Natural disasters and local government finance

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Abstract

We examine the quantitative impact of natural disasters, including earthquakes, on the cash flow as well as debt and other financial conditions of municipalities, using data from the Administrative Cash Flow Statements prepared by the Ministry of Finance to clarify the debt repayment capacity and cash flow status of local governments.

We found that municipalities affected by natural disasters, except for the Great East Japan Earthquake, faced a temporary deterioration in net cash flow per capita, cash flow from administrative activities, and primary balance immediately after the occurrence of the disaster. The reason for the deterioration in net cash flow was that the cash flow from extraordinary administrative activities could not be compensated for by the cash flow from ordinary administrative activities and cash flow from financing activities. This was reflected in the increase in the balance of local bonds and the decrease in the balance of the public finance adjustment fund, which has been declining since the first year of the disaster. Although there is a national financial assistance program for disaster-affected municipalities, municipalities have been withdrawing from the public finance adjustment fund and using it to finance emergency and restoration activities. The cash flow from administrative activities began to improve six years after the disaster, but this was due to an increase in local allocation tax grants for the principal and interest repayment of local bonds issued for disaster recovery projects, rather than an increase in tax revenues due to reconstruction.

In the municipalities affected by the Great East Japan Earthquake, net cash flow per capita increased after the disaster struck, and cash flow from administrative activities also continued to maintain an increasing trend almost consistently. This indicates that the cash flow situation is rather comfortable compared to those municipalities affected by natural disasters

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other than the Great East Japan Earthquake. The huge surplus generated by the cash flow from administrative activities is accumulated in special purpose funds and used as a source of funds for reconstruction-related projects to be implemented in subsequent fiscal years. This abundance of balances in the reserve funds greatly reduced the real debt, but as the reconstruction projects progress, the balances in the reserve funds are decreasing. At the current pace, the balance of the reserve funds is expected to drop to the same level as those of other municipalities affected by the Great East Japan Earthquake in the not-too-distant future.

I.   Introduction

Japan is known to be one of the most earthquake-prone countries in the world, with a land area of only 0.25% of the world's total, but the number of earthquakes with a magnitude of 6.0 or greater accounts for about 20% of the world's earthquakes.[1] There are 10 earthquakes that occurred near Japan since 2000 and were recognized by the Japan Meteorological Agency (hereinafter, JMA) as notable disasters and designated as earthquakes, for example, the 2000 Western Tottori Earthquake, the 2003 Tokachi-oki Earthquake, the 2004 Niigata Prefecture Chuetsu Earthquake, the 2007 Noto Peninsula Earthquake, the 2007 Niigata Prefecture Chuetsu-Oki Earthquake, the 2011 Tohoku-Pacific Ocean Earthquake (disaster name is the Great East Japan Earthquake (hereinafter, "GEJE")), the 2016 Kumamoto Earthquake, the 2018 Hokkaido Eastern Iburi Earthquake, etc.[2] Turning to natural phenomena other than earthquakes, 4 volcanic phenomena have been named by the JMA, for example, the 2000 Usu eruption and the 2000 Miyakejima eruption. In meteorological phenomena, 15 phenomena are given specific names, for example, the July 2012 Northern Kyushu Heavy Rainstorm (the disaster name given by Kumamoto Prefecture is the Kumamoto Widespread Flooding), the August 2014 Heavy Rainstorm (disaster names and alternate names vary by region, including the Hiroshima Landslide Disaster, the Fukuchiyama Heavy Rainstorm, the Tanba Heavy Rainstorm, the 2014 Kochi Heavy Rainstorm), the July 2018

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[1] See Ministry of Land, Infrastructure, Transport and Tourism "2020 White Paper on Land, Infrastructure, Transport and Tourism."

[2] For natural phenomena that have caused significant damage, the JMA, in principle, defines the name of the phenomenon as year of origin + name of the area (river name) where significant damage occurred + name of the phenomenon. In addition, the central and local governments may also define the name of the disaster caused by natural phenomena. For example, the 2011 Tohoku-Pacific Ocean Earthquake and the 1995 Southern Hyogo Prefecture Earthquake were named as natural phenomena by the JMA. As names for the disasters caused by the respective earthquakes, the central government has named them the Great East Japan Earthquake and the Great Hanshin Earthquake.

Heavy Rainstorm (otherwise known as the West Japan Heavy Rainstorm), the 2011 East Japan Typhoon, and the July 2020 Heavy Rainstorm (otherwise known as the Kumamoto Heavy Rainstorm). Including not only earthquakes, but also heavy rainstorms, typhoons, and volcanic phenomena, we are experiencing disasters every year that cause extensive damage.

While a sequence of earthquakes like the GEJE can cause extremely large damage, natural phenomena other than earthquakes also cause damage that cannot be ignored. Figure 1 shows the amount of damage caused by natural disasters since 2000 (excluding 2009 and 2010) in the following areas: public engineering facilities (rivers, flood control facilities, ports, etc.); agriculture, forestry, and fisheries (farmland, agricultural facilities, forest roads, fishing facilities, agricultural, forestry, and marine products, etc.); educational facilities (school facilities, cultural assets, etc.); public welfare facilities (social welfare facilities, water supply facilities, etc.); and other facilities (natural parks, telegraphs and telephones, and urban facilities). The total amount of damage since 2000 has amounted to about 18.5 trillion yen, with earthquakes accounting for about 7.2 trillion yen (39% of the total), typhoons about 5.9 trillion yen (32% of the total), and heavy rainstorms about 3.7 trillion yen (20% of the total) respectively.[3] Typhoons and heavy storms account for more than half of the total.

Figure 1: Amount of damage to public facilities by disaster (Cumulative total since 2000 (excluding 2009 and 2010))
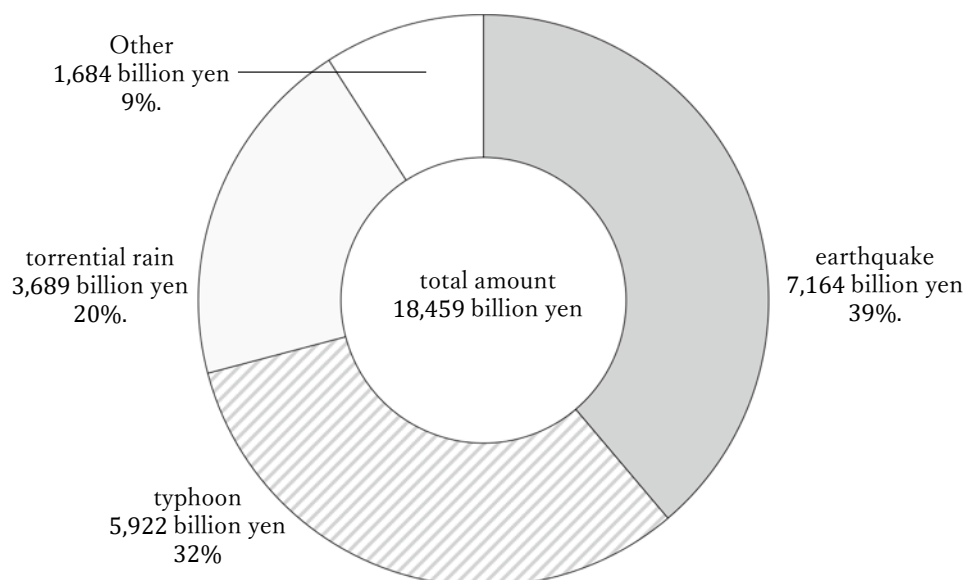
Source: Prepared by the authors from Cabinet Office, Japan (ed) *White Paper on Disaster Reduction.*
Note 1: Since the white papers did not contain data on the amount of damage to public facilities by disaster for 2009 and 2010, data for 2000-2008 and 2011-2019 were used.
Note 2: We used public work deflator (disaster recovery) from the Ministry of Land, Infrastructure, Transport and Tourism (ed) *Disaster Statistics*, with 2019 prices set as 1 and adjusted for each year's prices.

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[3] By facility, 50% of the damage was related to public civil engineering facilities, and 39% to agriculture, forestry, and fisheries.

Note that about 80% of the total damage from earthquakes was caused by the GEJE.

Needless to say, natural disasters not only cause human and material damage to residents and businesses in the affected areas, but also have a significant impact on the finances of local governments that implement recovery and reconstruction projects. As discussed below, most studies examining the impact of natural disasters on Japan's local finances focus on specific earthquakes and adopt a case study approach. As a result, it is difficult to say that they fully elucidate the overall trends of the affected local governments. In addition, although the implementation of recovery and reconstruction projects increases the expenditures of the affected local governments and at the same time increases their revenues due to financial support from the national government, few studies have focused primarily on changes in the balance of payments. In this paper, we examine the quantitative impact of natural disasters, including earthquakes, on the cash flow as well as debt and other financial conditions of municipalities, using data from the Administrative Cash Flow Statements prepared by the Ministry of Finance to clarify the debt repayment capacity and cash flow status of local governments.

This paper is organized as follows. Section II provides a perspective on the major studies examining changes in major expenditure and revenue items in the affected local governments. Section III outlines the national financial support system for the affected local governments. Section IV outlines the administrative cash flow statement. Section V outlines the trends of changes in the financial situation of the affected municipalities through quantitative analysis. Section VI is a summary.

II.   Literature Review

Studies examining the impact of natural disasters that have occurred since 2000 on the major expenditure, and revenue items of the affected local governments can be found in Oda (2003), Takeda (2009), Takayose (2014), Yokoyama (2014a, b), Kuwada (2014), Kawase (2015), Sato and Kuwada (2015), Miyazaki (2017), Kuwada (2019), Kuwada (2021a, b), and Japan Finance Organization for Municipalities (2021) (see Table 1 and Table 2).[4] The common trends regarding the impact of the disaster on the finances of the affected local governments as indicated by these previous studies are as follows. In terms of expenditure classified by purpose, (i) general administration expenses related to accumulation of reserve funds such as reconstruction funds, (ii) public welfare related to disaster relief such as setting up evacuation centers and providing emergency temporary housing, (iii) sanitation related to the disposal of disaster waste, and (iv) disaster recovery expenses tend to increase. In terms of expenditure classified by function, (i) social assistance such as disaster condolence pay-

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[4] One study that focuses on a specific tax category is Hiraga (2021). Using monthly data on bath tax revenues in Hakone, Hiraga (2021) examines the impact of volcanic activity around Owakudani and the Great East Japan Earthquake on the same tax revenues since May 2015. The empirical analysis reveals that the former impact persisted for about seven months, while the latter impact subsided after about two months. Other works that discuss the current state of and how the government's financial support for disaster-affected local governments should be provided include Nagamatsu (2000), Tajika and Miyazaki (2008), Miyazaki (2009), Kuwada (2016), Kuwada (2017), Seki (2019), and Kondoh and Miyazaki (2022).

Table 1: Previous studies focusing on the impact of natural disasters on municipal finance (1)

Article	name of natural disaster/phenomenon	period	name of local government	main impact on local finances (excluding disaster recovery expenses and disaster restoration project expenses)
Oda (2003)	The eruption of Usu volcano in 1977 and 2000	FY1975-2002	Abuta Town	- Expenditures by purpose: increases in public welfare; civil engineering work; and debt service. - Expenditures by function: increases in transfers to other accounts; ordinary construction work; and debt service. - Revenues: increases in national treasury disbursements; transfers from other accounts: and local bonds. - Others: increase in debt service ratio; ordinary balance ratio; and decrease in real balance ratio.
Takeda (2009)	The 2007 Noto Peninsula Earthquake	FY2006-2007	Wajima City	- Expenditures by purpose: increase in general administration; public welfare; sanitation; commerce and industry; and civil engineering work. - Expenditures by function: increases in non-personnel; subsidies; and reserve funds. - Revenues: increases in special LAT grants; national treasury disbursements; transfers from other accounts; miscellaneous income, and local bonds.
	The 2004 Niigata Prefecture Chuetsu Earthquake	FY2002-2007	Ojiya City	
Takayose (2014)	The great Hanshin Earthquake (Jan 17, 1995)	FY1993-1998	Hyogo Prefecture, and Kobe, Nishinomiya, Ashiya City, and Hokudan Town	- Expenditures by purpose: increase in general administration; public welfare; sanitation; and civil engineering work. - Revenues: increase in ordinary LAT grants; special LAT grants; national treasury disbursements; and local bonds. - Others: deterioration of the ordinary balance ratio; real balance ratio; and single year balance; increase in balance of local bonds; and decrease in balance of reserve funds.
	The Great East Japan Earthquake (March 11, 2011)	FY2010-2012	Iwate, Miyagi, Fukushima Prefecture, and Sendai, Kamaishi City, and Otsuchi, Onagawa, Minamisanriku Town	- Expenditures by purpose: increases in general administration; public welfare; sanitation; and civil engineering work. - Revenues: increases in special LAT grants; earthquake disaster reconstruction allocation tax grants; and national treasury disbursements. - Others: no change in the debt service ratio; real debt service ratio; future burden ratio; and balance of local bonds; and increase in balance of reserve funds.
Yokoyama (2014a)	The 1993 Southwest-off Hokkaido Earthquake	FY1992-2000	Okushiri Town	- Expenditures by purpose: increase in general administration; and public welfare. - Expenditures by function: increase in social assistance; non-personnel; and reserve funds. - Revenues: increase in special LAT grants; national treasury disbursements; transfers from other accounts, miscellaneous income; and local bonds.
Japan Finance Organization for Municipalities (2021)	The 2007 Noto Peninsula Earthquake	FY2005-2018	Ishikawa Prefecture, and Wajima City, and Anamizu Town	- Expenditures by purpose: increase in general administration; public welfare; sanitation; commerce and industry. - Expenditures by function: increase in non-personnel; and subsidizing. - Revenues: increase in special LAT grants; national treasury disbursements; miscellaneous income; and local bonds. - Other: no impact on the ratios for measuring financial soundness.
	The Typhoon Talas (typhoon No.12) in 2011	FY2010-2018	Wakayama Prefecture, and Shingu City, Tozukawa Village,	- Expenditures by purpose: increase in civil engineering work; sanitation; commerce and industry. - Expenditures by function: increase in social assistance; non-personnel; subsidized ordinary public work; and ordinary construction work. - Revenues: increase in special LAT grants; national treasury disbursements. - Others: both decrease and increase in public finance adjustment fund; impact on the fiscal soundness ratio in some governments.

ments, (ii) non-personnel expenses such as outsourcing of disaster waste disposal and leasing of temporary housing, (iii) subsidizing related to business resumption and restoration and repair of damaged housing, (iv) ordinary construction work related to construction of disaster public housing and group relocation promotion projects, (v) reserve funds, and (vi) disaster restoration project expenses tend to increase. In terms of revenue, (i) special local allocation tax grants (hereinafter, local allocation tax grants is referred to as "LAT grants") to support fiscal demand arising from the disaster (earthquake disaster reconstruction alloca-

Table 2: Previous studies focusing on the impact of natural disasters on municipal finance (2)

Article	name of natural disaster/phenomenon	period	municipalities	main impact on municipal finances (excluding disaster recovery expenses and disaster restoration project expenses)
Yokoyama (2014b)	The Great East Japan Earthquake (March 11, 2011)	FY2010-2011	Ishinomaki City	- Expenditures by purpose: increase in general administration; public welfare; sanitation; agriculture, forestry and fishery; and civil engineering work. - Revenues: increase in earthquake disaster reconstruction allocation tax grants; national treasury disbursements; and decrease in municipal tax.
Kawase (2015)	The Great East Japan Earthquake (March 11, 2011)	FY2010-2012	Ishinomaki City	- Expenditures by purpose: increase in public welfare; sanitation; and fire service. - Revenues: increase in LAT grants; earthquake disaster reconstruction allocation tax grants; and national treasury disbursements; and decrease in municipal tax.
Kuwada (2014)	The Great East Japan Earthquake (March 11, 2011)	FY2010-2012	Municipalities along the Pacific coast in Iwate Prefecture	- Expenditures by purpose: increase in general administration; public welfare; and sanitation. - Expenditures by function: increase in ordinary construction work; and reserve funds. - Revenues: increase in special LAT grants; earthquake disaster reconstruction allocation tax grants; and national treasury disbursement.
Sato and Kuwada (2015)	The Great East Japan Earthquake (March 11, 2011)	FY2001-2012	Iwate Prefecture	- Expenditure classified by function: decrease in investment expenses; and increase in reserve funds; and subsidizing. - Revenues: increase in national treasury disbursements (turned downward in 2012). - Others: increase in balance of local bonds; and deterioration of real debt service ratio.
Miyazaki (2017)	The Great East Japan Earthquake (March 11, 2011)	FY2010-2014	Municipalities in Iwate, Miyagi and Fukushima Prefectures	- Expenditures by purpose: increase in public welfare; agriculture, forestry and fishery; and civil engineering work. - Expenditures by function: increase in social assistance; non-personnel; and ordinary construction work. - Revenues: increase in individual inhabitant tax; and corporate inhabitant tax; and decrease in property tax.
Kuwada (2021a)	The Great East Japan Earthquake (March 11, 2011)	FY2009-2019	Municipalities along the Pacific coast in Iwate and Miyagi Prefectures	- Revenues: increase in municipal inhabitant tax on income; and large decrease in property tax in some municipalities.
Kuwada (2021b)	The 2016 Kumamoto Earthquake	FY2015-2018	Kumamoto Prefecture and municipalities in Kumamoto Prefecture	- Expenditures by purpose: increase in public welfare; sanitation; commerce and industry; and civil engineering work. - Revenues: increase in national treasury disbursements; and local bonds. - Others: not expected to meet the early financial soundness restoring standard.
Kuwada (2019)	The Typhoon Lionrock (typhoon No.10) in 2016	FY2015-2018	Iwate Prefecture, Iwaizumi town, Kuji City, and Miyako City	- Expenditures by purpose: increase in general administration; public welfare; civil engineering work; agriculture, forestry and industry; and commerce and industry. - Expenditures by function: increase in social assistance; non-personnel; and ordinary construction work. - Revenues: increase in special LAT grants, national treasury disbursements. - Others: almost no change in the ratios for measuring financial soundness.

tion grants for local governments affected by the GEJE), (ii) national treasury disbursements (include prefectural disbursements) grants to match disaster recovery projects, and (3) local bonds (except in the case of the GEJE) tend to increase.

In addition to these commonalities, we would like to mention some other interesting findings mentioned in previous studies. Oda (2003) examined the damage and financial situation of Abuta Town, which was damaged by the 1977 and 2000 Usu eruption. The study shows that the debt service ratio increased because investment in reconstruction projects was financed by local bonds, and that the main part of the projects related to disaster recovery was completed within two years. It is also noted that the real balance ratio[5] is generally

below the appropriate standard (3%-5%) and fell in FY2000.

Takeda (2009) looks at Wajima City, which suffered damage from the 2007 Noto Peninsula Earthquake, and Ojiya City, which was damaged by the 2004 Niigata Chuetsu Earthquake. It examines changes in the financial situation of the former in FY2006 and FY2007, and of the latter from FY2002 to FY2007. According to Article 8-2 of the Act on National Treasury's Sharing of Expenses for Public Engineering Works Damaged by Disaster, the government must take necessary measures to complete disaster recovery projects within 3 years that includes the year in which the disaster occurred. The paper reveals that the increase in total expenditure and revenue in Ojiya was limited to three years after the disaster. The paper argues, however, that even if the government provides extensive financial measures until recovery is complete, if sufficient financial resources are not secured for reconstruction, this could lead to a decline in the local economy.

Takayose (2014) discusses the national government's fiscal support measures for local governments taken in the Great Hanshin Earthquake and the GEJE. In addition, this paper examines the fiscal situation of Hyogo Prefecture and four cities and towns affected by the Great Hanshin Earthquake from FY1993 to FY1998, and the fiscal situation of Iwate, Miyagi, and Fukushima Prefectures, and five cities and towns affected by the GEJE from FY2010 to FY2012. Because of the relative lack of government financial support during the Great Hanshin Earthquake, Hyogo Prefecture and its cities and towns relied on local bonds to finance recovery and reconstruction, resulting in a significant increase in balances of local bonds and deterioration of various fiscal indexes. On the other hand, in the Great East Japan Earthquake, because of the generous fiscal support, the affected local governments were able to implement recovery and reconstruction projects without increasing their balances of local bonds, and various fiscal indicators did not deteriorate at all.

Yokoyama (2014a) examines the characteristics of the recovery and reconstruction projects in Okushiri Town, which was damaged by the 1993 Southwest-off Hokkaido Earthquake, and the changes in its expenditure and revenue items from FY1992 to FY2000. One of the unique features of Yokoyama (2014a) is that it examines changes in expenditures and revenues not only during the period when disaster recovery projects were being implemented, but also during the period when the projects were almost completed (FY1996-FY2000). On the expenditure side, it points out that ordinary construction work and subsidized ordinary public work accounted for a high proportion of expenditures due to reconstruction projects, and that debt service increased in line with the balance of local bonds. On the revenue side, while tax revenues, which temporarily declined due to the disaster, increased from before the disaster due to "special reconstruction procurement demand" from an influx of construction workers from outside the region, but subsequently declined again due to a re-

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[5] The real balance ratio is defined as the ratio of the real balance of payments to the standard fiscal scale. The real balance of payments is the formal balance of payments, i.e., total revenues minus total expenditures, subtracting the amount of financial resources to be carried over to the next fiscal year. The standard fiscal scale indicates the size of current general revenue that would normally be received by a local government under standard conditions, and is the amount of standard tax revenues, etc. plus ordinary LAT grants.

duction in the scale of disaster recovery projects.

Japan Finance Organization for Municipalities (2021) has taken Wajima City and Anamizu Town in Ishikawa Prefecture, which experienced the 2007 Noto Peninsula Earthquake, and Shingu City and Totsukawa Village in Wakayama Prefecture, which experienced Typhoon No. 12 in 2011. It examined the relatively long-term financial changes of these municipalities from two years before the disaster until FY2018, and in addition, interviews the municipalities affected by the disaster. The study also mentions changes in the real debt service ratios, future burden ratios, and ordinary balance ratios.[6] While some municipalities have experienced deterioration in these ratios, it was revealed that the main reasons for the deterioration were transfers to other accounts such as public enterprises and contributions to partial administrative unions, and that few municipalities responded that the disaster was the direct cause of the deterioration.

A relatively large number of studies have focused on the GEJE, including Yokoyama (2014b), Kawase (2015), Kuwada (2014), Sato and Kuwada (2015), Miyazaki (2017), and Kuwada (2021a), in addition to Takayose (2014) mentioned above.

Yokoyama (2014b) outlines the central government's support measures and summarizes both damage and also the recovery and reconstruction status of Ishinomaki City. Furthermore, it examines the financial situation of the city, citing its financial results from FY2010 to FY2012 and its fiscal outlook for FY2013 and beyond. The expenditure forecast indicates that mandatory expenses are expected to remain flat or increase due to the difficulty of reducing the number of public employees and an increase in public assistance expenses with the termination of various support measures. The revenue outlook indicates that a large recovery in overall municipal taxes is not expected, although an increase in municipal inhabitant taxes due to improved payroll income and an increase in property taxes due to the construction of new housing are expected. It is also stated that the earthquake disaster reconstruction allocation tax grants and national treasury disbursements related to restoration and reconstruction projects are expected to remain at a high level. In the overall budget forecast, expenses that are not covered by the central government's financial support are expected to be incurred, resulting in a shortfall of 5.36 billion yen over the three-year period from FY2013.

Kawase (2015), as well as Yokoyama (2014b), focuses on Ishinomaki City and assesses that the impact of the GEJE on the city's finances was minimally controlled by increasing the special LAT grants and the establishment of the earthquake disaster reconstruction allocation tax grants. It also points out that settlement of accounts was significantly lower than its budget for civil engineering work and disaster recovery, and that the reconstruction subsidy projects planned mainly for the infrastructure were not completed in the execution phase.

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[6] The real debt service ratio expresses the size of debt service as a percentage of the local government's fiscal size. The future burden ratio expresses the size of current liabilities, such as local bonds, as a percentage of the local government's fiscal size. The ordinary balance ratio is the ratio of the amount of general revenue that is spent on ordinary expenses to the total amount of general revenue that is received on current basis.

Kuwada (2014) reports the results of a detailed interview survey of 12 municipalities along the Pacific Coast in Iwate Prefecture and outlines the financial status of these municipalities from FY2010 to FY2012. It turns out that the more heavily damaged municipalities have larger total expenditures, increasing 14.8 times in Otsuchi Town, 11.2 times in Yamada Town, and 8.9 times in Rikuzentakata City for FY2012 compared to FY2010 expenditures. Local tax revenues remained flat or declined due to the exhaustion of the local economy and tax exemptions, but the revenue loss due to tax exemptions was covered by the earthquake disaster reconstruction allocation tax grants. The survey also stated that there was no significant change in local bond revenues, and that there was little need to issue bonds due to the central government's financial support.

Sato and Kuwada (2015) examine Iwate Prefecture's finances from FY2011 to FY2013 in detail, and also mention the characteristics of its financial results from FY2001 to FY2012. In Iwate Prefecture, the real debt service ratio and future burden ratio have remained high due to a cumulative increase in borrowings prior to the GEJE. It is expected that the future burden ratio will rise as the balance of reconstruction-related funds decreases due to the ongoing reversal of such funds.

Miyazaki (2017) analyzes the fiscal conditions from FY2010 to FY2014 for two groups of municipality groups: all 127 municipalities in Iwate, Miyagi, and Fukushima prefectures; and 37 of these municipalities in the coastal areas. While many studies focus on one or a few affected municipalities, the main feature of this study is that it attempts to capture the overall trends of each group. With regard to tax revenues, the study revealed that while inland municipalities have recovered to pre-disaster levels, coastal areas have not, and in particular, property tax revenues related to land and houses have declined significantly.

Kuwada (2021a) describes the actual status of the special zone system for reconstruction taxation and investigates changes in local tax revenues of coastal municipalities in Iwate and Miyagi prefectures from FY2009 to FY2019. Overall, in both prefectures, many municipalities increased their tax revenues in FY2019 compared to their pre-disaster levels. Separately, however, Otsuchi, Shichigahama, and Onagawa towns have taken longer to recover, largely because their property tax revenues have not recovered to pre-disaster levels. On the other hand, municipal inhabitant income tax revenues have recovered to pre-disaster levels in except half of Miyagi Prefecture's coastal municipalities, with Sendai City showing remarkable growth. From these trends, the paper concludes that interregional disparities exist in the recovery of tax revenues. Aside from tax revenues, according to the financial outlook by Rikuzentakata City, a revenue and expenditure shortfall of 310 million yen in FY2022 and 230 million yen in FY2023 is expected to occur, which is assumed to be offset by a withdrawal from the public finance adjustment fund.

As works dealing with natural disasters after the GEJE, Kuwada (2021b) and Kuwada (2019) can be cited.

Kuwada (2021b) clarifies the system and use of the reconstruction fund created in response to the 2016 Kumamoto Earthquake and examines the FY2015 financial statements to FY2017 budgets of the affected Kumamoto Prefecture and 15 municipalities in the prefec-

ture. With regard to the finances of those, the paper states that due to the large national government contribution to the restoration and reconstruction projects, the real financial burdens on those are only 4% to 7% of the total project cost, and that they are not expected to fall into a situation where they will reach the early financial soundness restoring standard under the Act on Assurance of Sound Financial Status of Local Governments.

Kuwada (2019) provides an overview of changes from the FY2015 financial statements to the FY2018 budget and industrial reconstruction policies in the affected local governments, focusing on Iwate Prefecture, Iwaizumi Town, Miyako City, and Kuji City, all of which were damaged by heavy rainstorms caused by Typhoon No. 10 in 2016. In Iwaizumi Town, the real single year balance for FY2016 was a deficit of 1.4 billion yen, but so far there has been little change in the ratios for measuring financial soundness.

We have reviewed the major domestic studies on natural disasters and local governments' finances, and we can point out the following four issues. (i) Earlier studies have shown that while expenditures tend to increase due to implementation of disaster recovery projects, revenues from special LAT grants and national treasury disbursements also tend to increase. Nevertheless, only about half of the previous studies discussed above mention the balance of payments. Specifically, Yokoyama (2014b) and Kuwada (2021a), which refer to the outlook of revenue and expenditure (formal balance of payments) of local governments; Oda (2003), Takayose (2014), and Japan Finance Organization for Municipalities (2021), which look at changes in the real balance ratio; and Kuwada (2019), which refers to the real single year balance. Neither of these studies, however, focuses mainly on the status of the balance of payments. (ii) Relatively little research has been conducted on natural disasters other than earthquakes, limited to Oda (2003), Kuwada (2019), and Japan Finance Organization for Municipalities (2021). (iii) Research that also focuses on the financial situation after four or five years from the disaster, that is, the period when all restoration projects have been completed, is limited to Yokoyama (2014a), Japan Finance Organization for Municipalities (2021) and Kuwada (2021a). (iv) With the exception of Miyazaki (2017), none of the studies attempted to grasp overall trends rather than focusing on individual affected municipalities, and none of the analyses were based on inferential statistics rather than descriptive statistics.

Thus, so far, there seems to be no empirical study that examines the impact of overall natural disasters not only on the revenue or expenditure items of local governments, but also on the balance of payments, using relatively long-term data that includes the recovery period.

III. Financial Support Measures for Affected Municipalities

As many previous studies have pointed out, the central government provides various financial assistance to disaster-affected local governments. This section briefly describes the mechanism of financial support through national treasury disbursements, the LAT grants, and the special LAT grants, focusing on disaster recovery projects related to public engi-

neering facilities.

When public engineering facilities managed by a government are damaged by a disaster, the government restores the damaged facilities to their original state. If it is difficult or inappropriate to restore them to their original state, installs replacement facilities. This is called a disaster recovery project.

Although disaster-affected municipalities can implement disaster recovery projects without receiving national treasury disbursements, in order to receive national treasury disbursements to implement disaster recovery projects related to public engineering facilities (rivers, coasts, erosion control facilities, roads, ports, fishing ports, sewage systems, parks, etc.), public schools, public housing, and various welfare facilities, the municipalities must meet the requirements stipulated in the Act on National Treasury's Sharing of Expenses for Project to Recover Public Civil Engineering Works Damaged by Disaster (hereinafter, "Sharing Act").[7] In addition, when the affected municipalities implement disaster recovery projects with national treasury disbursements for facilities other than public engineering facilities, such as farmland, agricultural facilities, and forest roads, they must meet the requirements stipulated in the Act on Temporary Measures for Subsidies from National Treasury for Expenses for Project to Recover Facilities for Agriculture, Forestry and Fisheries Damaged by Disaster (hereinafter, "Temporary Act").

The central government's share of disaster recovery projects related to public engineering facilities is determined as follows. The central government assesses the total amount of disaster recovery projects that meet the requirements of the Sharing Act during the year from January to December. The share of the central government's burden is excessively progressive. It bears 2/3 for the portion up to the amount equivalent to 50% of standard tax revenue of the affected municipality for that fiscal year, bears 75% for the portion exceeding 50% to 200% of the standard tax revenue, bears 100% for the portion exceeding 200% of the standard tax revenue, and bears 100% of the burden for the portion exceeding 200% of the standard tax revenue. The remainder is borne by the affected municipality, though the entire amount can be covered by the bonds for subsidized disaster recovery projects. Thus, 95% of the principal and interest repayments on these bonds are covered by the standard fiscal demand, which is the basis for calculating the LAT grants. As a result, even if the lowest subsidy rate of 2/3 under the Sharing Act, the actual burden is reduced to about 1.7% for the affected municipality that is eligible to receive the LAT grants (see Figure 2).

When a large-scale disaster occurs, the central government may designate the disaster as an extreme disaster in accordance with the Act on Special Financial Support to Deal with the Designated Disaster of Extreme Severity (hereinafter, "Extremely Severe Disaster Act"), reduce the amount of the local government's burden as determined by the Sharing Act or the Temporary Act, or provide special subsidies or other measures.

Extremely severe disasters are divided into nationwide and local extremely severe disas-
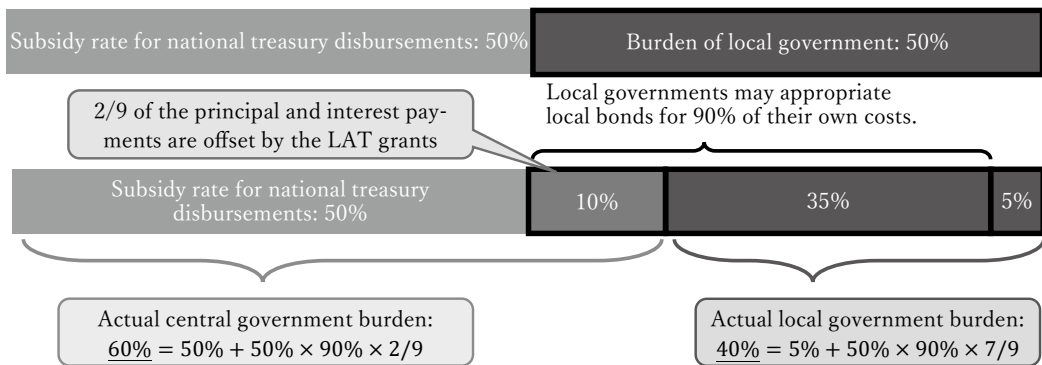
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[7] Specifically, the project must meet the following requirements: the disaster must be caused by an unusual natural phenomenon; the project cost per site must be at least 1.2 million yen for prefectures and ordinance designated cities, and at least 600 thousand yen for other municipalities; and the project must not be considered a maintenance work.

Figure 2: Cost sharing between central and local government in disaster recovery projects (subsidized projects)

○   In the case of subsidy rate for national treasury disbursements is 2/3 and the year in which the disaster occurred.

Subsidy rate for national treasury disbursements: 66.7%	Burden of local government: 33.3%

Local governments may appropriate local bonds for 100% of their own costs.

Subsidy rate for national treasury disbursements: 66.7%	95% of the principal and interest payments are offset by the LAT grants	

Actual central government burden: 98.3% = 66.7% + 33.3% × 95%

Actual local government burden: 1.7% = 33.3% × 5%
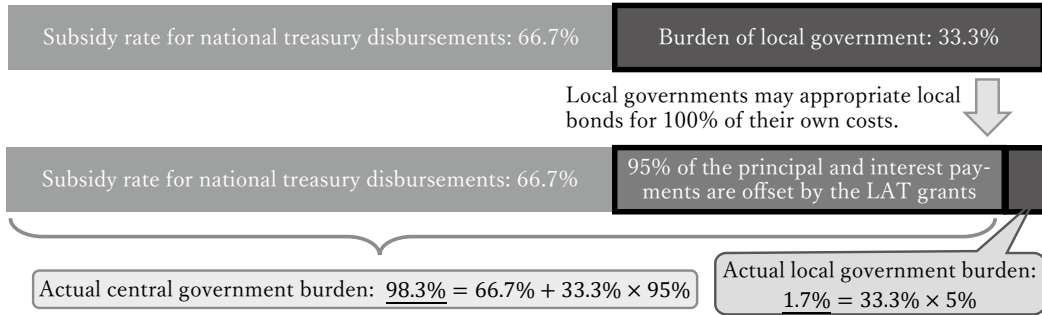
○   In the case of general public works projects (subsidy rate for national treasury disbursements is 50%).

Subsidy rate for national treasury disbursements: 50%	Burden of local government: 50%

2/9 of the principal and interest payments are offset by the LAT grants

Local governments may appropriate local bonds for 90% of their own costs.

Subsidy rate for national treasury disbursements: 50%	10%	35%	5%

Actual central government burden: 60% = 50% + 50% × 90% × 2/9

Actual local government burden: 40% = 5% + 50% × 90% × 7/9

Source: Prepared by authors from the Ministry of Land, Infrastructure, Transport and Tourism, "Outline of Subsidized Disaster Recovery Projects" (written in Japanese), https://www.mlit.go.jp/river/hourei_tsutatsu/bousai/saigai/hukkyuu/ppt.pdf, retrieved May 1, 2022.

ters. A nationwide extremely severe disaster is a disaster that meets the criteria for designation as an extremely severe disaster, and both disasters and applicable measures of aid and subsidies are designated. Applicable measures for the nationwide extremely severe disasters are roughly classified into (i) special financial assistance for disaster restoration of public engineering facilities, (ii) special subsidies for agriculture, forestry, and fisheries, (iii) special subsidies for small- and medium-sized enterprises, and (iv) other special financial assistance and subsidies, for a total of 22 types of applicable measures. On the other hand, the local extremely severe disasters are disasters that have not been designated as nationwide extremely severe disasters but meet the criteria for designation as the local extremely severe disasters. The designation of the local extremely severe disasters specifies the name of the affected prefecture and municipality in addition to the target disasters and applicable measures. There are eight types of applicable measures for local extremely severe disasters.

Both nationwide and local extremely severe disasters are all based on certain criteria.[8]

However, not all local governments affected by disasters designated as the nationwide extremely severe disasters or local governments designated as the local extremely severe disasters are eligible for the special assistances and subsidies. When the total amount of municipal burden due to extremely severe disasters during a year (from January to December) exceeds 5% (10% for prefectures) of its standard tax revenue in the same fiscal year, a public notice is issued to designate such municipalities as "Specified Local Public Entities." With this public notice, the municipality is eligible to receive special financial assistance and subsidies. Once a municipality is designated as the Specified Local Public Entity, it receives a grant that is the sum of its burden multiplied by an excessively progressive percentage.[9] According to the Workshop for disaster control system (2003), the percentage increase in the central government's burden for specified local public entities is generally around 10% to 20%. As a result, the final actual burden of local governments will be approximately 0.7% to 1.2% of the total project cost.

Although government subsidies do not apply to disaster restoration projects that do not meet the subsidy requirements stipulated in the Sharing Act and other laws, municipalities affected by extremely severe disasters can issue the Bonds for Small Disaster Restoration Project. For public engineering facilities, the appropriation rate of the bonds is 100%, and 66.5% to 95% of principal and interest payments are covered by the ordinary LAT grants, depending on the fiscal capacity index. Also, municipalities that have suffered damage from disasters other than extremely severe disasters may issue Bonds for Unsubsidized General

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[8] Among the measures applicable nationwide extremely severe disasters, in order for special financial assistance related to public engineering facilities disaster restoration projects, etc. to be applicable, there must be at least one prefecture that satisfies the following (A) or (B):
  (A) The estimated assessed amount of public facility disaster recovery project expenses, etc., exceeds 0.5% of the national total standard tax revenue.
  (B) The estimated assessed amount of public facility disaster recovery project expenses, etc., exceeds 0.2% of the national standard tax revenue, and either (b1) or (b2) below is met:
    (b1) There is at least one prefecture where the estimated amount of assessments for the affected prefecture exceeds 25% of the prefecture's standard tax revenue.
    (b2) There is at least one prefecture where the total estimated amount of assessments for the affected municipalities in the prefecture exceeds 25% of the prefectural total for municipal standard tax revenue.
Among the measures applicable to local extremely severe disasters, in order to be eligible for special financial assistance for public engineering facilities disaster recovery projects, etc., there must be at least one municipality that satisfies the following (A), (B), or (C):
  (A) The estimated assessed amount of public facility disaster recovery project expenses to be borne by the municipality exceeds the municipality's standard tax revenue × 50%.
  (B) In the case of a municipality with a standard tax revenue of 5 billion yen or less, the estimated assessed amount of public facility disaster recovery project expenses to be borne by the municipality exceeds the municipality's standard tax revenue × 20%.
  (C) In the case of a municipality with standard tax revenues exceeding 5 billion yen but not exceeding 10 billion yen, the estimated assessed amount of public facility disaster recovery project expenses, etc., to be borne by the municipality exceeds the municipality's standard tax revenues × 20% + (standard tax revenues − 5 billion yen) × 60%.
[9] In the case of a municipality, first, the normal local burden amount for restoration projects for extremely severe disasters is determined. Then, the amount of local contribution ranging from 5% to 10% of the standard tax revenue is multiplied by 60%; the amount ranging from 10% to 100% of the standard tax revenue is multiplied by 70%; the amount ranging from 100% to 200% of the standard tax revenue is multiplied by 75%; the amount ranging from 200% to 400% of the standard tax revenue is multiplied by 80%; the amount of local contribution in excess of 400% of the standard tax revenue is multiplied by 90%. The total of these amounts is the amount of special financial assistance.

Disaster Recovery Projects. The appropriation rate for these bonds is 100% in the case of public engineering facilities, and the ordinary LAT grants cover 47.5% to 85.5% of principal and interest repayments, depending on the fiscal capacity index. The special LAT grants are also available to cover 3% (1.5% for prefectures) of the amount of the subsidized disaster recovery projects (Figure 3).

Disaster-related calculations for the special LAT grants vary widely.[10] As shown in Figure 3, the special LAT grants are allocated according to the number of disaster-affected households, the number of destroyed houses, and the number of dead or missing persons, etc., as emergency measures. For disaster waste disposal projects, 50% of the total amount is subsidized by the central government, and 80% of the remaining municipal burden is covered by the special LAT grants. In addition, if a disaster satisfies certain criteria, such as being designated as an extremely severe disaster, the affected municipalities can issue the Bonds for Disaster Control for 20% of the remaining municipal burden, and 57% of principal and interest repayments of the bonds will be covered by the special LAT grants. Besides the Bonds for Disaster Control, there are other local bonds covered for part of principal and interest payments by the special LAT grants, such as the Bonds for Public Enterprises Disaster Recovery Project and the Bonds for Revenue Shortfall.

Local governments affected by the GEJE are designated as "Specified Disaster-affected Local Public Entities" by Cabinet Order under the Act for Extraordinary Expenditure and

Figure 3: Financial support through the special LAT grants

	Calculation Formula
Disaster recovery	- National treasury-related disaster recovery project expenses ×0.015 (prefectures) ×0.03 (municipalities)
Emergency response	- Number of disaster-affected households ×17,600 JPY (prefectures) ×23,500 JPY (municipalities)
	- Number of totally destroyed houses ×169,400JPY (municipalities) - Number of half-destroyed houses × 84,800JPY (municipalities) - Number of houses flooded above floor level × 4,800JPY (municipalities) - Number of houses flooded under floor level × 2,700JPY (municipalities)
	- Area of crops damaged × 3,400JPY (prefectures) × 6,700JPY (municipalities) - Area of crops damaged (damaged area exceeds 30%) × 5,400JPY (prefectures) × 9,600JPY (municipalities)
	- Number of dead and missing ×875,000JPY (prefectures and municipalities)
	- Number of handicapped persons ×437,000JPY (prefectures and municipalities)

Note: Unit prices are as of FY2017.
Source: Prepared by authors from the Ministry of Internal Affairs and Communications, "Comprehensive measures for demand in disaster through the special LAT grants" (written in Japanese), https://www.soumu.go.jp/main_content/000578166.pdf, retrieved May 1, 2022.

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[10] Asaba (2010) carefully describes disaster-related measures of the special LAT grants.

Assistance to Cope with Great East Japan Earthquake (hereinafter, "GEJE Special Act"), Article 2, paragraph 2. Initially, they were applied different national treasury burden rates from those under the Sharing Act and the Extreme Disaster Act. For example, the central government's burden rate for streets, improved housing, waterworks, general waste disposal facilities, traffic safety facilities, etc., and community drainage facilities were raised from 50% to 80% to 90% in principle. The rate for police facilities, firefighting facilities, public medical institutions, and public health centers were also raised from 1/3 or 50% to 2/3 in principle.[11] The rest of the local government's burden was financed entirely by bonds, and most or all the principal and interest payments were to be covered by the ordinary or special LAT grants. However, based on the fact that "Kobe City, which financially responded to the Great Hanshin Earthquake by issuing bonds and the LAT grants as usual, was subsequently burdened with a heavy debt service burden" (Kitamura, 2014), the central government established the earthquake disaster reconstruction allocation tax grants to cover the entire local burden of disaster restoration projects in the third supplementary budget for FY2011 by securing funds separately from the existing LAT grants system.[12] In addition to disaster recovery projects, there are other financial assistance programs that differ from those for general disasters. For example, the central government implements and bears the cost of disaster waste disposal projects that should normally be implemented and borne by the local governments.

IV. Summary of Administrative Cash Flow Statement[13]

The Ministry of Finance prepares the Administrative Cash Flow Statement to grasp the debt repayment capacity and cash flow (hereinafter, CF) status of local governments from the perspective of confirming the certainty of the repayment of fiscal loans. The Administrative Cash Flow Statement attempts to capture the flow of cash deposits (cash in hand, public finance adjustment fund, and sinking fund) in a fiscal year by dividing it into three parts: Administrative Activities part, Investing Activities part, and Financing Activities part (Figure 4).

The administrative activities part consists of "Administrative Expenditure" and "Administrative Revenue." The former includes expenses for administrative services that do not contribute to asset formation, while the latter includes general funds and specific funds that are used for the Administrative Expenditures. The difference between the Administrative Revenue and Expenditure is called "CF from Administrative Activities." Furthermore, based on whether or not the expenditures and revenues are made on a recurring basis each fiscal

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[11] Cabinet Office website, "Extreme Disaster Act, Great Hanshin Earthquake Special Act, Current Measures and Great East Japan Earthquake Special Act (revised July 29, 2011)" (written in Japanese), https://www.bousai.go.jp/2011daishinsai/pdf/siryo1_gekizin.pdf, retrieved May 1, 2022.
[12] Cabinet Office website, "Outline of Special Financial Assistance for Public Engineering Facilities Disaster Recovery Projects under the GEJE Special Act" (written in Japanese), https://www.bousai.go.jp/2011daishinsai/pdf/siryo4_higashi.pdf, retrieved May 1, 2022.
[13] The explanation in this section relies heavily on Ministry of Finance, Japan (2022).

Figure 4: Administrative Cash Flow Statement

■Administrative Activities■

Local tax
Local transfer tax
Local allocation tax grants
National treasury/Prefectural disbursements
Shares and charges, and contributions
Rents and fees, and charges
Business and other income

Cash Inflow from Ordinary Administrative Activities

Personnel expenses
Non-personnel expenses
Maintenance and repair
Social assistance
Subsidizing
Transfers to other accounts (excluding construction)
Interest payments

Cash Outflow from Ordinary Administrative Activities
Cash Flow from Ordinary Administrative Activities

Cash Inflow from Extraordinary Administrative Activities
Cash Outflow from Extraordinary Administrative Activities

Cash Flow from Administration Activities (A)

■Investing Activities■

National treasury/Prefectural disbursements
Shares and charges, and contributions
Income from property sales
Collection of loans
Fund withdrawals

Cash Inflow from Investing Activities

Ordinary construction work
Transfers to other accounts (construction related)
Investments and capital contributions
Loans
Fund accumulation

Cash Outflow from Investing Activities
Cash Flow from Investing Activities

■Financing Activities■

Local bond
　(of which, the Bonds for the Extraordinary Financial Measures)
Borrowing from the next fiscal year's account

Cash Inflow from Financing Activities

Repayment of principal
　(of which, the Bonds for the Extraordinary Financial Measures)
Repayment to the previous year's account

Cash Outflow from Financing Activities (B)
Cash Flow from Financing Activities

Net Cash Flow

Cash Flow from Administrative Activities after debt redemption (A-B)

Note:
Real debt
　(of which, local bonds)
Balance of reserve funds

Source: Prepared by authors from Ministry of Finance (2022) "Handbook for Grasping the Financial Status of Fiscal Loans for Local Governments (revised June 2022)".

year, the Administrative Expenditure is subdivided into "Cash Outflow from Ordinary Administrative Activities" and "Cash Outflow from Extraordinary Administrative Activities," while the Administrative Revenue is subdivided into "Cash Inflow from Ordinary Administrative Activities" and "Cash Inflow from Extraordinary Administrative Activities". The difference between the Cash Inflow and Outflow from Ordinary Administrative Activities is called "CF from Ordinary Administrative Activities," and the difference between Cash Inflow and Outflow from Extraordinary Administrative Activities is called "CF from Extraordinary Administrative Activities." The Cash Outflow from Extraordinary Administrative Activities mainly consists of disaster recovery project expenses and unemployment countermeasure project expenses. The Cash Inflow from Extraordinary Administrative Activities consists mainly of national treasury disbursements allocated to disaster restoration project expenses, unemployment countermeasure project expenses, and transfers from public corporations and property districts.[14]

The Investing Activities part consists of "Cash Outflow from Investing Activities" and "Cash Inflow from Investing Activities." The former is the expenses for administrative services that contribute to asset formation, i.e., ordinary construction work, transfers to other accounts (related to construction work), investments and capital contributions, loans, and fund accumulations. The latter are specific financial sources allocated to Cash Inflow from Investing Activities and revenues from the disposal of assets, i.e., national treasury disbursements (related to construction work), contributions, endowment income, proceeds from property sales, loan collections, and fund withdrawals.[15] The difference between Cash Inflow and Outflow from Investing Activities is called "CF from Investing Activities."

The Financial Activities part consists of "Cash Outflow from Financing Activities" and "Cash Inflow from Financing Activities." The former consists of expenditures that lead to a decrease in liabilities, i.e., principal repayments on local bonds and repayment to the previous year's account. The latter is revenues that lead to an increase in debt, i.e., the amount of local bond issues and borrowing from the next fiscal year's account. The difference between the Cash Inflow and Outflow from Financing Activities is called "CF from Financing Activities."

"Net CF" is the total of the CF from Administrative Activities, CF from Investing Activities, and CF from Financing Activities. The CFs mentioned above can be summarized as follows:

$$\text{Net CF} \equiv \begin{array}{c}\text{CF from}\\ \text{Administrative}\\ \text{Activities}\end{array} + \begin{array}{c}\text{CF from}\\ \text{Investing}\\ \text{Activities}\end{array} + \begin{array}{c}\text{CF from}\\ \text{Financing}\\ \text{Activities}\end{array}$$

---

[14] Disaster restoration project expenses are included in administrative special expenditures because they are restorations of damaged facilities in their original form and not expenditures that contribute to new assets.

[15] Fund accumulations in Cash Inflow from Investing Activities consists of accumulations from the special purpose funds, transfers to fixed investment funds, and transfers from the repayment funds, and does not include accumulations from the public finance adjustment funds and sinking funds. Fund withdrawals include withdrawals from special purpose funds, transfers from the fixed investment funds, and borrowing from the funds, and do not include withdrawals from the fiscal adjustment funds and sinking funds.

$$
\begin{array}{l}
\text{CF from} \\
\text{Administrative} \equiv \\
\text{Activities}
\end{array}
\begin{array}{l}
\text{CF from Ordinary} \\
\text{Administrative} \quad + \\
\text{Activities}
\end{array}
\begin{array}{l}
\text{CF from Extraordinary} \\
\text{Administrative} \\
\text{Activities}
\end{array}
$$

$$
= \left(
\begin{array}{c}
\text{Cash Inflow from} \\
\text{Ordinary Administrative} \\
\text{Activities}
\end{array}
-
\begin{array}{c}
\text{Cash Outflow from} \\
\text{Ordinary Administrative} \\
\text{Activities}
\end{array}
\right)
$$

$$
+ \left(
\begin{array}{c}
\text{Cash Inflow from} \\
\text{Extraordinary Administrative} \\
\text{Activities}
\end{array}
-
\begin{array}{c}
\text{Cash Outflow from} \\
\text{Extrardinary Administrative} \\
\text{Activities}
\end{array}
\right)
$$

$$
\begin{array}{l}
\text{CF from} \\
\text{Incesting} \equiv \\
\text{Activities}
\end{array}
\begin{array}{l}
\text{Cash Inflow from} \\
\text{Investing} \qquad - \\
\text{Activities}
\end{array}
\begin{array}{l}
\text{Cash Outflow from} \\
\text{Investing} \\
\text{Activities}
\end{array}
$$

$$
\begin{array}{l}
\text{CF from} \\
\text{Financing} \equiv \\
\text{Activities}
\end{array}
\begin{array}{l}
\text{Cash Inflow from} \\
\text{Financing} \qquad - \\
\text{Activities}
\end{array}
\begin{array}{l}
\text{Cash Outflow from} \\
\text{Financing} \\
\text{Activities}
\end{array}
$$

The differences between the Administrative CF Statement and the financial settlement statistics are as follows. First, in financial settlement statistics, withdrawals from the public finance adjustment fund and sinking fund are recorded as a revenue and accumulations are recorded as an expenditure, but in the Administrative CF Statement, none of these are recorded as a cash inflow or outflow because they are recognized as transfers of cash among items. Second, fund accumulations to special purpose funds for the sake of disposing of revenue surpluses are not recorded as the expenditure in the financial settlement statistics, but they are recorded as a cash outflow in the Administrative CF Statement because they are a decrease in cash. Third, carryovers from the previous year are recorded as a revenue in the financial settlement statistics, but are not recorded as a cash inflow in the Administrative CF Statement because they are part of the cash at the end of the previous year and are not a cash inflow during the current year.

Thus, the Net Cash Flow from Administrative Cash Flow Statement can be expressed as follows:

$$
\text{Net CF} \equiv \left(\text{revenue} - X - \frac{\text{carryovers from}}{\text{the previous year}} \right) - (\text{expenditure} - Y + Z)
$$

where X is withdrawals from the public finance adjustment fund and sinking fund, Y is the accumulations in the public finance adjustment fund and sinking fund, and Z is the accumulation in the purpose funds for the sake of disposing of revenue surpluses.

Using the idea that formal balance of payments is equal to revenue minus expenditure and that real balance of payments is equal to formal balance of payments minus financial resources that should be carried over to the next year, the relationship between the Net CF and the formal and real balance of payments from financial settlement statistics can be expressed as in equations (1) and (2).[16] From equations (1) and (2), even if the formal balance of payments or real balance is in the black, the Net CF may be in the red when the amount of car-

ryovers from the previous year is large compared to the financial resources that should be carried over to the next year, or when the outstanding balance of public finance adjustment fund and sinking fund is a net decrease ($Y-X<0$) and its amount is large.

$$\text{Net CF} = \frac{\text{formal balance}}{\text{of payments}} - \frac{\text{carryovers from}}{\text{the previous year}} + (Y-X) - Z \tag{1}$$

$$= \frac{\text{real balance}}{\text{of payments}} + \left(\begin{array}{c} \text{financial resources} \\ \text{that should be carried} \\ \text{over to the next year} \end{array} - \frac{\text{carryovers from}}{\text{the previous year}} \right) + (Y-X) - Z \tag{2}$$

The Administrative CF Statement provides not only primary balance (hereinafter, PB) but also stock information such as balance of reserve funds and real debt. The PB is generally obtained as the difference between revenue excluding local bonds and expenditure excluding debt services. When the reserve funds and carryovers are considered, the PB is redefined as the difference between the revenue excluding local bonds, carryovers, and withdrawals from the fiscal adjustment funds and sinking funds, and expenditure excluding public debt service and fund accumulations for those funds, as shown in equation (3).

$$\text{PB} \equiv \left\{ \text{revenue} - \left(\frac{\text{local}}{\text{bonds}} + \frac{\text{carriovers from}}{\text{the previous year}} + X \right) \right\} - \left\{ \text{expenditure} - \left(\frac{\text{debt}}{\text{services}} + Y \right) \right\}$$

$$= \frac{\text{formal balance}}{\text{of payments}} + \left(\frac{\text{debt}}{\text{services}} - \frac{\text{local}}{\text{bonds}} \right) + (Y-X) - \frac{\text{carriovers from}}{\text{the previous year}} \tag{3}$$

$$= \frac{\text{real balance}}{\text{of payments}} + \left(\frac{\text{debt}}{\text{services}} - \frac{\text{local}}{\text{bonds}} \right) + (Y-X)$$

$$ + \left(\begin{array}{c} \text{financial resources} \\ \text{that should be carried} \\ \text{over to the next year} \end{array} - \frac{\text{carriovers from}}{\text{the previous year}} \right) \tag{4}$$

$$= \text{Net CF} + \left(\frac{\text{debt}}{\text{services}} - \frac{\text{local}}{\text{bonds}} \right) + Z \tag{5}$$

From the definition equations of formal balance of payments and real balance of payments, we can obtain equations (4) and (5) as the relationship between the PB and the formal or real balance of payments in the financial settlement statistics. From equation (4), even if the real balance is in surplus, the PB may be in deficit when local bonds exceed debt services or when the outstanding balance of the public finance adjustment and sinking fund is in a net decrease.

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[16] When the formal balance of payments is in the red, the shortfall is compensated by bringing from the next fiscal year's revenue in practice. The effect of the increase in cash due to the supplementation is considered in the left-hand side of equation (1) (increase in the Cash Inflow from Financing Activities out of Net CF), but not in the right-hand side, since the formal balance of payments remains in the red figure. Therefore, when the formal balance of payments is in the red, the formal balance of payments in equation (1) is adjusted to the sum of the formal balance of payments and the bringing from the next fiscal year's revenue (the formal balance of payments is set to 0).

The reserve funds in the stock information are defined as the sum of cash deposits and the special purpose fund. Real debt is defined as a sum of the balance of local bonds and the amount equivalent to interest-bearing debt (borrowing from the next fiscal year's account, estimated amount to be paid after the next fiscal year due to liability obligations, shortfall in public enterprise accounts, estimated amount to be paid by the general account for land development corporations, and estimated amount to be paid by the general account for the third sector, etc.), minus reserve funds, etc.

The Administrative Cash Flow Statement captures the flow of cash deposits as follows: (A) The CF from Ordinary Administrative Activities is calculated; (B) the CF from Extraordinary Administrative Activities is added to this to obtain the CF from Administrative Activities; (C) the CF from Administrative Activities covers Cash Outflow from Investing Activities; and (D) the remainder (Cash Flow from Administrative Activities after Debt Redemption) and the Cash Inflow from Financing Activities and Investing Activities cover the Cash Outflow from Investing Activities. The CF from Administrative Activities indicates the basic ability of local governments to obtain financial resources, since it shows the change in cash deposits without withdrawing from reserve funds or issuing local bonds.

The CF from Administrative Activities is normally positive because its surplus needs to cover ordinary construction work expenses (the Cash Outflow from Investing Activities) and redemption of principal (the Cash Outflow from Financing Activities). However, when the CF from Extraordinary Administrative Activities is significantly negative due to the implementation of disaster recovery projects, the CF from Administrative Activities may become negative even though the CF from Ordinary Administrative Activities has a surplus.

V. Estimation

V-1. Hypothesis

We estimate in this section how the finances of the affected municipalities have changed over the years since the disaster. Prior to the estimation, we will make some predictions on the changes in CFs and other variables of the affected municipalities, considering the findings of previous studies.

First, the following effects are assumed for six indicators of income and expenditure: the Net CF from Administrative Activities, CF from Investing Activities, CF from Financing Activities, PB, and real balance (corresponding to **Estimation A** to be examined in Section V-2). During the first few years after the disaster, the CF from Extraordinary Administrative Activities may deteriorate due to the implementation of disaster recovery projects, while at the same time the CF from Ordinary Administrative Activities may increase due to financial support from the central government, so the impact on the Net CF from Administrative Activities is not certain. If the CF from Administrative Activities deteriorates, the municipalities may reduce the deficit in the Net CF from Investing Activities by curtailing public works projects and increase the CF from Financing Activities by issuing municipal bonds.

At the same time, as shown in equation (5), the PB is expected to worsen as local bonds increase. The CF from Administrative Activities may recover once the emergency and recovery measures are almost completed, because the CF from Extraordinary Administrative Activities will gradually improve, and the CF from Ordinary Administrative Activities will also increase due to the benefit of the LAT grants to cover the principal and interest payments on disaster recovery project bonds and other bonds. If the surplus in the CF from Administrative Activities is used to pay the principal and interest, then the CF from Financing Activities is expected to be in deficit and the PB is expected to ameliorate. As indicated in equation (2), the real balance of payments is expected to show a similar trend to the Net CF. The real balance of payments, however, will be smaller than the CF from Administrative Activities when the financial resources should be carried over to the next year's increase compared to the carryovers from the previous year because the implementation of restoration and recovery-related projects is postponed to the next year or later, or when there is a net increase in the public finance adjustment funds and sinking funds. Conversely, the real balance of payments will be larger than the CF from Administrative Activities when the financial resources to be carried over to the next year are small relative to the carryovers from the previous year, or when there is a net decrease in the public finance adjustment fund and sinking fund.

Next, the impact of the disaster on the CF from Administrative Activities is complex and not certain. Therefore, let us break down the CF from Administrative Activities into the CF from Ordinary Administrative Activities, Cash Inflow from Ordinary Administrative Revenues, Cash Outflow from Ordinary Administrative Activities, CF from Extraordinary Administrative Activities, Cash Inflow from Extraordinary Administrative Activities, and Cash Outflow from Extraordinary Administrative Activities, the following effects are assumed for each of them (corresponding to **Estimation B** to be examined in Section V-2). As mentioned above, immediately after a disaster strikes, the implementation of disaster restoration projects leads to a large increase in the Cash Outflow from Extraordinary Administrative Activities, and at the same time, the Cash Inflow from Extraordinary Administrative Activities is also expected to increase as part of its financial resources is covered by national treasury disbursements. If general revenues and local bonds were used to finance the disaster recovery project expenses, the CF from Extraordinary Administrative Activities would be in deficit. The Cash Inflow from Ordinary Administrative Revenues is expected to increase due to additional special LAT grants, while it may rather decrease if the impact of reduced tax revenues due to reduced local taxes or reduced income, etc. is greater. The Cash Outflow from Ordinary Administrative Activities may increase since it is expected that non-personnel and subsidizing expenditures for disaster waste disposal and reconstruction assistance will be incurred. Therefore, the impact on the CF from Ordinary Administrative Activities is not clear. Several years after the disaster, both the Cash Inflow and Outflow from Extraordinary Administrative Revenues are likely to decline, and the CF from Extraordinary Administrative Activities is expected to approach zero. The Cash Outflow from Ordinary Administrative Activities is expected to shrink as non-personnel expenses and subsidizing measures related

to emergency and recovery projects are completed. At the same time, the CF from Ordinary Administrative Activities is expected to expand as a result of an increase in Cash Inflow from Ordinary Administrative Activities due to the LAT grants to cover the principal and interest payments on bonds for disaster recovery projects.

The change in the Cash Inflow from Ordinary Administrative Revenues in the affected municipalities is also ambiguous. Breaking down the Cash Inflow from Ordinary Administrative Activities into the individual inhabitant tax, corporate inhabitant tax, property tax, LAT grants, special LAT grants, earthquake disaster reconstruction allocation tax grants, and national treasury disbursements, the following effects can be assumed for each of them (corresponding to **Estimation C** to be examined in Section V-2). Immediately after the disaster, individual inhabitant tax, corporate tax and property tax may decrease, but if reconstruction demand arises, it is likely to observe a tendency for them to increase. The LAT grants, special LAT grants, earthquake disaster reconstruction allocation tax grants, and national treasury disbursements will increase significantly immediately after the disaster. Among these, the LAT grants in particular are expected to be affected for a relatively long period of time as mentioned above. Looking at the expenditure side, the following effects are assumed for the main items of Cash Outflow from Ordinary Administrative Activities: personnel; non-personnel; subsidizing; and assistance (corresponding to **Estimation D** to be examined in Section V-2). Based on previous studies, it is expected that all of these expenses will increase in the first few years after a disaster.

Furthermore, after the disaster, not only disaster recovery projects but also investment activities for reconstruction are expected to be vigorous. The following effects are expected on national treasury disbursements, fund withdrawals, subsidized ordinary public work, subsidized ordinary public work, and fund accumulation, which constitute the Cash Inflow and Outflow from Investing Activities (corresponding to **Estimation E** to be examined in Section V-2). During the emergency and recovery response period, normal investment activities, especially non-subsidized ordinary public works, may be restrained, but subsidized ordinary public works to build public housing and roads for reconstruction will be implemented, so national treasury disbursements and subsidized ordinary public work are anticipated to increase. If the size of such subsidized ordinary public works is large enough, they may not be completed in a single year, but may be implemented over multiple years. In that case, fund withdrawals would occur after the funds for implementing subsidized ordinary public work have accumulated.

Finally, we would like to focus not only on flows but also on stocks. The following effects are assumed for the real debt, outstanding local bonds, reserve fund accumulations, fiscal adjustment funds, sinking funds, and special purpose funds (corresponding to **Estimation F** to be examined in Section V-2). If disaster recovery bonds are used to finance disaster recovery projects, the balance of local bonds will increase, and if a portion of the public finance adjustment fund is used to finance disaster recovery projects, that balance will decrease. However, in either case, the real debt is considered to grow. Several years after the disaster, the outstanding balance of local bonds may decrease as redemption of the bonds for

disaster recovery projects begins, but may also increase due to stimulating investment activity. If the outstanding balance of local bonds is on a downward trend, the sinking fund would also be expected to decline moderately. As noted earlier, the balance of the special purpose funds is expected to rise once the large investment activities have started to take place, but thereafter it is expected to begin to diminish.

Based on the above, we use the data on municipal cash flows in Section V-2 to test whether the above assumptions are valid.

V-2.   *Estimation Formula*

We estimate the following equation (6) as a panel estimation in this subsection using municipal data from FY2008 to FY2020 from the Administrative Cash Flow Statement outlined in Section IV to clarify the plausibility of the hypotheses in the previous subsection.

$$y_{it} = \alpha + \sum_{k=0}^{12} \beta^k x_{it}^k + \sum_{\ell=0}^{10} \widetilde{\beta}^\ell \widetilde{x}_{it}^\ell + \gamma z_{it} + \sum_{t=2009}^{2020} \theta_t d_t + \lambda_t + \mu_i + \varepsilon_{it} \tag{6}$$

y_{it} on the left side of equation (6) is the explained variable. As described in Section V-1, we first focus on the six indicators, the Net CF, CF from Administrative Activities, CF from Investing Activities, CF from Financing Activities, PB, and real balance of payments as a large grouping, and estimate the amount of these balances converted to per capita as the explained variable in order to standardize the differences in size among municipalities (**Estimation A**). Next, we decompose the per capita CF from Administrative Activities into the CF from Ordinary Administrative Activities, Cash Inflow from Ordinary Administrative Activities, Cash Outflow from Ordinary Administrative Activities, CF from Extraordinary Administrative Activities, Cash Inflow from Extraordinary Administrative Activities, and Cash Outflow from Extraordinary Administrative Activities, and also estimate models with these as explained variables (**Estimation B**). Furthermore, the main items of the per capita Cash Inflow from Ordinary Administrative Activities, i.e., individual inhabitant tax, corporate inhabitant tax, property tax, LAT grants, special LAT grants, earthquake disaster reconstruction allocation tax grants, and national treasury disbursements (included in Cash Inflow from Ordinary Administrative Activities), are estimated as explained variables (**Estimation C**). Similarly, we estimate the main items of Cash Outflow from Ordinary Administrative Activities, i.e., per capita personnel, non-personnel, non-personnel, subsidizing, and subsidizing expenses, as the explained variables (**Estimation D**). Subsequently, we decompose the per capita CF from Investing Activities into per capita national treasury disbursements (included in CF from Investment Activities), fund withdrawals, non-subsidized ordinary public work, subsidized ordinary public work, and fund accumulation. Models with these as explained variables are estimated (**Estimation E**). Finally, turning to the stock variables, we estimate the per capita real debt, outstanding balance of local bonds, reserve funds, public finance adjustment fund, the sinking fund, and special purpose funds as the explained variables (**estimation F**).

The second term on the right side of equation (6), x_{it}^k, is a dummy variable that is set to 1 if municipality i was designated as the Specified Local Public Entity (not including the Specified Disaster-affected Local Public Entities specified by government ordinance in the GEJE Special Act) for extremely severe disasters occurring k years ago ($k = 0$ means the first year of the disaster) in year t and 0 otherwise. For example, $x_{it}^0 = 1$ means that the municipality i was designated as the Specified Local Public Entity in fiscal year t, i.e., it was severely affected by a natural disaster in fiscal year t. $x_{it}^4 = 1$ and $x_{it}^7 = 1$ mean that it was affected by a natural disaster 4 and 7 years before fiscal year t, respectively. If $x_{it}^0 = 1$ holds, then x_{it+h}^h, since it means a natural disaster occurred h years earlier in fiscal year $t + h (\forall h \geq 0)$. Generally, the redemption period of bonds for disaster recovery projects is basically set at 10 years (with a deferment period of 2 years), we assumed that the recovery and reconstruction projects would be completed in 10 years, and set k to 13 years longer than the redemption period (i.e., $k = 0, \ldots, 12$). By looking at the coefficients β^k for the dummy variables x_{it}^k, it is possible to capture how many years after a disaster the effects of past disasters persist or emerge (up to 13 years). Because the Administrative Cash Flow Statement data are recorded from FY2007, the data for x_{it}^k were taken from the *Disaster Statistics* from FY1996, which is 12 years before FY2007.

$\tilde{x}_{it}^\ell$ in the third term on the right side of equation (6) is a dummy variable that is set to 1 if municipality i was designated as the Specified Disaster-affected Local Public Entity ℓ years ago in fiscal year t, and 0 otherwise ($\ell = 0$ means the first year of the GEJE).[17] The reason for using these dummy variables is to capture differences in the financial impact of the GEJE and other natural disasters. However, since the GEJE occurred in FY2010 and the latest year of data is FY2020, ℓ ranges from 0 to 10. $\tilde{\beta}^\ell$ are the coefficients of $\tilde{x}_{it}^\ell$.

z_{it} is a vector of control variables consisting of the log population and its square. γ is the coefficient vector of z_{it}. λ_t and μ_i mean time and individual effect, respectively. ε_{it} is the error term. The descriptive statistics for these variables are shown in Table 3 and Table 4.

V-3. Estimation Results

V-3-1. Estimation A

Table 5 presents the results for **Estimation A** with per capita Net CF from Administrative Activities, per capita CF from Investing Activities, per capita CF from Financing Activities, per capita PB, and per capita real balance of payments as the explained variables. The bold numbers in the rows from "Damaged by natural disaster first year dumdum" to "Damaged by natural disaster 12-year passing dummy" are the estimated β^k values. Similarly, the bold numbers in the rows from "Damaged by the GEJE first year dummy" to "Damaged by

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[17] The Cabinet Order concerning the designation of Specified Disaster-affected Local Public Entities came into effect on May 2, 2011, and was partially replaced by two subsequent amendments. Therefore, the most recent Specified Disaster-affected Local Public Entities are used in our analysis. For the names of designated municipalities, see "List of the Specified Disaster-affected Local Public Entities and Areas" (https://www.bousai.go.jp/2011daishinsai/2011jyosei-tokutei.html, viewed on May 1, 2022) by the Cabinet Office.

Table 3: Descriptive Statistics (Part 1)

	sample size	Avg	S.D.	Min	Max
Net CF†	24,302	7.00	53.01	-2593	1844
CF from Administrative Activities†	24,302	93.46	131.84	-1143	6604
CF from Investing Activities†	24,302	-82.59	125.54	-6550	1111
CF from Financing Activities†	24,302	-3.86	59.37	-1214	1448
PB†	24,302	18.14	90.15	-2790	1808
Real balance ratio	24,374	5.91	8.27	-730.7	131.3
CF from Ordinary Administrative Activities†	24,302	88.31	125.21	-1146	6634
Cash Inflow from Ordinary Administrative Activities†	24,302	518.80	360.12	157	7220
Cash Outflow from Ordinary Administrative Activities†	24,302	430.50	272.80	121	4862
CF from Extraordinary Administrative Activities†	24,302	5.16	28.56	-401	1340
Cash Inflow from Extraordinary Administrative Activities†	24,302	7.77	25.21	0	1368
Cash Outflow from Extraordinary Administrative Activities†	24,302	8.77	40.00	0	1378
Individual inhabitant tax†	24,302	42.97	17.31	4	310
Corporate inhabitant tax†	24,302	9.53	11.97	0	470
Property tax†	24,302	66.37	69.64	0	1795
LAT grants†	24,302	234.44	268.23	0	3547
Special LAT grants†	24,302	28.66	48.27	0	1180
Earthquake disaster reconstruction allocation tax grants†	24,302	3.44	31.76	0	1339
National treasury disbursements (ordinary administrative activities)†	24,302	98.12	114.70	16	6735
Personnel expenses†	24,302	104.31	74.60	28	1078
Non-personnel expenses†	24,302	95.85	112.24	21	4277
Social assistance†	24,302	67.28	28.67	8	745
Subsidizing†	24,302	87.76	79.11	7	1275
National treasury disbursements (extraordinary administrative activities)†	24,302	5.09	29.25	0	1164
Disaster recovery project expenses†	24,302	8.70	39.89	0	1373
Government and other expenditures (investment income)†	24,302	42.96	157.56	0	8733
Fund withdrawal†	24,302	18.38	87.98	0	4113
Non-subsidized ordinary public work†	24,302	57.92	88.06	0	2434
Subsidized ordinary public work†	24,302	63.99	173.93	0	8727
Fund accumulation†	24,302	24.49	126.70	-89	6694

Note: Variables marked with † indicate that they are per capita.

Table 4: Descriptive Statistics (Part 2)

	sample size	Avg	S.D.	Min	Max
Balance of real debt†	24,302	307.40	618.19	-12373	6417
Balance of local bonds†	24,302	648.29	562.80	0	9959
Balance of reserve funds†	24,302	359.84	659.93	0	12659
Balance of public finance adjustment funds†	24,302	125.10	237.60	0	7772
Balance of sinking funds†	24,302	37.37	97.24	0	2496
Balance of special purpose funds†	24,302	164.62	412.36	0	11856
Natural disaster damaged first year dummy	24,374	0.03	0.16	0	1
Same 1-year passing dummy	24,374	0.03	0.16	0	1
Same 2-year passing dummy	24,374	0.03	0.17	0	1
Same 3-year passing dummy	24,374	0.03	0.17	0	1
Same 4-year passing dummy	24,374	0.03	0.17	0	1
Same 5-year passing dummy	24,374	0.03	0.18	0	1
Same 6-year passing dummy	24,374	0.03	0.18	0	1
Same 7-year passing dummy	24,374	0.03	0.18	0	1
Same 8-year passing dummy	24,374	0.03	0.18	0	1
Same 9-year passing dummy	24,374	0.03	0.17	0	1
Same 10-year passing dummy	24,374	0.03	0.17	0	1
Same 11-year passing dummy	24,374	0.03	0.17	0	1
Same 12-year passing dummy	24,374	0.03	0.16	0	1
GEJE damaged first year dummy	24,374	0.01	0.09	0	1
Same 1-year passing dummy	24,374	0.01	0.09	0	1
Same 2-year passing dummy	24,374	0.01	0.09	0	1
Same 3-year passing dummy	24,374	0.01	0.09	0	1
Same 4-year passing dummy	24,374	0.01	0.09	0	1
Same 5-year passing dummy	24,374	0.01	0.09	0	1
Same 6-year passing dummy	24,374	0.01	0.09	0	1
Same 7-year passing dummy	24,374	0.01	0.09	0	1
Same 8-year passing dummy	24,374	0.01	0.09	0	1
Same 9-year passing dummy	24,374	0.01	0.09	0	1
Same 10-year passing dummy	24,374	0.01	0.09	0	1
Log population	24,302	10.10	1.48	5.06	15.14

Note: Variables marked with † indicate that they are per capita.

Table 5: Estimated results on per capita CF, etc. (Estimate 1)

Variable	Net CF		CF from Administrative Activities		CF from Investing Activities		CF from Financing Activities		PB		Real balance ratio	
Damaged by natural disaster												
First year dummy	2.75	(1.20)	-15.27 ***	(-4.48)	2.84	(0.72)	15.18 ***	(6.41)	-11.72 ***	(-3.29)	0.79 **	(2.46)
1-year passing dummy	-8.75 ***	(-3.89)	-19.50 ***	(-5.82)	1.06	(0.27)	9.70 ***	(4.16)	-16.87 ***	(-4.81)	0.58 *	(1.84)
2-year passing dummy	1.81	(0.80)	-5.75 *	(-1.70)	3.58	(0.92)	3.97 *	(1.69)	-0.25	(-0.07)	0.80 **	(2.49)
3-year passing dummy	0.14	(0.07)	-4.17	(-1.29)	0.23	(0.06)	4.09 *	(1.82)	-0.42	(-0.13)	0.92 ***	(3.00)
4-year passing dummy	1.03	(0.48)	-2.91	(-0.91)	3.02	(0.82)	0.92	(0.41)	3.39	(1.02)	0.80 ***	(2.66)
5-year passing dummy	0.14	(0.07)	3.97	(1.24)	-2.79	(-0.76)	-1.04	(-0.47)	4.45	(1.34)	0.42	(1.40)
6-year passing dummy	0.52	(0.25)	8.51 ***	(2.72)	-2.07	(-0.57)	-5.91 ***	(-2.72)	9.13 ***	(2.80)	0.16	(0.53)
7-year passing dummy	-0.90	(-0.43)	1.26	(0.40)	3.61	(1.00)	-5.78 ***	(-2.65)	7.58 **	(2.31)	0.18	(0.62)
8-year passing dummy	2.97	(1.43)	10.92 ***	(3.51)	-3.70	(-1.03)	-4.25 **	(-1.97)	9.19 ***	(2.83)	-0.02	(-0.06)
9-year passing dummy	4.68 **	(2.23)	13.94 ***	(4.46)	0.12	(0.03)	-9.38 ***	(-4.32)	15.49 ***	(4.74)	0.02	(0.05)
10-year passing dummy	3.09	(1.44)	8.84 ***	(2.77)	-2.63	(-0.71)	-3.13	(-1.41)	7.84 **	(2.35)	0.23	(0.75)
11-year passing dummy	4.06 *	(1.86)	3.44	(1.06)	6.42 *	(1.71)	-5.80 **	(-2.56)	11.24 ***	(3.30)	0.29	(0.94)
12-year passing dummy	-0.11	(-0.05)	-1.18	(-0.36)	0.19	(0.05)	0.88	(0.39)	0.21	(0.06)	0.07	(0.24)
Damaged by the GEJE												
First year dummy	-5.76	(-1.23)	-13.88 **	(-1.99)	9.05	(1.13)	-0.93	(-0.19)	-6.28	(-0.86)	-0.57	(-0.87)
1-year passing dummy	30.88 ***	(6.61)	39.70 ***	(5.70)	-6.43	(-0.80)	-2.38	(-0.49)	32.09 ***	(4.41)	3.97 ***	(6.01)
2-year passing dummy	19.79 ***	(4.25)	23.48 ***	(3.38)	4.40	(0.55)	-8.09 *	(-1.68)	26.69 ***	(3.67)	4.08 ***	(6.21)
3-year passing dummy	10.59 **	(2.28)	22.07 ***	(3.18)	0.95	(0.12)	-12.42 **	(-2.58)	22.09 ***	(3.05)	3.35 ***	(5.10)
4-year passing dummy	6.22	(1.34)	99.18 ***	(14.30)	-80.27 ***	(-10.03)	-12.70 ***	(-2.64)	18.70 **	(2.58)	4.37 ***	(6.65)
5-year passing dummy	-2.36	(-0.51)	41.22 ***	(5.95)	-30.41 ***	(-3.80)	-13.18 ***	(-2.74)	10.51	(1.45)	2.54 ***	(3.88)
6-year passing dummy	-9.64 **	(-2.08)	37.51 ***	(5.42)	-37.27 ***	(-4.66)	-9.88 **	(-2.05)	-0.23	(-0.03)	3.92 ***	(5.98)
7-year passing dummy	-10.25 **	(-2.21)	33.86 ***	(4.89)	-27.60 ***	(-3.45)	-16.50 ***	(-3.43)	6.07	(0.84)	2.58 ***	(3.94)
8-year passing dummy	-5.19	(-1.12)	20.11 ***	(2.90)	-8.32	(-1.04)	-16.97 ***	(-3.53)	11.64	(1.61)	3.02 ***	(4.61)
9-year passing dummy	7.91 *	(1.70)	25.90 ***	(3.73)	-0.61	(-0.08)	-17.39 ***	(-3.60)	24.95 ***	(3.43)	2.16 ***	(3.28)
10-year passing dummy	-5.19	(-1.11)	17.73 **	(2.55)	-12.34	(-1.54)	-10.58 **	(-2.19)	4.94	(0.68)	1.38 **	(2.10)
within R2	0.059		0.066		0.042		0.121		0.131		0.062	
Model	FE		FE		FE		FE		FE		FE	

Note 1: The numbers in bold and in parentheses represent coefficients and t-values, respectively.
Note 2: *** means rejecting the null hypothesis that the coefficient is zero at 1%, ** means 5%, and * means 10% significance level.
Note 3: Due to paper space limitations, reports other than the coefficients of dummy variables for the number of years passed since the disaster have been omitted.

the GEJE 10-year passing dummy" are the estimated $\tilde{\beta}^{\ell}$ values. The numbers in parentheses to the right of the coefficients are the standard errors. The following trends appear in the CF situation of the municipalities.

First, let us examine the coefficients of the dummy variables for the number of years passed since the natural disaster. In the per capita Net CF column, only the coefficient of the 1-year passing dummy after natural disaster is significantly negative, indicating that the Specified Local Public Entity's CF is temporarily severe in the year following the occurrence of the natural disaster. The estimated results for per capita CF from Administrative Activities and CF from Financing Activities show that for Specified Local Public Entities, per capita CF from Administrative Activities decreased by 15 thousand yen in the first year of the disaster and by 20 thousand yen in the following year. The decrease in the CF from Administrative Activities was compensated by a surplus in the CF from Financing Activities in the first year of the natural disaster, but was not fully compensated one year later, resulting in the Net CF turning into a deficit. In light of the findings of Oda (2003) and Takeda (2009), it can be concluded that if most disaster recovery projects are almost implemented within 3 years including the year of the disaster, the CF situation of local governments during the emergency and recovery response period are going to be temporarily severe, even if bonds for disaster recovery projects are issued or financial assistance is provided by the central government. PB also deteriorated in the first year of the disaster and the following year, with similar trends observed for the CF from Administrative Activities.

Second, it was expected that the real balance of payments of the Specified Local Public Entities would be linked to some extent to the CF from Administrative Activities, but in fact it was not. Contrary to that expectation, it is noteworthy that a positive and significant sign is observed from immediately after the disaster until 4 years later. In other words, the Specified Local Public Entities seem to improve their financial situation immediately after the natural disaster, with per capita real balance of payments of 2-5 thousand yen more than the rest of municipalities. Let us recall that in equation (2), the Net CF includes not only the real balance of payments but also the net increase in the public finance adjustment fund and sinking fund Y-X. Although the real balance of payments increases among the Specified Local Public Entities, it is inferred that the decrease in the public finance adjustment funds and sinking funds has led to a cash outflow, pulling down the Net CF total. This interpretation is going to be reconfirmed in **Estimation F**.

Third, the CF from Administrative Activities of the Specified Local Public Entities generally shows signs of improvement after approximately 6 years from disaster. 6 years after the disaster, the CF from Administrative Activities improves and a portion of the CF is used for debt redemption, thereby decreasing the CF from Financing Activities and improving PB. Then, can we conclude from these results that restoration projects are almost complete and full-scale recovery will be realized 6 years after the disaster? To answer this question, it is necessary to examine the estimation results of **Estimation C**, which decomposes the Cash Inflow from Ordinary Administrative Activities.

Finally, the CF situation of the Specified Disaster-affected Local Public Entities presents

a completely different picture from that of the Specified Local Public Entities. The Net CF for the Specified Disaster-affected Local Public Entities increased from one year to three years after the GEJE, indicating that CF improved significantly in the municipalities affected by the GEJE during this period. The CF from Administrative Activities also decreased in the first year of the GEJE, but increased consistently from the following year, resulting in a per capita difference of approximately 100 thousand yen compared to Non-specified Disaster-affected Local Public Entities four years later. The CF from Investing Activities declined significantly from 4 to 7 years after the GEJE, and it is considered that public works projects with a burden on the municipalities were intensively implemented during this period. The CF from Financing Activities was almost consistently negative, contributing to a decrease in debt. In addition, while the real balance of payments shows improvement in most years, it is not linked to the trend of the Net CF turning negative in the 6th and 7th year after the GEJE.

V-3-2.   Estimation B

Table 6 shows the estimation results of **Estimation B** with the CFs subdivided by per capita CF from Administrative Activities as the explained variable. Concretely, in addition to per capita CF from Ordinary and Extraordinary Administrative Activities, the former is further subdivided into per capita Cash Inflow and Outflow from Ordinary Administrative Activities, and the latter is further subdivided into per capita Cash Inflow and Outflow from Extraordinary Administrative Activities. The following general trends can be pointed out.

First, the results of the estimation of the CF from Ordinary and Extraordinary Administrative Activities for the Specified Local Public Entities reveal the following two points. One is that the reason for the deterioration of the CF from Administrative Activities in the 3rd year immediately after the natural disaster for the Specified Local Public Entities in Table 5 is that the CF from Ordinary Administrative Activities does not grow enough to make up for the shortfall in CF from Extraordinary Administrative Activities in the same period. The other is that the reason for the improvement in the CF from Administrative Activities was that both the CF from Ordinary and Extraordinary Administrative Activities improved after 6 years of the disaster.

Second, focusing on the Cash Inflow and Outflow from Extraordinary Administrative Activities of the Specified Local Public Entities, the coefficients of each are very large for the first three years after the natural disaster, but the coefficients of cash outflow are always larger than those of cash inflow. This is not surprising, given that disaster recovery project expenses are included in the Cash Outflow from Extraordinary Administrative Activities, and the national treasury disbursements allocated to these expenses are included in the Cash Inflow from Extraordinary Administrative Activities. This is because a part of the disaster recovery project expenses is covered by national treasury disbursements, and the shortfall is covered by local bonds (Cash Inflow from Financing Activities) and general revenues (Cash Inflow from Ordinary Administrative Activities).

Third, although the impact of the disaster on the CF from Administrative Activities in the first year was not statistically significant, significant positive impacts are obtained in the

Table 6: Estimated results on per capita CF from ordinary/extraordinary administrative activities, etc. (Estimate 2)

Variable	CF from Ordinary Administrative Activities	Cash Inflow from Ordinary Administrative Activities	Cash Outflow from Ordinary Administrative Activities	CF from Extraordinary Administrative Activities	Cash Inflow from Extraordinary Administrative Activities	Cash Outflow from Extraordinary Administrative Activities
Damaged by natural disaster						
First year dummy	**2.69** (0.82)	**13.75*** (3.42)	**11.05*** (3.50)	**-18.86*** (-18.43)	**19.33*** (13.60)	**37.29*** (27.05)
1-year passing dummy	**-6.43** (-1.98)	**0.42** (0.11)	**6.85** (2.21)	**-13.98*** (-13.95)	**46.54*** (33.29)	**59.62*** (43.96)
2-year passing dummy	**-0.81** (-0.25)	**2.50** (0.63)	**3.31** (1.06)	**-5.87*** (-5.84)	**15.82*** (11.23)	**20.75*** (15.19)
3-year passing dummy	**-3.24** (-1.04)	**0.22** (0.06)	**3.46** (1.16)	**-1.59*** (-1.67)	**1.35** (1.00)	**2.29** (1.75)
4-year passing dummy	**-1.17** (-0.38)	**5.65** (1.50)	**6.81** (2.31)	**-2.40** (-2.54)	**0.16** (0.12)	**1.90** (1.47)
5-year passing dummy	**3.64** (1.18)	**15.40*** (4.09)	**11.76*** (3.99)	**-0.25** (-0.26)	**2.48*** (1.86)	**2.15*** (1.67)
6-year passing dummy	**7.10** (2.35)	**9.72*** (2.64)	**2.62** (0.91)	**0.78** (0.84)	**4.25*** (3.26)	**2.84** (2.24)
7-year passing dummy	**2.63** (0.87)	**11.31*** (3.06)	**8.67*** (2.99)	**-2.01** (-2.17)	**-1.57** (-1.20)	**-0.20** (-0.16)
8-year passing dummy	**12.17*** (4.05)	**12.61*** (3.44)	**0.44** (0.15)	**-1.86** (-2.02)	**1.33** (1.03)	**2.59*** (2.06)
9-year passing dummy	**11.17*** (3.70)	**14.06*** (3.81)	**2.90** (1.00)	**2.21** (2.38)	**0.26** (0.20)	**-2.51** (-1.99)
10-year passing dummy	**8.84*** (2.87)	**13.72*** (3.64)	**4.88*** (1.65)	**-0.58** (-0.61)	**0.63** (0.47)	**0.62** (0.48)
11-year passing dummy	**5.14** (1.63)	**9.84** (2.56)	**4.69** (1.56)	**-2.44** (-2.54)	**6.31*** (4.65)	**8.01*** (6.08)
12-year passing dummy	**0.54** (0.17)	**3.00** (0.78)	**2.46** (0.82)	**-2.52*** (-2.64)	**2.85** (2.10)	**4.57*** (3.48)
Damaged by the GEJE						
First year dummy	**-15.25** (-2.27)	**-14.08*** (-1.71)	**1.17** (0.18)	**0.70** (0.35)	**0.82** (0.28)	**-0.54** (-0.19)
1-year passing dummy	**50.57*** (7.51)	**116.16*** (14.13)	**65.59*** (10.17)	**-11.66*** (-5.81)	**28.19*** (9.71)	**39.06*** (13.87)
2-year passing dummy	**30.77*** (4.58)	**135.97*** (16.58)	**105.20*** (16.35)	**-8.09*** (-4.04)	**41.49*** (14.32)	**48.78*** (17.36)
3-year passing dummy	**28.71*** (4.28)	**127.11*** (15.53)	**98.40*** (15.32)	**-7.42*** (-3.72)	**33.00*** (11.41)	**39.64*** (14.13)
4-year passing dummy	**102.49*** (15.30)	**161.76*** (19.77)	**59.28*** (9.23)	**-4.11** (-2.06)	**19.32*** (6.69)	**22.63*** (8.07)
5-year passing dummy	**46.49*** (6.94)	**105.36*** (12.88)	**58.86*** (9.17)	**-6.15*** (-3.08)	**18.30*** (6.33)	**23.57*** (8.41)
6-year passing dummy	**37.25*** (5.57)	**86.08*** (10.53)	**48.83*** (7.62)	**-0.60** (-0.30)	**24.91*** (8.63)	**24.65*** (8.80)
7-year passing dummy	**32.92*** (4.92)	**57.97*** (7.10)	**25.06*** (3.91)	**0.14** (0.07)	**21.11*** (7.32)	**20.17*** (7.21)
8-year passing dummy	**17.44*** (2.61)	**45.87*** (5.61)	**28.43*** (4.44)	**1.83** (0.92)	**19.41*** (6.72)	**16.73*** (5.98)
9-year passing dummy	**26.53*** (3.95)	**50.39*** (6.14)	**23.86*** (3.71)	**-1.31** (-0.65)	**12.29*** (4.24)	**12.92*** (4.60)
10-year passing dummy	**3.14** (0.47)	**27.35*** (3.33)	**24.21*** (3.76)	**13.87*** (6.94)	**34.30*** (11.83)	**19.71*** (7.01)
within R2	0.067	0.414	0.579	0.027	0.088	0.146
Model	FE	FE	FE	RE	FE	FE

Note 1: The numbers in bold and in parentheses represent coefficients and t-values, respectively.

Note 2: ***means rejecting the null hypothesis that the coefficient is zero at 1%, **means 5%, and *means 10% significance level.

Note 3: Due to paper space limitations, reports other than the coefficients of dummy variables for the number of years passed since the disaster have been omitted.

first year for the Cash Inflow and Outflow from Ordinary Administrative Activities, respectively. This indicates that both Cash Inflow and Outflow from Ordinary Administrative Activities are affected by the disaster. In addition, the consistent and significant increase in the Cash Inflow from Ordinary Administrative Revenues from the 5th year after the disaster results in a surplus in the CF from Ordinary Administrative Activities. The detailed interpretation of the estimated results in the Cash Inflow and Outflow from Ordinary Administrative Activities will be discussed in light of the estimated results in the subsequent Table 7 (**Estimation C**) and Table 8 (**Estimation D**).

Finally, in the Specified Disaster-affected Local Public Entities, the CF from Ordinary Administrative Activities deteriorated as a result of a drop in the Cash Inflow from Ordinary Administrative Activities in the first year, thereafter, it has always greatly exceeded the Cash Outflow from Ordinary Administrative Activities, significantly boosting the CF from Ordinary Administrative Activities. The large excess of the CF from Ordinary Administrative Activities greatly exceeded the shortfall in the CF from Extraordinary Administrative Activities, leading to the increase in the CF from Administrative Activities as shown in Table 5. The CF from Extraordinary Administrative Activities continues to be in deficit until 5 years after the GEJE, but generally resolves itself afterwards, a trend similar to that of the Specified Local Public Entities. However, the trends of the Cash Inflow and Outflow from Extraordinary Administrative Activities differ from those of the Specified Local Public Entities to the extent that they have continued to increase for 10 years after the occurrence of the GEJE.

V-3-3.　Estimation C

Table 7 shows the estimation results of **Estimation C** using the major components of per capita Cash Inflow from Ordinary Administrative Activities as the explained variables: per capita individual inhabitant tax; per capita corporate inhabitant tax; per capita property tax; per capita LAT grants; per capita special LAT grants; per capita earthquake disaster reconstruction allocation grants; and per capita national treasury expenditures (included in the Cash Inflow from Ordinary Administrative Activities).

For the Specified Local Public Entities, significant positive values are obtained for the per capita individual inhabitant tax in the 1st, 3rd, and 6th years after the natural disaster, but the coefficients are small, ranging from 0.2 to 0.3 thousand yen per capita. In addition, a significant negative value is obtained for per capita property tax in the first three years, but the coefficients are all small. No significant results are obtained for per capita corporate inhabitant tax. The recovery of tax revenues due to reconstruction demand, as pointed out by Yokoyama (2014a), is not confirmed as an overall trend for the Specified Local Public Entities. In Table 6, the Cash Inflow from Ordinary Administrative Revenues was significantly positive after the 5th year from the disaster, but this is not due to a recovery in tax revenues from reconstruction, but rather to increases in LAT grants and special LAT grants. In fact, in many years, the coefficients against LAT grants and special LAT grants are positive and significant, and the values of the coefficients are also higher than those of various tax revenues.

Table 7: Estimated results on per capita cash inflow items included in ordinary administrative activities (Estimate 3)

variable	Individual inhabitant tax	Corporate inhabitant tax	Property tax	LAT grants	Special LAT grants	Earthquake disaster reconstruction allocation tax grants	National treasury disbursements
Damaged by natural disaster							
First year dummy	**0.33** ** (2.22)	**0.16** (0.61)	**-1.16** * (-1.75)	**13.14** *** (8.24)	**16.92** *** (27.68)	**0.92** (0.99)	**2.33** (0.76)
1-year passing dummy	**-0.09** (-0.60)	**-0.12** (-0.46)	**-1.11** * (-1.69)	**1.93** (1.23)	**3.47** *** (5.77)	**-0.19** (-0.20)	**1.77** (0.59)
2-year passing dummy	**0.11** (0.75)	**0.16** (0.60)	**-1.24** * (-1.87)	**4.76** *** (3.01)	**4.97** *** (8.20)	**0.03** (0.03)	**-0.97** (-0.32)
3-year passing dummy	**0.28** * (2.00)	**-0.13** (-0.51)	**-0.95** (-1.50)	**0.95** (0.63)	**3.19** *** (5.52)	**0.42** (0.48)	**-0.03** (-0.01)
4-year passing dummy	**0.13** (0.93)	**-0.10** (-0.39)	**-0.24** (-0.38)	**3.80** ** (2.54)	**3.53** *** (6.16)	**-0.93** (-1.06)	**2.33** (0.81)
5-year passing dummy	**-0.06** (-0.43)	**0.22** (0.90)	**-0.40** (-0.64)	**4.00** *** (2.68)	**1.98** *** (3.46)	**0.30** (0.35)	**6.01** ** (2.11)
6-year passing dummy	**0.23** * (1.67)	**0.03** (0.11)	**-0.08** (-0.14)	**4.14** *** (2.83)	**0.78** (1.39)	**-0.21** (-0.24)	**3.20** (1.14)
7-year passing dummy	**0.15** (1.11)	**0.31** (1.25)	**0.28** (0.46)	**4.41** *** (3.01)	**1.90** *** (3.39)	**-0.92** (-1.07)	**-1.69** (-0.60)
8-year passing dummy	**0.14** (1.00)	**0.21** (0.85)	**0.97** (1.60)	**7.90** *** (5.43)	**3.31** *** (5.95)	**-0.55** (-0.64)	**2.95** (1.06)
9-year passing dummy	**0.07** (0.48)	**0.03** (0.12)	**0.37** (0.61)	**8.52** *** (5.83)	**1.17** ** (2.10)	**0.27** (0.32)	**5.57** ** (1.99)
10-year passing dummy	**0.13** (0.96)	**0.02** (0.09)	**0.53** (0.85)	**8.81** *** (5.90)	**1.45** ** (2.53)	**1.20** (1.37)	**4.52** (1.58)
11-year passing dummy	**0.11** (0.75)	**0.06** (0.24)	**0.49** (0.77)	**6.47** *** (4.25)	**1.84** *** (3.14)	**0.41** (0.46)	**3.26** (1.12)
12-year passing dummy	**0.03** (0.22)	**-0.04** (-0.17)	**0.39** (0.62)	**3.42** ** (2.25)	**1.67** *** (2.86)	**0.07** (0.08)	**0.55** (0.19)
Damaged by the GEJE							
First year dummy	**0.04** (0.14)	**-1.45** *** (-2.65)	**-0.98** (-0.72)	**-6.94** ** (-2.13)	**-2.09** * (-1.68)	**0.16** (0.08)	**-7.90** (-1.28)
1-year passing dummy	**-2.49** *** (-8.19)	**-1.67** *** (-3.05)	**-6.04** *** (-4.44)	**59.71** *** (18.32)	**22.04** *** (17.65)	**41.72** *** (21.86)	**61.71** *** (10.02)
2-year passing dummy	**-1.86** *** (-6.12)	**0.03** (0.06)	**-4.94** *** (-3.64)	**35.21** *** (10.83)	**-2.77** ** (-2.22)	**49.65** *** (26.07)	**103.96** *** (16.91)
3-year passing dummy	**-0.21** (-0.71)	**-0.10** (-0.18)	**-4.28** *** (-3.16)	**31.35** *** (9.66)	**-2.52** ** (-2.03)	**44.91** *** (23.63)	**97.86** *** (15.96)
4-year passing dummy	**0.53** * (1.75)	**0.01** (0.01)	**-1.77** (-1.31)	**36.44** *** (11.23)	**-2.74** ** (-2.20)	**46.49** *** (24.47)	**124.30** *** (20.27)
5-year passing dummy	**1.46** *** (4.82)	**0.14** (0.26)	**-2.24** * (-1.65)	**43.67** *** (13.46)	**-2.30** * (-1.85)	**55.80** *** (29.38)	**61.35** *** (10.01)
6-year passing dummy	**1.04** *** (3.44)	**0.12** (0.23)	**-2.33** * (-1.72)	**38.95** *** (12.02)	**-1.68** (-1.35)	**49.06** *** (25.86)	**48.52** *** (7.93)
7-year passing dummy	**1.48** *** (4.89)	**0.43** (0.78)	**-1.85** (-1.37)	**34.06** *** (10.52)	**-2.88** ** (-2.32)	**44.16** *** (23.29)	**27.12** *** (4.44)
8-year passing dummy	**1.42** *** (4.70)	**0.34** (0.62)	**-1.75** (-1.29)	**33.22** *** (10.26)	**-3.46** *** (-2.78)	**43.99** *** (23.19)	**17.62** *** (2.88)
9-year passing dummy	**1.54** *** (5.09)	**0.05** (0.10)	**-0.96** (-0.71)	**38.14** *** (11.73)	**1.46** (1.17)	**44.58** *** (23.40)	**13.02** ** (2.12)
10-year passing dummy	**1.16** *** (3.83)	**0.09** (0.17)	**-0.86** (-0.64)	**19.53** *** (6.00)	**-3.58** *** (-2.87)	**35.69** *** (18.73)	**9.44** (1.54)
within R2	0.384	0.053	0.045	0.440	0.141	0.113	0.296
model	FE	FE	FE	FE	FE	FE	RE

Note 1: The numbers in bold and in parentheses represent coefficients and t-values, respectively.

Note 2: *** means rejecting the null hypothesis that the coefficient is zero at 1%, ** means 5%, and * means 10% significance level.

Note 3: Due to paper space limitations, reports other than the coefficients of dummy variables for the number of years passed since the disaster have been omitted.

This is presumably due to special LAT grants as well as compensation by LAT grants for principal and interest repayments on bonds for disaster recovery projects, etc.

Among specified disaster-affected local public entities, individual inhabitant tax revenues increase from the fourth year after the GEJE, although there are years in the Specified Disaster-affected Local Public Entities in which revenue declines in all three tax categories for several years after the disaster. This is consistent with the findings of Miyazaki (2017) and Kuwada (2021a). However, the increase in the Cash Inflow from Extraordinary Administrative Activities in these municipalities is solely attributable to dependent sources of revenue, with the exception of the first year of the GEJE. With the exception of the first year of the disaster, earthquake disaster reconstruction special allocation tax grants and national treasury disbursements have increased significantly.

V-3-4.　Estimation D

Table 8 presents the estimation results of **Estimation D** with the main components of per capita Cash Outflow from Ordinary Administrative Activities: per capita personnel costs; per capita non-personnel costs; per capita social assistance costs; and per capita subsidizing costs as the explained variables.

For the Specified Local Public Entities, an increasing trend was observed in the first year of the natural disaster in expenditures except for social assistance. Personnel expenses generally increased until the sixth year, and subsidizing expenses continued to increase until five years after the disaster. As mentioned in previous studies, the increase in personnel expenses can be attributed to the increase in workload, the increase in non-personnel expenses to the construction of temporary housing, and the increase in subsidizing expenses to subsidize companies and inhabitants. However, the social assistance expenses are significantly negative from the 1st year to the 7th year after the disaster. Although the cause of this is not clear, it is possible that the income requirements of the existing subsidy programs are met by the livelihood support for disaster victims and that these programs are no longer applicable, or that child allowance and medical expense subsidies have decreased due to the relocation of victims out of the disaster area.

In the Specified Disaster-affected Local Public Entities, non-personnel expenses are extremely high, and a considerable amount is still being spent as of FY2020. Subsidizing expenses also continue to increase significantly, although there are some fluctuations. Thus, it can be seen that these municipalities are still in the process of reconstruction.

V-3-5.　Estimation E

Table 9 presents the results of **Estimation E**, which decomposes per capita CF from Investing Activities into per capita national treasury disbursements; per capita fund withdrawals; per capita non-subsidized ordinary public work; per capita subsidized ordinary public work; and per capita fund accumulation.

Table 5 shows little variation in the CF from Investing Activities for the Specified Local Public Entities. When the CF from Investing Activities is decomposed, a significant positive

Table 8: Estimated results on per capita cash outflow items included in ordinary administrative activities (Estimate 4)

Variable	Personnel expenses		Equipment		Social assistance		Subsidizing	
Damaged by natural disaster								
First year dummy	1.72 ***	(3.48)	5.41 **	(2.18)	0.57	(1.49)	4.27 ***	(3.11)
1-year passing dummy	1.41 ***	(2.91)	2.10	(0.86)	-0.69 *	(-1.81)	4.34 ***	(3.22)
2-year passing dummy	1.98 ***	(4.04)	-2.10	(-0.85)	-0.83 **	(-2.18)	4.97 ***	(3.66)
3-year passing dummy	0.91 *	(1.95)	-2.46	(-1.05)	-0.64 *	(-1.74)	3.99 ***	(3.07)
4-year passing dummy	0.65	(1.40)	-0.76	(-0.33)	-0.79 **	(-2.18)	6.10 ***	(4.75)
5-year passing dummy	0.81 *	(1.75)	6.47 ***	(2.79)	-0.90 **	(-2.48)	3.92 ***	(3.06)
6-year passing dummy	1.14 **	(2.51)	-0.49	(-0.21)	-0.82 **	(-2.30)	1.66	(1.32)
7-year passing dummy	0.25	(0.56)	6.32 ***	(2.77)	-0.69 *	(-1.95)	1.24	(0.99)
8-year passing dummy	0.18	(0.40)	-0.57	(-0.25)	0.25	(0.71)	-0.02	(-0.02)
9-year passing dummy	0.96 **	(2.12)	-0.81	(-0.35)	-0.46	(-1.30)	2.06	(1.64)
10-year passing dummy	-0.32	(-0.69)	1.32	(0.57)	0.13	(0.35)	2.17 *	(1.69)
11-year passing dummy	-0.49	(-1.03)	2.27	(0.96)	-0.11	(-0.29)	2.25 *	(1.72)
12-year passing dummy	-0.26	(-0.55)	0.76	(0.32)	-0.12	(-0.32)	1.72	(1.31)
Damaged by the GEJE								
First year dummy	0.16	(0.16)	-0.22	(-0.04)	-1.01	(-1.28)	1.49	(0.53)
1-year passing dummy	0.10	(0.10)	39.83 ***	(7.86)	12.99 ***	(16.47)	9.29 ***	(3.32)
2-year passing dummy	-0.22	(-0.22)	82.37 ***	(16.29)	1.39 *	(1.76)	21.51 ***	(7.70)
3-year passing dummy	0.42	(0.42)	78.49 ***	(15.56)	-2.60 ***	(-3.31)	19.61 ***	(7.03)
4-year passing dummy	-0.02	(-0.02)	53.58 ***	(10.62)	-3.40 ***	(-4.33)	7.59 ***	(2.72)
5-year passing dummy	0.91	(0.91)	53.70 ***	(10.65)	-3.68 ***	(-4.69)	5.50 **	(1.97)
6-year passing dummy	1.36	(1.36)	39.79 ***	(7.90)	-3.79 ***	(-4.83)	8.77 ***	(3.15)
7-year passing dummy	0.97	(0.97)	20.06 ***	(3.99)	-3.96 ***	(-5.05)	6.26 **	(2.25)
8-year passing dummy	0.84	(0.84)	7.42	(1.47)	-4.25 ***	(-5.42)	20.66 ***	(7.42)
9-year passing dummy	0.06	(0.06)	10.69 **	(2.11)	-0.38	(-0.48)	7.50 ***	(2.68)
10-year passing dummy	-4.15 ***	(-4.12)	14.88 ***	(2.94)	-4.26 ***	(-5.40)	15.96 ***	(5.71)
within R2	0.468		0.177		0.749		0.645	
Model	FE		FE		FE		FE	

Note 1: The numbers in bold and in parentheses represent coefficients and t-values, respectively.
Note 2: ***means rejecting the null hypothesis that the coefficient is zero at 1%, **means 5%, and *means 10% significance level.
Note 3: Due to paper space limitations, reports other than the coefficients of dummy variables for the number of years passed since the disaster have been omitted.

Table 9: Estimated results on per capita inflow/outflow items included in investing activities (Estimate 5)

variable	(In) National treasury disbursements		(In) Fund withdrawal		(Out) Non-subsidized ordinary public work		(Out) Subsidized ordinary public work		(Out) Fund accumulation	
Damaged by natural disaster										
First year dummy	**0.98**	(0.29)	**6.85** **	(2.47)	**2.90**	(1.27)	**2.12**	(0.42)	**-6.99**	(-1.48)
1-year passing dummy	**3.35**	(1.01)	**4.42**	(1.62)	**-5.82** ***	(-2.60)	**10.15** **	(2.04)	**-3.76**	(-0.81)
2-year passing dummy	**4.18**	(1.26)	**1.78**	(0.65)	**-6.72** ***	(-2.98)	**6.56**	(1.31)	**0.68**	(0.15)
3-year passing dummy	**2.42**	(0.77)	**0.48**	(0.18)	**-2.69**	(-1.25)	**5.30**	(1.11)	**1.36**	(0.30)
4-year passing dummy	**0.45**	(0.14)	**0.29**	(0.11)	**-0.64**	(-0.30)	**-2.19**	(-0.46)	**-1.65**	(-0.37)
5-year passing dummy	**2.42**	(0.78)	**0.25**	(0.10)	**-2.21**	(-1.04)	**5.12**	(1.08)	**6.82**	(1.55)
6-year passing dummy	**13.08** ***	(4.28)	**-3.71**	(-1.46)	**-3.43**	(-1.64)	**10.95** **	(2.37)	**2.94**	(0.68)
7-year passing dummy	**0.99**	(0.32)	**-4.51** *	(-1.77)	**-5.37** **	(-2.57)	**-3.60**	(-0.78)	**3.24**	(0.75)
8-year passing dummy	**-1.99**	(-0.65)	**-3.11**	(-1.23)	**1.91**	(0.92)	**-8.89** *	(-1.93)	**1.22**	(0.28)
9-year passing dummy	**-2.50**	(-0.82)	**-1.02**	(-0.40)	**0.25**	(0.12)	**-8.40** *	(-1.81)	**5.61**	(1.30)
10-year passing dummy	**-0.27**	(-0.09)	**0.69**	(0.27)	**3.52** *	(1.65)	**-3.95**	(-0.84)	**7.87** *	(1.78)
11-year passing dummy	**10.44** ***	(3.27)	**-1.60**	(-0.60)	**-6.36** ***	(-2.92)	**6.44**	(1.34)	**4.59**	(1.02)
12-year passing dummy	**2.19**	(0.69)	**0.88**	(0.33)	**-2.53**	(-1.16)	**2.59**	(0.54)	**-3.29**	(-0.73)
Damaged by the GEJE										
First year dummy	**-9.67**	(-1.44)	**0.40**	(0.07)	**-7.76** *	(-1.67)	**-6.69**	(-0.65)	**-2.50**	(-0.26)
1-year passing dummy	**4.97**	(0.74)	**-0.23**	(-0.04)	**-9.70** **	(-2.08)	**10.58**	(1.03)	**63.67** ***	(6.61)
2-year passing dummy	**2.12**	(0.31)	**37.61** ***	(6.65)	**-1.23**	(-0.26)	**29.13** ***	(2.83)	**265.73** ***	(27.64)
3-year passing dummy	**7.00**	(1.04)	**87.64** ***	(15.52)	**-2.54**	(-0.55)	**87.50** ***	(8.52)	**76.49** ***	(7.97)
4-year passing dummy	**11.55** *	(1.72)	**98.09** ***	(17.37)	**-1.81**	(-0.39)	**107.54** ***	(10.48)	**178.24** ***	(18.58)
5-year passing dummy	**16.10** **	(2.40)	**115.14** ***	(20.40)	**4.11**	(0.89)	**136.44** ***	(13.30)	**81.48** ***	(8.50)
6-year passing dummy	**17.91** ***	(2.68)	**103.67** ***	(18.39)	**0.84**	(0.18)	**141.96** ***	(13.85)	**63.74** ***	(6.65)
7-year passing dummy	**21.62** ***	(3.23)	**88.92** ***	(15.78)	**1.78**	(0.38)	**120.37** ***	(11.75)	**58.44** ***	(6.10)
8-year passing dummy	**20.39** ***	(3.05)	**85.45** ***	(15.16)	**1.77**	(0.38)	**97.10** ***	(9.47)	**44.68** ***	(4.66)
9-year passing dummy	**11.93** *	(1.78)	**65.74** ***	(11.61)	**-3.55**	(-0.76)	**68.76** ***	(6.68)	**44.25** ***	(4.60)
10-year passing dummy	**14.25** **	(2.12)	**74.91** ***	(13.23)	**-5.86**	(-1.26)	**80.02** ***	(7.77)	**35.16** ***	(3.65)
within R2	0.015		0.086		0.059		0.052		0.058	
Model	RE		FE		FE		FE		FE	

Note 1: The numbers in bold and in parentheses represent coefficients and t-values, respectively.
Note 2: ∗∗∗ means rejecting the null hypothesis that the coefficient is zero at 1%, ∗∗ means 5%, and ∗ means 10% significance level.
Note 3: Due to paper space limitations, reports other than the coefficients of dummy variables for the number of years passed since the disaster have been omitted.
Note 4: (IN) and (OUT) means the item classified as a cash inflow and outflow, respectively.

value is obtained for fund withdrawal in the first year of the disaster. Since there is no change in the amount of non-subsidized and subsidized ordinary public work in the 1st year of the disaster, it is reasonable to assume that the fund withdrawn in the 1st year of the disaster is not used to finance public works but rather is withdrawn from the special purpose fund that is set up to respond to disasters. In addition, the decrease in non-subsidized public work in the year following the disaster and 2 years later can be interpreted as the postponement or cancellation of non-subsidized public work to be implemented during normal times, thereby curbing the decrease in CF from Investing Activities.

On the other hand, specified disaster-affected local public entities continue to accumulate huge amounts of fund accumulation from the year after and to draw down the accumulated funds from two years after the GEJE. The large deficit in the CF from Investing Activities from 4 to 7 years after the disaster in Table 5 can be attributed to the large amount of subsidized ordinary public works as well as the continued fund accumulation. Although the coefficients against the national treasury disbursements recorded in Cash Inflow from Investing Activities are not negligible, they account for only about 10-20% of the coefficients against subsidized ordinary public work expenses. It can be concluded that subsidized ordinary public work is largely financed by the reserve funds and earthquake disaster reconstruction special allocations tax grants.

V-3-6. Estimation F
Table 10 presents the results of **Estimation F** with the stock indicators as the explained variables: per capita real debt; per capita outstanding balance of local bonds; per capita outstanding balance of reserve fund; per capita outstanding balance of public finance adjustment fund; per capita outstanding balance of sinking fund; and per capita outstanding balance of special purpose funds.

The impact of natural disasters on the Specified Local Public Entities is more pronounced on the stock side than on the flow side. Per capita real debt increases from the year following the disaster, peaking at 60 thousand yen per capita 4 years later. Subsequently, real debt returns to the same level as that of Non-specified Local Public Entities after 9 years, and the accumulation of such debt is eliminated. The increase in real debt can be explained by the increase in the balance of local bonds and the decrease in the balance of reserve funds. Total local bond balances increased from the year following the disaster, and even 12 years after the disaster, the entire increase has yet to be eliminated. If the increase in the outstanding balance of local bonds is mainly due to disaster recovery project bonds, one might argue that this is not a serious problem, since most of the principal and interest payments are covered by LAT grants. However, even if the local governments bear only a small share of the total, the amount of disaster recovery projects will increase if the scale of the disaster is large, so this is not a neglectable issue in terms of fiscal management. Furthermore, if the local governments have issued local bonds that have a larger share of the local burden than the disaster recovery project bonds, the burden in subsequent years will be even heavier. The public finance adjustment fund has remained at a low level from the 1st year of

Table 10: Estimated results on per capita balance of debt and reserve funds, etc. (Estimate 6)

Variable	Balance of real debt	Balance of municipal bonds	Balance of reserve funds	Balance of fiscal adjustment funds among reserve funds	Balance of sinking funds among reserve funds	Balance of special purpose funds among reserve funds
Damaged by natural disaster						
First year dummy	**-13.98** (-1.07)	**-6.95** (-1.13)	**6.15** (0.55)	**-8.38** ** (-2.08)	**-1.55** (-1.34)	**2.91** (0.31)
1-year passing dummy	**33.70** *** (2.62)	**18.58** *** (3.08)	**-16.62** (-1.51)	**-10.01** ** (-2.53)	**-0.84** (-0.74)	**-9.77** (-1.04)
2-year passing dummy	**33.83** *** (2.61)	**19.71** *** (3.24)	**-13.67** (-1.23)	**-7.80** * (-1.96)	**-1.49** (-1.30)	**-8.63** (-0.92)
3-year passing dummy	**47.06** *** (3.80)	**27.52** *** (4.74)	**-24.70** ** (-2.33)	**-8.68** ** (-2.28)	**-3.84** *** (-3.52)	**-14.11** (-1.57)
4-year passing dummy	**59.92** *** (4.89)	**36.98** *** (6.44)	**-27.14** ** (-2.59)	**-8.31** ** (-2.21)	**-4.00** *** (-3.71)	**-17.19** * (-1.93)
5-year passing dummy	**39.77** *** (3.25)	**29.69** *** (5.18)	**-13.48** (-1.29)	**-7.84** ** (-2.08)	**-3.32** *** (-3.08)	**-2.83** (-0.32)
6-year passing dummy	**36.96** *** (3.08)	**28.76** *** (5.12)	**-12.78** (-1.25)	**-8.50** ** (-2.30)	**-2.39** ** (-2.27)	**0.04** (0.00)
7-year passing dummy	**36.97** *** (3.08)	**23.97** *** (4.26)	**-16.99** * (-1.65)	**-12.02** *** (-3.25)	**-4.44** *** (-4.20)	**2.76** (0.32)
8-year passing dummy	**45.07** *** (3.78)	**32.89** *** (5.89)	**-13.86** (-1.36)	**-11.86** *** (-3.23)	**-2.27** ** (-2.16)	**2.47** (0.29)
9-year passing dummy	**16.15** (1.35)	**19.71** *** (3.51)	**1.35** (0.13)	**-9.26** ** (-2.51)	**-2.59** ** (-2.46)	**12.94** (1.49)
10-year passing dummy	**9.04** (0.74)	**15.22** *** (2.65)	**3.62** (0.35)	**-8.67** ** (-2.30)	**-1.51** (-1.40)	**12.35** (1.39)
11-year passing dummy	**-11.42** (-0.91)	**5.79** (0.99)	**16.13** (1.51)	**-4.15** (-1.08)	**-0.11** (-0.10)	**18.80** ** (2.07)
12-year passing dummy	**3.84** (0.31)	**12.52** ** (2.14)	**8.15** (0.76)	**-2.49** (-0.65)	**1.29** (1.18)	**11.28** (1.24)
Damaged by the GEJE						
First year dummy	**35.35** (1.32)	**19.06** (1.52)	**-13.36** (-0.58)	**-8.58** (-1.04)	**-2.32** (-0.99)	**-3.54** (-0.18)
1-year passing dummy	**-38.22** (-1.43)	**28.64** ** (2.29)	**70.71** *** (3.09)	**-7.29** (-0.89)	**-3.95** * (-1.68)	**53.83** *** (2.77)
2-year passing dummy	**-280.46** *** (-10.52)	**34.98** *** (2.80)	**319.29** *** (14.00)	**0.75** (0.09)	**-4.42** * (-1.88)	**282.68** *** (14.59)
3-year passing dummy	**-280.23** *** (-10.53)	**36.15** *** (2.90)	**321.07** *** (14.11)	**4.32** (0.53)	**-3.47** (-1.48)	**274.51** *** (14.20)
4-year passing dummy	**-373.88** *** (-14.06)	**35.20** *** (2.82)	**413.68** *** (18.18)	**9.59** (1.17)	**-3.31** (-1.41)	**359.30** *** (18.59)
5-year passing dummy	**-342.55** *** (-12.88)	**34.87** *** (2.80)	**381.13** *** (16.76)	**8.08** (0.99)	**-2.90** (-1.24)	**332.43** *** (17.20)
6-year passing dummy	**-295.04** *** (-11.11)	**36.03** *** (2.89)	**334.47** *** (14.72)	**6.13** (0.75)	**-0.79** (-0.34)	**294.27** *** (15.24)
7-year passing dummy	**-262.10** *** (-9.87)	**27.54** ** (2.21)	**293.31** *** (12.92)	**7.08** (0.87)	**-0.14** (-0.06)	**261.96** *** (13.58)
8-year passing dummy	**-229.92** *** (-8.66)	**18.20** (1.46)	**250.95** *** (11.05)	**5.45** (0.67)	**1.17** (0.50)	**223.31** *** (11.57)
9-year passing dummy	**-222.61** *** (-8.35)	**12.80** (1.02)	**238.81** *** (10.47)	**9.26** (1.13)	**3.28** (1.40)	**200.82** *** (10.36)
10-year passing dummy	**-191.45** *** (-7.18)	**4.61** (0.37)	**198.95** *** (8.72)	**10.66** (1.30)	**2.41** (1.03)	**163.33** *** (8.42)
within R2	0.131	0.145	0.237	0.225	0.153	0.117
Model	FE	FE	FE	FE	FE	FE

Note 1: The numbers in bold and in parentheses represent coefficients and t-values, respectively.

Note 2: ∗∗∗ means rejecting the null hypothesis that the coefficient is zero at 1%, ∗∗ means 5%, and ∗ means 10% significance level.

Note 3: Due to paper space limitations, reports other than the coefficients of dummy variables for the number of years passed since the disaster have been omitted.

the disaster until 10 years later, and the sinking fund has shown similar trends. It is clear that specified local public entities, while receiving financial support from the central government, have been generating financial resources for recovery and reconstruction by drawing down the public finance adjustment fund and sinking fund.

Specified Disaster-affected Local Public Entities show quite the opposite trend, with a marked decrease in real debt 2 years after the GEJE. Although the level of outstanding local bonds is the same as that of the Specified Local Public Entities, this is due to the fact that fund accumulation in the special purpose funds greatly exceeded the increase in local bonds. This is consistent with the point that "while the GEJE caused massive damage all at once, large amounts of fiscal measures were prepared all at once, so the sizes of funds are such that many local governments cannot easily spend it all" (Harada, 2014). However, per capita outstanding balance of reserve funds has turned to a downward trend after peaking at 414 thousand yen in the 4th year after the GEJE, and has fallen to 199 thousand yen 10 years later. On average, per capita outstanding balance of reserve funds is decreasing by 36 thousand yen per year, and if this pace continues, the level is expected to reach the same level as that of Non-specified Disaster-affected Local Public entities in FY2025.

VI.   Conclusion

This paper attempts to identify changes in CFs in municipalities affected by natural disasters and the GEJE using municipal data from Administrative Cash Flow Statements. The four main conclusions are as follows.

First, looking at the CF situation of the Specified Local Public Entities affected by natural disasters other than the GEJE, it is clear that the affected municipalities are temporarily cash-strapped as a result of the disaster, as per capita Net CF, per capita CF from Administrative Activities, and per capita PB worsen immediately after the occurrence of the disaster. On the contrary, per capita real balance of payments has increased since the first year of the disaster, hence it will be necessary to compare not only the real balance of payments but also the indicators from Administrative Cash Flow Statements in order to grasp the cash flow situation of the local governments. The reason for the deterioration in the Net CF is that the CF from Ordinary Administrative Activities and CF from Financing Activities cannot compensate for the deterioration in Cash Flow from Extraordinary Administrative Activities due to the implementation of disaster recovery projects. This is reflected in the increase in the outstanding balance of local bonds and the decrease in the outstanding balance of the public finance adjustment fund. The CF from Administrative Activities began to improve 6 years after the disaster, but this is due to an increase in LAT grants to compensate for the principal and interest repayment of local bonds issued after the disaster, rather than an increase in tax revenue due to reconstruction demands.

Second, looking at the stock indicators of the Specified Local Public Entities, the impact of natural disasters on the stock side is long-term, with real debt increasing from the following year of the disaster, and the increase finally being eliminated 9 years later. Focusing on

the outstanding balance of reserve funds, which constitute the real debt, it is shown that the fund has started to decrease since the 1st year of the disaster and used to finance emergency and recovery projects. Although central government support for the affected municipalities exists, the affected municipalities are also drawing on the public finance adjustment fund. It is important for local governments to accumulate a certain amount of public finance adjustment funds in advance to ensure that emergency and recovery activities are not hindered by financial difficulties.

Third, with regard to the cash flow of the Specified Disaster-affected Local Public Entities, per capita Net CF increased after the GEJE, and the CF from Administrative Activities also continued to increase, except for the 1st year of the disaster. Compared to Specified Local Public entities, the CF situation of Specified Disaster-affected Local Public Entities shows considerable leeway. This result is consistent with the findings of previous studies that indicate that the GEJE provided generous financial support through earthquake disaster reconstruction special allocation tax grants and national treasury disbursements. The huge surplus generated by the CF from Administrative Activities is accumulated in special purpose funds and used as sources for reconstruction-related projects to be implemented later.

Finally, with regard to stock indicators for the Specified Disaster-affected Local Public Entities, contrary to the Specified Local Public Entities, their real debts are rather declining due to the existence of abundant reserve funds. However, due to the progress of reconstruction projects, the outstanding balance of reserve funds is rapidly declining, and at the current pace, it is expected that the outstanding balance will fall to the same level as that of Non-specified Disaster-affected Local Public Entities in the not-too-distant future.

Regardless of these conclusions, the following issues remain to be addressed in this paper.

First, we treat the designation of the Specified Local Public Entity or Specified Disaster-affected Local Public Entity as proxy variables for having been affected by major natural disasters. This means that all municipalities that have suffered damage exceeding a certain level, regardless of the type of disaster, would be treated equally in the estimation. Although the substance of disaster recovery projects differs depending on the type and scale of the disaster, and the impact on financial situation is also expected to differ, this point is not fully taken into account in this paper.

Second, this paper does not reflect that different municipalities have different approaches to disaster prevention and mitigation. Municipalities that have experienced several large typhoons may be better prepared in advance and may be able to control the scale of their disaster recovery projects. An analysis focusing on this point would clarify the costs and benefits of disaster prevention and mitigation measures.

Finally, a more elaborate policy evaluation may be possible by conducting an analysis focusing on specific measures among the central government's financial support to disaster-affected municipalities. For example, Seki (2019) points out that municipalities that narrowly failed to reach the criteria for designation as extremely severe disasters are not eligible for high rates of assistance, resulting in an increased fiscal burden. It would be

meaningful to quantitatively analyze the impact of discontinuous measures such as the extremely severe disasters system on local finance. These are issues to be addressed in the future.

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