

Effectiveness of Official Development Assistance for Tuberculosis Control by Governance of Recipients

Hye-Seung Wee, Sok Chul Hong, and Minah Kang

To evaluate the importance of governance in controlling tuberculosis (TB), we explored the relationship between recipient countries' governance and TB control outcome. Using OECD statistics, World Development Indicators dataset, and Worldwide Governance Indicators database, we tested the role of governance in 117 developing countries from 2002 to 2014 in terms of TB control. Results show that the current level of good governance and its accumulated stock over time are keys to improving the effectiveness of foreign aid in reducing the incidence of TB.

Keywords: Tuberculosis control, Aid effectiveness, Official development assistance, Governance

JEL Classification: I15, I18, O19

Hye-Seung Wee, Department of International Relations & Cooperation, National Health Insurance Service, Wonju, Republic of Korea. (E-mail): hswee@nhis.or.kr, (Tel): 82-33-736-2925, (Fax): 82-33-749-9600; Sok Chul Hong, Department of Economics, Seoul National University, Seoul, Republic of Korea. (E-mail): sokchul.hong@snu.ac.kr, (Tel): 82-2-880-2294, (Fax): 82-2-886-4231; Minah Kang, Corresponding Author, Department of Public Administration, Ewha Womans University, Seoul, Republic of Korea. (E-mail): minahkang@ewha.ac.kr, (Tel): 82-2-3277-4100, respectively.

We have benefited from useful comments and suggestions from Sok Pyo Hong and Chulhee Lee and the participants in Korea's Allied Economic Associations (KAEA) annual meetings. This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2015S1A3A2046566).

I. Background and Purpose of Research

Tuberculosis (TB) is second only to HIV/AIDS as the greatest killer worldwide because of an infectious agent (Vitoria *et al.* 2009). According to the WHO statistics, 9.6 million people were affected by TB in 2014, and 1.5 million died from this disease (WHO 2015). The demand of international support for the prevention and treatment of TB through official development assistance (ODA) has increased because TB is one of the main causes of morbidity and mortality in low-income countries.

Despite the rapidly increasing foreign aid for TB control, a large number of developing and low-income countries suffer from TB without proper diagnosis and treatment. TB is an air-borne disease and prevalent in low-income countries, where malnutrition and human immunodeficiency virus (HIV) infection are endemic. No perfect vaccine against TB is currently available. As such, the only solution to control TB is timely diagnosis and treatment. In a resource-limited environment, the same resources may be used more effectively for detection and notification by countries with enhanced governance than by countries with poor governance. To cure pulmonary TB with drugs, patients should take medicines for 6 months only to prevent developing drug resistance. In addition, monitoring the medicine intake of patients for 6 months requires high level of governance among health care providers.

Currently, a large share of ODA fund is allocated to the public health division (Piva, and Dodd 2009). However, studies on the effectiveness of ODA fund, especially for health-related programs, are limited. Our research aims to evaluate the effectiveness of ODA fund disbursed to TB control, with TB-related health outcomes, which can be interpreted as TB control program performance in recipient countries. In particular, this research focuses on the role of governance of recipient countries in improving the effectiveness of ODA funding for TB control.

The successful control of TB requires highly effective public health system and government efforts to perform timely diagnosis and to monitor patient undergoing long-term treatment. While our objective is to control TB in recipient countries, different levels of governance may affect the effectiveness of the whole program with the same amount of ODA fund. Therefore, the effectiveness of ODA amount for TB control heavily relies on the governance of ODA recipient countries (Atun *et al.* 2010).

However, limited research has addressed the importance of governance in recipient countries when the effectiveness of a specific program funded by ODA is evaluated, especially in the context of TB control. In this study, the effectiveness of ODA for TB control was empirically tested in terms of TB incidence rates from 2002 to 2014 among 117 countries that have received the ODA funding for TB controls. The aspects of governance necessary to improve the effectiveness of ODA were also examined.

II. Governance and Effectiveness of TB Control

The casual relationship between foreign aid and economic growth of recipient countries has been investigated. Previous studies on the effectiveness of foreign aid in economic development showed inconsistent viewpoints. For example, some scholars indicated that foreign aid is positively related to economic variables, which foster economic growth of developing countries (Chenery, and Strout 1966; Griffin 1970; Hansen, and Tarp 2000; Levy 1988; Clemens *et al.* 2012). Other researchers argued that foreign aid does not affect the economic growth; as such, foreign donors' prudence should be observed in allocating resources into developing countries (Boone 1996; Rajan, and Subramanian 2008). Conversely, some studies have suggested that conditional effectiveness of aid occurs only when recipient countries have good economic policies (Burnside, and Dollar 2000; Clemens *et al.* 2012; Jin, and Oh 2012). On the basis of empirical studies, Burnside and Dollar (2000) argued that a country with sound macroeconomic policies in monetary, fiscal, and international trade areas effectively uses foreign aid.

The role of governance has been reviewed to verify whether outcomes in terms of population health are better in recipient countries with good governance than in recipient countries with poor governance. Rajkumar and Swaroop (2008) empirically showed the positive relationship between public health expenditure and two governance variables, namely, the level of corruption and the quality of bureaucracy. However, few studies have investigated the association between the governance of recipient countries and the effectiveness of ODA regarding specific assistance programs. On the basis of this aspect, we examined the ODA fund for TB control and tested the significance of governance in recipient countries. Instead of using a broad concept of public

expenditure, we focused on the effectiveness of ODA amount disbursed only for TB control.

Good governance is required by TB control program to a greater extent than other diseases because of the characteristics of this disease. First, TB is hard to diagnose because it is air-borne disease. A patient is infected by inhaling the TB bacillus (*Mycobacterium tuberculosis*). Second, infant vaccines, such as bacillus Calmette–Guerin (BCG), cannot effectively prevent TB (Okada 2006; Small, and Fujiwara 2001). For this reason, the United States and Canada with a low TB incidence rate do not mandate infant BCG immunization (Small, and Fujiwara 2001; Zwerling *et al.* 2011). Third, preventing and controlling TB in developing countries are difficult because TB is endemic in countries with low income and prevalent malnutrition.

TB epidemic also presents a problem even in affluent countries, such as the United States. One example is the TB outbreak in New York in the late 1980s. Lack of financial resources for TB control and miscommunication caused by internal problem exacerbates the situation. On the basis of the TB resurgence experience in New York City, Coker (1998) defined TB as a social and political disease. Furthermore, low-income counties that cannot afford to control TB by their government budget or those with poor public health system have a high disease burden.

Government commitment and continuous management are essential for countries with poor health infrastructure to set up a health system for the prompt diagnosis, treatment, and monitoring of TB. Therefore, the governance level of recipient countries is crucial to ensure the success of the program. Gerring *et al.* (2012) showed that democracy is important in terms of its stock and level. In this study, we also developed the stock variable of governance to verify the long-term role of governance in improving the effectiveness of disbursing the amount of ODA for TB control.

III. Data and Variables

We constructed an unbalanced country-level panel data from 2002 to 2014 for 117 recipient countries. The key variable in this study is the annual disbursed amount of ODA for TB control per capita; these data were obtained from OECD statistics. ODA fund includes the official assistance to governments; thus, private funding sources, such as Bill

& Melinda Gates Foundation or other private corporate donations, were excluded. Considering the aim of this study, we collected the annual ODA fund amounts based on disbursement level, not commitment level. Disbursement was counted when actual international fund transfer was carried out.

We used the TB incidence rate per 100,000 persons from the World Development Indicators to measure the effectiveness of TB control programs. In epidemiology, the incidence indicates the number of new patients within a specific period divided by the population at risk, whereas prevalence corresponds to the total number of patients in a given population (*e.g.*, per 100,000 persons) (Dye *et al.* 1999). We used TB incidence as dependent variables.

Considering the pathogenic mechanism of TB incidence and the role of socioeconomic determinants of TB infection, we controlled the variables for income per capita, HIV/AIDS prevalence rate as the percent of infected populations aged 15–49 years, and population density. We initially controlled the income per capita according to previous studies that showed a significant correlation between TB rate and poverty (Huber 1907; Spence *et al.* 1993; Barr *et al.* 2001). We also added HIV/AIDS prevalence as a control variable because people living with HIV/AIDS are more vulnerable to TB than people who do not have HIV/AIDS due to the weak immune system of the former (Mukadi *et al.* 2001; Selwyn *et al.* 1989). Population density captures the effect of urbanization and sanitation (Antunes, and Waldman 2001).

We tested whether the governance of recipient countries affects the effectiveness of the amount of ODA for TB control. We examined governance by using Worldwide Governance Indicators (WGI).¹

¹ Voice and accountability indicate the perceptions of the extent to which a country's citizens can participate in selecting their government and exercising their freedom of expression, freedom of association, and a free media. Political stability and absence of violence measure the perceptions of the likelihood of political instability and politically motivated violence, including terrorism. Government effectiveness captures the perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Regulatory quality involves the perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Rule of law captures the perceptions of the extent to which

TABLE 1
SUMMARY STATISTICS

	2002			2008			2014		
	# Obs.	Mean	Std. Dev.	# Obs.	Mean	Std. Dev.	# Obs.	Mean	Std. Dev.
TB incidence	116	227.96	233.28	118	201.99	224.01	119	167.57	164.06
ODA per capita	120	0.01	0.04	120	0.27	0.43	119	0.36	0.56
GNI per capita (1,000 USD)	76	5.46	6.64	88	7.34	8.52	80	8.18	9.64
Population density	119	162.80	579.25	119	180.06	647.91	118	199.65	727.07
Prevalence of HIV	86	3.12	5.68	86	2.82	5.31	86	2.60	5.21
Governance indicator									
Government effectiveness (GE)	120	-0.59	0.63	120	-0.58	0.68	120	-0.58	0.70
Political stability and absence of violence (PV)	120	-0.50	0.86	120	-0.44	0.95	120	-0.48	0.91
Voice and accountability (VA)	120	-0.53	0.81	120	-0.51	0.82	120	-0.48	0.82
Regulatory quality (RQ)	120	-0.59	0.71	120	-0.56	0.73	120	-0.54	0.74
Rule of law (RL)	120	-0.61	0.67	120	-0.60	0.67	120	-0.57	0.63
Control of corruption (CC)	120	-0.54	0.62	120	-0.54	0.66	120	-0.55	0.68

Note: Each variable is reported for years of 2002, 2008, and 2014. The TB incidence is a dependent variable in our estimation, calculated among the population of 100,000. ODA per capita is the disbursed ODA amount dedicated for TB control divided by the total population. Governance indicators range approximately from -2.5 (weak governance) to +2.5 (strong governance), calculated using various data sources.

These indicators contain six dimensions of governance: voice and accountability, political stability and absence of violence, government

agents have confidence in and abide by the rules of society, especially the quality of contract enforcement, property rights, the police, the courts, and the likelihood of crime and violence. Control of corruption includes the perceptions of the extent to which public power is exercised for private gain, including petty and grand forms of corruption and “capture” of the state by elites and private interests. (<http://info.worldbank.org/governance/wgi/index.aspx>)

effectiveness, regulatory quality, rule of law, and control for corruption. WGI had been updated every 2 years between 1996 and 2002 and has been annually updated since 2002. The sources of WGI are based on 31 different surveys, gathering the view and experience from survey respondents and experts in public and private sectors and NGOs. These indexes range approximately from -2.5 (weak governance) to +2.5 (excellent governance). We reported the summary statistics of the TB incidence rate, ODA per capita, control variables, and governance indexes by year in Table 1.

IV. Estimation Model

We hypothesized that high level of governance will help recipient countries utilize ODA to control TB more effectively. We initially estimated the effectiveness of ODA for TB controls by using panel regression as follows:

$$TB_{irt} = \alpha + \beta ODA_{irt} + \gamma TB_{irt-1} + X_{irt}H + \delta_i + \delta_t + \delta_{rt} + \varepsilon_{irt} \tag{1}$$

where TB_{irt} is the observed TB incidence rate of country i in region r at year t and ODA_{irt} is the disbursed amount of ODA for TB control per capita. We control for the 1-year lagged TB incidence rate to reflect the initial condition and the time trend. X_{irt} includes other control variables discussed in section III. δ_i is the country’s fixed effects, which control for a country’s time-invariant characteristics. δ_t is the year’s fixed effects, which capture the effects of year-specific events or shocks. Last, δ_{rt} is the region-by-year fixed effects, which control for the regional characteristics that vary across years. The addition of the 1-year lagged TB incidence rate and the three types of fixed effects minimizes the potential problems of omitted variables and endogeneity. In Equation (1), β measures the overall effectiveness of ODA for TB control in terms of the TB incidence rate.

To estimate the effectiveness of the amount of ODA by the level of governance of recipient countries, we added clustered governance dummy variables and their interaction terms with ODA variable:

$$TB_{irt} = \alpha + \beta ODA_{irt} + \sum_{j=2}^4 \beta_j \times ODA_{irt} \times D(GOV_{irt} = j) + \sum_{j=2}^4 \varphi_j \times D(GOV_{irt} = j) + \gamma TB_{irt-1} + X_{irt}H + \delta_i + \delta_t + \delta_{rt} + \varepsilon_{irt} \tag{2}$$

In Equation (2), we measured a country's governance with its level in year t , that is, GOV_{irt} . For each type of governance indicator, we evenly clustered each index into four groups ([1] bad, [2] poor, [3] good, and [4] excellent from bottom 25% to top 25%) for each year. These groups are denoted by $D(GOV_{irt} = j)$ in the equation. A high j means an enhanced level of governance. Afterward, we interacted them with ODA_{irt} . β_j indicates the difference in the effectiveness of the amount of ODA between j -group-governance countries and the lowest-governance countries.

According to Gerring *et al.* (2012), we also estimated the effects of governance by using the stock of governance variable. For the analysis, we estimated Equation (2) by replacing the governance indicator GOV_{irt} with $\sum_t GOV_{irt}$, which measures the value of accumulated governance indicators over country i from the beginning year to year t . Other specification is the same as that in Equation (1).

V. Governance and ODA Effectiveness

The estimation results based on Equation (1) are reported in Table 2. Column (1), which controls for the amount of ODA and the one-year lagged TB incidence rate, shows that a high amount of ODA for TB controls a significantly reduced TB incidence rate. We included the additional control variables from columns (1) to (7) and found that the magnitude of the effect slightly decreases but remains statistically significant and considerable. The coefficient in column (7) suggests that a \$1 increase in ODA per capita reduces the TB incidence rate by 7.2 cases per 100,000 persons. This result implies that ODA for TB controls has been effective in minimizing the TB incidence at least from 2002 to 2014.

Table 3 shows the estimation result based on Equation (2). We conducted separate regressions for six types of governance indicators and obtained the following key findings. First, the coefficient of ODA per capita, that is β in Equation (2), measures the effect of ODA for TB control in terms of the TB incidence rate among countries whose governance scores are considered weak (bottom 25%). For most indicators except voice and accountability, the countries with poor governance did not effectively use ODA to control for TB incidence. Second, the coefficients of interaction terms, that is, β_j in Equation (2), strongly suggest that the effect of ODA on reducing TB incidence becomes substantial as the

TABLE 2
ESTIMATED EFFECT OF ODA FOR TB CONTROL ON TB INCIDENCE RATE

Dependent variable: TB incidence rate per 100,000 persons	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ODA per capita	-8.9444*** (1.1612)	-8.9042*** (1.1603)	-8.9165*** (1.1604)	-8.8962*** (1.1571)	-7.8743*** (1.2331)	-7.9087*** (1.3666)	-7.2486*** (1.3977)
TB incidence rate in previous year	0.9828*** (0.0020)	0.9829*** (0.0020)	0.9825*** (0.0021)	0.9898*** (0.0037)	0.9888*** (0.0037)	0.9916*** (0.0043)	0.9790*** (0.0119)
Population density		0.0048 (0.0030)	0.0042 (0.0030)	0.0033 (0.0031)	0.0038 (0.0031)	0.0021 (0.0037)	0.2313*** (0.0479)
GNI per capita			-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0000 (0.0001)	-0.0001 (0.0001)	0.0002 (0.0004)
Prevalence of HIV				-0.3742** (0.1571)	-0.3637** (0.1575)	-0.5498*** (0.1907)	2.2057* (1.1398)
Year FEs					X		
Region × Year FEs						X	X
Country FEs							X
Adjusted R-squared	0.997	0.997	0.997	0.997	0.997	0.997	0.998

Note: Number of observations is 822. Each estimation is based on equation (1). Standard errors are reported in parentheses. A single asterisk denotes statistical significant at the 90% level of confidence, while double and triple asterisks denote the statistical significance at 95% and 99% levels of confidence, respectively.

TABLE 3
ESTIMATED EFFECT OF ODA FOR TB CONTROLS ON TB INCIDENCE RATE BY THE LEVEL OF GOVERNANCE

Control variables	Level index of governance					
	Government effectiveness (1)	Political stability & absence of violence (2)	Voice & accountability (3)	Regulatory quality (4)	Rule of law (5)	Control of corruption (6)
ODA per capita (β)	4.6849 (3.6613)	-0.5805 (4.2028)	-5.4907** (2.4521)	-0.3994 (3.5715)	2.0012 (3.0850)	1.1635 (2.8532)
Governance: Poor (φ_2)	-8.1634*** (2.6584)	1.5891 (1.8847)	-1.9785 (2.5118)	2.5985 (2.8785)	-1.4718 (2.1750)	-1.3198 (1.8572)
Good (φ_3)	-9.4114*** (2.9983)	1.6661 (2.3571)	-4.9069 (3.0126)	2.4030 (3.3396)	-4.4626* (2.6081)	-2.8912 (2.3414)
Excellent (φ_4)	-9.5003** (3.7844)	-2.9793 (2.7545)	-6.7614* (3.6634)	1.9274 (3.9043)	-1.2646 (3.3259)	-8.2388*** (2.8584)
Poor \times ODA (β_2)	-9.9712** (3.9982)	-1.8662 (4.2530)	4.1094 (3.3316)	-12.2868*** (4.0643)	7.1961* (4.3537)	-0.2073 (3.2793)
Good \times ODA (β_3)	-12.6756*** (4.1304)	-5.5544 (4.4188)	1.6758 (3.3219)	0.1275 (3.9452)	-11.2888*** (3.4266)	1.6159 (3.4386)
Excellent \times ODA (β_4)	-15.0914*** (4.0902)	-9.8816** (4.4278)	-7.3711** (3.1872)	-10.3799*** (3.9373)	-12.4167*** (3.5946)	-21.2366*** (3.3967)

Note: Number of observations is 822. Each estimation is based on equation (2). We also controlled the TB incidence rate in the previous year, population density, income per capita, HIV prevalence rate, region-by-year fixed effects, and country fixed effects, as shown in column (7) of Table 2. The dummy variable indicates bad governance, and its interaction with ODA variable is omitted in the reference groups. Standard errors are reported in parentheses. A single asterisk denotes the statistical significance at the 90% level of confidence, while double and triple asterisks denote the statistical significance at 95% and 99% levels of confidence, respectively.

governance of recipients enhances. The effectiveness of ODA is very significant among those with excellent governance (top 25%). Third, the coefficients of governance dummies show that the TB incidence rate is highly associated with governance. In general, countries with good or excellent governance has a low TB incidence rate. This result suggests that governance is also important in disease control, leading to improved public health investment and effective allocation of ODA funds.

In Table 4, we estimated the effectiveness of the amount of ODA for TB control by the stock of governance rather than its annual level. The stock of governance is measured as the value of governance indexes accumulated from the beginning year to year t . Other specifications of regressions are the same with those of Table 3 and Equation (2).

Two points should be noted. First, the effect of using governance stock variables is slightly different from that of using governance level variables. The role of political stability and absence of violence in TB control becomes more substantial in Table 4 than in Table 3. This result suggests that a long-term improvement of political stability is more important in public health resource allocation and disease control than in short-term change. The significance of long-term governance level is also found for the control of corruption. However, the effect of government effectiveness, which captures the quality of public and civil services, independence from political pressures, and policy formulation and implementation, is estimated to be more substantial in a short-term perspective (Table 3) than in a long-term perspective (Table 4). This result may suggest that a change in public-health policies can immediately affect the level of disease control.

Second, the effectiveness of the amount of ODA on TB control by governance is estimated to be slightly different between the two estimations. In general, the effectiveness caused by political stability and control of corruption becomes substantial from Table 3 to Table 4, but the effectiveness caused by other governance measures is not as substantial. This result is similar to the pattern discussed above. The importance of governance in a short-term or long-term aspect depends on the type of governance. However, the exact mechanism by which each governance feature can affect the effectiveness of the amount of ODA in TB control needs further investigation.

TABLE 4
ESTIMATED EFFECT OF ODA FOR TB CONTROL ON TB INCIDENCE RATE BY THE ACCUMULATED STOCK OF GOVERNANCE
Dependent variable: TB incidence rate per 100,000 persons

Control variables	Stock of governance					
	Government effectiveness (1)	Political stability & absence of violence (2)	Voice & accountability (3)	Regulatory quality (4)	Rule of law (5)	Control of corruption (6)
ODA per capita (β)	-5.4467** (2.2652)	0.1403 (2.6410)	-5.6852** (2.2308)	-5.7461* (2.9409)	-0.4748 (2.9431)	-0.5951 (2.2508)
Governance: Poor (φ_2)	-3.5229* (1.8254)	-3.2681* (1.7751)	-3.7429* (1.9452)	-1.4804 (1.8835)	-3.6266** (1.7490)	-5.3933*** (1.6759)
Good (φ_3)	-4.9437** (2.5173)	-4.1340 (2.8466)	-4.9048* (2.8847)	-0.8406 (2.6203)	-7.3565*** (2.4725)	-9.3594*** (2.3545)
Excellent (φ_4)	-1.9846 (4.0777)	-16.3848*** (3.8193)	-7.9080* (4.3076)	-0.4155 (4.0296)	-6.2798 (4.0344)	-16.5365*** (3.4664)
Poor \times ODA (β_2)	0.8523 (2.9636)	-1.7741 (3.6991)	4.8715 (3.1144)	1.0427 (3.3084)	-6.7211* (3.4474)	0.4047 (3.1665)
Good \times ODA (β_3)	2.4909 (3.6016)	-20.5629*** (4.2496)	-7.6391 (4.8551)	9.2814** (4.3239)	-4.6546 (3.8275)	-8.4259** (3.7561)
Excellent \times ODA (β_4)	-8.8205** (3.5085)	-9.0497*** (3.1076)	-5.2889* (3.2074)	-9.9257*** (3.7980)	-11.9085*** (3.9176)	-11.8000*** (3.0260)

Note: We replaced the measure of governance with accumulated stock index that was calculated as average of governance indexes from year 2002 to 2014. Other specification is the same with that of Table 3. Standard errors are reported in parentheses. A single asterisk denotes statistical significance at the 90% level of confidence, double and triple asterisks denote the statistical significance at 95% and 99% levels of confidence, respectively.

VI. Discussion and Implication

In this study, we empirically showed the importance of governance in recipient countries in improving the effectiveness of ODA for disease control not only in a short-term perspective but also in a long-term perspective. Our results are similar to some previous findings. For instance, the effect of ODA is conditionally significant when recipient countries have good governance. However, the merit of our study is that we estimated the relationship between health aid and health outcome by using TB control, whereas most previous studies examined the relationship between foreign aid and economic growth. Given that TB is endemic in low-income countries, studies on aid effectiveness help find ways on the eradication of TB. TB control is necessary to improve human capital and economic development in countries with low income. The key implication of our study is that the effectiveness of ODA can be improved when the governance of recipient countries is enhanced. Providing TB-related medicines without empowering the governance would not cause desirable results for TB control.

This study has some limitations. First, we used the ODA fund for disease control, excluding other private funding sources, such as Bill & Melinda Gates Foundation. Underreported issues are also observed in OECD's Creditor Reporting System data (Mishra, and Newhouse 2009). Health aids are reported not by recipient countries but by donor; therefore, our results can be underestimated. Second, this study uses a very limited set of control variables because of lack of information. Thus, we omitted various socioeconomic conditions that can affect TB incidence. Although income per capita was retained, this may not capture the effect of income distribution.

Third, although we added one-year lagged TB incidence and panel analysis in the regressions, the issue on potential endogeneity between ODA and TB control remains, as frequently mentioned in studies on measuring ODA effect (Boone 1996; Burnside, and Dollar 2000; Hansen, and Tarp 2000; Rajan, and Subramanian 2008; Rajkumar, and Swaroop 2008). Donors may decide whether and how much ODA they will provide depending on the level of TB incidence in recipient countries. However, studies have argued that foreign aid has been mostly decided by donors' strategic interest, not by the recipients' needs (Mckinlay, and Little 1977; 1978a; 1978b; 1979). Multilateral fund has not been influenced by donors' interest compared with bilateral fund

(Rajan, and Subramanian 2008). A large part of ODA funding for TB control program comes from multilateral funding sources. This scenario suggests that the endogeneity issue in this study may be unsubstantial.

Although the amount of worldwide subsidies for TB control, particularly ODA, has increased over time, the TB mortality and its incidence rate are still substantial in many developing countries. This phenomenon partially implies that subsidies and ODA are utilized ineffectively. This study suggests that the effectiveness of ODA fund is closely related to the governance of recipient countries not only in a short-term perspective but also in a long-term perspective. Furthermore, good governance is the prerequisite for an effective use of ODA fund for TB control.

(Received 30 October 2017; Revised 6 November 2017; Accepted 15 November 2017)

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