



# Does official development assistance affect a donor's exports? South Korea's case

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## Abstract

This paper studies the impact of official development assistance (ODA) provided by South Korea for its exports to recipient countries. The empirical analysis is based on data from 1996 to 2014 and covers 121 recipient countries. The paper uses a 3SLS estimation method that accounts for a two-way causal relationship between ODA and exports while the endogeneity and sample selection bias are accounted for. Using the gravity model, we confirm the positive effects of ODA when fixed unobserved effects are controlled. The model is further generalized by disaggregating ODA into its underlying types of aid. Our results show that technical cooperation and loans have positive and significant effects, but grants have a negative impact on South Korea's exports to recipient countries. In addition, we also examine South Korea's ODA allocations. Our findings suggest that there is a two-stage decision-making process in the provision of aid. In the first stage, the aid's humanitarian purpose plays a key role in responding to countries' needs even when there is lower bilateral trade with these countries. In the second stage, decisions regarding the size of ODA are considered and these present a mixed purpose for giving ODA to higher importer countries.

**Keywords** Gravity model · Official development assistance · Exports · Three-stage least squares · South Korea

**JEL Classification** F14 · F21 · F35

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## Introduction

Many developed countries have offered different types of cooperation to developing countries such as providing funds, transferring technologies for social and economic growth, and assistance for disaster relief. Such cooperation, mainly undertaken by governments, is called official development assistance<sup>1</sup> (ODA). Earlier, South Korea was an ODA recipient country which benefited from ODA after the Korean War (1950–1953). South Korea's effective use of foreign aid helped it move out of the list of poorest countries in the world to (depending on the exchange rate) becoming the 10th or 12th largest economy in the world in terms of nominal GDP.<sup>2</sup> ODA played a relevant role in the outstanding process of growth and transformation in the country. South Korea declared its global role as an ODA donor in 2010 when it joined the Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD).<sup>3</sup> More information on the transition of South Korea from a recipient of ODA to a donor and to its striking growth is provided in Sect. 3.

As a member of DAC, South Korea has to make ODA contributions in terms of scale and effectiveness. In keeping with this, the DAC membership obligations' rules, the amount of ODA provided by the South Korean government increased to more than 2.2 trillion won<sup>4</sup> based on budgetary statistics in 2014. For improving the effectiveness of aid, the international community recommended that the donors should not tie the aid to conditions to enhance the recipients' independence and reduce their implementation costs. Therefore, ODA's expansion in volume terms is a heavy burden for South Korea as it is also facing growing domestic demand. Hence, it is important to study ODA's economic impact on a donor country to ensure that its ODA policy is sustainable. To examine whether there are economic gains for a donor like South Korea this paper's aim is to answer the question: Does South Korea's ODA affect its exports as a donor?

There are various reasons why exports matter to South Korea. Successful economic development, or what is also called the 'Korean miracle,' is a result of an export-oriented industry structure and policy. The transition from being an ODA recipient country to a donor has no precedent in the emerging world.<sup>5</sup>

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<sup>1</sup> Official Development Assistance (ODA) is defined by the OECD Development Assistance Committee (DAC) as government aid that promotes and specifically targets the economic development and welfare of developing countries. ODA flows to countries and territories on the DAC list of ODA recipients and to multilateral development institutions that are (i) provided by official agencies, including state and local governments, or by their executive agencies; (ii) concessional (that is, grants and soft loans) administered with the promotion of the economic development and welfare of developing countries as the main objective (Source: The OECD website).

<sup>2</sup> International Monetary Fund's World Economic Outlook database (April 2021).

<sup>3</sup> For more see Jiyoung Kim (2011). Foreign Aid and Economic Development: The Success Story of South Korea. *Pacific Focus*, 26 (2).

<sup>4</sup> US\$1 = 1151 won, July 26, 2021.

<sup>5</sup> Source: Korea's ODA (<http://www.odakorea.go.kr/>).

In 2014, South Korea ranked the highest among OECD member for its dependence on international trade.<sup>6</sup> In addition, South Korea had 199,000 trade enterprises in 2014.<sup>7</sup> This implies that South Korea's trade was an important driving force in its continuous economic growth and development.

There are several studies on ODA and exports. However, our study helps improve the knowledge gap in ODA's effects on South Korea's exports through an empirical analysis. Much of the existing literature shows that there are positive relationships between ODA and exports and existing studies identify the causality in both directions. As implied in literature our study takes into account the possibility of the existence of simultaneous relationships between ODA and exports. We use the three-stage least squares (3SLS) estimation method to estimate the two-way causalities between ODA and exports. Moreover, our paper also addresses a sample selection bias problem which may occur due to differences in the probability of being a receiver of South Korea's ODA. This problem is minimized using the inverse Mills ratio which is obtained from a Logit regression with fixed effects controlled.<sup>8</sup> This approach to the model's specification makes it possible to estimate the impact of South Korea's ODA on its exports more accurately.

Our results show that there is a positive effect of South Korea's ODA on its exports to recipient countries; this is consistent with the findings of earlier studies.<sup>9</sup> However, our estimated ODA effect on export is smaller than the previous studies' estimates suggesting that earlier studies overestimated this impact by ignoring the two-way causality relationship and selection bias. For a deeper understanding, we also estimated the effects of ODA by disaggregating ODA into grants, loans, technical cooperation, and humanitarian assistance. We found that technical cooperation and loans had a positive and significant impact on South Korea's exports but grants had a negative and significant impact. South Korea's aid allocation is led by humanitarian purposes under which it responds to lower income countries and those which are experiencing disasters even though it has lower bilateral trade with these countries. In the second stage the size of the ODA is based on countries with higher imports from South Korea.

The rest of this study is organized as follows. The next section introduces relevant literature and its findings. In the subsequent section, the history of South Korea's ODA to Africa is summarized followed by which the models and estimation procedures are introduced. Then the data and its sources are provided. After this, the results of the analysis and their interpretation are presented. The penultimate section

<sup>6</sup> Source: IMF/Yonhap News Agency ([http://www.koreatimes.co.kr/www/news/biz/2014/08/291\\_73001.html](http://www.koreatimes.co.kr/www/news/biz/2014/08/291_73001.html)).

<sup>7</sup> Source: Statistics Korea (<http://kostat.go.kr>).

<sup>8</sup> Generally, a Probit model is used for estimating the inverse Mills ratio. Here we use the Logit model to consider fixed effects by period, continent, and income levels.

<sup>9</sup> There are two channels of ODA: bilateral and multilateral. Bilateral ODA is distributed directly from donor countries to recipient countries while multilateral ODA is given through international organizations rather than by one specific country. This research focused on bilateral ODA to analyze by recipient countries.

checks the robustness of the results. The last section concludes and gives the policy implications of our findings.

## Literature review

The majority of existing studies on foreign aid focus on two aspects, namely aid allocation and aid effectiveness, which are generally analyzed separately. Studies on aid allocation focus on the motivation and determinants of foreign aid by analyzing a donor's aid allocation. Studies on aid effectiveness address the issue of how to improve the usefulness of the aid so that it can reach its goals like meeting the sustainable development goals (SDGs).

Research on aid allocation considers both the donor and the recipient's interests and, to this purpose, it analyses the determinants of foreign aid. Recent strand of literature on ODA tend to combine these two needs and identify various determinants of foreign aid including those associated with economic interests, diplomatic relations, and humanitarian concerns. This new approach was first initiated by McKinley and Little (1977, 1978a, b, 1979) with a series of empirical studies on major development aid donors (USA, UK, and France). Their results showed that donors provided aid not only to meet the recipients' needs, but also for fulfilling their own diverse interests. Alesina and Dollar (2000) estimated a full model of aid allocation with 21 major donors and 180 recipient countries. They showed that donors' aid allocations mirrored their political considerations and recipients' needs at the same time. According to Alesina and Dollar (2000), Israel and Egypt received additional aid especially from the USA which emphasizes defense and security in its aid allocation. French's aid allocation is adapted in such a manner to compensate its former colonies with extra help. Japan seems to respond to countries whose voting patterns in the United Nations (UN) are in accordance with its international policy. It is also seen that the negative coefficients of the recipient's income were statistically significant during the whole period of selected time frame. Which means the poorer countries obtained more aid than their richer counterparts.

Berthélemy and Tichit (2004) analyzed three-dimensional panel data by considering the donors' self-interests and the recipients' needs. Their research showed that donors paid attention to good political governance in recipient countries for giving them aid. You (2009), Koo and Kim (2011), Kim and Oh (2012) and Cho and Chung (2015) empirically examined South Korea's ODA allocation patterns. You (2009) studied the distribution of South Korea's ODA from 1992 to 2008 using a Heckman two-stage estimation method because the decision-making process for South Korea's ODA follows two stages: choosing the ODA recipients and deciding the amount of ODA for the chosen recipient countries. You (2009) found that distribution of South Korea's ODA relied on USA's alliances, the size of trade with South Korea, the size of South Korea's FDI in the ODA recipient countries, and the economic levels of ODA recipients. You's (2009) results also indicate that South Korea considered civil and international aspects while taking decisions about giving ODA to recipient countries.

In another related article, Koo and Kim (2011) analyzed South Korea's ODA allocations with data from 1989 to 2007. Their contribution is that South Korea's

economic interests were much more influential than recipients' needs when deciding its ODA allocations. An interesting aspect of their analysis is the authors' view of global influence on the total volume of world aid. Their results imply that South Korea's ODA was affected by international expectations. Kim and Oh (2012) analyzed the major determinants of South Korea's ODA allocations with data from 1987 to 2009. They found that the country's ODA policies changed with political regimes. Their findings suggest that South Korea provided more aid to countries with relatively higher income levels, indicating compliance with its economic interests. However, the differences in terms of political regimes were small and not statistically significant.

As far as ODA effectiveness is concerned, the empirical literature investigated two aspects, namely the effects on recipients' development and donor's gains. A large number of papers estimate the effects of aid on recipient countries, and the results of these studies are debatable. Dalgaard et al.'s (2004) article reported that no matter the recipients' governance have formed, aid in the 1990s has a positive effect on the economic growth of recipient countries, and aid effectiveness followed the law of diminishing returns. Galiani et al. (2017) concluded that an increase in aid/GNI ratio by 1% led to an increase in the growth rate of per capita GDP by 0.35% in recipient countries. They used an income threshold designated by the International Development Association in 1987 as an instrumental variable of aid.

Others suggest that aid recipients are affected positively by development aid under certain conditions. According to Isham et al. (1995), one of the required conditions for receiving aid is high civil liberties. Burnside and Dollar (2000) also suggest that foreign aid's effect on recipients grows only if the recipient governments design and implement suitable financial and trade policies. However, Easterly (2003), Easterly et al. (2004) shows that aid adversely affected recipient societies, pointing to widespread corruption of politicians and the elite. Nunn and Qian (2014) examined the impact of food aid. Based on their research, food aid from USA led to civil conflicts at both the inter-state and intra-state levels leading to a negative effect of aid on recipients' growth.

The history of foreign aid as also its volume is small in emerging donor countries like South Korea as compared to major donors like USA, Japan, Germany, and France. Hence, it is hard to get a better understanding of South Korea's aid effectiveness from the recipients' perspective. Lee and Park (2007) examined South Korea's ODA effectiveness keeping in mind its 20 years of history by focusing on the effects of aid in recipient countries. Due to the small size of aid to each of the recipient countries, their study came to the conclusion that there was no significant impact of South Korea's ODA on recipient countries' economic growth.

A few of studies focus, instead, on the donor's interests. Sohn (2005), Ranajoy and Tathagata (2006), Rahman (2009), Binh et al. (2011), Lee and Lee (2012) and Kang (2014) tested ODA's effectiveness from the donor's perspective with a gravity model. By using the Korean President's visits to recipient countries as an instrumental variable, Lee and Lee (2012) analyzed the effect of directly distributed ODA on South Korea's exports and estimated an elasticity of 0.143 during 1991 to 2008. A remarkable finding of their research is that ODA impact on South Korea's exports varied over industrial sectors. The labor-intensive sector (textiles) was affected more than the capital-intensive

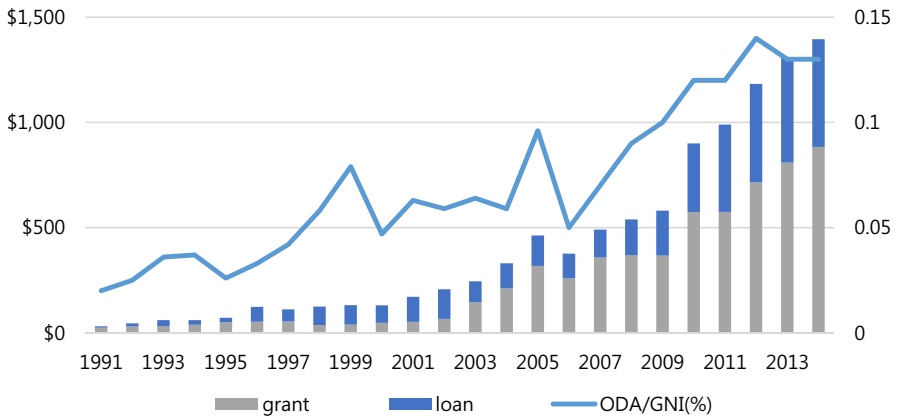
sector (machinery). In addition, Kang (2014) did theoretical and empirical analyses of multiple ODA types. Park and Lee (2015) examined aid effectiveness by humanitarian, commercial, and diplomatic motives. They used the Hausman–Taylor method and system-GMM to address the endogeneity problem. Their findings confirmed that there was a positive effect of total ODA, loans, grants, and technical cooperation on South Korea's exports but they found no such effect of the provision of humanitarian aid.

These contributions provide plenty of information about the relationship between ODA and a donor's exports, but these studies focus on a single side of the issue—aid allocation or aid effectiveness. Since aid allocation and aid effectiveness represent two distinct but related important aspects, we consider both of them and, in doing so, we take into account their complementary role. Therefore, their relationships need to be considered simultaneously for which a systematic study method can be useful.

### **South Korea's transition from an ODA recipient to an ODA donor in a nutshell**

South Korea is a unique country in the economic development field as it is the first country to successfully graduate from being a major recipient of ODA to becoming a major donor. South Korea received aid from many developed countries, mainly the United States after its liberation in 1945. A majority of the aid was invested in curbing post-war inflation and for securing financial stability and industrial facilities. Most of foreign aid was in the form of grants which contributed to South Korea's rapid economic growth at an average annual rate of 4.9% during the late 1950s. From the 1960s, grants to South Korea were replaced by loans and the country enacted the Foreign Investment Promotion Act in January 1960. South Korea actively attracted foreign investments and effectively utilized these foreign resources by launching a sequence of 5-Year Economic Development Plans. Foreign aid and investments provided important resources for industrial infrastructure and technological development in the country. South Korea ended its financial dependence on the World Bank's assistance in 1995. The estimated total aid that South Korea benefitted from is about 12 billion USD.

As a donor, the first development aid that South Korea provided was for a training program implemented by USAID in 1963. South Korea also implemented the same training program in 1965. It provided development assistance mostly funded by the UN in the 1970s and gradually expended its own funds. In 1987, the Economic Development Cooperation Fund (EDCF) was established in the Export–Import Bank of Korea which was in charge of providing developing countries with concessional loans. In 1991, the Korea International Cooperation Agency (KOICA) was established under the Ministry of Foreign Affairs and Trade to administer grant aid. South Korea joined the Organization for Economic Cooperation and Development (OECD) in 1996 and became the 24th member of the OECD Development Assistance Committee (DAC) in 2010. Since then, South Korea has enacted the Framework Act on International Development Cooperation (Framework Act) which came into force in July 2010. This Act lays down the legal basis for a more effective



**Fig. 1** Korea's total bilateral net commitments in the form of grants and loans and ODA share of GNI (1991–2014)

ODA system. The Korean government formulated integrative Country Partnership Strategies (CPS) for each priority partner country to improve its ODA's effectiveness through strategic concentration. South Korea increased its ODA level gradually and reached 0.13% of the nation's GNI in 2014. Figure 1 shows the development of South Korea's total bilateral net commitments and the ODA/GNI ratio over time.<sup>10</sup>

Effective use of foreign aid and industrial-oriented development strategies were crucial for South Korea's sustained economic growth. Since South Korea survived and thrived on aid, today there is an increasing demand from developing countries pursuing South Korea's economic development path for ODA. These countries also have expectations from South Korea about sharing the know-how and policies that it formulated during its experience as a receiver of ODA. One of major regions showing great interest in the South Korea model of development is Africa, especially the sub-Saharan region. There are 34 African countries among the 50 least developed countries (LDCs) in the world. As development in Africa is a huge challenge for the international community, South Korea is increasing its support to the continent. In March 2006, South Korea announced its Initiative for African Development and followed this up by doubling its budget for African aid as its commitment to providing assistance to the continent's growth by 2008.

The Knowledge Sharing Program (KSP) launched by Korea's Ministry of Strategy and Finance (MOSF) is a part of this process. KSP is a development and economic cooperation program which aims to share its sharing Korea's development experience with partner countries; it also offers comprehensive policy consultations. African countries such as Ethiopia, Gabon, Ghana, and Mozambique are among KSP's partners.<sup>11</sup>

<sup>10</sup> Source: The Economic Development Cooperation Fund (EDCF, <http://www.edcfkorea.go.kr>) and the Korea International Cooperation Agency (KOICA, <http://www.koica.go.kr/>).

<sup>11</sup> Source: The Knowledge Sharing Program (<http://ksp.go.kr>).



The World Trade Organization's (WTO) campaign, *Aid for Trade* helps developing countries, particularly the least developed ones in trade. It includes a variety of programs which can help build recipient countries' trade capacity and development infrastructure. As a donor, South Korea has comparative advantages in the *Aid for Trade* campaign as it has knowledge that it gained from its own experience unlike other developed countries passing through different stages of development. Though South Korea's ODA is small in terms of its short history and small volume, its policy and strategy for ODA is based on its rich experience and is considered important.

## Models and estimation

### The baseline model

Lee and Park (2007), Kim (2009), You (2009), Koo and Kim (2011), and Kim and Oh (2012) show that bilateral trade with recipient countries is one of key determinants of South Korea's ODA. On the other hand, Lee and Park (2007), Lee and Lee (2012), and Kang (2014, 2015) provide evidence using the gravity model's estimation that there is a positive impact of South Korea's bilateral ODA distribution on its exports to recipient countries. These two aspects of previous studies indicate that there is evidence of a significant effect of both ODA on exports (or trade) and vice versa. Since these two variables correlate, a simultaneous equation system of ODA and exports needs to be modeled. Our study uses a three-stage least squares (3SLS) panel system estimator which treats South Korea's exports and ODA as endogenous. The main advantage of this approach is that it is more efficient than the two-stage least squares (2SLS) estimation method. A 2SLS estimation of each equation is possible recursively but it ignores the simultaneous correlation between the various equations' error terms. On the other hand, 3SLS is an equations' estimation method which estimates all coefficients in each equation simultaneously using the generalized least squares (GLS) method (Zellner and Theil 1962). The system of ODA and export equations estimated using the 3SLS method is specified as

$$\ln(\text{Export}_{it}) = \beta_0 + \beta_1 \ln(\text{ODA}_{it}) + \beta_2 X_{it} + \beta_3 Z_{1it} + \beta_4 W_{1i} + \beta_5 V_{1t} + \varepsilon_{1it} \quad (1)$$

$$\begin{aligned} \ln(\text{ODA}_{it}) = & \alpha_0 + \alpha_1 \ln(\text{Export}_{it}) + \alpha_2 X_{it} + \alpha_3 Z_{2it} + \alpha_4 W_{2i} + \alpha_5 V_{2t} \\ & + \sigma \hat{\lambda}_{it} + \varepsilon_{2it} \text{ where } \hat{\lambda}_{it} = \frac{\phi(Z_{it} \hat{\delta})}{\Phi(Z_{it} \hat{\delta})}. \end{aligned} \quad (2)$$

Equation (1) is a modified version of the gravity model used by Kang (2014) to estimate South Korea's ODA effects on its exports to recipient countries and Eq. (2) is a model of provision of South Korea's ODA referred to by Kim and Oh (2012) and Kim (2014). The subscripts  $i$  and  $t$  represent a recipient country ( $i=1, 2, \dots, 121$ ) and year of observation ( $t=1996, 1997, \dots, 2014$ ), respectively.  $\ln(\text{Export}_{it})$  is the logarithm of exports from South Korea to recipient countries;  $\ln(\text{ODA}_{it})$  is the logarithm of ODA from South Korea to recipient countries; the vector  $X_{it}$  contains



a number of explanatory variables including log of per capita GDP, log of FDI from South Korea, log of population, the political stability index, and a 1-year lagged growth rate.  $Z_{1it}$  contains variables which affect exports but less likely South Korea's ODA and include the tariff rate, gap in log of per capita GDP of the recipient country, and economic freedom;  $W_{1i}$  is log of distance from South Korea; the vector  $V_{1t}$  contains South Korea's producer price index (PPI) and period dummy variables to control for individual country-invariant country effects;  $Z_{2it}$  contains country  $i$ 's characteristics related to receiving ODA at time  $t$  with variables oil revenue, death rate, government efficiency, civil liberties, corruption, a 1-year lagged log of ODA, disaster degree, and the DAC list.  $W_{2i}$  includes continent dummy variables;  $V_{2t}$  has period dummy variables representing different administrations; and lastly,  $\hat{\lambda}_{it}$  is the inverted Mills ratio obtained as the ratio of density and distribution function at the estimated parameters,  $\delta$ .

The reason for including the Mills ratio,  $\hat{\lambda}_{it}$ , in Eq. (2) is as follows. Several studies discuss sample selection problems related to ODA recipient countries. Cingraneli and Pasquarello (1985), Neumayer (2003), and Furuoka (2005) conducted research using a two-stage decision-making process of aid allocations using data from US, Japan, and European countries. You (2009) was the first to discuss this issue in South Korea's case. Based on interviews with government employees who worked in the ODA policy field, You's research evaluated South Korea's ODA policy using the Heckman two-stage estimation method. The following model describes the estimation problem:

$$\begin{aligned}
 ODA_{it} &= \beta X_{it} + \varepsilon_{it} & \text{if } ODA_{it}^* > 0 \\
 ODA_{it} &= \text{not observed} & \text{if } ODA_{it}^* \leq 0 \\
 ODA_{it}^* &= \delta Z_{it} + v_{it} & (3) \\
 ODA_{dummy_{it}} &= 1 & \text{if } ODA_{it}^* > 0 \\
 ODA_{dummy_{it}} &= 0 & \text{if } ODA_{it}^* \leq 0,
 \end{aligned}$$

where  $ODA_{it}^*$  is the volume of ODA for country  $i$  at time  $t$  from South Korea;  $ODA_{it}$  is the volume of ODA for country  $i$  at time  $t$  from any donor; and  $ODA_{dummy_{it}}$  is whether or not country  $i$  gets ODA from South Korea at time  $t$ . Using only the observed data, the estimates of  $\beta$  will be biased because the selection process is ignored. Therefore, to minimize the possible selection bias problem, the inverse Mills ratio is obtained from Eq. (4). The decision for South Korea's ODA recipients is specified as

$$ODA_{dummy_{it}} = \alpha_0 + \alpha_1 \ln(\text{ex} + \text{import}_{it}) + \alpha_2 X_{it} + \alpha_3 Z_{3it} + \alpha_4 W_{2t} + \alpha_5 V_{2t} + \varepsilon_{3it}, \tag{4}$$

where  $ODA_{dummy_{it}}$  is the ODA dummy variable. To take into account differences in the probability of receiving aid in the first stage, we generated  $ODA_{dummy_{it}}$  which has value 1 if country  $i$  received ODA from South Korea at time  $t$  and 0 otherwise;  $\ln(\text{ex} + \text{import}_{it})$  is the logarithm of trade volume between South Korea and the recipient countries; the vector  $X_{it}$  contains a number of explanatory variables: log of per capita GDP, log of FDI from South Korea, log of population, the political stability index,

and the one-year lagged growth rate.  $Z_{3it}$  contains country  $i$ 's characteristics related to receiving ODA at time  $t$  with a number of variables including dummy of oil revenue, death rate, government efficiency, civil liberties, corruption, dummy of a 1-year lagged ODA, dummy of disaster, and the DAC list membership.  $W_{2i}$  and  $V_{2t}$  are defined in the same way as those in Eqs. (1 and 2).

We estimated a Logit model to control period, continent, and income level fixed effects and obtained the Mills ratio which was plugged into the least squares model of ODA provisions accounting for possible sample selection bias. It is worth mentioning here that we not only use a Logit model, but also a Probit and a linear probabilistic model. We estimate both ODA and exports jointly as a system of interdependent equations. In the following section, we also account for heterogeneity in the effects of ODA types on exports.

### ODA type-specific analysis models

The models presented in this section are used for investigating aid effects over various types of ODA provided by South Korea (grants, loans, technical cooperation, and humanitarian assistance). As Kang (2015) points out, ODA types may have heterogeneous effects on exports. For this analysis, Eqs. (5)–(9) are jointly estimated:

$$\begin{aligned} & \ln(\text{Export}_{it}) \\ &= \beta_0 + \beta_1 \ln(\text{grant}_{it}) + \beta_2 \ln(\text{loan}_{it}) + \beta_3 \ln(\text{tech}_{it}) + \beta_4 \ln(\text{human}_{it}) + \beta_5 X_{it} + \beta_6 Z_{1it} + \beta_7 W_{1i} + \beta_8 V_{1t} + \varepsilon_{1it}, \end{aligned} \tag{5}$$

$$\begin{aligned} & \ln(\text{grant}_{it}) \\ &= \alpha_0 + \alpha_1 \ln(\text{Export}_{it}) + \alpha_2 \ln(\text{loan}_{it}) + \alpha_3 \ln(\text{tech}_{it}) + \alpha_4 \ln(\text{human}_{it}) + \alpha_5 X_{it} \\ & \quad + \alpha_6 Z_{2it} + \alpha_7 W_{2i} + \alpha_8 V_{2t} + \sigma \hat{\lambda}_{it} + \varepsilon_{2it}, \end{aligned} \tag{6}$$

$$\begin{aligned} \ln(\text{loan}_{it}) &= \gamma_0 + \gamma_1 \ln(\text{Export}_{it}) + \gamma_2 \ln(\text{grant}_{it}) + \gamma_3 \ln(\text{tech}_{it}) + \gamma_4 \ln(\text{human}_{it}) + \gamma_5 X_{it} \\ & \quad + \gamma_6 Z_{2it} + \gamma_7 W_{2i} + \gamma_8 V_{2t} + \sigma \hat{\lambda}_{it} + \varepsilon_{3it}, \end{aligned} \tag{7}$$

$$\begin{aligned} \ln(\text{tech}_{it}) &= \delta_0 + \delta_1 \ln(\text{Export}_{it}) + \delta_2 \ln(\text{grant}_{it}) + \delta_3 \ln(\text{loan}_{it}) + \delta_4 \ln(\text{human}_{it}) + \delta_5 X_{it} \\ & \quad + \delta_6 Z_{2it} + \delta_7 W_{2i} + \delta_8 V_{2t} + \sigma \hat{\lambda}_{it} + \varepsilon_{4it}, \end{aligned} \tag{8}$$

$$\begin{aligned} \ln(\text{human}_{it}) &= \phi_0 + \phi_1 \ln(\text{Export}_{it}) + \phi_2 \ln(\text{grant}_{it}) + \phi_3 \ln(\text{loan}_{it}) \\ & \quad + \phi_4 \ln(\text{tech}_{it}) + \phi_5 X_{it} + \phi_6 Z_{2it} + \phi_7 W_{2i} + \phi_8 V_{2t} + \sigma \hat{\lambda}_{it} + \varepsilon_{5it} \\ \hat{\lambda}_{it} &= \frac{\phi(Z_{it} \hat{\delta})}{\Phi(Z_{it} \hat{\delta})}, \end{aligned} \tag{9}$$

where  $\ln(\text{grant}_{it})$ ,  $\ln(\text{loan}_{it})$ ,  $\ln(\text{tech}_{it})$ , and  $\ln(\text{human}_{it})$  are the logs of grants, loans, technical cooperation, and humanitarian assistance, respectively. By analyzing this

model, we estimated the heterogeneous effects of exports on each type of aid consistently and efficiently.

## Data

Our study is based on a comprehensive dataset covering South Korea's 121 ODA recipient countries between 1996 and 2014; 1996 is the last year that South Korea received a positive amount of net ODA from other developed countries and 2014 is the most recent year for which data are available.

The unit of observation in the dataset is country, that is, recipient by year. A country that received ODA from South Korea at least once between 1996 and 2014 is a part of the sample. Because selecting ODA recipients itself may affect South Korea's exports, even recipients of a small amount of aid have been included in the analyzed data. These countries in the sample are in the OECD DAC list of ODA recipients.<sup>12</sup> This list is announced every 3 years. There are five categories based on per capita GNP: LDC (Least Developed Countries), OLIC (Other Low-Income Countries), LMIC (Lower Middle-Income Countries), UMIC (Upper Middle-Income Countries), and HIC (High-Income Countries). There were 14 countries<sup>13</sup> in the list during 1996–2014.

To model the variables, we got export flows from South Korea to the recipient countries from the Korea Customs Services website (<http://www.customs.go.kr>) and South Korea's ODA commitments were downloaded from the OECD database by year and recipient country. Since the commitments reflect the donor's intentions and specific purposes it is better to use commitments as a main interest variable for this analysis in comparing disbursements.<sup>14</sup> For measuring the ODA type-specific effects, ODA disbursements allow an estimation which categorizes aid into grants, loans, technical cooperation, and humanitarian assistance. These types of variables are transformed to a natural logarithm to allow an easier interpretation and for handling right-skewedness due to zero values.<sup>15</sup>

As explanatory variables of the gravity model of exports, we mainly use per capita GDP, population size, distance, tariff, and gap in per capita GDP between South Korea and a recipient country. We sourced the per capita GDP and population size from the World Bank's World Development Indicators (WDI) by year and recipient country. The leading French Center for Research and Expertise on the World Economy (CEPII) provides the most populated cities' simple distance between two countries and we used this for measuring the distance variable. Distance is expected to be negatively related to trade. We got the bilateral foreign direct investment data

<sup>12</sup> Source: The OECD website (<http://www.oecd.org/dac>).

<sup>13</sup> 'Exit' countries are Bahrain, Barbados, Brunei, Cyprus, Hong Kong, Israel, Kuwait, Malta, Oman, Qatar, Saudi Arabia, Singapore, Trinidad and Tobago, and United Arab Emirates.

<sup>14</sup> Source: The OECD website (<http://www.oecd.org/dac/stats/faq>).

<sup>15</sup> Among 2,299 observations, exports and ODA had 44 (1.9 percent) and 513 (22.3 percent) zero values, respectively.

from the Export–Import Bank of Korea. Inward and outward FDI flows are expected to positively influence both exports and ODA. Tariffs are the weighted mean applied tariff by the product import's share corresponding to each recipient country. These data are downloaded from the World Bank database. It should be noted that tariffs are considered trade barriers.

To explain the determinants of South Korea's ODA, we downloaded several variables from the World Bank's World Development Indicators (WDI) database such as oil revenue, death rate, and growth rate. The index's variables regarding recipient's characteristics such as political stability, government efficiency, civil liberties, and corruption are downloaded from the Global Economy website. For the disaster variable, we used data on natural disasters provided by the Center for Research on the Epidemiology of Disasters (CRED).<sup>16</sup> The data are restricted to natural disasters to consider this as an exogenous result. Taking all this into account we generated a dummy variable whether the recipient country had experienced natural disasters during the specific year. We also produced a disaster degree variable quantifying the death toll.

We extracted the producer price index from the Federal Reserve's economic data in South Korea and used it in the model's specifications. The price index reflects the business environment and the competitiveness of the South Korea's industry in the international market (for a more detailed description and sources of data used refer to Online Appendix Table A1). The summary statistics of the variables used in our analysis are given in Table 1.

Table 2 shows the correlation matrix of the variables used in the gravity model's specifications. There is a slight positive relationship between exports and ODA which is consistent with other theoretical and empirical studies. There is scant positive association of exports with the distance variable. This is because the absolute distance between two countries has now become meaningless. As an alternative variable, cost of transportation or shipping time could be suggestive in the context of globalization. We show that ODA and per capita GDP have a negative relationship reflecting the humanitarian purposes of the aid. As expected, there is a significant positive association between ODA and the disaster variable. Many of the variables which are regressors of exports also have a significant relationship with ODA. This implies that the estimation should be considered as a system accounting for a two-way causal relationship between ODA and exports.

Table 3 represents the mean of the key variables by the recipients' common characteristics. Column (1) in the second panel shows that the size of exports from South Korea to ODA recipients increases over time. This implies that it is important to use a time trend in the model's specifications. The relation between exports and distance is not clear (fourth panel in Column (1)). Based on the gravity model, as the distance increases, the volume of exports should decrease. Column (2) gives the average ODA for each group. The purpose of South Korea's ODA is not absolutely humanitarian as indicated by the first panel. Interestingly, as Alesina and Dollar (2000) showed, populous countries could get more aid. Column (5) shows that low-income

<sup>16</sup> Source: The CRED website (<http://www.emdat.be/explanatory-notes>).

**Table 1** Summary statistics of the data

	Mean	Std. Dev	Minimum	Maximum
<i>A. Dependent variables</i>				
Export flows to recipients (USD thousand)	912.16	2711.23	0	32,606.20
1 if a country receives ODA from Korea	0.78	0.42	0	1.00
Bilateral ODA commitments to recipients (USD thousand)	3312.09	12,412	0	234,560.00
Bilateral technical cooperation disbursements to recipients (USD thousand)	713.91	1906.64	0	21,440.00
Bilateral humanitarian disbursements to recipients (USD thousand)	95.45	726.55	0	14,000.00
Bilateral grant disbursements to recipients (USD thousand)	1782.52	6815.42	0	149,540.00
Bilateral loan disbursements to recipients (USD thousand)	1558.93	8409.95	0	198,610.00
<i>B. Independent variables</i>				
GDP per capita of recipients (constant 2005 dollars)	4972.06	8323.10	72.75	63,479.40
Population of recipients (millions)	30.82	108.65	0.07	1295.29
Outward FDI (South Korea to recipients) (USD thousand)	51,053.13	229,029.76	0	3,715,000.00
Tariff rates in recipient countries	221.98	275.28	1.00	829.00
Export and import flows between Korea and a recipient (USD thousand)	1804.33	4894.18	0	48,819.14
Lagged growth rate of a recipient country	4.61	6.85	-62.08	149.97
1 if a country has oil rents	0.45	0.50	0	1.00
Oil rents (percent)	6.27	13.23	0	77.19
Disaster degree (0 = not affected; 1 = the death toll under 25; 2 = the death toll between 26 and 1000; 3 = the death toll over 1000)	0.97	0.87	0	3.00
1 if a country experiences a natural disaster	0.63	0.48	0	1.00
Control for corruption (-2.5 weak; 2.5 strong)	-0.34	0.76	-1.91	2.42
Political stability index (-2.5 weak; 2.5 strong)	-0.33	0.92	-3.18	1.54
Government effectiveness index (-2.5 weak; 2.5 strong)	-0.32	0.76	-2.32	2.43
Death rate (per 1000 people)	8.52	4.02	1.48	27.62
Civil liberties (1 = best; 7 = worst)	3.84	1.57	1.00	7.00
Economic freedom overall index (0-100)	57.16	10.35	16.00	91.00

Table 1 (continued)

	Mean	Std. Dev	Minimum	Maximum
<i>C. Control variables</i>				
Korea Producer Price Index	88.32	12.25	68.00	107.00
Gap in log of GDPpc between South Korea and recipients	2.22	1.36	-1.39	5.19
Distance b/w the most populated cities (km)	9830.8	3927.31	118.63	19,447.35
Period (0 = 1996~1999; 1 = 2000~2004; 2 = 2005~2009; 3 = 2010~2014)	1.58	1.09	0	3.00
Continent (0 = Asia, 1 = America, 2 = Africa, 3 = Europe, 4 = Oceania)	1.33	1.06	0	4.00
DAC list (0 = LDC, 1 = OLIC, 2 = LMIC, 3 = UMIC, 4 = HIC, 5 = Exit)	1.70	1.46	0	5.00
Observations	2299			

**Table 2** Correlation matrix,  $N = 2299$  observations

	Export	ODA	GDPpc	Popula- tion	GDP gap	FDI	Tariff	Eco- nomic freedom	Distance	Korea PPI	Disaster	Oil rev- enues	Natural resource	Death rate	Political stability	Civil liberties	School	Con- trol cor- rupt
Export	1																	
ODA	0.2223 <sup>a</sup>	1																
GDPpc	0.3088 <sup>a</sup>	-0.1164 <sup>a</sup>	1															
Population	0.2645 <sup>a</sup>	0.0705 <sup>a</sup>	-0.0968 <sup>a</sup>	1														
GDP gap	-0.2336 <sup>a</sup>	0.1627 <sup>a</sup>	-0.7658 <sup>a</sup>	0.1076 <sup>a</sup>	1													
FDI	0.6720 <sup>a</sup>	0.2961 <sup>a</sup>	0.1354 <sup>a</sup>	0.1602 <sup>a</sup>	-0.0914 <sup>a</sup>	1												
Tariff	-0.0304	0.0497 <sup>b</sup>	-0.0336	0.0234	0.0276	-0.0011	1											
Economic freedom	0.3043 <sup>a</sup>	-0.0972 <sup>a</sup>	0.4716 <sup>a</sup>	-0.0715 <sup>a</sup>	-0.5111 <sup>a</sup>	0.1381 <sup>a</sup>	0.1195 <sup>a</sup>	1										
Distance	0.0188	0.0682 <sup>a</sup>	0.0711 <sup>a</sup>	-0.0184	0.0069	0.0333	0.0130	0.0354 <sup>c</sup>	1									
Korea PPI	0.1859 <sup>a</sup>	0.2135 <sup>a</sup>	0.0473 <sup>b</sup>	0.0259	0.0535 <sup>b</sup>	0.1478 <sup>a</sup>	0.1598 <sup>a</sup>	0.0484 <sup>b</sup>	0.0000	1								
Disaster	0.0199	0.1222 <sup>a</sup>	-0.3626 <sup>a</sup>	0.1713 <sup>a</sup>	0.3870 <sup>a</sup>	0.0581 <sup>a</sup>	0.1209 <sup>a</sup>	-0.1087 <sup>a</sup>	0.0526 <sup>b</sup>	-0.0125	1							
Oil rev- enues	0.0010	0.0078	0.2915 <sup>a</sup>	-0.0326	-0.2794 <sup>a</sup>	0.0006	-0.0419 <sup>b</sup>	-0.2170 <sup>a</sup>	-0.0197	0.0402 <sup>c</sup>	-0.0973 <sup>a</sup>	1						
Natural resource	-0.0559 <sup>a</sup>	-0.0010	0.2120 <sup>a</sup>	-0.0535 <sup>b</sup>	-0.0762 <sup>a</sup>	-0.0379 <sup>c</sup>	-0.0388 <sup>c</sup>	-0.2847 <sup>a</sup>	-0.0313	0.0671 <sup>a</sup>	-0.0795 <sup>a</sup>	0.8512 <sup>a</sup>	1					
Death rate	-0.2150 <sup>a</sup>	-0.0963 <sup>a</sup>	-0.4300 <sup>a</sup>	-0.0232	0.5693 <sup>a</sup>	-0.1413 <sup>a</sup>	-0.0929 <sup>a</sup>	-0.3345 <sup>a</sup>	-0.0437 <sup>b</sup>	-0.1674 <sup>a</sup>	0.1970 <sup>a</sup>	-0.1211 <sup>a</sup>	0.0037	1				
Political stability	0.0812 <sup>a</sup>	-0.1363 <sup>a</sup>	0.4106 <sup>a</sup>	-0.1978 <sup>a</sup>	-0.5087 <sup>a</sup>	0.0510 <sup>b</sup>	-0.0290	0.4325 <sup>a</sup>	-0.0370 <sup>c</sup>	-0.0095	-0.3435 <sup>a</sup>	-0.0752 <sup>a</sup>	-0.1279 <sup>a</sup>	-0.2849 <sup>a</sup>	1			
Civil lib- erties	-0.0400 <sup>c</sup>	0.0816 <sup>a</sup>	-0.0440 <sup>b</sup>	-0.0104	0.2431 <sup>a</sup>	-0.0227	-0.1292 <sup>a</sup>	-0.4463 <sup>a</sup>	-0.0614 <sup>a</sup>	-0.0772 <sup>a</sup>	0.0219	0.3898 <sup>a</sup>	0.4156 <sup>a</sup>	0.0749 <sup>a</sup>	-0.4457 <sup>a</sup>	1		
School	0.0345 <sup>c</sup>	0.0735 <sup>a</sup>	0.0546 <sup>a</sup>	0.0117	-0.1706 <sup>a</sup>	0.0496 <sup>b</sup>	0.1532 <sup>a</sup>	0.1269 <sup>a</sup>	-0.0681 <sup>a</sup>	0.1635 <sup>a</sup>	-0.0512 <sup>b</sup>	-0.0044	-0.0739 <sup>a</sup>	-0.3108 <sup>a</sup>	0.1693 <sup>a</sup>	-0.1972 <sup>a</sup>	1	
Control for cor- ruption	0.2865 <sup>a</sup>	-0.1473 <sup>a</sup>	0.6006 <sup>a</sup>	-0.0771 <sup>a</sup>	-0.6510 <sup>a</sup>	0.1241 <sup>a</sup>	0.0059	0.6785 <sup>a</sup>	-0.0140	-0.0065	-0.2911 <sup>a</sup>	-0.1281 <sup>a</sup>	-0.2151 <sup>a</sup>	-0.3765 <sup>a</sup>	0.6568 <sup>a</sup>	-0.4733 <sup>a</sup>	0.1292 <sup>a</sup>	1

See Table 1. a, b, and c indicate significance at the 1, 5, and 10% level, respectively



**Table 3** Mean of variables by recipients' characteristics,  $N=2299$  observations

	Export (USD 1000)	ODA (USD 1000)	GDPpc (USD 1000)	FDI (USD 1000)	Growth rate
Income level (constant 2005) of recipient					
1. below 72.75	198.08	4119.29	394.22	18,775.57	5.14
2. 72.75–658.04	883.68	6742.60	1132.32	66,322.94	4.69
3. 658.04–1931.34	555.47	2138.52	3335.98	25,241.67	4.25
4. 1931.34–5239.82	2013.30	242.63	15,043.21	93,946.94	4.38
Period					
1. Year 1996–1999	408.23	565.59	4429.73	17,331.33	4.64
2. Year 2000–2004	482.93	1332.10	4677.27	12,038.39	3.53
3. Year 2005–2009	989.56	3210.85	5224.81	75,650.21	5.93
4. Year 2010–2014	1667.12	7600.63	5447.95	92,448.23	3.88
Continent, recipient					
1. Asia	2310.56	8102.37	9203.41	137,685.10	5.44
2. America	620.75	1310.95	4762.85	37,681.12	3.34
3. Africa	190.65	1694.63	1851.96	5089.82	5.20
4. Europe	793.34	946.65	8873.39	25,036.01	3.28
5. Oceania	17.91	387.54	2059.51	2,789.02	2.39
Distance to recipient					
1. below 118.00 km	960.19	2310.46	4184.09	35,204.91	4.40
2. 118.00–7292.73	536.26	2511.90	4003.78	37,658.63	4.98
3. 7292.73–8981.47	1417.01	5221.75	5104.73	107,312.70	4.84
4. 8981.47–13,047.52	747.69	3230.93	6627.90	24,482.78	4.23
Population of recipient					
1. below 0.01 million	79.99	109.25	8164.99	3594.47	4.21
2. 0.01–1.79	958.50	1728.96	6395.40	32,427.49	4.67
3. 1.79–6.90	643.45	3218.84	2657.90	43,495.39	4.88
4. 6.90–23.42	1966.76	8188.57	2672.42	124,662.80	4.69

countries experienced higher growth rates relative to high-income countries. This is obvious since less developed countries have more chances of improving, but once a country reaches a certain level of development its potential growth diminishes.

## An analysis of the results

Table 4 presents the binary estimation results of the decision model for South Korea's ODA provisions. Columns (1) through (3) show the estimation results using the linear probability model (LPM) and the maximum likelihood of Probit and Logit models, respectively. Because the actual magnitude of the marginal effects varies with the point of evaluation in the Probit and Logit models, the coefficients in Column (2) are reported as marginal effects evaluated at average (or marginal effects at

**Table 4** Binary estimation results of the decision model for South Korea's ODA provision

	(1)	(2)	(3)
Model	Linear probability model	Probit model	Logit model
Dependent variables	ODA_dummy	ODA_dummy	ODA_dummy
ln(ex + import)	-0.010**	-0.006*	-0.008**
ln(FDI)	-0.002	-0.001	-0.001
Oil rev_dum	0.002	0.003	0.004
Political stability	0.054***	0.048***	0.050***
Gov't efficiency	0.023	0.027	0.021
Corruption	-0.061***	-0.053**	-0.051**
Civil liberties	-0.001	0.002	0.002
Death rate	-0.009***	-0.007***	-0.007***
ln(GDPpc)	-0.146***	-0.115***	-0.110***
ln(population)	0.042***	0.040***	0.041***
Growth rate	-0.001	-0.001	-0.001
Disaster_dum	0.045***	0.042***	0.042***
ODAlag_dum	0.432***	0.218***	0.204***
America	0.032	0.008	0.006
Africa	-0.023	-0.039*	-0.043*
Europe	-0.152***	-0.181***	-0.189***
Oceania	-0.040	-0.061	-0.066
Constant	1.404***		
Observations	2299	2299	2299
R-squared	0.473		
Period	Yes	Yes	Yes
Income level	Yes	Yes	Yes

See Table 1. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1% level respectively. *Period* categorizes years into five according to the government (Young-Sam Kim (1996–1997), Dae-Jung Kim regime (1998–2002), Moo-Hyun Roh (2003–2007), Myung-Bak Lee (2008–2012), and Geun-Hye Park (2013–2014)). *Income level* is the quantile-based classifier by per capita GDP

the mean) in each group. The coefficients across the three models suggest a qualitatively similar story about the impact of regressors on the probability of receiving aid ( $\Pr(\text{ODA} = 1)$ ), but the magnitude of estimation from LPM, Probit, and Logit models is slightly different. Since LPM has drawbacks such as biased estimation and estimated probabilities outside the unit interval  $[0, 1]$ , to consider fixed effects by period, continent, and income levels, we calculated the proxy, namely the inverse Mills ratio under the Logit model and used it for explaining the amount of ODA.

The variables in our analysis are among those considered as determinants of South Korea's ODA. However, the interpretations of coefficients in the Probit and Logit regressions are not as straightforward as in the linear regression where an interpretation is possible under some assumptions. Estimated coefficients of per capita GDP and population demonstrate that like other major donors, the Korean government also responds to lower income and bigger countries (Alesina and

Dollar 2000). If the disaster variable changes from zero to one, the probability of the variable ODA taking the value one rises by 4.2% points. Holding other variables constant at their respective means, a one-unit increase in political stability leads to an increase in the predicted probability that the recipient country receives as directly distributed ODA from South Korea by an additional 5%. As the coefficient of  $\ln(\text{export} + \text{import})$  indicates, if a country has a lower trade volume with South Korea, there is higher probability of it's getting ODA from South Korea. This result is contrary to the findings of many previous studies and implies that there is a two-stage decision-making process in South Korea's ODA as You (2009) demonstrates. To check this, we did the Heckman two-stage estimation and Online Appendix Table A2 presents the results. All the coefficients are qualitatively the same except the coefficients of  $\ln(\text{export} + \text{import})$  and  $\ln(\text{FDI})$ . This finding suggests that like in other major donors there is a gatekeeping stage in South Korea's ODA decisions.

### Aggregate level results

Estimates of the system of equations models explained in Sect. 4.1 are reported in Columns from (1) to (4) of Table 5. Columns (1) and (3) report the estimated coefficients when the dependent variable is log of South Korea's exports to a recipient country, Columns (2) and (4) show the estimated coefficients when the dependent variable is the log of South Korea's directly distributed ODA to a recipient country. The difference between Model 1 (Columns (1) and (2)) and Model 2 (Columns (3) and (4)) is whether the fixed effects (period, continent, and income level) are controlled or not.

From Table 5 it emerges that there is a positive relationship between South Korea's ODA and its exports. The log of ODA ( $\beta_1$  in Eq. (1 or 5)) shows the coefficients of 0.0333 and 0.0377 from each model, respectively, with statistical significance at the conventional level. This result can be interpreted as a 10% increase in South Korea's ODA leading to around a 0.4% increase in exports to the recipient. This estimated impact of ODA on exports is small implying that previous studies overestimated its effect on exports. Our finding supports the thinking that the two equations should be estimated jointly.

There are several things that are noticeable in the odd numbered columns in Table 5. Our results support the gravity model in most parts. The coefficient of tariff is negative and statistically significant at the 1% level in both the models, implying that tariff is a trade barrier. The coefficient of population is positive and statistically significant at the 1% level. However, the estimated distance effect is negative but insignificant. Due to the evolution of transportation systems, distance in international trade may not be that important any more. The estimated per capita GDP effect is positive and statistically significant in both the models, implying that there is an income effect on South Korea's exports to a recipient country. The FDI results are consistent with previous studies, showing that FDI has a complementary relationship with South Korea's exports (Lee and Lee, 2012). From the growth rate

**Table 5** Three-stage least squares estimation—aggregate level exports and ODA commitment models

	(1)	(2)	(3)	(4)
Model	Model1		Mode2	
Dependent variables	ln(export)	ln(ODA)	ln(export)	ln(ODA)
ln(ODA)	0.0333**		0.0377**	
ln(distance)	-0.0426		-0.0315	
Tariff	-0.0164***		-0.0177***	
diff ln(GDPpc)	0.630*		1.355***	
KOREA PPI	0.00841		0.0207**	
Econ Free	0.0199***		0.0201***	
ln(export)		0.524***		0.554**
ln(GDPpc)	1.493***	-0.766***	2.222***	-0.924***
ln(FDI)	0.149***	-0.0705***	0.148***	-0.0809**
Oil revenue		0.00272		0.00844**
ln(population)	0.893***	-0.295**	0.892***	-0.319
Death rate		-0.0925***		-0.0999***
Political stability	-0.224***	0.176**	-0.224***	0.268***
Gov't efficiency		-0.0363		0.202
Civil liberties		-0.0732**		-0.00457
Corruption		-0.291**		-0.292**
Growth rate	0.00833**	-0.00489	0.00879**	-0.0109*
ln(ODAlag)		0.701***		0.682***
Disaster degree		0.101*		0.135**
invMR		-0.0562		0.554***
America				-0.196
Africa				-0.331***
Europe				-0.908***
Oceania				-0.476*
OLIC				0.102
LMIC				0.377*
UMIC				0.0344
HIC				-1.890***
Exit				-2.407***
Constant	-12.63***	6.919***	-20.47***	7.913***
Observations	2178	2178	2178	2178
R-squared	0.716	0.678	0.715	0.684
Period	No	No	Yes	Yes
DAC list		No		Yes

See Table 1. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1% level respectively. *Period* categorizes years into five according to the government (Young-Sam Kim (1996–1997), Dae-Jung Kim regime (1998–2002), Moo-Hyun Roh (2003–2007), Myung-Bak Lee (2008–2012), and Geun-Hye Park (2013–2014)). The DAC list has 6 categories: LDC (Least Developed Countries), OLIC (Other Low-Income Countries), LMIC (Lower Middle-Income Countries), UMIC (Upper Middle-Income Countries), HIC (High-Income Countries), and Exit which means a country is not eligible for getting ODA due to a high enough per capita GNP

variables, it can be seen that a higher growth rate brings in more imports from South Korea to the recipient countries. One more interesting aspect is the economic freedom of recipient countries. The positive sign indicates that the higher the economic freedom of a recipient country, the greater its dependence on South Korea's exports. Given the measure of the index of economic freedom, this higher number reflects a high likelihood of rule of law, government size, regulatory efficiency, and an open market.<sup>17</sup>

The coefficients in even numbered columns indicate the determinants and purpose of South Korea's ODA. The estimated positive coefficients of exports are given in models 1 and 2 with their being statistically significant at the conventional level. The coefficients of per capita GDP are negative and statistically significant at the 1% level in both the models. The parameter estimate for Africa is negative and significant at the 1% level which suggests that countries in Africa get less ODA from South Korea as compared to those in Asia. The coefficient of political stability is positive and significant which implies that South Korea as a donor cares about recipients' political stability for aid effectiveness. There is a positive and statistically significant coefficient of the variable  $\ln(\text{ODA}_{t-1})$ . This implies that South Korea's ODA at least keeps the volume of development aid to recipient countries at a high level. The coefficient of disaster degree amounts to around 0.135 in model 2 meaning that more of South Korea's ODA goes to a recipient which has experienced a natural disaster. Lastly, the parameter estimate for the inverse Mills ratio is statistically significant at the 1% level showing that a model with correction for the selection bias is suitable.

## Results of type-specific aid effects

Table 6 reports the coefficients estimated with South Korea's ODA disbursement to a recipient country as the dependent variable. Column (1) gives the estimated coefficients when the dependent variable is the log of exports and Columns (2)–(5) give the results when the dependent variables are log of grants, loans, technical cooperation, and humanitarian assistance, respectively. This model is designed to estimate the relative effects of South Korea's ODA on its exports to recipient countries distinguished by ODA types.

Column (1) in Table 6 shows that technical cooperation is the most effective aid type in terms of increasing South Korea's exports. The estimated positive coefficient of the explanatory variable is 0.800 with statistical significance at the 1% level, and the coefficient of loan turns out to be 0.277 and statistically significant at the 1% level. However, the estimated coefficient for grants is negative and significant.

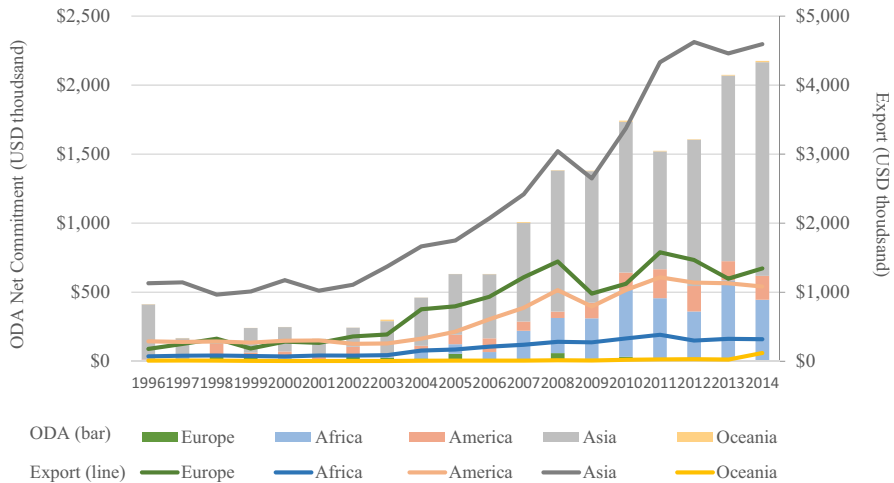
The estimated coefficients suggest a qualitatively similar effect as shown in Table 5 in terms of the effect of regressors such as tariffs, distance, economic freedom, GDP per capita, population, and political stability on South Korea's exports to recipient countries. Some of them stay statistically significant at the conventional level while others turn insignificant in the disaggregate model. The estimated coefficients for the log

<sup>17</sup> The index is a composite measure as it is based on several other indices from multiple sources (Source: <https://www.heritage.org/>).

**Table 6** Three-stage least squares estimation—aggregate level exports and disaggregate ODA type commitment models

	(1)	(2)	(3)	(4)	(5)
Dependent variables	ln(export)	ln(grant)	ln(loan)	ln(tech)	ln(human)
ln(grant)	−0.863***		0.929***	0.932***	−1.719***
ln(loan)	0.277***	1.082***		−1.012***	1.881***
ln(tech)	0.800***	1.072***	−0.996***		1.860***
ln(human)	−0.029	−0.549***	0.521***	0.513***	
ln(distance)	−0.016				
Tariff	−0.009				
diff ln(GDPpc)	1.229**				
Korea PPI	−0.004				
Eecon Free	0.021***				
ln(export)		−0.346	0.320	0.324	−0.614
ln(GDPpc)	2.022***	1.187***	−1.099***	−1.111***	2.057***
ln(FDI)	0.101***	−0.035	0.033	0.033	−0.061
Oil revenue		−0.021***	0.020***	0.020***	−0.038***
ln(population)	0.779***	0.136	−0.123	−0.128	0.239
Death rate		0.121***	−0.112***	−0.113***	0.207***
Political stability	−0.393***	−0.968***	0.901***	0.906***	−1.699***
Gov't efficiency		−0.215	0.202	0.201	−0.386
Civil liberties		0.153***	−0.141***	−0.144***	0.270*
Corruption		0.588***	−0.542***	−0.551***	1.029**
Growth rate	0.003	−0.004	0.004	0.004	−0.008
ln(ODAlag)		−0.448***	0.412***	0.420***	−0.778***
Disaster degree		0.024	−0.029	−0.022	0.061
invMR		−1.266***	1.167***	1.185***	−2.179***
AMERICA		0.674***	−0.615***	−0.631***	1.159*
Africa		0.507***	−0.458***	−0.476***	0.861
Europe		1.184***	−1.084***	−1.109***	2.006***
Oceania		1.728***	−1.588***	−1.617***	2.953***
OLIC		−0.621***	0.577***	0.581***	−1.084***
LMIC		−0.584**	0.539**	0.545**	−0.986**
UMIC		−0.663*	0.611	0.618*	−1.104
HIC		−0.017	0.019	0.009	0.056
Exit		−0.277	0.262	0.252	−0.388
Constant	−15.559***	−6.502***	6.017***	6.088***	−11.289***
Observations	2178	2178	2178	2178	2178
R-squared	0.491	−0.099	0.015	0.007	−7.006
Period	Yes	Yes	Yes	Yes	Yes
DAC list		Yes	Yes	Yes	Yes

See Table 1. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1% level respectively. *Period* categorizes years into five according to the government (Young Sam Kim (1996–1997), Dae–Jung Kim regime (1998–2002), Moo-Hyun Roh (2003–2007), Myung-Bak Lee (2008–2012), and Geun-Hye Park (2013–2014)). The DAC list has 6 categories: LDC (Least Developed Countries), OLIC (Other Low-Income Countries), LMIC (Lower Middle-Income Countries), UMIC (Upper Middle-Income Countries), HIC (High-Income Countries), and Exit which means a country is not eligible for getting ODA due to a high enough per capita GNP



**Fig. 2** Korea's total bilateral net ODA commitments and Exports by Region (unit USD thousand)

of exports in Columns (2)–(5) are insignificant which implies that the effect of increasing exports is dispersed due to the disaggregation of ODA. The parameter estimates for oil revenue are interesting. If a country has higher oil revenue, it could get two types of assistance: loans and technical cooperation. The coefficients of the inverse Mills ratio in all types are statistically significant at the conventional level.

Overall, analogous with previous literature, our results demonstrate that there is a statistically significant effect of South Korea's ODA on its exports to recipient countries. As Kim and Oh (2012) suggest, the results support the idea that South Korea's ODA policy may have a dual-track structure. An interesting result is that there are heterogeneous effects of ODA types; ODA as technical cooperation is the most effective in terms of increasing exports to recipient countries.

## Robustness checks

In this section, we present the robustness checks that we performed to assess the relevance of the main estimation. It mainly discusses two issues—a practiced free trade agreement (FTA) and sub-sample regression. First, to deal with FTA's impact on export volumes since 2004, the FTA variable is added in the baseline model and its effect is estimated. Secondly, a sub-sample is made to identify the pure impacts of South Korea's ODA on exports to recipient countries which were in the DAC list during the analysis period. These robustness checks produce consistent results.

## Practiced FTA

South Korea's FTA has been in effect since April 1, 2004 with Chile. Since then, South Korea has also approved FTA with Singapore, the European Free Trade



**Table 7** Three-stage least squares estimation—aggregate exports and ODA commitment models controlling for FTA

	(1)	(2)
Dependent variables	ln(export)	ln(ODA)
ln(ODA)	0.038***	
ln(distance)	-0.027	
Tariff	-0.019***	
diff ln(GDPpc)	1.084**	
KOREA PPI	0.019*	
Econ Free	0.020***	
FTA	0.443***	
ln(export)		0.416*
ln(GDPpc)	1.949***	-0.767***
ln(FDI)	0.143***	-0.057*
Oil revenue		0.008**
ln(population)	0.888***	-0.196
Death rate		-0.096***
Political stability	-0.235***	0.227***
Gov't efficiency		0.196
Civil liberties		-0.012
Corruption		-0.283**
Growth rate	0.009**	-0.010
ln(ODAlag)		0.682***
Disaster degree		0.134**
invMR		0.511***
America		-0.180
Africa		-0.308**
Europe		-0.856***
Oceania		-0.428
OLIC		0.087
LMIC		0.354*
UMIC		-0.001
HIC		-1.887***
Exit		-2.421***
Constant	-17.789***	6.914***
Observations	2178	2178
R-squared	0.717	0.711
Period	Yes	Yes
DAC list		Yes

See Table 1. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1% level respectively. *Period* categorizes years into five according to the government (Young Sam Kim (1996–1997), Dae-Jung Kim regime (1998–2002), Moo-Hyun Roh (2003–2007), Myung-Bak Lee (2008–2012), and Geun-Hye Park (2013–2014)). The DAC list has 6 categories: LDC (Least Developed Countries), OLIC (Other Low-Income Countries), LMIC (Lower Middle-Income Countries), UMIC (Upper Middle-Income Countries), HIC (High-Income Countries), and Exit which means a country is not eligible for getting ODA due to a high enough per capita GNP

Association (EFTA, 4 countries), the Association of Southeast Asian Nations (ASEAN, 10 countries), India, the European Union (EU, 27 countries), Peru, US, Turkey, and Colombia. These FTAs lead to an increase in trade volumes between South Korea and partner countries. Figure 2 shows this tendency. Because of this reason, FTA needs to be controlled to estimate the exact impact of ODA on South Korea's exports.

Table 7 shows the results of our estimation after including the FTA variable in the model's specifications. FTA's coefficients are positive and statistically significant at the 1% level. This provides empirical evidence of FTA's promotion in South Korea's exports. However, the coefficients of  $\ln(\text{ODA})$  in Column (1) does not have a big effect as compared to Columns (1) and (3) in Table 5.

### Sub-sample

There were 14 countries in the DAC list of ODA recipient countries during the study period.<sup>18</sup> The model is estimated with the sub-sample in which these countries are excluded.<sup>19</sup> The results are reported in Columns (3) and (4) of Table 8. Comparing Column (1) with Column (3), the coefficients suggest a qualitatively similar story about the impact of regressors on South Korea's exports to recipient countries, whereas the estimated positive coefficient of  $\ln(\text{ODA})$  in the latter case is larger at 0.099 with statistical significance at the 1% level. Comparing Columns (2) and (4), the directions of all coefficients are the same and the absolute magnitudes of coefficients in Column (4) are bigger than those in Column (2) when the coefficients of exports, per capita GDP, and population are considered.

### Conclusion and policy implications

This study focused on the impact of South Korea's ODA on its exports to 121 recipient countries using panel data from 1996 to 2014. The data used for this study are secondary data downloaded from the websites of the World Bank, OECD statistics, and the Korean National Statistical Office. This study estimated South Korea's ODA allocations by considering a two-stage decision-making process.

Using a disaster dummy variable which is a new determinant of South Korea's aid allocations and an oil reserve dummy variable as exclusion restrictions, we minimized the sample selection problem which comes up in a number of such studies. Estimating ODA's effects on exports by correcting for sample selection bias is a contribution of this study. Another contribution of this study is that it uses the three-stage least squares estimation method for a consistent and efficient estimation and analysis of the system of interdependent ODA and export

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<sup>18</sup> 'Exit' countries are Bahrain, Barbados, Brunei, Cyprus, Hong Kong, Israel, Kuwait, Malta, Oman, Qatar, Saudi Arabia, Singapore, Trinidad and Tobago, and the United Arab Emirates.

<sup>19</sup> By definition, these countries cannot obtain ODA from any donor. Received aid cannot be counted as ODA.

**Table 8** Three-stage least squares estimation—aggregate exports and ODA commitments with full and sub-sample of data (DAC graduated countries excluded)

	(1)	(2)	(3)	(4)
Sample	Full sample		Subsample	
Dependent variables	ln(export)	ln(ODA)	ln(export)	ln(ODA)
ln(ODA)	0.038**		0.099***	
ln(distance)	−0.032		−0.019	
Tariff	−0.018***		−0.009*	
diff ln(GDPpc)	1.355***		1.361***	
KOREA PPI	0.021**		0.014	
Econ Free	0.020***		0.015***	
ln(export)		0.554**		0.898***
ln(GDPpc)	2.222***	−0.924***	2.211***	−1.150***
ln(FDI)	0.148***	−0.081**	0.136***	−0.119***
Oil revenue		0.008**		0.009*
ln(population)	0.892***	−0.319	0.868***	−0.609**
Death rate		−0.100***		−0.092***
Political stability	−0.224***	0.268***	−0.228***	0.332***
Gov't efficiency		0.202		0.131
Civil liberties		−0.005		0.002
Corruption		−0.292**		−0.233*
Growth rate	0.009**	−0.011*	0.007	−0.011
ln(ODAlag)		0.682***		0.624***
Disacat		0.135**		0.122**
invMR		0.554***		0.485**
America		−0.196		−0.223
Africa		−0.331***		−0.331***
Europe		−0.908***		−0.912**
Oceania		−0.476*		−0.436
OLIC		0.102		0.083
LMIC		0.377*		0.335
UMIC		0.034		0.007
HIC		−1.890***		−1.797***
Exit		−2.407***		
Constant	−20.467***	7.913***	−20.022***	9.294***
Observations	2178	2178	2059	2059
R-squared	0.715	0.684	0.700	0.553
Period	Yes	Yes	Yes	Yes
DAC list		Yes		Yes

See Table 1. \*, \*\*, and \*\*\* indicate significance at the 10, 5, and 1% level, respectively. *Period* categorizes years into five according to the government (Young Sam Kim (1996–1997), Dae-Jung Kim regime (1998–2002), Moo-Hyun Roh (2003–2007), Myung-Bak Lee (2008–2012), and Geun-Hye Park (2013–2014)). The DAC list has six categories: LDC (least developed countries), OLIC (other low-income countries), LMIC (lower middle-income countries), UMIC (upper middle-income countries), HIC (high-income countries), and Exit which means a country is not eligible for getting ODA due to a high enough per capita GNP

equations. The usefulness of this methodology allows an analysis of the two-way causal relationship between ODA and exports.

The main findings of this study are: (i) South Korean ODA has a positive influence on the country's exports, (ii) in disaggregated form, technical cooperation-type ODA was found to have the largest effect among the four ODA types but, grants had a negative impact on South Korea's exports, and (iii) South Korea's ODA policy may have a dual-track structure showing that the relationship between ODA's allocation and trade turns from negative to positive.

However, despite its significant contributions, our study has some limitations. To analyze ODA's effects specifically on exports we excluded imports to eliminate the contaminated effect. Since exports to South Korea seemed very significant when looking at its export-oriented growth strategy, we focused on the impact on exports to evaluate the returns from ODA. Therefore, to capture the general effect of ODA on South Korean trade, further detailed studies are needed. Also, disbursement data are better for estimating the effects more precisely than commitment data. However, because of data limitations, we used ODA commitment data.

The policy implications of our study include first, our results suggest that ODA has a positive impact on South Korea's exports to recipient countries. This is not only because of tied-aid but also because of the natural interaction through technical cooperation. If the South Korean government sets a target of promoting its exports for economic growth, development cooperation could be one of answers. Second, there is a 'gatekeeping' stage before the ODA is allocated to individual recipient countries. In the first stage when a decision is taken on South Korea's ODA receivers, bilateral trade is considered negatively. In the second decision-making stage regarding the volume of ODA to selected recipients, exports have a positive impact on South Korea's ODA. This two-stage decision-making process is not a problem in itself but it can reduce the impact of South Korea's ODA on exports to recipient countries if the selected countries are less likely to import South Korean goods.

These days many developing and even developed countries are interested in economic development cooperation because that is sustainable and practical from a long-term perspective. This strategy is also in line with the United Nations Sustainable Development Goals. This research provided a detailed analysis of South Korean ODA and highlighted policy insights on South Korea's ODA which can also have implications for other upcoming donor countries' ODA policies. As everything has its pros and cons, economic cooperation may also have its own shortcomings. We leave this interesting issue for future studies to investigate.

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**Code availability** The codes are available upon request.

## Declarations

**Conflict of interest** The authors declare no conflicts of interest. The authors have no relevant financial or non-financial interests to disclose.

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