent Variable	**Finance and Insurance**	**Real Estate**	**Transportation and Communication**	**Utilities**	**Services**
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	−0.577** (0.275)	−0.190 (0.172)	0.543 ** (0.246)	−0.308 (0.563)	−0.337 *** (0.111)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	0.020 (0.284)	−0.507 * (0.256)	0.284 (0.263)	0.093 (0.570)	−0.072 (0.118)
$UDUM * \Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	1.099 (0.677)	0.770 *** (0.270)	−0.606 (0.452)	−1.011 (0.783)	0.009 (0.207)
$UDUM * \Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	0.048 (0.457)	0.963 (0.582)	0.406 (0.452)	0.343 (0.677)	0.492 (0.406)
JOB_{it}	0.028 *** (0.009)	0.019 *** (0.006)	0.020 ** (0.456)	−0.014 (0.011)	0.022 *** (0.004)
$\frac{\Delta L_{it}}{L_{it}}$		0.106 *** (0.033)	−0.016 (0.043)	0.057 * (0.039)	0.025 ** (0.015)
Const.	−0.060 (0.008)	0.107 *** (0.007)	−0.055 *** (0.008)	−0.009 (0.016)	0.020 *** (0.004)
R^2	0.873	0.981	0.956	0.678	0.966

Note: Robust standard errors are in parentheses. Asterisks indicate significance levels: ＊=10%, ＊＊=5%, and ＊＊＊=1%. For brevity, dummy variables for years are not shown.

Table 4a. Estimation Results of Equation (1) (The case limiting sample periods to 1980-2001): Estimation Method = LSDV, NOB=940.

Dependent Variable	Aggregate Investment	Manufacturing	Agriculture, etc.	Mining	Wholesale and Retail
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	0.154	0.175	1.620	−0.062	−0.811 **
	(0.566)	(1.505)	(3.131)	(1.423)	(0.343)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.081	0.148	−4.088	1.997 *	0.348
	(0.597)	(1.518)	(3.319)	(1.020)	(0.355)
const	0.010	0.006	0.082	−0.192 ***	0.041 ***
	(0.014)	(0.029)	(0.068)	(0.017)	(0.006)
R^2	0.479	0.288	0.026	0.429	0.821
Dependent Variable	Finance and Insurance	Real Estate	Transportation and Communication	Utilities	Services
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	−0.515	0.068	0.660 **	−0.602	−0.415 ***
	(0.349)	(0.213)	(0.333)	(0.690)	(0.145)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	0.054	−0.395	0.490	−0.071	0.045
	(0.344)	(0.290)	(0.298)	(0.664)	(0.142)
const	−0.043 ***	0.126 ***	−0.043 ***	−0.014	0.035 ***
	(0.005)	(0.004)	(0.005)	(0.013)	(0.003)
R^2	0.870	0.978	0.954	0.551	0.953

Note: Robust standard errors are in parentheses. Asterisks indicate significance levels: ＊=10%, ＊＊=5%, and ＊＊＊=1%. For brevity, dummy variables for years are not shown.

Table 4b. Estimation Results of Equation (2) (The case limiting sample periods to 1980-2001): Estimation Method = LSDV, NOB=940

Dependent Variable	Aggregate Investment	Manufacturing	Agriculture, etc.	Mining	Wholesale and Retail
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	0.271	0.158	0.839	0.517	−0.592 *
	(0.560)	(1.553)	(2.872)	(1.474)	(0.337)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.163	−0.052	−2.364	1.548 *	0.181
	(0.596)	(1.506)	(3.171)	(0.835)	(0.304)
$UDUM * \Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	−1.442	0.318	8.967	−7.107 **	−2.681 ***
	(0.972)	(1.555)	(14.565)	(2.931)	(0.740)
$UDUM * \Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	0.834	2.307	−19.128 **	4.647	1.718
	(1.158)	(2.637)	(8.931)	(4.400)	(1.060)
const	0.009	0.006	0.088	−0.195 ***	0.041 ***
	(0.014)	(0.029)	(0.066)	(0.017)	(0.006)
R^2	0.479	0.288	0.003	0.434	0.824
Dependent Variable	Finance and Insurance	Real Estate	Transportation and Communication	Utilities	Services
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	−0.642 *	0.040	0.718 **	−0.513	−0.421 ***
	(0.360)	(0.220)	(0.336)	(0.701)	(0.149)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	0.075	−0.511	0.450	−0.151	0.001
	(0.356)	(0.306)	(0.290)	(0.672)	(0.133)
$UDUM * \Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	1.061 *	0.421	−0.714	−1.084	0.099
	(0.866)	(0.325)	(0.588)	(0.949)	(0.241)
$UDUM * \Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.135	1.360 **	0.402	0.823	0.510
	(0.720)	(0.558)	(0.488)	(0.702)	(0.512)
Const.	−0.043 ***	0.126 ***	−0.043 ***	−0.014	0.035 ***
	(0.005)	(0.004)	(0.005)	(0.013)	(0.003)
R^2	0.871	0.978	0.954	0.552	0.953

Note: Robust standard errors are in parentheses. Asterisks indicate significance levels: ＊=10%, ＊＊=5%, and ＊＊＊=1%. For brevity, dummy variables for years are not shown.

Table 5a. Estimation Results of Equation (1). Estimation Method = System GMM.

Dependent Variable	Aggregate Investment	Manufacturing	Agriculture, etc.	Mining	Wholesale and Retail
$\Delta I_{it-1}/I_{it-1}$	−0.564 ***	−0.395 ***	−0.451 ***	0.088	−0.045
	(0.051)	(0.033)	(0.087)	(0.058)	(0.032)
$\Delta I_{it-2}/I_{it-2}$	−0.419 ***	−0.245 ***	−0.339 ***		
	(0.082)	(0.059)	(0.063)		
$\Delta I_{it-3}/I_{it-3}$	−0.207	−0.140	−0.246 ***		
	(0.166)	(0.103)	(0.072)		
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	0.887 *	0.645	4.945	2.060 *	−0.470 *
	(0.507)	(1.286)	(3.167)	(1.127)	(0.250)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.092	−0.896	−2.809	3.777 **	0.291
	(0.525)	(1.134)	(4.086)	(1.330)	(0.358)
const	−0.163 ***	0.019	0.375 ***	−0.202 ***	0.037 ***
	(0.011)	(0.032)	(0.119)	(0.017)	(0.008)
NOB	1222	1222	1222	1316	1316
AR(1)	−4.179 ***	−3.685 ***	−3.987 ***	−2.934 ***	−4.650 ***
AR(2)	1.417	−0.126	0.092	0.854	0.501
Dependent Variable	Finance and Insurance	Real Estate	Transportation	Utilities	Services
$\Delta I_{it-1}/I_{it-1}$	−0.132 **	−0.410 ***	−0.067	0.034	0.018
	(0.065)	(0.053)	(0.057)	(0.046)	(0.065)
$\Delta I_{it-2}/I_{it-2}$	−0.083 *	−0.475 ***			
	(0.046)	(0.035)			
$\Delta I_{it-3}/I_{it-3}$	−0.339 ***	−0.534 ***			
	(0.132)	(0.073)			
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	−0.671 *	0.276	0.582 *	−0.189	−0.243 **
	(0.384)	(0.216)	(0.314)	(0.787)	(0.099)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.481	−0.099	0.311	0.402	0.026
	(0.414)	(0.163)	(0.224)	(0.667)	(0.133)
Const.	0.138 ***	−0.048	−0.039 ***	−0.014	0.034 ***
	(0.009)	(0.038)	(0.055)	(0.013)	(0.086)
NOB	1222	1222	1316	1316	1316
AR(1)	−4.799 ***	−4.816 ***	−4.071 ***	−4.820 ***	−4.536 ***
AR(2)	−1.177	1.052	0.147	0.603	1.468

Note: Robust standard errors are in parentheses. Asterisks indicate significance levels: ＊=10%, ＊＊=5%, and ＊＊＊=1%. For brevity, dummy variables for years are not shown.

Table 5b. Estimation Results of Equation (2): Estimation Method = System GMM

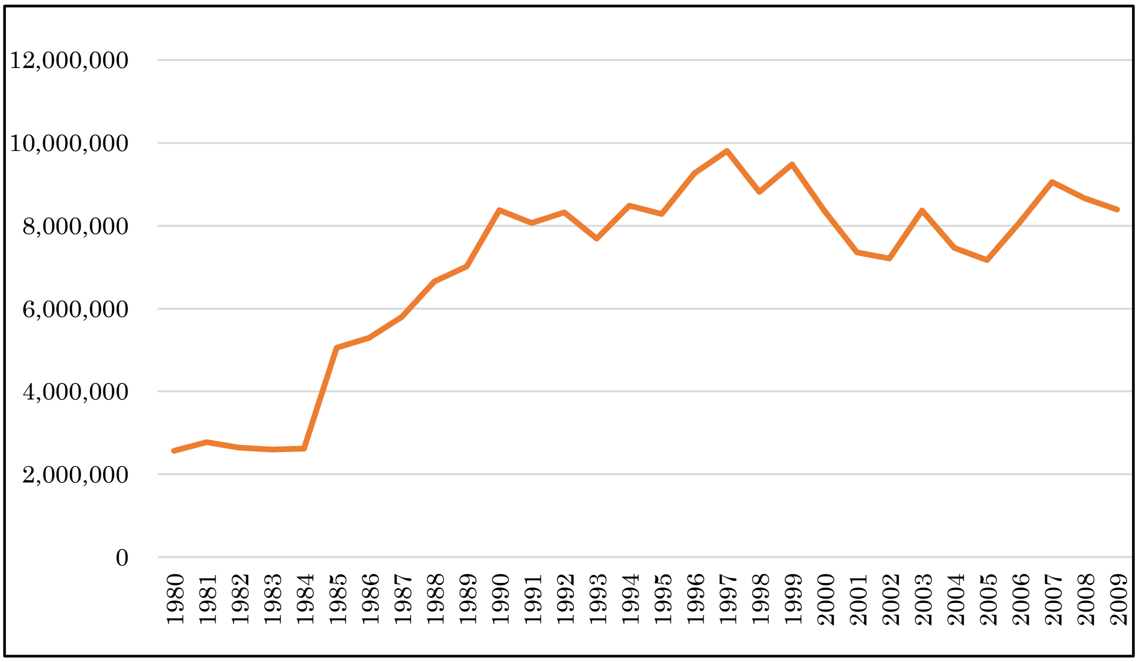
Dependent Variable	Aggregate Investment	Manufacturing	Agriculture, etc.	Mining	Wholesale and Retail
$\Delta I_{it-1} / I_{it-1}$	−0.564 ***	−0.397 ***	−0.433 ***	0.088	−0.044
	(0.051)	(0.033)	(0.090)	(0.057)	(0.032)
$\Delta I_{it-2} / I_{it-2}$	−0.417 ***	−0.248 ***	−0.329 ***		
	(0.082)	(0.060)	(0.063)		
$\Delta I_{it-3} / I_{it-3}$	−0.198	−0.143	−0.246 ***		
	(0.168)	(0.103)	(0.069)		
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	0.918 *	0.431	1.999	2.104 *	−0.287
	(0.509)	(1.417)	(2.980)	(1.140)	(0.248)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.051	−1.075	−1.258	2.873 **	0.125
	(0.517)	(1.136)	(3.824)	(1.227)	(0.312)
$UDUM$	−0.514	3.123	27.593 *	0.507	−1.455
$* \Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	(0.935)	(2.364)	(14.695)	(1.592)	(0.955)
$UDUM$	−0.495	2.532	−7.217	8.353 **	1.401
$* \Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	(1.014)	(1.907)	(6.262)	(3.599)	(1.407)
Const.	−0.164 ***	0.328 ***	0.180 **	−0.203 ***	0.037 ***
	(0.011)	(0.048)	(0.076)	(0.019)	(0.008)
NOB	1222	1222	1222	1316	1316
AR(1)	−4.186 ***	−3.675 ***	−4.035 ***	−2.909 ***	−4.684 ***
AR(2)	1.456	−0.110	0.120	0.810	0.614

Table 5b. Estimation Results of Equation (2): Estimation Method = System GMM (cont.)

Dependent Variable	Finance and Insurance	Real Estate	Transportation	Utilities	Services
$\Delta I_{it-1}/I_{it-1}$	−0.132 **	−0.410 ***	−0.068	0.036	0.016
	(0.066)	(0.052)	(0.057)	(0.045)	(0.064)
$\Delta I_{it-2}/I_{it-2}$	−0.081 *	−0.477 ***			
	(0.047)	(0.036)			
$\Delta I_{it-3}/I_{it-3}$	−0.319 **	−0.538 ***			
	(0.133)	(0.075)			
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	−0.798 **	0.238	0.616 *	−0.073	−0.259 ***
	(0.397)	(0.221)	(0.316)	(0.834)	(0.098)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.393	−0.156	0.228	0.296	−0.036
	(0.438)	(0.174)	(0.215)	(0.686)	(0.120)
$UDUM * \Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	1.096	0.575	−0.224	−0.980	0.255
	(1.101)	(0.440)	(0.529)	(1.076)	(0.244)
$UDUM * \Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	−0.550	0.684	0.757	0.867	0.612
	(0.639)	(0.518)	(0.514)	(0.757)	(0.481)
Const.	0.007	0.515 ***	−0.039 ***	−0.014	0.034 ***
	(0.006)	(0.021)	(0.006)	(0.013)	(0.009)
NOB	1222	1222	1316	1316	1316
AR(1)	−4.792 ***	−4.778 ***	−4.054 ***	−4.817 ***	−4.491 ***
AR(2)	−1.067	1.122	0.170	0.578	1.603

Note: Robust standard errors are in parentheses. Asterisks indicate significance levels: ＊=10%, ＊＊=5%, and ＊＊＊=1%. For brevity, dummy variables for years are not shown.

Figure A.1. The investment of transportation and communications



Source: Prefectural private capital stock provided by Cabinet Office in Japan.

Table A.1. Estimation results of Equation (1). (The case that sample periods are limited after 1988)

	Basic case	The case adding some variables	The case limiting until 2001	System GMM
$\Delta I_{it-1} / I_{it-1}$				−0.037
				(0.052)
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	0.972 ***	0.797 ***	0.117 ***	1.041 ***
	(0.269)	(0.269)	(0.411)	(0.362)
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	0.330	0.208	0.436	0.373
	(0.221)	(0.258)	(0.321)	(0.271)
JOB_{it}		0.021 **		
		(0.011)		
$\frac{\Delta L_{it}}{L_{it}}$		−0.084		
		(0.076)		
const	0.126 ***	0.110 ***	0.127 ***	−0.039 ***
	(0.006)	(0.011)	(0.006)	(0.003)
NOB	1034	940	658	987
AR(1)				−3.290 ***
AR(2)				−0.315

Note: Robust standard errors are in parentheses. Asterisks indicate significance levels: ＊=10%, ＊＊=5%, and ＊＊＊=1%. Dummy variables for year are not shown for the sake of brevity.

Table A.2. Estimation results of Equation (2). (The case that sample periods are limited after 1988)

	Basic case	The case adding some variables	The case limiting until 2001	System GMM
$\Delta I_{it-1} / I_{it-1}$				−0.036
				(0.053)
$\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	1.050 ***	0.858 ***	1.249 ***	1.100 ***
	(0.274)	(0.274)	(0.413)	−0.362
$\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	0.259	0.149	0.364	0.268
	(0.214)	(0.244)	(0.295)	(0.264)
$UDUM$	−0.785 *	−0.694	−0.805	−0.305
$*\Delta\left(\frac{GI_{it}}{Y_{it}}\right)$	(0.438)	(0.491)	(0.679)	(0.627)
$UDUM$	0.507	0.710	0.840 *	0.835
$*\Delta\left(\frac{GI_{it-1}}{Y_{it-1}}\right)$	(0.398)	(0.479)	(0.490)	(0.548)
JOB_{it}		0.021 **		
		(0.012)		
$\frac{\Delta L_{it}}{L_{it}}$		−0.086		
		(0.076)		
const	0.127 ***	0.109 ***	0.127 ***	−0.039 ***
	(0.006)	(0.011)	(0.006)	(0.003)
NOB	1034	940	658	987
AR(1)				−3.274 ***
AR(2)				−0.371

Note: Robust standard errors are in parentheses. Asterisks indicate significance levels: ＊=10%, ＊＊=5%, and ＊＊＊=1%. Dummy variables for year are not shown for the sake of brevity.