

Japan's Official Development Assistance and Exports to Asian Countries: The Donor's Perspective

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Abstract: *The study investigates the link between Japan's bilateral official assistance (Official Development Assistance or ODA) and its exports to 15 recipient countries in Asia between 1972 and 2008. The study adopts the Dynamic Ordinary Least Squares and Error Correction Model econometric techniques, and the Gravity Model of international trade to examine the relationship. The aim is first to investigate the short-and long-run dynamic effects of Japan's ODA on its exports to the recipient countries. Second, the study applies Granger causality analysis to examine the casual relationship, if any, between Japan's ODA and its exports to the recipient countries. Third, the study also analyses the short and long-term effects of the bilateral official assistance from other (Japan excluded) development assistance committee's countries (DAC) on Japan's exports to the recipients. The primary findings of this study are as follows: (i) In the long-run, for US\$1.0 of ODA spent by Japan, the average return is between US\$1.41-US\$1.86 in the pre-1992 period and between US\$2.03-US\$2.62 in the post-1992 period. In the short-run, the average return is between US\$1.30-US\$1.50. (ii) Consistent with previous empirical studies, the findings suggest that Japan's ODA enhances its exports to the recipient countries, not vice versa - both in the short and long-run. (iii) Interestingly, and contrary to other case studies, the results suggest that ODA from other DAC countries does not crowd out but instead enhance Japan's exports to Asian countries.*

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1. Introduction

One of the core objectives of the official development assistance (ODA) is to promote sustainable economic development of recipient countries and alleviate poverty (see Sachs, 2005; Riddell, 2008). However, several authors have argued

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that since the inception of foreign aid programmes, historical ties, political and strategic goals, and commercial and economic interests of donors remain the dominant features of current foreign aid relationships (see Alesina and Dollar, 2000; Bourguignon and Sundberg, 2007). While commercial and economic interests of donors are important in determining aid allocations, only a few studies have explored the commercial and economic effects of aid from the donor's perspective. The study examines the short term and long term impact of Japan's ODA to 15 recipient Asian countries¹ for the period between 1972 and 2008 especially in the commercial and economic dimensions.

Japan is considered one of the leading international donors to developing countries especially in the last four decades, and was the world's largest from 1991 to 2000. In 2010, Japan disbursed about US\$11 billion of foreign aid to developing countries, 67% of which was deemed as bilateral aid. Despite its generous ODA, Japan is among the least generous of all the members of OECD's Development Assistance Committee (DAC). Its indicator of generosity (i.e. the ratio of Japan's bilateral aid to GNI) was 0.20% in 2010 (only Greece, Italy and Korea ranked below Japan)². This is consistent with the low public support among Japanese citizens for aid disbursement to poor countries compared with other major donor nations. Poll estimates as alluded to by Riddell (2008; p.116) and results of the World Values Survey 2005-2008³ attest to this. Therefore, showing positive effects of Japan's aid on its economy will not only provide empirical evidence for a 'win-win' or 'mutual interests' hypothesis (i.e. Japanese ODA serves a dual purpose of promoting Japanese exports to recipient countries while promoting development in recipient countries) and which, in turn, might help boost public support in Japan for foreign aid but could also help Japan's developmental agencies and NGOs to lobby for more ODA from their government (i.e. improving the indicator of generosity) to enhance development in recipient countries.

In spite of vast interest in such linkages between donor ODA and donor exports, it has been scarcely researched as there is only one known empirical study by Wagner (2003) that has investigated the impact of Japan's ODA on its exports⁴ data prior to 1992. However, since 1992, Japan's ODA philosophy and stated principles have undergone significant changes and among the majors ones are the following: First, Japan's tying percentage has dropped significantly from 27% in 1992 to 4% in 2008. Second, Japan introduced Foreign Aid Guidelines in 1991 and Foreign Aid Charter in 1992 which imposed certain political conditions on its recipients. Third, immediately after introducing these guidelines and the Charter, Japan began to focus more on the social infrastructure rather than physical infrastructure (which had been the main target of Japan's ODA prior to this). Therefore, one can expect these changes to have an impact on the nature of relationship between Japan's ODA and its trade.

The previous study mentioned above addresses only the short-term impact of Japan's ODA on its exports in a static model while the present work addresses the long-term as well as short-term impacts using two dynamic and sophisticated methodologies: The first of these methodologies, the Dynamic Ordinary Least Squares (DOLS), estimates only long term effects of ODA on trade while the second, the Error Correction Model, estimates both short and long term effects of ODA on trade. Also, in order to use these methodologies, we first address nonstationarity and endogeneity in the panel data. It is important to note that by examining the long-term impacts of ODA we are investigating spillover effects which could be both positive and negative effects. Identifying long-term positive effects has two important implications: First, some of the impacts of Japan's ODA on the Asian exports take time to materialise as they are mostly attributed to the goodwill and technological transfer dependency. Second, the Japan's ODA helps take Japan's steady-state level of exports to Asian countries to a newer and higher level (see Greene, 2003:561).

An important related issue that has also not been empirically investigated in the previous study is the impact of other donors' ODA on Japan's exports. In theory, Japan and other countries via their ODA enhance the economic growth and income of recipient Asian countries and thus their capacity to import goods and services from abroad particularly from the donors themselves. ODA indirectly favours donor nations by stimulating exports from the former to recipient countries. However, there could be situations whereby other donors' ODA has reduced Japan's exports as recipient nations favour exports from the former. Thus, other donors' ODA (i.e. DAC countries excluding Japan) can have positive or negative impact on Japan's exports. Therefore, the issue deserves an empirical investigation (see Martinez-Zarzoso *et al.*, 2009; Nowak-Lehmann, *et al.*, 2009; Zarin-Nejadan, 2008).

Another related and important argument of ODA and its causal relationship in terms of export is whether an increase in donor countries' exports to recipient nations can lead to a further increase in the quantum of ODA. McGillivray and Morrissey (1998) among others, point out that exports can lead to an increase in aid principally because: (i) lobby groups in donor countries are known to exert pressure on their government to use the ODA to boost exports; (ii) the ODA can be used as a tool by the donor to reward and/or cement its relationship with countries with which it has pre-existing commercial ties; (iii) the donor can use the ODA as a tool to reward countries for buying its products. Thus, the study will empirically examine the above themes.

Our primary results suggest that for US\$1.0 of ODA spent by Japan, the average return is between US\$1.41-US\$1.86 in the pre-1992 period and between US\$2.03-US\$2.62 in the post-1992 period. In the short-run, the average return is between US\$1.30-US\$1.50. Interestingly, and contrary to other case studies,

we find that ODA from other DAC countries does not crowd out Japan's exports to Asian countries but instead enhances its. Also, in both the short and long term, Japan's ODA has a positive effect on its exports and not vice versa.

The rest of the paper is organised as follows: Section 2 provides a brief theoretical background; Section 3 reviews the empirical literature; Section 4 outlines and discusses the economic model; Section 5 contains econometric methodology and the empirical results while Section 6 concludes the paper by highlighting main findings of the study.

2. Theoretical Background

There is a large body of work that looks at the impact of ODA on both recipient and donor countries. Djajić et al. (2004) make a significant contribution to the dynamic theory of ODA. One of the shortcomings of static models⁵ according to the author is negligence to incorporate the future effects of the ODA for both donor and recipient country. In a model with two countries and two periods where foreign aid is provided only for a limited period (temporary transfer) and under certain conditions, the authors demonstrate that both donor and recipient country benefit from the ODA. Thus, the recipient country benefits from the transfer in the first period, and the donor country benefits from transfer in the next period. Shimomura (2007) extends the Djajić et al. model into infinite time horizon model under certain conditions arguing that persistent unilateral ODA benefits both the donor and recipients. The present paper focuses entirely on the impacts of ODA on donor's exports to recipient's nations. In the following, we will attempt to explain how the ODA can influence the recipient's imports to benefit the donor.

Impacts of ODA on the donor's exports "may not be just an object of theoretical curiosity". The following examples are some of the concrete evidences that illustrate how the ODA can have a noticeable impact on the donor's exports both in the short and long term. First, donors have traditionally promoted their exports to recipients by tying ODA directly to their exports. That is, the ODA is used a tool to influence recipient nation to import goods and services from the donor. The donor can directly but implicitly (informally) tie its aid to exports by directing aid towards projects that require imported goods and services (i.e. supplies) from firms in its country and in which the donor has strong competitive advantage. Second, aid can have indirect impacts on the recipient nation by creating a stock of "goodwill" or "habit formation" that morally obligate the recipient to purchase goods and services from the donor. Third, ODA can be used to finance projects that require the recipient to purchase goods (i.e. parts) and/or bring technicians from the donor country to service the project. That is, the ODA can lead to "trade dependence" in the

long-run. So, the above cases indicate that ODA can directly and indirectly influence the recipient's imports in a direction that benefits the donor.

From the macroeconomic perspective, the ODA can have short and long run impact on the recipients' imports: In the short run, the ODA can have positive impact on the recipient's budget which in turn can lead it to improve its capacity to purchase goods and services from abroad. The ODA can also increase recipient's domestic savings resulting in a boost in domestic investment and consequently generating higher economic growth, at least in the long run. Economic growth increases the recipient nations' income and thus its capacity to purchase goods and services from abroad. Therefore, it can propel the recipient's imports in a direction that favours and benefits donor's exports. The present paper uses Japan's aid disbursement to 15 Asian countries and Japan's exports as an interesting example to investigate the direct and indirect as well as short and long-run effects of donor's aid on its exports.

3. A Brief Overview of Empirical Literature

Although there is a sizable literature that examines the relationship between ODA and donor's trade relationship with its recipients. In this section we summarise the only related important research studies on this.

Arvin and Baum (1997) develop an economic model that distinguishes between two types of ODA (i.e. tied and untied). In this model, untied aid is assumed to generate a stock of "goodwill" for a donor in a recipient country. That is, the stock of goodwill acts as an instrument of influence on the donor's exports to the recipient nations. The model also assumes that the donor chooses, over time, optimal levels of these types of ODA to maximise the value of their net benefit. To test the model's hypotheses, the authors apply non-linear ordinary least squares method on the data of 17 OECD countries between 1972 and 1990. The results suggest that if the main objective of providing ODA is to boost donor's exports, then the distinction between these types of ODA is important. Also, they argue that to maintain the stock of "goodwill" the donor must keep a constant flow of untied aid to the recipient. They stress that the last two points are essential for the donor to maximise its return from ODA⁶. They conclude that the impacts of both types of ODA on donor's exports to its recipient are roughly the same. The Arvin and Choudry's (1997) study has a fairly similar conclusion.

Tajoli (1999) develops a simple theoretical framework to study the relationship between tied ODA and trade flows and its implications in terms of welfare on developing countries. Using the model, he demonstrates that tied ODA can lead to deterioration of the recipient's term of trade or stronger competition between donor countries; so, the adverse effects of these factors can

overcome the tied ODA's positive impacts on the donor's exports to its recipient. The author tests his model's hypothesis by investigating the impact of Italy's tied aid on developing countries between 1982 to 1991. This empirical analysis was performed using pooled and panel econometric models with generalised least squares and fixed effects procedures. The study concludes that tying aid does not necessarily increase trade flow and donor countries market shares of exports to recipient nation.

Vogler-Ludwig et al. (1999) use data from Germany and 43 of its recipient countries over the period 1976-1995 to investigate the impact of the German ODA on its exports to the recipients. To analyse this impact, the authors use a model in which they assume that the German exports are a function of the gross national product of recipients and ODA flows from Germany and other donors to their recipients. To test their hypothesis the authors performed a number of estimations: one for each country separately, and another for all the countries (i.e. pooled estimation). The authors found the results of the countries estimated separately are mixed while the result of the pooled estimation is positive. Also, authors use a bi- and trivariate Granger-causality method to test three hypotheses which had already been argued by Arvin, Cater and Choudhry (1998)⁷. The authors tested these three hypotheses and found that these test results vary from one country to the other. However, their analysis indicates a strong link between Germany's untied aid and its exports to recipient countries.

Wagner (2003) uses a gravity model to analyse data of a sample of 20 donors and 109 recipients between 1970 and 1992. For estimation purpose, the author uses non-linear econometric model that distinguishes between direct impacts (i.e. export gains that result from the projects directly financed by ODA) and indirect impacts (export gains that result indirectly from ODA disbursement; for more details about direct and indirect impacts, see section 2). The author's estimated results suggest that 1% increase in the amount of aid increases the donors' exports by 0.195% using the pooled OLS (0.062 in the fixed-effect specification). These results translate into rate of return of US\$2.29 in pooled OLS (US\$0.73 in fixed-effect specification) of exports per dollar disbursed in aid. The author also estimated both direct and indirect impacts per dollar disbursed aid. He found that 35 cents was gained from direct impact and 98 cents from indirect impact. Also, the author used the averages of previous five years of ODA data to investigate the past ODA impact on current exports. He found that a dollar of aid generates 18 cents of exports in the subsequent years of giving aid assistance. The author used dummy variable to isolate Japan and to examine the impact of its ODA on its exports to the recipients. He found that Japan's return was US\$1.20 per dollar in aid assistance⁸. It is important to note that Wagner's study of Japan examined only short-run impact, whereas study

examines both short and long-run impacts using longer time series dimensions and more advanced econometric methodologies that suit objectives.

Nowak-Lehmann et al. (2009) use the gravity model framework to study the relationship between Germany's ODA and its exports to its recipients. The authors also use cointegration methodologies to estimate the parameters of the gravity model. The author's estimated results indicate that for each US\$1 of ODA disbursed by Germany, the average return is between US\$ 1.04-US1.50 of exports. The authors also find that ODA from other European countries crowds out German's exports to its recipients. Also, they conclude that in the long-run German's ODA causes German's exports not vice versa.

The present study follows the same econometric methodologies used by Nowak-Lehmann et al. (2009). The methodologies have the following advantages over the previous ones used in the literature: (i) the methodologies capture the ODA's effects that take a long time to materialise; (ii) the error correction model (ECM) distinguishes between short and long-term effects of ODA on exports; (iii) estimated results from the methodologies are robust to several estimation issues such as endogeneity, omitted variables and measurement error (Banerjee, 1999; Pillips and Moon, 2000; Batagi and Koa, 2000); (iv) the methodologies take into account some estimation issues which could bias estimated results, including unit root (Granger and Newbold, 1974), cointegration (Engle and Granger, 1987) and endogeneity in the data series.

4. Empirical Model

The study uses the gravity model of international trade (gravity model afterwards) to analyse, among other things, the impact of Japan's ODA on its exports to its recipients. The model states that trade between two countries is explained by their gross domestic product (GDPs), or gross national product (GNPs) and populations, by the distance between their two economic centres, and by country-pair fixed factors that impede or facilitate trade such as whether two trading partners have trade agreements, common language and common border and whether one or both of them have had a colonial history. Additionally, Anderson and van Wincoop (2003) introduce another important term into gravity equation which they call "multilateral resistance". According to them, multilateral resistance is implicit price indices that capture "all" and "true" border effects that limit trade between two countries. Thus, the gravity model can be specified in the following functional form:

$$EXP_{ij} = \beta_0 GDP_i^{\beta_1} GDP_j^{\beta_2} POP_i^{\beta_3} POP_j^{\beta_4} DIS_{ij}^{\beta_5} F_{ij}^{\beta_6} MR_{ij}^{\beta_7} \epsilon_{ij} \quad (1)$$

Where β_0, \dots, β_7 are coefficients, EXP_{ijt} denotes exports from the donor i to the recipient country j in period t , GDP_i (GDP_j) denotes the GDPs of the exporter (importer); POP_i (POP_j) denotes exporter (importer) populations; DIS_{ij} denotes the distance between two economic centres of trading countries; F_{ij} denotes other factors that facilitate or impede trade such as whether two trading partners have trade agreements, common language, common border, and whether one or both of them have had a colonial history; MR_{ij} denotes multilateral resistance; and ε_{ijt} random error term. However, our preferred empirical specification of model (1) is in the log-linear form (see Armstrong, 2007, for a good survey of the gravity model).

Since the GDP and populations of the trading partners in model (1) are not the major interest variables in the present empirical model, they are replaced with variables to proxy the overall economic mass of the trading partners. We follow the approach of Serlenga and Shin (2007), Martinez-Zarzoso et al. (2009) and F. Nowak-Lehmann et al. (2009) in constructing the latter variables as follows: we assume that the coefficients of GDPs of the trading partners are restricted to be equal ($\beta_1 = \beta_2$); similarly, the coefficients of populations are restricted to be equal ($\beta_3 = \beta_4$). By applying logarithmic rules to the log-linear version of model (1), the log of both total GDP and total population (proxies for the overall economic mass) can be derived from the GDPs and populations of the trading partners as follows: $\log(TGDP_t) = \log(GDP_{it}) + \log(GDP_{jt}) = \log(GDP_{it} \times GDP_{jt})$; and $\log(TPOP_t) = \log(POP_{it}) + \log(POP_{jt}) = \log(POP_{it} \times POP_{jt})$. We expect a positive relationship between total GDP and Japan's exports. That is, the larger TGDP indicates the larger exporter production (which implies more goods available to export) and/or the larger importer income (which implies strong importer demand for imported goods). We expect a negative relationship between total POP and Japan's exports. That is, the larger TPOP could indicate larger resource endowment, which implies self-sufficiency and less dependence on international trade⁹.

Solaga and Winders (2001) point out the importance of bilateral exchange rates in controlling for price effects in the gravity equation and thus we included this variable in our empirical framework. We expect that bilateral exchange rates to have negative impact on Japan's exports. That is, an appreciation in the exchange rate decreases exports.

In our empirical framework (i.e. the gravity model) of this study, we control for two types of heterogeneous factors. First is the time-invariant factors which are specific to country-pair but common to all years and often called bilateral-fixed factors (e.g. distance between economic centres and whether two trading partners have trade agreements, common language, common border, and if one or both of them have had colonial history). Also, as pointed out by Feenstra (2004) that the multilateral resistance indices are unobserved and

difficult to calculate, these indices are regarded as part of bilateral fixed factors. Second type is the heterogeneous factors which are specific to a particular year but common to all country pairs and often called time-fixed factors (e.g. a trade shock to all country pairs, but in a particular year). Also, the latter factors capture any common trends towards greater exports. Although there are a number of ways to control for these factors, fixed effect model is used as preferred model to deal with these issues.

The major objective of study is to examine the impact of ODA on bilateral exports. Thus, ODA variables (both Japan's disbursed aid and other major donors' (DAC) disbursed aid) are included in the gravity model as well. It is expected that relationship between Japan's ODA and its exports to be positive while the relationship between DAC's ODA to be either positive or negative (see section 1 for more explanation). To capture Japan's ODA policy change after 1992, a new variable is introduced by interacting the dummy variable (which takes value zero for years prior 1992 and 1 for years after 1992) with the log ODA variable.

Thus, the relation between aid and exports are formulated in the following long-run relationship:

$$\begin{aligned} \log(EXP_{ijt}) = & \beta_0 + \beta_1 \log(TGDP_t) + \beta_2 \log(TPOP_t) + \beta_3 \log(EXCH_{ijt}) + \\ & \beta_4 \log(AIDJAP_{ijt}) + \beta_5 \log(AIDDAC_{kjt}) + \beta_6 \text{POST1992} * \\ & \text{Log(AIDJAP)} + \phi_{ij} + \pi_t + \varepsilon_{ijt} \end{aligned} \quad (2)$$

Equation (2) is a log-linear model, where EXP_{ijt} denotes exports from the donor i , Japan, to the recipient country j in period t , in current price US\$; β_0 captures the factors that are common to all years and all trade partners; $TGDP_t$, denotes total GDP in time t , in current price US\$; $TPOP_t$, denotes total population, in period t . $EXCH_{ijt}$ captures nominal exchange rate effect; $AIDJAP_{ijt}$ and $AIDDAC_{kjt}$ denote aid disbursed by Japan and DAC countries (Japan excluded) respectively to the recipient country j , in current price US\$; $\text{POST1992} * \text{Log(AIDJAP)}$ denotes the interaction variable between the dummy and the log Japan's ODA variables; and ϕ_{ij} captures all unobserved country-pair specific factors; π_t denotes unobserved factors specific to the period t but common to all country pairs; and ε_{ijt} random error term.

5. Data and the sources

The data of ODA disbursements in million denominated in US currency is from the OECD Development Database. The data of total exports (US\$) from UN COMTRADE database (<http://comtrade.un.org/db/>). The data on GDP

(US\$ at the current price), total population, and exchange rates sourced from the exchange rates are from the World Bank (World Development Indicators database). The exchange rates of Japan and the Asian countries are expressed in local currency per US\$; however, to standardise data, cross rates of local exchange rates per Japanese Yen were used.

Table 1: Summary Statistics

	Obs	Mean	Std.dev	Min	Max
EXPJAP	555	1.98×10^9	4.05×10^9	0.00	2.93×10^{10}
TGDP	555	2.20×10^{23}	5.53×10^{23}	9.64×10^{18}	6.14×10^{24}
TPOP	555	1.22×10^{16}	2.63×10^{16}	1.37×10^{13}	1.45×10^{17}
EXCH	555	4.26	15.80	0.00	97.84
AIDJAP (mil)	555	217.82	317.34	0.01	2225.38
AIDDAC (mil)	555	253.27	311.73	0.14	1823.13
LEXPJAP	555	8.31	1.30	0.00	10.47
LTGDP	555	22.36	1.15	18.98	24.79
LTPOP	555	15.37	0.93	13.14	17.16
LEXCH	555	-0.70	0.94	-2.11	1.99
LAIDJAP	555	7.68	1.08	4.00	9.35
LAIDDAC	555	7.96	0.78	5.15	9.26
D	555	0.46	0.50	0	1

Note: L's in front of the last six variables denote logarithms

6. Econometric issues

There are some potential issues with estimating model (2). The following are three major issues and some ways of addressing them:

6.1 Endogeneity

The first problem we may encounter in estimating model (2) is the possibility of the presence of correlation between one or more of the right-hand side variables with error terms in the model. That is, the presence of this correlation could result in unreliable estimates and thus the conclusion. However, we address the issue as follows: The first technique used to estimate long-run parameters of the model (2) is Dynamic Ordinary Least Squares (DOLS). As explained in detail in the following section, the procedure has an internal ability to mitigate the problem of the endogeneity bias. The second technique used to estimate parameters is the error correction model (ECM). It is well known that whenever using this technique to estimate model (2) in a single-equation framework and without additional equations, the condition of the weak exogeneity in all right-hand side variables of the model is essential (Urbain, 1992; Enders,

2004). So, to address the issue of endogeneity, these conditions are tested (the details of tests are elsewhere below). The second problem in estimating model (2) and when using fixed effects estimation is the endogeneity bias which is associated with the persistency in the exports' series when T is small (Nichell, 1981; Verbeek, 2003, p.361). However, Bond (2006) demonstrates that the bias can be comfortably ignored when T is between 30 and 40. Therefore, given that the time series dimensions of the data used are in this range, the problem can be ignored.

6.2 *Heteroskedasticity and serial correlation*

The second issue is the possibility of the presence of heteroskedasticity and serial correlation in error terms. This issue is addressed by relying solely on comparative analysis. That is, three estimations for each of the econometric technique used in this study, is conducted before comparing their estimated results. The first of these three estimations does not take into account the issues of serial correlation and heteroskedasticity, whereas the last two estimations take into account these issues. The first of the last two estimations is conducted using an approach introduced by Newey and West (1987). The approach adjusts for the "within given individual country" general forms of serial correlation and heteroskedasticity to produce autocorrelation and heteroskedasticity-consistent standard errors. We assume that the serial correlation of error terms between any pair-country to be contemporaneous and equal and are captured by the time dummy variables (Verbeek, 2004, p356 and p111; Arellano, 2003, section 2.3)¹⁰. The second of the last two estimations is conducted using an approach proposed by Beck and Katz (1995). The approach corrects for heteroskedasticity, cross-sectional (spatial) dependence, and within-cross-section first order (temporal) autocorrelation. Contrary to the technique proposed by Newey and West (1987), it allows for heterogeneity in the contemporaneous correlation of error terms between pair-country units. It also produces robust panel-corrected standard errors (PCSE). Beck and Katz (1995) demonstrate that the technique performs well in small samples characterised by big time periods compared with a number of cross sections. Therefore, it suits our data¹¹.

6.3 *Sample selection bias*

As explained earlier, only 15 Asian countries are examined excluding among others, some African, Latin American and Asian countries which are also recipients of Japan's ODA. From the econometric perspective, using incomplete panel data can pose "sample selection bias", which in turn can have serious consequences on the estimates, analyses and conclusions. However, we argue that sample selection bias is irrelevant to the current study for the following

reasons: First, since Japan's ODA is targeted only for Asian countries, the conclusion we derive from the samples is exclusive to the latter. Second, it is important to note that sample selection bias problem is mostly related to country-specific terms (Verbeek and Nijman, 1992; Vella, 1998). Therefore, since fixed effects framework are used the country-specific terms are captured using dummies (or removed) thus eliminating the problem (Verbeek and Nijman, 1992; Vella, 1998). Hence, excluding some countries from samples does not pose any serious problem for estimations and inferences - at least from the econometric.

7. Econometric Methodology and Estimation Results

7.1 Unit Root Test

The starting point of our empirical analysis is to test if the structural variables (data) examined exhibit unit root process. While there are a number of tests for unit root, for the present study two tests are applied: the first test was proposed by Breitung (2000), and the second test by Choi (2001). The Breitung (2000) test is a member of the group of tests that assume a common unit root process. Breitung (2000) and Westerlund et al. (2009) demonstrate that the test has best results and lowest distortions compared with most of the first generation unit root tests. The Choi (2001) test, which is one of the Fisher-type tests, is a member of the group of tests that assume individual unit root process. The test is nonparametric, less restrictive, simple, straightforward and easy to use compared with any test in its group. Choi (2001) shows that the test outperforms many unit root tests that assume individual unit root process including another Fisher-type test which was proposed by Maddala and Wu (1999). These tests suit panel data with a small number of cross-sectional units with large time-series for each cross-sectional unit.

After inspecting the graphs of the data used in model (2), we assumed both intercept and trend all the tests, except for the interaction variable test in which no intercept and trend are assumed. Table (2) shows the statistics of both unit root tests for all variables in the model. For the first-differenced of the variables, except for the population variable, the statistics indicate that these variables are significant at least at the 5% level and thus, are stationary. For the population variable, the Choi (2001) test statistic indicates that the variable is statistically significant at the 5% level, while the Breitung (2000) statistics indicate that the variable is not statistically significant at any conventional level. For these variables in levels, the Breitung (2000) test statistics indicate that, except for the total population and Japan's ODA disbursement variables, other five variables are not statistically significant at any conventional level and thus, they exhibit unit root. For the total population and Japan's ODA disbursement variables,

the test statistics indicate that these variables are statistically significant at the 1% level. The Choi (2001) test statistics indicate that, except for the Japan's exports variable, the remaining six variables are not statistically significant at any conventional level and thus, they exhibit unit root. For Japan's exports variable, the test statistics indicate that the variable is statistically significant at the 1% level and thus, it is stationary.

However, there are important caveats worth mentioning with regard to the conclusions about the variables which are stationary in levels. First, a panel unit root test could reject the null hypothesis when in actual fact the hypothesis is true. The test's underperformance could be due to the presence of cross-country cointegration or/and cross-country dependence in error terms (Banerjee, Marcellino and Osbat, 2001; Verbeek, 2004 among others). Second, the rejection of the null hypothesis could be the result of the rejection of only one individual country's series in the panel, while other series in the panel are non-stationary (see Maddala and Wu, 1999; Choi, 2001 among others). Therefore, to clarify these ambiguities, we followed Pesaran's suggestion (Pesaran, 2011), who argues that in the case of rejecting unit root hypothesis in the panel data, the proportion of cross-section countries in the panel for which the unit root is rejected needs to be estimated and the conclusion of the test should be interpreted based on this proportion. So, we performed individual unit tests for each country in the panel data for Japan's exports, total population and Japan's ODA disbursement variables. We applied the augmented Dickey-Fuller (ADF) test for Japan's exports and its ODA disbursement variables, while we applied Kwiatkowski, Phillips, Schmidt and Shin (1992) test (usually referred to as KPSS test) for the total population variable. The reason for choosing the KPSS test instead of the ADF test is that we found each series of individual country of the total population variable is a stable autoregressive process of order one AR(1) with root near unity. However, as demonstrated by DeJong et al. (1989) and argued by Kwiatkowski et al. (1992), the ADF test does not perform well always and often fails to reject the null hypothesis in such autoregressive process even when the series do not in fact contain unit root.

The individual unit root tests statistics are not reported here, but for both Japan's exports and its ODA disbursement variables, the ADF test statistics indicated that all series of individual countries variables in levels contain unit root, while the first-differenced of these variable are stationary. For the total population variable, the KPSS test rejected the null hypothesis in 12 out of 15 of the series of individual countries in levels (i.e. 12 series of individual countries exhibit unit root in levels), while failing to reject the null hypothesis in 12 out of 15 of the series of individual countries at the first-differenced variables (i.e. 12 series of individual countries are stationary).¹²

Therefore, considering the above, we can conclude that all variables in model (2) are integrated of order one I (1).

Table 2: Panel unit root test results of the Breitung and Fisher-ADF

	Breitung		Fisher-ADF	
	Statistic	Prob Level	Statistic	Prob
LEXP	1.21	0.89	-3.56***	0.00
LTGDP	2.19	0.20	-0.60	0.28
LTPOP	-10.86***	0.00	-0.70	0.24
LEXCH	1.59	0.94	2.70	1.00
LAIDJAP	-2.66***	0.00	0.71	0.76
LAIDDAC	1.80	0.96	0.21	0.58
POST1992*LAIDJAP	-0.03	0.49	1.85	0.97
	First-difference			
Δ LEXP	-8.22***	0.00	-16.34***	0.00
Δ LTGDP	-2.43***	0.00	-10.69***	0.00
Δ LTPOP	4.32	1.00	-1.95**	0.03
Δ LEXCH	-9.87***	0.00	-10.33***	0.00
Δ LAIDJAP	-11.93***	0.00	-21.40***	0.00
Δ LAIDDAC	-9.98***	0.00	-16.37***	0.00
Δ POST1992*LAIDJAP	-21.07***	0.00	-19.19***	0.00

Note: All variables are in logarithms. Breitung and Fisher-ADF represent the panel unit root tests of Breitung (2000) and Choi (2001) respectively. ***, ** indicates statistical significance at 1%, 5% level respectively. Statistics of the tests are asymptotically distributed as standard normal.

7.2 Panel Co-integration test

Having established in the preceding section that all the series are integrated of order one, (1), it is necessary to test for cointegration relationship in the data (Granger, 1983). While there are a number of panel cointegration tests (a good survey for cointegration tests, see Wagner and Hlouskova, 2010), we choose Pedroni (1999, 2004) test for the present study.

Pedroni (1999, 2004) allows for cross-section heterogeneity in intercepts, coefficients of regressors and deterministic trends. He proposes two sets of statistics for cointegration: The first is called “within-dimension-based statistic or panel cointegration statistic”. This is constructed by pooling the autoregressive estimated coefficients of the second-stage regression across cross-sections. The within-dimension statistic are, in turn, divided into two sets of statistics, unweighted and weighted. Each of these statistics (weighted and unweighted) has four test statistics: (i) Panel v – statistic; (ii) Panel Phillips-Perron type ρ – statistic; (iii) Panel Phillips-Perron type t – statistic; (iv) Panel augmented Dickey-Fuller (ADF) type t – statistic. The second sets of statistics are called “between-dimension or between-group”. These are constructed by taking the average of all cross-sections autoregressive estimated coefficients in the panel in the second stage. These has three test statistics: (i) Group Phillips-

Perron type ρ – statistic; (ii) Group Phillips-Perron type t – statistic; (iii) Group augmented Dickey-Fuller (ADF) type t – statistic¹³.

Table 3: Results results of Pedroni (1999, 2004) panel cointegration test

	unweighted Statistic	weighted Prob	unweighted Statistic	weighted Prob
W thin-dimension				
Panel ν -Statistic	-0.56	0.71	-3.05	0.99
Panel rho-Statistic	2.10	0.98	1.45	0.93
Panel PP-Statistic	-2.06***	0.02	-4.78***	0.00
Panel ADF-Statistic	-2.13***	0.02	-5.08***	0.00
between-dimension				
Group rho-Statistic	1.75	0.96		
Group PP-Statistic	-5.41***	0.00		
Group ADF-Statistic	-5.74***	0.00		

Note: *** indicates statistical significant at 1% level. Probabilities Panel ν – statistic is one-sided test, where large positive values indicate rejection of the null hypothesis of no cointegration, whereas large negative values of other remaining statistics indicate rejection of the null hypothesis of no cointegration

After a close inspection of the graphs of cross-sections data, we included individual fixed and time trends effects when we applied Pedroni tests to model (2). Table (3) shows the empirical results of the Pedroni (1999, 2004) tests. Out of 11 statistics, six of them indicate the existence of the long-run relationships between the variables at the 1% level of significance¹⁴. Overall, we may conclude that there is convincing evidence of cointegration relationships among the variables in model (2).

7.3 *Dynamic Ordinary Least Squares (DOLS)*

After ascertaining evidences of cointegrating relationships among the variables in the models (2) (i.e. variables have long-run equilibrium relationships), the next step is to estimate parameters that describe long-term relationship among these variables. We employ the dynamic ordinary least squares (DOLS) technique for the estimation of these models. The technique was first developed by Stock and Watson (1993) who propose regressing the dependent variable onto contemporaneous level regressors, lags and leads of the first differences, and a constant using ordinary least squares. By doing so, the estimation technique produces unbiased estimates even when some or all independent variables are endogenous. Additionally, Kao and Chiang (2000) propose another type of dynamic ordinary least (DOLS, henceforth) technique that can be used in

the fixed effects framework. The authors demonstrate that the ordinary least squares (OLS), fully modified OLS (FMOLS) and the DOLS estimators are all asymptotically normally distributed. However, in a finite sample, when any of regressors are endogenous, and/or the error terms exhibit serial correlation, the OLS and FMOLS estimators and their t-statistics have “a non-negligible bias” which bias drops substantially by adding an adequate number of leads and lags of the first differences of regressors to the DOLS model. Thus, the DOLS outperforms both the OLS and FMOLS in estimating long-run parameters in both homogeneous and heterogenous panels.

Therefore, we use the fixed effect panel DOLS for estimating the long-run parameters of the model (2) which are detailed in this paper. The DOLS specification in our case can be formulated as:

$$\begin{aligned} \log(EXP_{ijt}) = & \gamma_0 + v_{ij} + \theta_t + \varphi_1 \log(TGDP_t) + \varphi_2 \log(TPOP_t) + \varphi_3 \log(EXCH_{ijt}) \\ & + \varphi_4 \log(AIDJAP_{ijt}) + \varphi_5 \log(AIDDAC_{ijt}) + \varphi_6 POST1992 * \log(AIDJAP_{ijt}) + \\ & \sum_{s=-p}^p \rho_s \Delta \log(TGDP_{t-s}) + \sum_{s=-p}^p \rho_s \Delta \log(TPOP_{t-s}) + \sum_{s=-p}^p \rho_s \Delta \log(EXCH_{ijt, t-s}) + \\ & \sum_{s=-p}^p \rho_s \Delta \log(AIDJAP_{ijt, t-s}) + \sum_{s=-p}^p \rho_s \Delta \log(AIDDAC_{ijt, t-s}) + \sum_{s=-p}^p \rho_s \Delta POST1992 \\ & * \log(AIDJAP_{ijt, t-s}) + \varepsilon_{ijt} \end{aligned} \tag{3}$$

Where γ_0 embodies factors that are similar in all years and to all countries-pairs; v_{ij} embodies factors that are specific to year t and similar to all country-pairs; θ_t embodies factors that are specific to the country-pairs and common to all years; p denotes the length of lag and lead; and ε_{ijt} denotes disturbance errors. The dependent and independent variables are defined as in equation (2). Both v_{ij} and θ_t are captured via dummy variables.

Table (4) reports the estimated results of Model (3). In the table, column 1 reports the usual estimated results (that is, the estimates were produced without using any technique that controls or correct for heteroskedasticity and serial correlation in the data). Column 2 shows the estimated results produced using Newey-West (1987) technique with three lags; Column 3 shows the estimated results produced using Beck and Katz's (1995) PCES technique with two lags and two leads. The choice of lags in former technique, and lead and lags in the latter technique were arbitrary. It is important to note that we carried out F tests for dummies of both country and year fixed effects in both DOLS and ECM methodologies each of which with three techniques mentioned above. The results suggest that the estimated coefficients on dummies variables are statistically significant at 5% level. Therefore, we included these fixed effects in all estimations of both DOLS and ECM methodologies (the tests results are not reported here, but available upon request).

Table (4) reports the DOLS estimated results of model (3). In the table, the estimated coefficients of the interaction terms of Japan's ODA with the pre and post 1992 dummies are almost similar and highly significant in the three techniques. This indicates that the long-run effects of Japan's ODA on Japan's exports are different between pre- and post-1992. For the pre-1992 period, only coefficients on LAIDJAP variables are considered, as pre-1992 dummy is zero. The techniques' estimate suggest that the elasticities of Japan's ODA on its exports range between 0.18-0.20 and statistically significant at 5% level. In dollar terms, the estimated returns of US\$1 of Japan's ODA spent range between US\$1.62-\$1.83. For the post-1992 period, coefficients on LAIDJAP and Post1992* LAIDJAP are summed together as post-1992 dummy is one. Thus, the three techniques' estimates indicate that the elasticities of the Japan's ODA on its exports range between 0.33-0.39 and statistically significant at 1 percent level¹⁵. In dollar terms, the estimated returns of US\$1 of Japan's ODA spent range between US\$2.26-\$2.62. The above estimates indicate that Japan's ODA generate substantial benefits to her in terms of increased exports to Asian countries. Interestingly, the benefits are higher in post-1992 compared with pre-1992. Subsection (7.5) provides some discussion of why this is the case.

The table also shows that contrary to previous studies, ODA from other DAC donors to Asian countries does not reduce Japan's exports to these countries, but in fact enhances it. The three techniques suggest that the elasticities of the DAC's ODA on Japan's exports range between 0.34-0.37 and statistically significant at 5% level. The estimated returns of US\$1 spent by other DAC donors of ODA ranged between US\$2.66-US\$2.89. Subsection (7.5) provides some discussion of why this is so.

The remaining estimated coefficients of other control variables have the expected signs in all the techniques. The estimated coefficients of bilateral exchange rates have the expected signs and are highly significant. That is, an appreciation of the Japanese Yen with respect to Asian countries currencies decreases the country's exports to these countries. The estimated coefficients on the total GDP variables are positive as expected in these three techniques.

These estimates are statistically significant at 5% level in the first and third technique and 10% in the second technique. This indicates that the larger total GDP implies the higher Japan's income which in turn indicates the higher level of its production (i.e. more goods available for export); and/or the higher Asian countries' income which in turn implies strong demand for imported goods from Japan. The estimated coefficients on the total population are negative as expected in all of the three techniques. These estimates are statistically significant at 5% in all of these techniques. This implies self-sufficiency and less dependence on international trade in either or both of trading partners.

Table 4: Long-run estimates of the DOLS model

Technique	1		2		3	
Variable	Estimate	Stats	Estimate	Stats	Estimates	Stats
LTGDP	0.41***	3.34	0.41*	1.76	0.41**	2.06
LTPOP	-2.22***	-4.46	-2.22**	-2.56	-2.02**	-2.14
LEXCH	-0.19***	-4.13	-0.19**	-2.34	-0.19**	-2.20
LAIDJAP	0.20***	3.84	0.20**	2.37	0.18**	2.05
LAIDDAC	0.37***	5.36	0.37**	2.52	0.34***	2.95
Post1992*LAIDJAP	0.19***	5.67	0.19***	3.62	0.15***	3.02
Long-run return on Japan bilateral aid pre-1992	US\$1.83		US\$1.83		US\$1.62	
Long-run return on Japan bilateral aid post-1992	US\$2.62		US\$2.62		US\$2.26	
Long-run return on other DAC bilateral aid (Japan excluded)	US\$2.89		US\$2.89		US\$2.66	
Total return on bilateral aid (Japan + other DAC) for pre- 1992	US\$4.72		US\$4.72		US\$4.28	
Total return on bilateral aid (Japan + other DAC) for post- 1992	US\$5.52		US\$5.52		US\$4.91	
Dummies for country and year fixed effects	yes		yes		yes	
Adj R ²	96		-			
R ²	97		-		95	
Obs	480		480		480	

Notes: The dependent variable is a log of Japan exports to Asian countries. Models (1), (2) and (3) were regressed using usual OLS method; Newey-West (1987) method, with option force of the newey command; and Beck and Katz's (1995) PCSE method, with option corr (ar1) of the command xtpcse respectively. The estimations were conducted using 2 leads and lags. ***, ** and * indicate statistical significance at the 1% %5 and 10% respectively.

The long-runs average returns on Japan's ODA and other donors are calculated according to the following formula:

$$\frac{\partial X}{\partial Y} = \beta_i x \frac{X}{Y} \text{ for the pre - 1992 period and } = \beta_i \frac{X}{Y} + \beta_j x D x \frac{X}{Y} \text{ for the post - 1992 period;}$$

β_i denote the coefficients for the variables LAIDJAP and LAIDDAC; β_j denotes the coefficient for POST1992*LAIDJAP; Y denotes the average of LEXPJAP; X denotes the averages of LAIDJAP and LAIDDAC; D average for the dummy variable. These coefficients are taken from Table (4) and averages from the Table (1).

7.4 Weak Exogeneity and Causality Tests

Having established that there are evidences of long-run equilibrium relationships among series of models (2), and also having obtained long-run estimates of this model using the DOLS, our next task is to perform more estimations using different econometric methodology called Conditional Error Correction Model

(the CECM henceforth). We employ this methodology to check the sensitivity of the estimated results of the DOLS using a different technique. Before doing so, it is important to investigate the issue of endogeneity. That is, to check if there is a correlation between any of the first difference of independent variables and error terms in the CECM. As mentioned above, the existence of this correlation could result in incorrect estimates.

Among others, Enders (2004), Greene (2003), and Verbeek (2004) show that a single equation of the CECM (which includes contemporaneous first difference of independent variables), can be estimated appropriately by OLS, only if the contemporaneous first difference of independent variables in the equation satisfy the assumption of weakly exogenous¹⁶. Urbain (1992) and Enders (2004) explain that if the first difference of a dependent variable (in the CECM) does not respond to the long-run equilibrium relationship, it is a weakly exogenous variable. In order to test for weak exogeneity, we adopt the approach proposed by Engle and Granger (1987) in which they recommend using t-test for testing the statistical significance of the lagged residual variable in the CECM. Therefore, to implement weakly exogeneity test, we use Engle and Granger’s (1987) two-steps procedures. In the first step, we estimate the long-run models (2)¹⁷, and then obtain estimated residuals ε_{ijt} ; these residuals are called equilibrium residuals (let’s denote these residuals series with ECT). In the second step, we estimate every equation in the following Vector Autoregressive Error Correction Models (VECM, thereafter) systems separately¹⁸. For the robustness check purpose, we estimate each equation with one lag, two lags, and three lags (lags were chosen arbitrary). Therefore, the VECM (p) can be written in the following matrix forms:

$$\begin{bmatrix} \Delta LEXP_{ijt} \\ \Delta LTGDP_{ijt} \\ \Delta LTPOP_{ijt} \\ \Delta LEXP_{ijt} \\ \Delta LAIDJAP_{ijt} \\ \Delta LAIDDAC_{ijt} \\ \Delta POST1992 * LAIDJAP_{ijt} \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \\ \alpha_6 \\ \alpha_7 \end{bmatrix} + \begin{bmatrix} v_{i1} \\ v_{j2} \\ v_{j3} \\ v_{j4} \\ v_{j5} \\ v_{j6} \\ v_{j7} \end{bmatrix} + \begin{bmatrix} \theta_{t1} \\ \theta_{t2} \\ \theta_{t3} \\ \theta_{t4} \\ \theta_{t5} \\ \theta_{t6} \\ \theta_{t7} \end{bmatrix} + \sum_{s=1}^p \begin{bmatrix} \gamma_{11s} & \gamma_{12s} & \gamma_{13s} & \gamma_{14s} & \gamma_{15s} & \gamma_{16s} \\ \gamma_{21s} & \gamma_{22s} & \gamma_{23s} & \gamma_{24s} & \gamma_{25s} & \gamma_{26s} \\ \gamma_{31s} & \gamma_{32s} & \gamma_{33s} & \gamma_{34s} & \gamma_{35s} & \gamma_{36s} \\ \gamma_{41s} & \gamma_{42s} & \gamma_{43s} & \gamma_{44s} & \gamma_{45s} & \gamma_{46s} \\ \gamma_{51s} & \gamma_{52s} & \gamma_{53s} & \gamma_{54s} & \gamma_{55s} & \gamma_{56s} \\ \gamma_{61s} & \gamma_{62s} & \gamma_{63s} & \gamma_{64s} & \gamma_{65s} & \gamma_{66s} \\ \gamma_{71s} & \gamma_{72s} & \gamma_{73s} & \gamma_{74s} & \gamma_{75s} & \gamma_{76s} \end{bmatrix}$$

$$\begin{bmatrix} \Delta LEXP_{ijt-s} \\ \Delta LTGDP_{ijt-s} \\ \Delta LTPOP_{ijt-s} \\ \Delta LEXP_{ijt-s} \\ \Delta LAIDJAP_{ijt-s} \\ \Delta LAIDDAC_{ijt-s} \\ \Delta POST1992 * LAIDJAP_{ijt-s} \end{bmatrix} + \begin{bmatrix} \rho_1 \\ \rho_2 \\ \rho_3 \\ \rho_4 \\ \rho_5 \\ \rho_6 \\ \rho_7 \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \varepsilon_{1ijt} \\ \varepsilon_{2ijt} \\ \varepsilon_{3ijt} \\ \varepsilon_{4ijt} \\ \varepsilon_{5ijt} \\ \varepsilon_{6ijt} \\ \varepsilon_{7ijt} \end{bmatrix} \tag{4}$$

For the purpose of testing for weak exogeneity we estimate each equation in the system of simultaneous equations (model 4 thereafter) separately using OLS then, we test for the null hypothesis (in each equation) that $\rho_i = 0$ against the alternative that $\rho_i \neq 0$ using t-test. If the estimated coefficient of the lag of equilibrium residual variable is insignificant (i.e. fail to reject the null hypothesis), then the dependent variable of that equation is weakly exogenous.

Table 5: Estimated results

Dependent Variable	Number of lags					
	1 lags		2 lags		3 lags	
	Estimates	t-stat	Estimates	t-stat	Estimates	t-stat
Δ LEXP	-0.47***	-17.69	-0.81***	-35.90	-0.27***	-7.92
Δ LTGDP	0.00	1.24	0.00	0.67	-0.00	-0.59
Δ LTPOP	-0.00	-1.37	-0.00	-1.17	-0.00*	-1.72
Δ LEXCH	-0.00	-0.37	-0.00	-0.27	-0.01	-0.56
Δ LAIJAP	0.00	0.16	-0.00	-0.04	0.05	0.95
Δ LAIJAC	-0.00	-0.10	-0.00	-0.21	-0.01	-0.22
Δ POST1992*LAIJAP	-0.00	0.38	0.01	0.25	0.13	0.01

*** indicates statistical significance 1%

Table (5) shows the estimated coefficient results of the first lags of equilibrium residuals of all six equations in the matrix equations (each of the six equations has three estimations and each was estimated using a different lag level-lags are range from one to three; see the table). For the three error correction models with the first difference of log Japan's exports as the dependent variable, the estimated coefficients of lags of equilibrium residuals are negative and statistically significant at 1% level. However, the estimated coefficients of the lags of equilibrium residuals for 14 out of 15 other equations in the system of equations (i.e. equations with the first difference of other variables as dependent variables) are not statistically significance at any conventional level. The remaining one is statistically significant at 10% level. Clearly, these results show that except for the difference of log pertaining to Japan's exports, other variables do not respond to deviations from long run equilibrium, thus, they are weakly exogenous.

As explained in section 1, the Donor's ODA allocation policies have been a matter of intense debate in many donor countries. That is, in addition to the argument that donor's ODA can promote donor's exports to its recipients, there is also a related argument that donor's exports can lead to a further increase of donor's ODA to its recipients. Since Japan has always been one of the major donors, then the latter argument is relevant to its ODA. The present study investigates this argument using empirical data using Granger Causality test

analysis. The source of causation between Japan's ODA and its exports to Asian countries can be identified by testing the coefficients on both Japan's ODA and Japan's exports (i.e. coefficients on $\Delta LEXP$ and $\Delta LAIDJAP$), and coefficients on error correction terms in Eq (1) and (5) in model (4). For the short run causality, we test $H_0 : \gamma_{15s} = 0$ against $H_1 : \gamma_{15s} \neq 0$ for all s in Eq (1); and $H_0 : \gamma_{11s} = 0$ against $H_1 : \gamma_{11s} \neq 0$ against for all s in Eq (5). For the long run causality, we test $H_0 : \rho_l = 0$ against $H_0 : \rho_l \neq 0$ in Eq (1) and $H_0 : \rho_s = 0$ against $H_0 : \rho_s \neq 0$ in Eq (1) in Eq (5). We also perform joint tests on short run and error correction terms coefficients to check for the strong causality. The short run and joint tests are performed using a standard F-test, whereas for long run tests, we use a standard t-test.

Table (6) shows the estimated results of the panel causality tests between Japan's exports and its ODA. In the $\Delta LEXPJAP$ equation (i.e. equation 1), F-statistics of the tests for Japan's ODA and for Japan's ODA/ECT, and t-statistic of the test for the error correction term suggest that there is strong evidence of short and long run causalities which run from Japan's ODA to its exports. However, in the $\Delta LAIDJAP$ equation (i.e. equation 5), F-statistics of the test for of Japan's exports and Japan's exports/ECT, and the t-statistic of the test for the error correction term suggest that there is no evidence of causality between Japan exports and its ODA. Therefore, these tests indicate that long and short-term causalities between Japan's ODA and its exports are uni-directional, and run only from Japan's ODA to Japan's exports.

Table 6: Panel causality test results

Dependent variable	Source of causation (independent variable)				
	Short run			Long run	
	$\Delta LEXPJAP$	$\Delta LAIDJAP$	ECT	Joint (ECT and $\Delta LEXPJAP$)	Joint (ECT and $\Delta LAIDJAP$)
$\Delta LEXPJAP$	-	3.87**	-0.27**	-	19.32**
$\Delta LAIDJAP$	0.24	-	0.05	0.37	-

Note: *** indicates statistical confidence at the 1% level

7.5 Error Correction Model for Japan's ODA and Japan's Exports

Having confirmed that except for the first difference of Japan exports variable, all other five dependent variables in model (4) are weakly exogenous, we are in a position to estimate the CECM of the Japan's exports and its ODA. In order to do that, we use the first equation the system of equations, model (4) but we replace ECT_{t-1} with $LEXP_{ij,t-1} - \beta_0 - \phi_{ij} - \pi_t - \psi' z_{ij,t-1}$ variable (another way of

writing the first lag of equilibrium error). Thus, the CECM equation can be formulated as follows:

$$\Delta LEXP_{ij,t} = \alpha_1 + v_{ij1} + \theta_{t1} + \sum_{s=0}^2 \gamma'_{1s} \Delta z_{ij,t-s} + \rho_1 (LEXP_{ij,t-1} - \beta_0 - \phi_{ij} - \pi_t - \psi'_1 z_{ij,t-1}) + \varepsilon_{1ij,t} \tag{5}$$

Where γ'_{1s} and ψ'_1 are 1 x 7 row vectors of coefficients;

$\Delta z_{ij,t-s} = (\Delta LEXP_{ij,t-s} \ \Delta LTGDP_{ij,t-s} \ \Delta LTPOP_{ij,t-s} \ \Delta LEXCH_{ij,t-s} \ \Delta LAIDJAP_{ij,t-s} \ \Delta LAIDDAC_{ij,t-s} \ \Delta POST1992 * LAIDJAP_{ij,t-s})'$ is 7x1 column vector; and $z_{ij,t-1} = (LTGDP_{ij,t-1} \ LTPOP_{ij,t-1} \ LEXCH_{ij,t-1} \ LAIDJAP_{ij,t-1} \ LAIDDAC_{ij,t-1} \ POST1992 * LAIDJAP_{ij,t-1})'$ is 6 x 1 column vector.

For the estimation purposes, the preferred version of equation (5) is the following Autoregressive Distributed Lag equation (see Enders, 2004):

$$\Delta LEXP_{ij,t} = \alpha_1 + v_{ij1} + \theta_{t1} + \sum_{s=0}^2 \gamma'_{1s} \Delta z_{ij,t-s} + \rho_1 LEXP_{ij,t-1} + \rho_1 \beta_0 + \rho_1 \phi_{ij} + \rho_1 \pi_t + \rho_1 \psi'_1 z_{ij,t-1} + \varepsilon_{1ij,t} \tag{6}$$

Note: By comparing equations (5) and (6), it is easy to derive estimated coefficients of the variables in equation (5) from estimated coefficients of equation (6).

The equation (6) is estimated with two lags. After applying the General-to-Specific technique we reported the estimated results of this equation in Table (7). The first column results were estimated using the usual OLS, the second and the third column were estimated using long run and short run estimates of ECM model.

Table 7: Japan's ODA and Japan exports to Asian countries

Technique	1		2		3	
Variable	Estimates	Stats	Estimates	Stats	Estimates	Stats
	Long run estimates					
LTGDP	0.53***	4.61	0.53**	2.53	0.65***	4.55
LTPOP	-1.64***	-3.49	-1.64**	-2.09	-1.37**	-1.96
LEXCH	-0.16***	-3.96	-0.16**	-2.50	-0.12**	-2.05
LAIDJAP	0.20***	4.71	0.20***	3.00	0.16***	3.02
LAIDDAC	0.26***	4.90	0.26**	2.59	0.18***	3.59
Post1992*LAIDJAP	0.16***	5.07	0.16***	3.16	0.15***	3.46
ECT _{t-1}	-0.83***	-	-0.83***	-	-0.95***	-
	38.85		7.15		57.33	

Table 7 (continued)

Long-run return on Japan bilateral aid pre-1992	US\$1.86	US\$1.86	US\$1.41			
Long-run return on Japan bilateral aid post-1992	US\$2.55	US\$2.55	US\$2.03			
Long-run return on other DAC bilateral aid (Japan excluded)	US\$2.06	US\$2.06	US\$1.42			
Total return on bilateral aid (Japan + other DAC) for pre-1992	US\$3.92	US\$3.92	US\$2.83			
Total return on bilateral aid (Japan + other DAC) for post-1992	US\$4.61	US\$4.61	US\$3.44			
	Short run estimates					
$\Delta \text{LEXPJAP}_{t-1}$	-0.03	-1.38	-0.03	-1.19	-0.05***	-2.74
ΔLTGDP	0.89***	4.43	0.89**	2.38	0.91**	5.68
ΔLTPOP	-8.42**	-2.08	-8.42	-1.44	-11.81	-1.30
$\Delta \text{LAIDJAP}$	0.16***	4.46	0.16***	3.90	0.14***	4.29
$\Delta \text{Post1992*LAIDJAP}_{t-1}$		-2.81				
	-0.14***		-0.14***	-2.88	-0.10**	-2.19
$\Delta \text{Post1992*LAIDJAP}_{t-2}$	-0.12***	-2.61	-0.12***	-3.36	-0.08**	-2.12
Short-term return on Japan bilateral aid	US\$1.50	US\$1.50	US\$1.30			
Dummies for country and year fixed effects	yes	yes	yes			
Adj R ²	78	-	-			
R ²	80	-	89			
Obs	510	510	510			

Notes: The dependent variable is the first difference of a log of Japan exports to Asian countries. Models (1), (2) and (3) were regressed using usual OLS method; Newey-West (1987) method, with option force of the newey command and with 3 lags; and Beck and Katz's (1995) PCSE method, with option corr(ar1) of the command xtpcse respectively. ***, ** and * indicate statistical significance at 1% %5 and 10% respectively.

The short- and long-runs average returns on Japan's ODA and other donors are calculated according to

$$\frac{\partial X}{\partial Y} = \beta_i x \frac{X}{Y} \text{ for the pre - 1992 period and } = \beta_i \frac{X}{Y} + \beta_j x D x \frac{X}{Y} \text{ for the post - 1992 period;}$$

$\frac{\partial X}{\partial Y} = \beta_i x \frac{X}{Y}$ for the short-run estimates. β_i denote the coefficients for the variables LAIDJAP and LAIDDAC; β_j denote the coefficient for POST1992*LAIDJAP; Y denotes the average of LEXPJAP; X denotes the averages of LAIDJAP and LAIDDAC; D average for the dummy variable. These coefficients are taken from Table (4) and averages from the Table (1).

Newey-West (1987) and Beck and Katz's (1995) PCES methods respectively. As mentioned in subsection (6), we use the latter two methods for robustness checks of within and between groups' heteroskedasticity and serial correlation.

As expected, the lagged of error correction terms are negative and highly significant in all the three techniques. The results indicate the existence of cointegration among long run variables, which are also consistent with the previous tests of cointegration (i.e. Pedroni test). With regard to the long-run estimated coefficients, the results of the ECM and the DOLS model are fairly closed, i.e. the estimated results are robust to these two methodologies.

The estimated coefficients of the interaction terms of Japan's ODA with the pre- and post-1992 dummies are almost similar and highly significant in the three techniques. This finding indicates that the long-run effects of Japan's ODA on its exports are different between the pre- and post-1992 periods.

For the pre-1992 period, only estimated coefficients on LAIDJAP variables are considered as the pre-1992 dummy is zero. In the table, the estimated results of the three techniques suggest that in the long-run, for every 10% increase in Japan's ODA to Asian countries, the estimated increase is between 1.6% and 2.0% of its exports to these countries. These estimated coefficients are statistically significant at 5% level. In dollar terms, the estimated returns of US\$1 of Japan's ODA range between US\$1.41-\$1.86. For the post-1992 period, coefficients on LAIDJAP variables and Post1992* LAIDJAP are summed together, as post-1992 dummy is one. The three techniques estimated coefficients suggest that, in long run, for every 10% increase in Japan's ODA to Asian countries, the expected increase is between 3.1% and 3.6% of Japan's exports to these countries. The estimates are statistically significant at 1% level¹⁹. In dollar terms, the estimated return for every US\$1 of Japan's ODA ranges between US\$2.03 and US\$2.55.

The preceding estimated results indicate that there is a strong evidence of the long-run effects of Japan's ODA on its exports to Asian countries. Furthermore, and interestingly, the effects are larger in post 1992 compared with pre-1992. This finding is an interesting one in the sense that it goes against the conventional view of tying ODA to exports. In other words, while the Japan "aid tying" percentage has dropped since 1970s (for example, the tying percentages, including partial tying, were 74%, 23%, 14% and 6% in 1980, 1990, 2000 and 2010 respectively)²⁰ the present study suggests that the estimated returns of US\$1 spent are much lower in pre-1992 with compared with post-1992. This finding is consistent with the study by Martínez-Zarzós et al. (2009) who concluded that the estimated returns on German ODA has increased since 1960s despite the fact that its aid tying percentage has declined.

Therefore, the large commercial benefits that accrue to Japan from its ODA could be attributed to the goodwill for Japan in Asian countries rather than due to tying ODA to its exports. This finding suggests that tying aid is not only an unimportant policy instrument to promote donor's exports but also an inefficient procedure for ensuring commercial benefits to the donor.

For the short-run impact of Japan's ODA on its exports, the estimated coefficients suggest that 10% increase in its ODA increases Japan's exports by 1.6% in technique (1) and (2) and by 1.4% in technique (3). These estimates are statistically significant at 1% level. In dollar terms, the estimated returns of US\$1 of Japan's ODA spent ranges between US\$1.30-US\$1.50. These estimated results are fairly similar to Wagner's (2003) findings whereby the author suggests that the estimated return for Japan from its ODA on its exports is US\$1.20. The short-run estimated results of the present and Wagner's studies are lower than the long-run estimated results of the present study is detailed above. This difference could be explained by the fact that in the long-term, some of the ODA effects on exports will materialise. Therefore, one of the advantages of using ECM technique and DOLS model is to capture these dynamic effects on Japan's exports.

Similar to the results of DOLS and contrary to previous studies, ODA from other DAC donors to Asian countries does not reduce Japan's exports to these countries but in fact, enhances it. In long run, the estimated coefficients of Technique (1), (2) and (3) suggest that 10% increase in other DAC donors' ODA to Asian countries increases Japan exports to these countries by 2.6%, 2.6% and 1.8% *t* respectively and are statistically significant at 5% level. The estimated returns of US\$1 spent by other DAC donors of ODA ranged between US\$1.42-US\$2.06 in these techniques. The following subsection discusses this interesting finding.

One can hypothesise that ODA from other DAC countries may have relaxed the budget constraints of Asian countries in short-run and/or promoted their economic growths, and increasing their incomes in the long-run. In other words, ODA from other DAC countries may have helped the Asian countries to earn more financial resources that allowed them to import goods from either or both (Japan and other DAC countries). Thus, the positive impact in our study could imply that in the long run, Japan may have benefited from the ODA-induced Asian development in which other DAC countries' ODA played an important role. There are several reasons why the Asian countries could benefit from the additional financial assistance to import more goods from Japan: (i) Japan's ODA may have created larger stock of goodwill in the Asian countries compared with the other DAC countries; (ii) Japanese firms have a far better competitive advantage in the Asian region compared with the

other DAC countries; (iii) the largeness of Japan economy, and/or proximity of Japan to Asian countries. Further research should be conducted on this issue.

The remaining estimated coefficients of other control variables have all the expected signs in these techniques. The bilateral exchange rate has the expected signs in the long run and statistically significant at 5% level. That is, an appreciation of the Japanese Yen with respect to Asian currencies decreases Japan's exports to these countries. As expected, the estimated coefficients on the total GDP are positive and statistically significant at 5% level in all three techniques, and in both short and long runs. Hence, the larger total GDP implies higher Japanese income which in turn indicates the higher level of its production (i.e. more goods available for export); and/or the higher Asian countries' income which in turn implies strong demand for imported goods. The estimated coefficients on the total population are negative, as expected, in all three techniques, in both short and long runs. However, these estimated coefficients are statistically significant at, at least, 5% level in only technique (1) and (2) for the long run estimates; and in only Technique (1) for short run ones. This implies self-sufficiency and less dependence on international trade in either or both the trading partners.

8. Conclusion

No doubt determining the relationship between Japan's ODA and its exports is of considerable interest to Japan's policy makers, aid agencies and taxpayers alike. The main objective of our paper is to investigate short and long-run dynamic effects of Japan's ODA on her exports to the recipient countries.

Our findings suggest that Japan's ODA has positive and significant impacts on its exports to Asian countries. Our study indicates clearly that these impacts are not only limited in the short-run (i.e. the impact which is assumed to be immediate and complete at the end of the period of Japan's ODA disbursement) but also in the long-run. Furthermore, in the long-run, the effects are much larger in post-1992 compared with pre-1992. Therefore, the study argues that the large commercial benefits that accrue to Japan from its ODA could be attributed to the goodwill for Japan in Asian countries rather than tying ODA to exports; as the latter approach is an unimportant and inefficient policy instrument to promote exports.

Our estimated results suggest that, in the long-run, for US\$1.0 of ODA spent by Japan the average return is between US\$1.41-US\$1.86 in pre-1992 period and US\$2.03-US\$2.62 in post-1992 period. In the short-run, the average return is between US\$1.30-US\$1.50. These results have several important implications: The first is that some of the impacts of Japan's ODA on Asian exports take time to materialise. Thus, the large commercial benefits that accrue

to Japan from its ODA could be attributed to the goodwill for Japan in Asian countries rather than tying ODA to exports. The second implication is that in the long-term, Japan's ODA propel the Asian countries' exports level into a new, and higher permanent level.

The above findings may be useful to Japan's developmental agencies and NGOs to lobby for more ODA and boost development in poor countries. Therefore, the findings are important to those who have considerable interests in understanding the impact of Japan's ODA on its economy. It also serves Japan's developmental agencies, NGOs and ODA lobby groups in campaign and lobbying for an increased ODA to enhance development in poor countries.

Our study's estimated results show that ODA from the other DAC countries enhance (i.e. positive impact) Japan's exports to its recipient nations. These findings are indeed contrary to those of the most recent studies ((Martinez-Zarzoso *et al.*, 2009; Nowak-Lehmann *et al.*, 2009; Zarin-Nejadan 2008) which conclude that the exports from donor nations (Germany for the former two authors and Switzerland for the latter author) are affected negatively by ODA from the other major donors. The question is how come Japan benefits from ODA of other DAC countries? It is possible that in the long run, Japan may have benefited from the ODA-induced Asian development in which other DAC countries' ODA played an important role.

Our findings are consistent with recent case studies (studies on Germany and Switzerland's ODA) which conclude that in both short and long-run, Japan's ODA contributes to enhancing its exports and not vice versa. Therefore, our findings refute the argument that Japan uses the ODA as an instrument to increase its exports to the recipients. It is worth mentioning that our study uses ODA disbursement as a good proxy for ODA commitment. However, Osei *et al.* (2004) suggest using ODA commitment for studying the aid and trade relationship. We recommend further research on ODA commitment and its impact on Asian countries.

The study has certain limitations. We excluded in our analysis many African, Latin American and Asian countries, which are recipients of Japan's ODA. The reason being we needed to estimate data with an appropriate sample size (i.e. an appropriate time series and cross-section dimensions) for the econometric methodology and wished to concentrate on Japan's major trading partners (which happened to be the Asian countries). However, as we argued above, excluding these countries does not pose any serious estimation problems. Despite this, we strongly recommend an extension of this research by including most, if not all, countries which are recipients of Japan's ODA with the intention to investigate both the short and long-run effects of the Japan's ODA on the recipient countries' exports.

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Notes

- ¹ The sample includes Bangladesh, Philippines, Bhutan, India, Thailand, Pakistan, Nepal, Maldives, Malaysia, Lao, Indonesia, Myanmar, Lebanon, Sri Lanka and Syrian.
- ² For these statistics, see: <http://webnet.oecd.org/oda2010/> and <http://dx.doi.org/10.1787/dcr-2011-30-en>
- ³ The survey estimates that only 18% of Japanese people were willing to pay higher taxes in order to increase Japan's foreign aid to developing countries, which is the lowest among the countries surveyed (Public Opinion on Global Issues, 2012:15).
- ⁴ Based on the author's research and knowledge.
- ⁵ It is worth noting that before Djajić et al. (2004) and Shimomura (2007), most of the theoretical frameworks that were used to study ODA transfer implications for both donor and recipients were in static settings. See Suwa-Eisenmann and Verdier (2007) for an extensive survey of the theoretical literature on ODA and trade.
- ⁶ Arvin, Choudhry and Drewes (1996) derive a linear function for the donor's level of exports, then specify generalised least squares to model the function and to estimate the data of 54 recipient countries and Canada as a donor. They found that untied aid has cumulative effects that could exit over a period of time.
- ⁷ For more details about these three hypotheses, see Arin, Cater and Choudhry (1998).
- ⁸ Also Nilsson (1997) uses the gravity model to analyse the trade effects of aid from European Union countries to 108 recipients between 1975 and 1992 (three years average). The author found that a 1% increase in aid increases exports by 0.23% which translates into a US\$2.6 increase of exports per US\$1 of aid.
- ⁹ It is important to mention that we estimated the unrestricted version of both model 3, 6 (i.e. models that do not equate the coefficients GDPs and POPs of trading partners) and found that both unrestricted and restricted models give the same estimates for the coefficients of the main variables of interest (i.e. Japan's ODA and DAC's ODA). The estimated results of unrestricted models are not reported here but available upon request.
- ¹⁰ Other techniques which use cluster-robust commands (i.e. any technique that produce cluster-robust standard errors) are only reliable when data sets have relatively small number of time periods and large cross-sections. For more

discussion for this issue, see Arellano (2003), Verbeek (2004, p.361), Nichols and Schaffer (2007), and Roodman (2009). We obtain Newey-West standard errors by using command, `newey` (with options `lag(#)` and `force`) in Stata.

- ¹¹ It is worth stating that there are a number of procedures that correct for cross-sectional dependence, though each requires strong assumptions about the nature of cross-sectional dependence. For instance, we use dummy variables for capturing effects of unobserved factors that are specific to year t and common to all countries-pairs, and also for other unobserved factors that are specific to the country-pairs and common to all years. For more details, see Beck and Katz (1995) and the Stata Journal (2007).
- ¹² The details of individual unit root tests are not reported but available upon request.
- ¹³ Pedroni (1999) demonstrates that the panel-ADF and Group-ADF tests have better sample properties than other test, therefore, they are more reliable.
- ¹⁴ It is important to note that Pedroni (1999) shows that the Panel-ADF and group-ADF tests have better small sample properties than other tests, thus, they are more reliable.
- ¹⁵ The derivation of the t statistics for the sum of coefficients on LAIDJAP and Post1992* LAIDJAP is not reported here, but available upon request.
- ¹⁶ For definition and detailed treatment of weakly exogeneity, see Engle, Hendry and Richard (1983).
- ¹⁷ Since we estimate these models using OLS technique, one might expect issues such as spurious regression, simultaneity bias and measurement error; however, since such series of each model are cointegrated, the OLS technique produces Superconsistent estimates, that is, with regard to OLS estimates, these issues are not potential problems (see, e.g., Davidson and Mackinnon, 1993; and Green 2003).
- ¹⁸ Sims (1980) and Green (2003) point out that all variables in such models are treated endogenously.
- ¹⁹ The derivation of the t statistics for the sum of coefficients on LAIDJAP and Post1992* LAIDJAP is not reported here, but available upon request.
- ²⁰ Source: Author's calculation based on the data from OECD.

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